



CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither their safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE," and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

To help avoid accidental air bag deployment and personal injury, when servicing a vehicle that requires repair of the SIR system and another vehicle system, it is recommended that the SIR system be repaired first using service manual procedures.

CAUTION: General Motors service manuals are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your vehicle that may cause it not to operate properly.

1996 CHEVROLET CAPRICE, IMPALA SS AND BUICK ROADMASTER SERVICE MANUAL

BOOK 1

FOREWORD

This manual provides information on diagnosis, service procedures, adjustments, and specifications for the 1996 Chevrolet Caprice, Impala SS and Buick Roadmaster.

An understanding of the material contained in this manual and in the appropriate Dealer Service Bulletins will help technicians to better service vehicle owners.

The 1996 Caprice, Impala SS, and Roadmaster service manual has been separated into two books:

BOOK 1

Contains all sections EXCEPT Driveability and Emissions (Sections 6E and 6E3), and Electrical Diagnosis (Section 8A).

BOOK 2

Contains Driveability and Emissions (Sections 6E and 6E3), Automatic Transmission Diagnosis (7A-14A), and Electrical Diagnosis (Section 8A).

1996 Transmission/Transaxle/Transfer Case Unit Repair Manual - Contains unit repair information for all automatic and manual transmissions and transaxles, and transfer cases. Also contained within the automatic transmission and transaxle information is the fluid flow and circuit description information.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at the time of publication. The right is reserved to make changes at any time without notice.

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NORTH AMERICAN OPERATIONS
General Motors Corporation
WARREN, MICHIGAN 48090

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1996 CHEVROLET CAPRICE, IMPALA SS AND BUICK ROADMASTER

SERVICE MANUAL

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GENERAL MOTORS SERVICE MANUAL COMMENTS

If you find an error, omission, or have a suggestion on any General Motors Service Manual, we want to hear from you.

United States and Canada - (General Motors Dealer Employees Only)

1-800-828-6860

(Monday - Thursday 8:00 AM to 8:00 PM EST)

(Friday 8:00 AM to 6:00 PM EST)

Fax #: 810-265-9327

Canada French Speaking - (General Motors Dealer Employees Only)

1-800-503-3222

(Monday - Friday 8:00 AM to 6:00 PM EST)

Fax #: 810-265-9327

International English Speaking - (General Motors Dealer Employees Only)

810-265-0840

(Monday - Friday 8:00 AM to 6:00 PM EST)

Fax #: 810-265-9327

These phone numbers can be called Monday through Friday. Be prepared to give the following information:

- Your name
- Your dealership's name

- Your phone number
- Model year and vehicle line
- Publication part number (if present)
- Vehicle Identification Number of vehicle being worked on.
- Section and page number(s)
- Description of problem

This phone number cannot provide technical assistance. Contact your regular technical assistance source.

The personnel answering this phone number will provide the author of the information with your comments and will follow-up until an answer is given.

If you wish to send examples or marked-up pages, the person who takes your call will tell you how to do that.

United States and Canadian Vehicle Owner/Operator

If you are the owner or operator of the vehicle, please give your comments to the applicable Customer Assistance Center. The phone number and address are in your Owner's Manual.





SECTION 0A

GENERAL INFORMATION

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under On-Vehicle Service and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) HANDLING

Refer to CAUTIONS and the SIR Component and Wiring Location view in SECTION 9J when performing service on or around SIR components or SIR wiring. SIR equipped vehicles can be identified by:

- Steering wheel hub marked “INFLATABLE RESTRAINT.”
- “INFLATABLE RESTRAINT” indicator lamp in instrument cluster.
- Code “2” for the seventh digit of the vehicle identification number (VIN).

DISCONNECTING THE BATTERY NEGATIVE CABLE

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with “live” exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the “OFF” or “LOCK” position.

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

Figure 1

NOTICE: When handling an electronic part that has an ESD sensitive label (Figure 1) or is identified as ESD sensitive in the list that follows, the service technician should follow these guidelines to reduce any possible electrostatic charge buildup on the service technician’s body and the electronic part in the dealership:

1. Do not open package until it is time to install the part.
2. Do not touch electrical terminals of the part or its pigtail connector(s) with a finger or tool.
3. Before removing the part from its package, ground the package to a known good ground on the vehicle.
4. Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across the seat, sitting down from a standing position or walking a distance.

0A-2 GENERAL INFORMATION

Not all parts that can be damaged by ESD have an ESD label. Components that can be damaged by ESD are:

- Chime module
- Cruise control module
- SIR Sensing and Diagnostic Module (SDM)
- Powertrain Control Module (ECM)
- Automatic day/night mirror
- Radio
- Antilock Brake System Electronic Control Module (EBTCM)
- Automatic air conditioning control assembly
- Twilight sentinel amplifier

Solid state components also can be damaged if they are bumped or dropped, or if they are laid on a metal work bench or on an electrically operated item such as a radio, a TV or an oscilloscope.

SPECIAL TOOL ORDERING INFORMATION

Special service tools that are shown in this service manual that have tool product numbers beginning with "J" are available for worldwide distribution from:

Kent-Moore
SPX Corporation
29784 Little Mack
Roseville, MI 48066-2298
1-800-345-2233

Monday through Friday
8:00 a.m. through 8:00 p.m. EST
Telex: 244040 KMTR VR
Fax: 810-578-7375

General Motors dealers and non General Motors repair facilities can purchase scan tools and accessories through Kent-Moore at the above address and phone number.

BODY IDENTIFICATION

Paint codes, trim numbers, seat option codes, and other body information are included on the Service Parts Identification Label. Refer to "Service Parts Identification Label" in this section.

FEDERAL VEHICLE THEFT PREVENTION STANDARD

Federal law requires General Motors to place a Vehicle Identification Number (VIN) label on certain parts of selected vehicles. The purpose of the standard is to reduce motor vehicle thefts by making parts removed from stolen vehicles easier to trace and

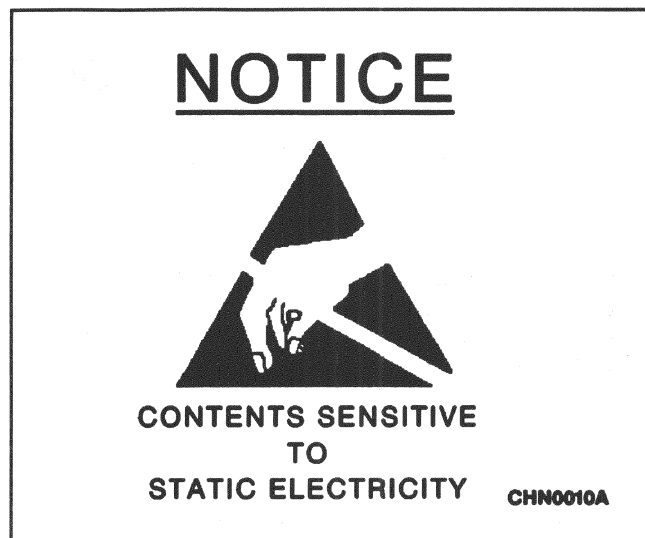


Figure 1 - ESD Sensitive Parts Label

recover. The label is permanently attached to an interior surface of the part and displays the complete VIN. The label on a replacement part contains the letter "R," the manufacturer's logo and the symbol "DOT."



Important

- THESE LABELS ARE NOT TO BE DEFACED, REMOVED OR COVERED. The labels must be shielded from paint, rust proofing and undercoating (dealer preparation included).

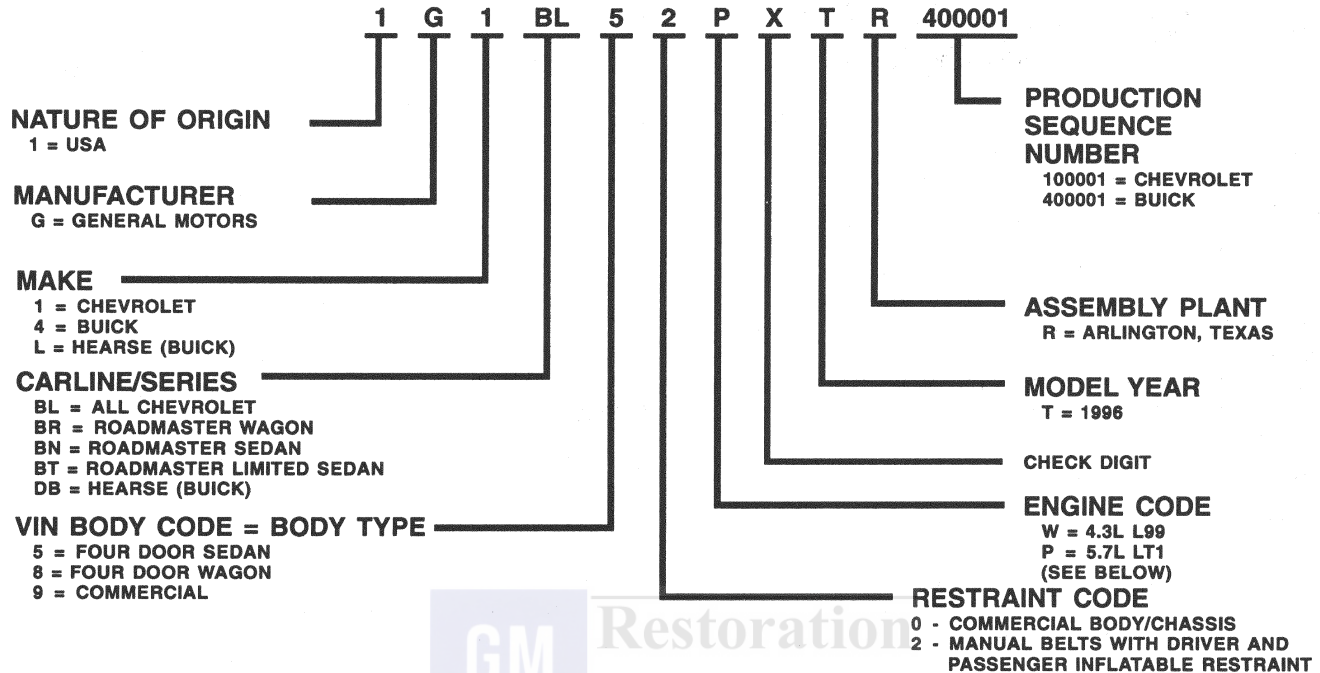
VEHICLE IDENTIFICATION NUMBER

Figure 2

The Vehicle Identification Number (VIN) legally identifies the vehicle. A VIN plate is attached to the upper left of the instrument panel and can be seen from outside the vehicle. A bar code VIN is also on the vehicle identification plate. Each sequential unit number is prefixed by letters and numbers that are explained in the following chart. The VIN also appears on the Vehicle Certificate of Title and Registration. A derivative of the VIN is stamped on the engine and transmission. The code gives the model year, plant of manufacture and a sequence number that also indicates the car division. A VIN number is also stamped on the frame.

VEHICLE IDENTIFICATION NUMBER

Each vehicle carries a 17 digit Vehicle Identification Number used for license and insurance identification and in general reference to the automobile. The number is located on a plate riveted to the windshield lower frame at the driver's side of the car where it is visible through the windshield. The Vehicle Identification number is decoded as follows:



C10029

ENGINE CODE	DISPLACEMENT		BORE AND STROKE		FUEL SYSTEM	NET HORSEPOWER/TORQUE	COMPRESSION RATIO
	CU. IN.	LITERS	mm	INCHES			
W (L99)	265	4.3	94.89X76.20	3.736X3.00	Multiport Fuel Injection	200 HP@5000 RPM 235 lb. ft. @ 2400 RPM	9.9:1
P (LT1)	350	5.7	101.6X88.4	4.00X3.48	Multiport Fuel Injection	w/o Trailer Tow 260 HP @ 5000 RPM 330 lb. ft. @ 2400 RPM	10.0:1
						w/Trailer Tow 250 HP @ 5000 RPM 310 lb. ft. @ 2400 RPM	

T5742

MODEL IDENTIFICATION

Models (series) and body styles for the current year are listed in the previous chart.

ENGINE IDENTIFICATION

Figure 4

The L99 4.3 liter V8 (VIN W) engine is standard for the Chevrolet sedan. The LT1 5.7 liter V8 (VIN P) engine is optional for the Chevrolet sedan and standard for the Chevrolet wagon, Impala SS and Buick. The VIN code (refer to chart) provides detailed

engine information by the engine code letter located on the vehicle identification plate. Stick-on-labels attached to the engine indicate the engine unit number and code. These labels also contain bar codes for in-plant identification. Engines are stamped with an engine identification number which identifies the assembly plant, the month produced, the day produced and the engine type code. All engines and transmissions are stamped with a VIN derivative, created from the complete VIN. Refer to "Vehicle Identification Number" in this section.

The stamping contains nine positions. Position 1 is the GM car division identifier. Position 2 is the model year code. Position 3 is the car assembly plant

0A-4 GENERAL INFORMATION

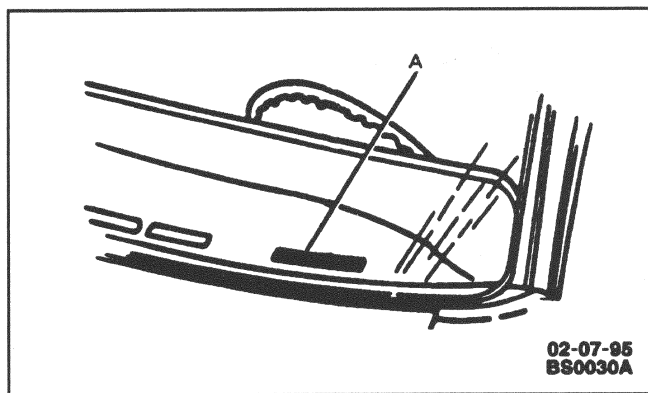


Figure 2 - VIN Plate Location

code. Positions 4 through 9 contain the assembly plant sequential number of the vehicle (Figure 3). If the engine in the vehicle is the original engine, information can be derived from the eighth VIN position letter or number (refer to previous chart). To determine if the engine is original, compare the VIN and the VIN derivative. The VIN derivative should be the same as positions 3 and 10 through 17 of the VIN.

TRANSMISSION USAGE

Figure 5

One transmission is available. It is the HYDRA-MATIC 4L60-E automatic overdrive transmission with 4 forward gear ranges and a reverse gear range. The transmission usage chart lists the different application codes available.

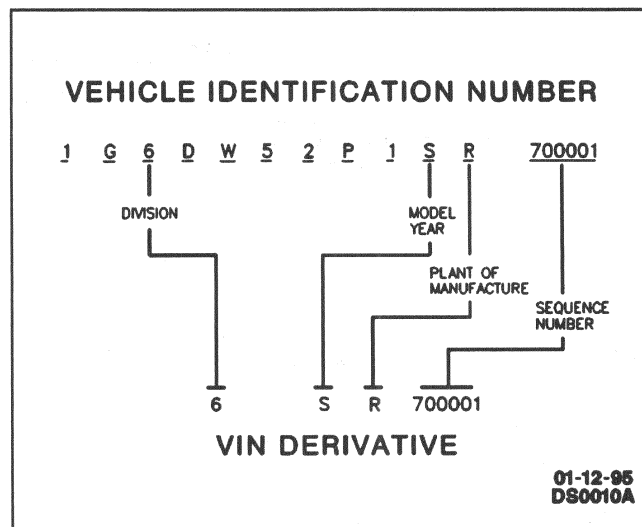


Figure 3 - VIN Derivative

TRANSMISSION IDENTIFICATION

Figure 5

The transmission has two identifying stampings: the transmission identification and the VIN derivative. The transmission identification number gives the transmission model, when it was made, and the application code. The transmission identification number is stamped on the automatic transmission case (Figure 5). The VIN derivative is created from the complete VIN and is stamped in either of 2 places. Refer to "Vehicle Identification Number" in this section.

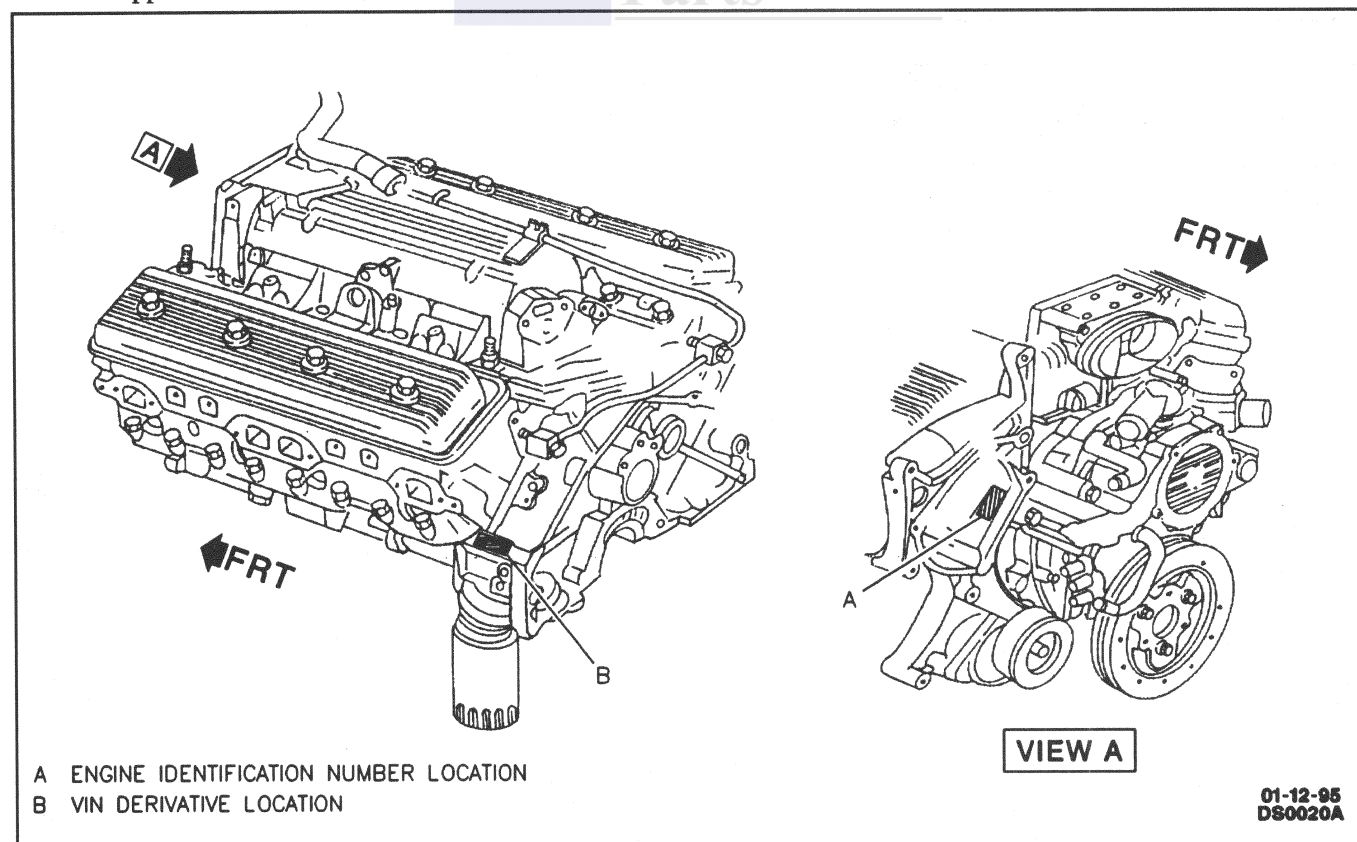
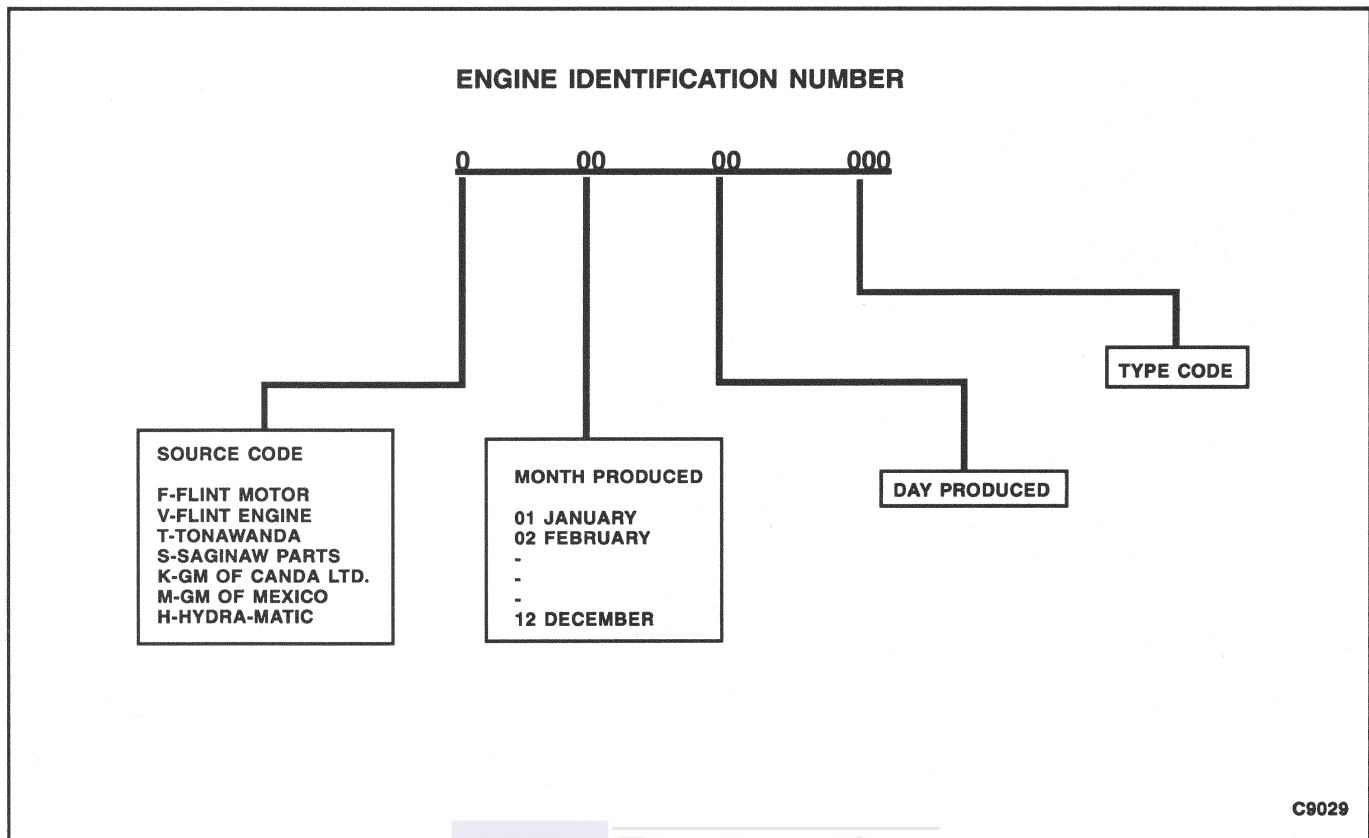


Figure 4 - Engine Identification Locations



GENERAL VEHICLE LIFTING AND JACKING

Figures 6 and 7

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. The additional support will reduce the possibility of the vehicle's falling off the hoist. When removing major components of the vehicle while the vehicle is on a hoist, the vehicle frame should be chained to the hoist pads at the same end as the removed components to prevent tip-off. Failure to follow these precautionary measures could result in vehicle damage, serious personal injury or death.

NOTICE: When jacking or lifting a vehicle at the frame side rails or other prescribed lift points, be certain that lift pads do not contact the catalytic converter, brake pipes or fuel lines. Such contact may result in damage or unsatisfactory vehicle performance.

When a vehicle is lifted with a vehicle jack or floor jack, the wheels at the opposite end should be blocked. Jackstands should be used to provide additional support. Jackstands should be placed under either the frame, the front suspension crossmember or the rear axle.

The vehicle should be on a clean, hard, level surface before any lifting procedure begins. All lifting equipment must meet weight standards and be in good working order. Make sure all vehicle loads are equally distributed and secure. If the only support for the vehicle is at the frame side rails, make sure the lifting equipment does not put too much stress on or weaken the frame side rails.

Recommended vehicle lifting points are shown in Figures 6 and 7. If any other hoist methods are used, take special care not to damage the fuel tank, filler neck, exhaust system or underbody.

LOCK CYLINDER CODING

Key Identification and Usage

Figure 8

The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. Two non-interchangeable keys are used.

- Square-headed key is used in the ignition lock cylinder.
- Oval-headed key is used in all other lock cylinders.

Key identification is obtained from the four-character key code stamped on the knockout portion of the key head and from an identification letter stamped on the key shank. After the code number has been recorded by the owner, the plugs should be knocked out of the key head. Using these numbers, owners of key-cutting equipment can determine the lock combination by consulting a code

0A-6 GENERAL INFORMATION

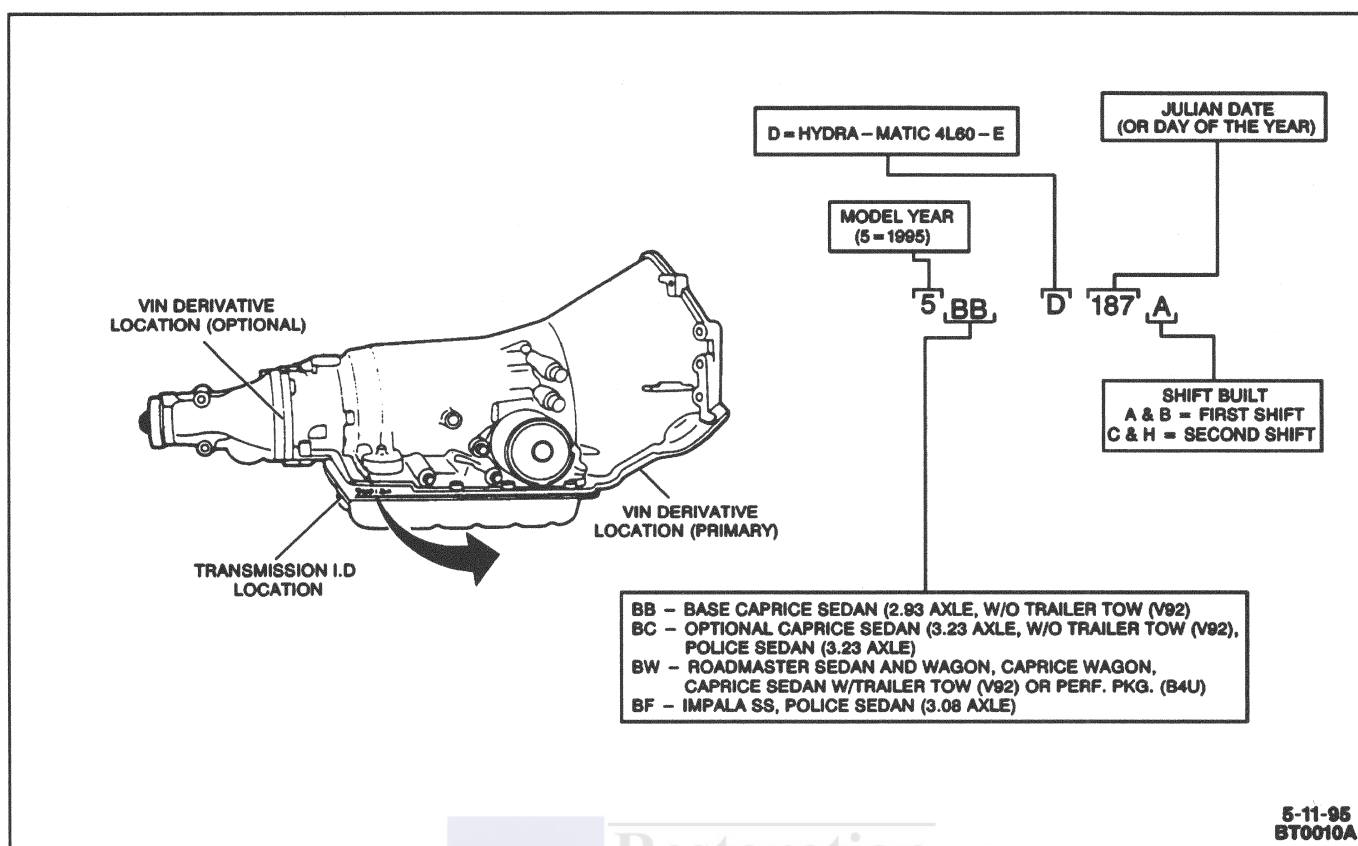


Figure 5 - Transmission Identification (HYDRA-MATIC 4L60-E)

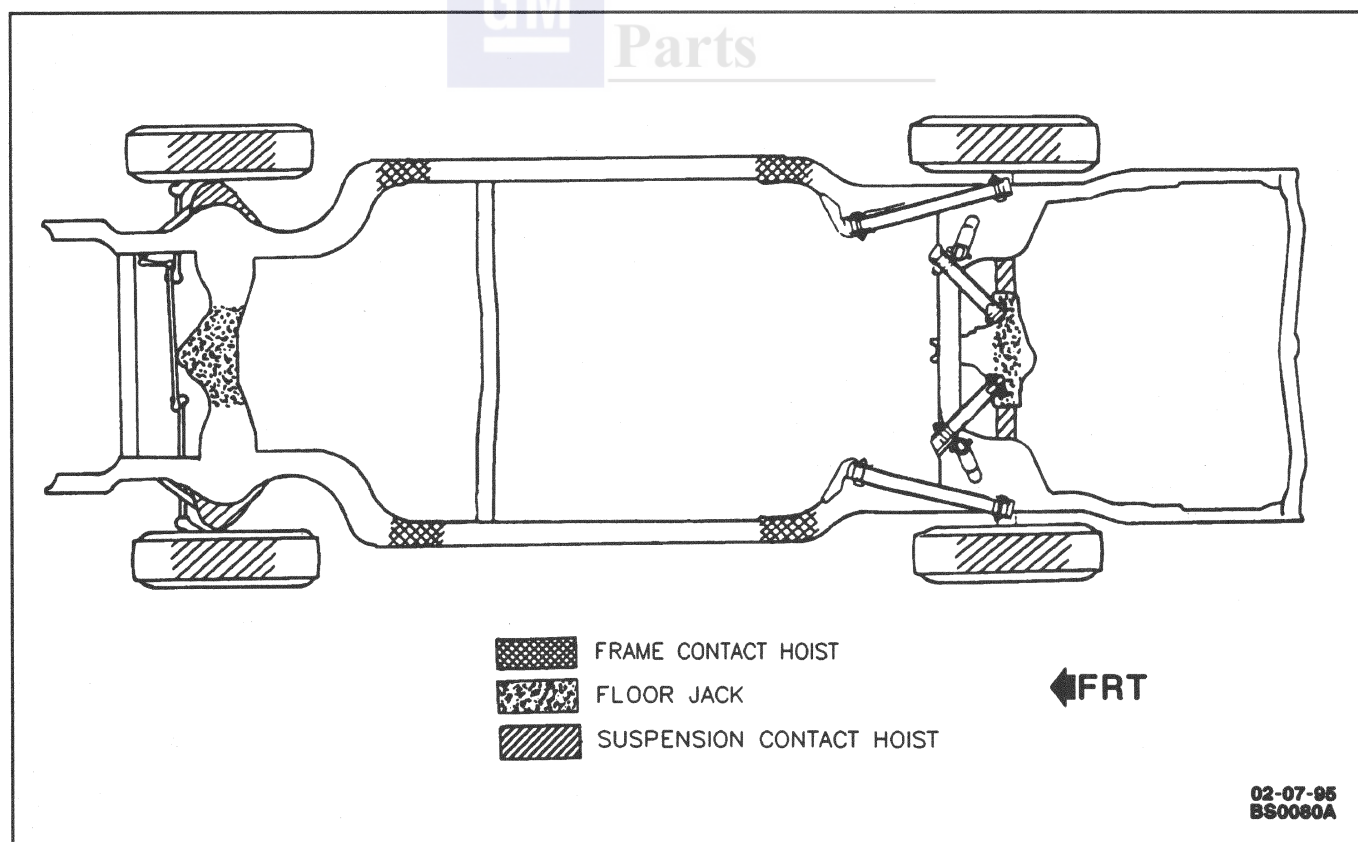
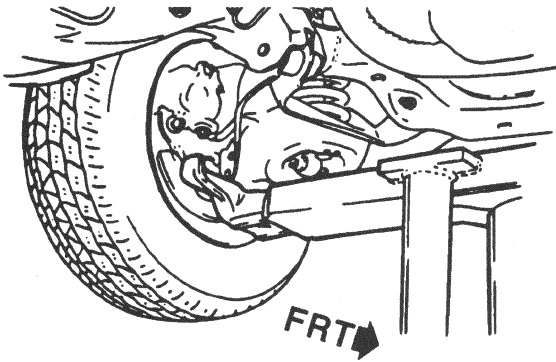
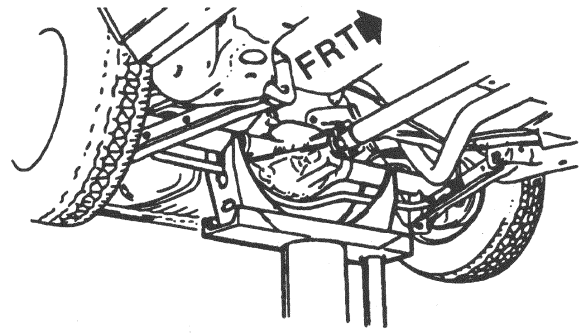


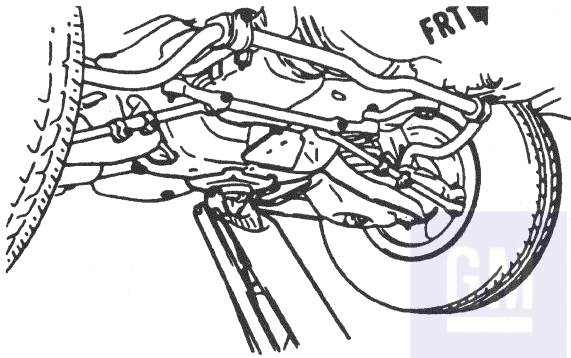
Figure 6 - Lifting and Jacking Points (1 of 2)



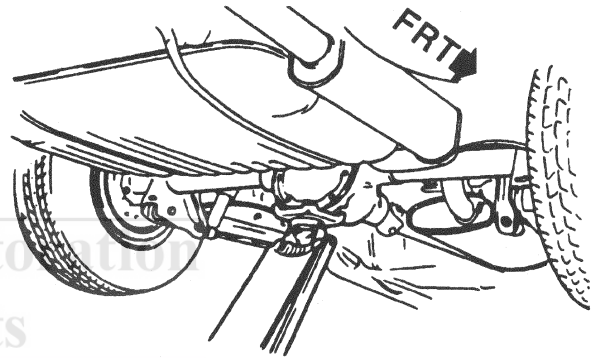
SUSPENSION CONTACT HOIST, UNDER
FRONT LOWER CONTROL ARM



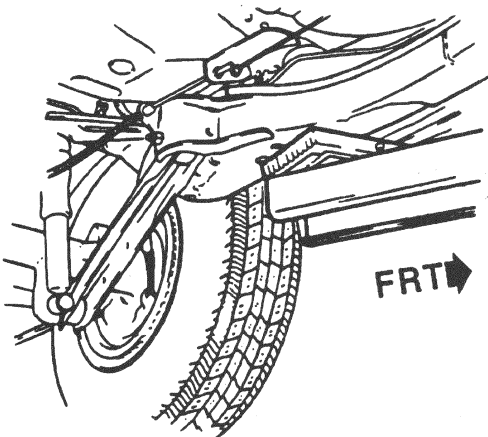
SUSPENSION CONTACT HOIST, LIFTING
ON DIFFERENTIAL HOUSING (DO NOT
LIFT ON STABILIZER BAR IF PRESENT)



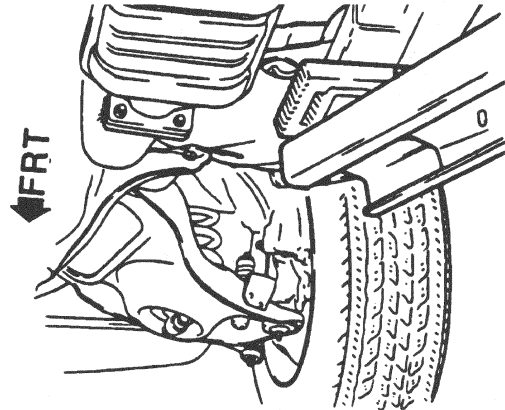
WHEN USING FLOOR JACK, LIFT
ON CENTER OF FRONT CROSSMEMBER



WHEN USING FLOOR JACK, LIFT
AT CENTER OF DIFFERENTIAL HOUSING—
NOT ON STABILIZER BAR (IF PRESENT)



FRAME CONTACT HOIST,
FORWARD OF REAR TIRE



FRAME CONTACT HOIST,
REARWARD OF FRONT TIRE

02-07-95
BS0090A

Figure 7 - Lifting and Jacking Points (2 of 2)

0A-8 GENERAL INFORMATION

list available from equipment suppliers. If the key code numbers are not available from records or from the knockout plug, the lock combination (tumbler numbers and position) can be determined by laying the key on the diagram (Figure 8).

Cutting Keys

Figure 8

1. Determine correct PASS-Key II® code if cutting key for ignition cylinder. Refer to SECTION 9D.
2. Determine special code from the code list or key code diagram (Figure 8).
3. Cut a blank key with the correct PASS-Key II® code to proper level for each of six tumbler positions or according to directions supplied by the key-cutting equipment manufacturer.
4. Check key operation in lock cylinder.
 - If ignition key was cut and vehicle starts with original key but will not start with new key, PASS-Key II® code is incorrect. Refer to SECTION 9D.

Replacement Lock Cylinders

Figure 9

Lock cylinders (3) are available from service parts warehouses completely coded and with a new key. The new lock cylinder (3) has a locking bar staked in place. Tumblers (1) and springs are also available and must be assembled into the lock cylinder (3) according to the key code.

Assembling and Coding Lock Cylinders

ALL LOCK CYLINDERS EXCEPT INSTRUMENT PANEL COMPARTMENT

Figures 8 through 11

Tumblers (1) for all locks are shaped exactly alike, with the exception of the notch position on one side. As the key is inserted in the lock cylinder (3), tumblers (1) are lowered to the correct height so that notches on each tumbler (1) are at the same level. When the notches on all six tumblers line up, the side bar (4) is pushed into the notches by two small springs. This allows the lock cylinder (3) to turn in its bore. Five types of tumblers (1) are used to make the various lock combinations. Each tumbler (1) is coded

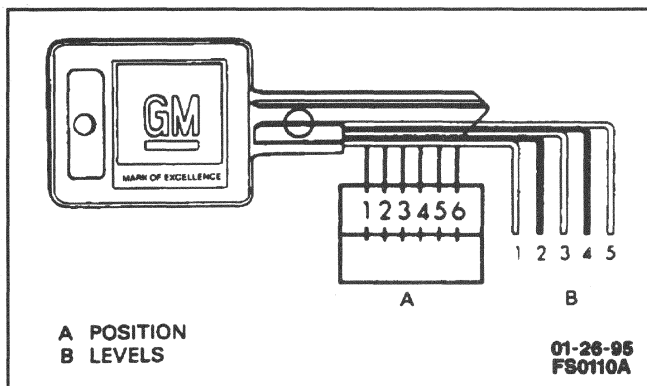


Figure 8 - Key Code Diagram

according to a number, one through five, stamped on its side.



Assemble

1. Determine tumbler numbers and arrangement.
 - With the numerical key code, use code list provided by the key cutting equipment supplier.
 - Without the numerical key code or without the code list, refer to Figure 8.
 - A. Lay key on the key code diagram. Be sure key is outlined by the diagram.
 - B. Start with position number one. Find and record the lowest level (tumbler number) that is visible. Repeat for each of the remaining five positions.
2. Tumblers (1) in their proper slots in the order called for by the code (Figure 8).
 - Start with position number one, nearest open end or lock cylinder head (2).
3. Tumblers (1) by pulling side bar (4) out with fingers.
4. One tumbler spring (6) above each tumbler (1).
5. Spring retainer (5) so that end prongs slide into slots at each end of lock cylinder (3).
 - Press spring retainer (5) down (Figure 10).
6. Insert key into lock cylinder (3) to check for proper installation.
 - Side bar (4) will drop down if tumblers (1) are installed properly. If incorrectly assembled, take apart and assemble correctly.

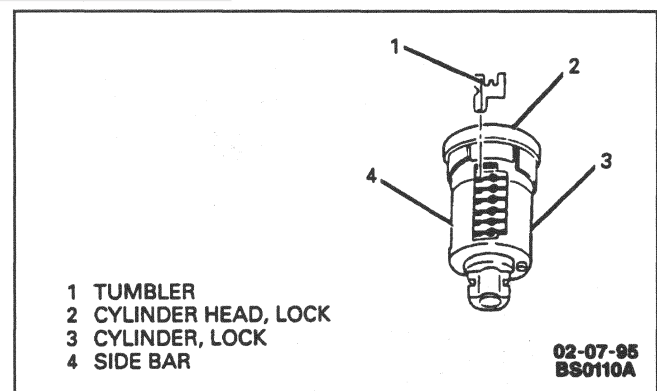


Figure 9 - Lock Cylinder Components

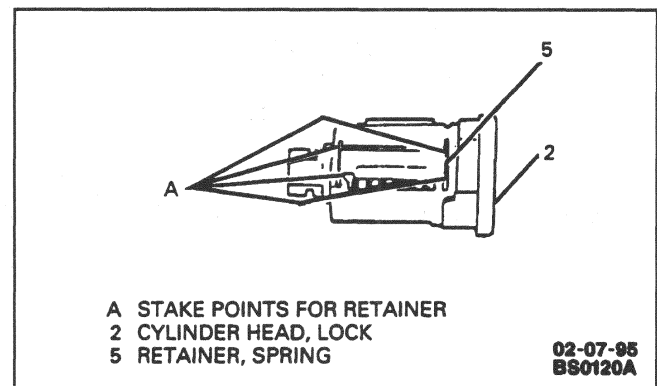


Figure 10 - Installing Spring Retainer

NOTICE: Use leather or wood at each vise jaw to prevent damage to the cylinder.

7. Remove key and secure lock cylinder (3) in a vise with spring retainer (5) exposed.
 - A. Stake spring retainer (5) securely in place at each end. Use a suitable staking tool and stake cylinder metal over the spring retainer (5).
 - B. Black lock cylinders should be lubricated with Multi-Purpose Lubricant (GM P/N 12345120 or equivalent) or light machine oil. All other lock cylinders should be lubricated with a general purpose silicone lubricant.

INSTRUMENT PANEL COMPARTMENT LOCK CYLINDER

Figures 11 and 12

A lock cylinder with snap-in tumblers (1) is used for the instrument panel compartment lock. The lock cylinder has four or five tumbler positions. The number one or two position (closest to the lock cylinder head (2)) is a brass retainer tumbler. The two through five positions or three through five positions are standard tumbler positions depending upon cylinder type. Therefore, only the last four or five tumbler combinations are required.

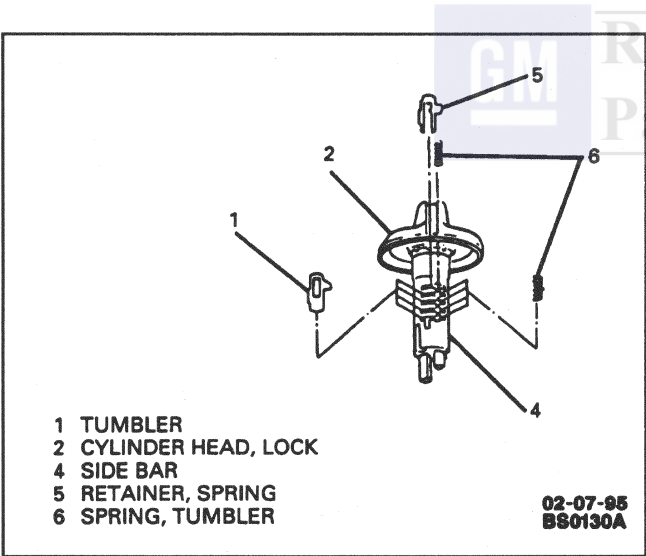


Figure 11 - Installing Tumblers

Assemble

1. Determine tumbler numbers and arrangement as previously described and install tumblers (1).
2. After installation, tap tumblers (1) flush with the cylinder.

METRIC FASTENERS

Figure 13

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

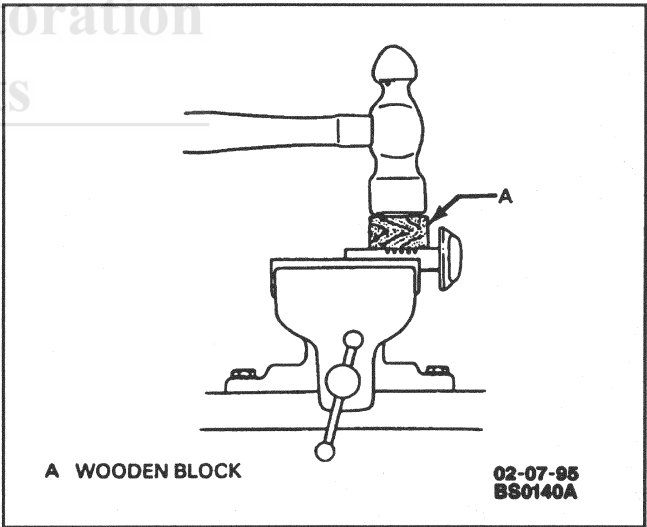


Figure 12 - Locking Tumblers in Place

CUSTOMARY		METRIC	
1/4	— 20	M6.0	X 1
THREAD MAJOR DIAMETER IN INCHES	NUMBER OF THREADS PER INCH	THREAD MAJOR DIAMETER IN MILLIMETERS	DISTANCE BETWEEN THREADS IN MILLIMETERS
THREAD PITCH			

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Figure 13 - Thread Notation

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- Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.
- Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

Most fasteners used on this vehicle are metric. Metric fasteners may be close in dimension to well-known customary fasteners in the inch system. Replacement fasteners must be the correct nominal diameter, thread pitch and strength.

Original equipment metric fasteners, except for exposed bumper bolts, beauty bolts, or other specialty bolts have numbers on their heads that identify them as metric. Cross-recess head screws can be identified by a Posidriv® or a Type 1A cross-recess. Either type of cross-recess screwdriver can be used to remove Posidriv® recess head screws, but Type 1A will perform better.

NOTICE: Most metric fasteners have a blue or green color coating. This coating should not be used to positively identify fasteners because not all metric fasteners are color-coated. Damage to the fastener or part could result if a customary fastener is incorrectly used to replace a metric fastener. Metric and customary thread notations differ slightly. For example, the thread major diameter of a 1/4-20 bolt/screw is 1/4 inch, and the bolt/screw has 20 threads per inch. The thread major diameter of an M6.0x1 bolt/screw is 6.0 mm, and the bolt/screw has 1 mm between threads.

FASTENER STRENGTH IDENTIFICATION

Figure 14

Most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt/screw. Customary fastener strength property classes range from grade 2 to 8. Radial lines are embossed on the head of each bolt/screw to identify the strength class. Some metric nuts are marked with strength identification numbers on the nut face (Figure 14). When replacing fasteners, be careful to use bolts/screws and nuts of a strength class equal to the original fasteners (the same number marking).

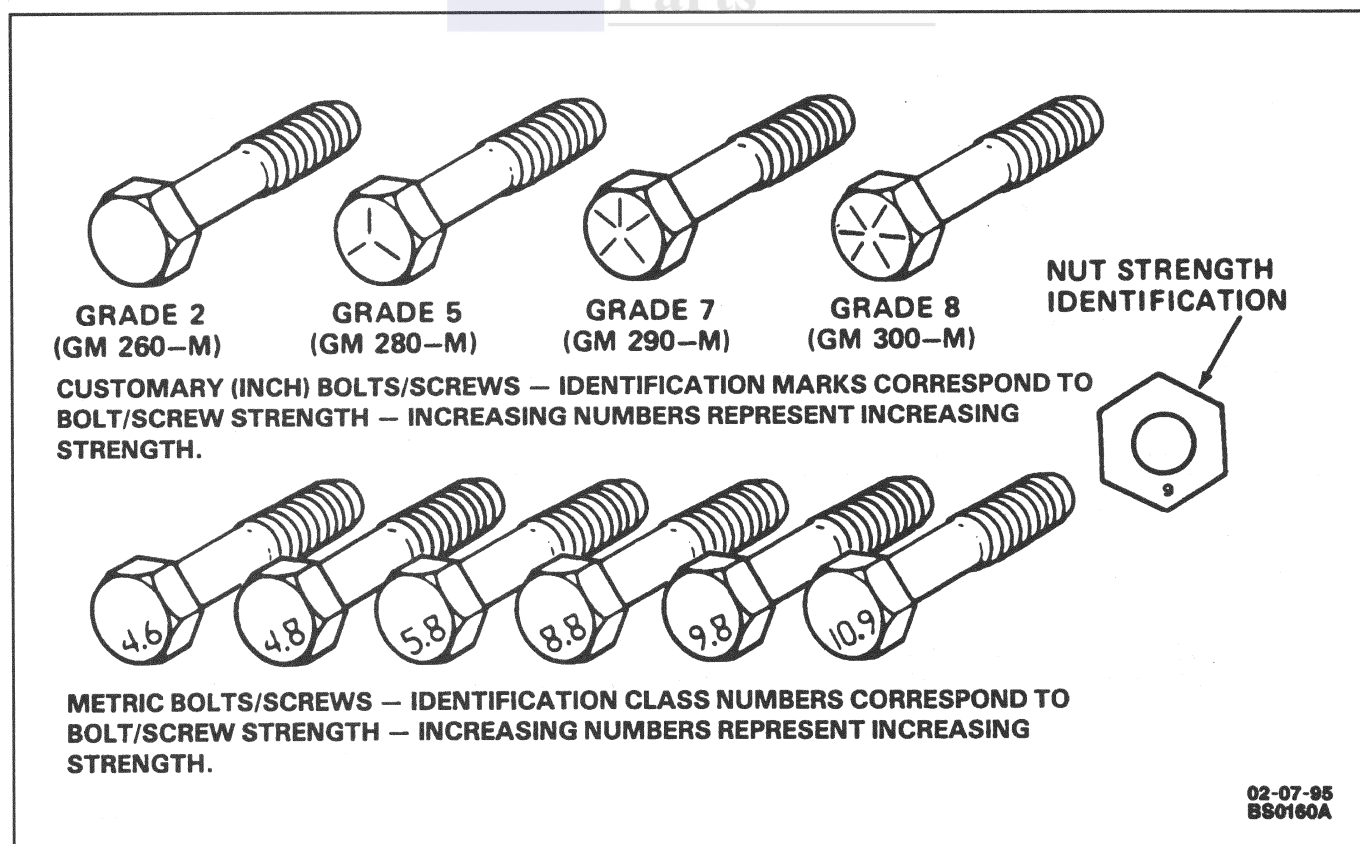


Figure 14 - Fastener Strength Markings

Also select replacement fasteners of the correct size. Correct replacement bolts/screws and nuts are available through General Motors Service Parts Operation (GMSPO).

Many metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States. The fasteners may have different strength or thread pitch and may not have the numbered head marking system. The metric fasteners used on GM products are designed to new international standards that might not be used by some nondomestic bolt/screw and nut suppliers.

PREVAILING TORQUE FASTENERS

Figures 15 and 16

A prevailing torque nut is designed to develop an interference between the nut and bolt/screw threads. This interference is usually created by distortion of the top of an all-metal nut or by a nylon patch in the threads in the middle of a hex flat. In other cases, a nylon insert may be used (Figure 15).

A prevailing torque bolt/screw is designed to develop an interference between the bolt/screw and nut threads or between the bolt/screw and tapped hole threads. This interference is created by distorting some of the threads or by using a nylon patch or adhesive (Figure 15).

Rusty or damaged bolts/screws and nuts should be replaced with new parts of the same strength class. Clean, unrusted bolts/screws and nuts can be reused. Be sure to use the following recommendations:

1. Clean dirt and other foreign material from nut or bolt/screw.
2. Inspect nut or bolt/screw for cracks, elongation or other signs of abuse or overtightening.
 - If nut or bolt/screw is worn in any way, replace with a nut or bolt/screw of the same strength class.
3. Assemble the parts and hand-start nut or bolt/screw.

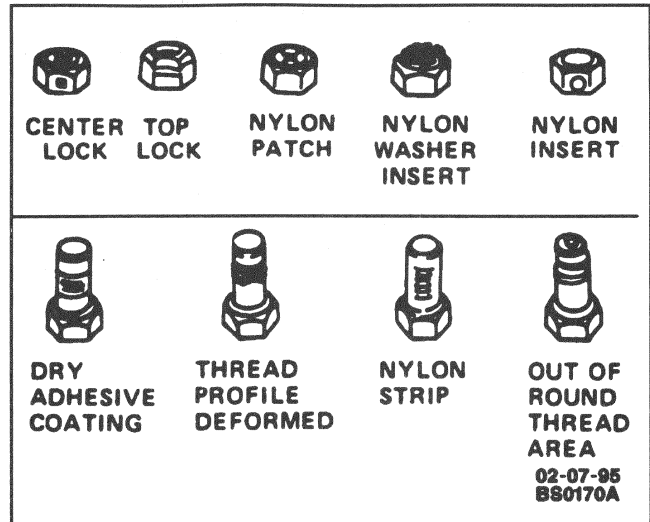


Figure 15 - Prevailing Torque Nuts and Bolts/Screws

4. Check that nut or bolt/screw develops the proper torque before it seats (Figure 16).
 - If nut or bolt/screw fails to develop torque correctly, replace with a nut or bolt/screw of the same strength class.
5. Tighten fastener to the torque specified in the appropriate installation procedure in this manual.

ENGLISH-SI METRIC CONVERSIONS

To convert english units to metric units, multiply the english units by the conversion factor shown in the conversion chart. To convert metric units to english units, divide the metric units by the conversion factor shown in the conversion chart.

DECIMAL AND METRIC EQUIVALENTS

Inch-to-millimeter decimal equivalents are shown in the decimal equivalent chart.

FASTENER TYPE	TORQUE UNITS	METRIC – SIZE FASTENERS							
		6	6.3	8	10	12	14	16	20
Nuts and All Metal Bolts/Screws	N·m	0.4	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	Lb. In.	4	4	7	12	19	27	37	62
Adhesive or Nylon Coated Bolts/Screws	N·m	0.4	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	Lb. In.	4	4	5	11	14	21	30	50
FASTENER TYPE	TORQUE UNITS	INCH – SIZE FASTENERS							
		.250	.312	.375	.437	.500	.562	.625	.750
Nuts and All Metal Bolts/Screws	N·m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	Lb. In.	4	5	12	16	21	28	37	55
Adhesive or Nylon Coated Bolts/Screws	N·m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	Lb. In.	4	5	9	12	16	23	30	49

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Figure 16 - Prevailing Torque Fastener Specifications

0A-12 GENERAL INFORMATION

STANDARD NOMENCLATURE FOR ELECTRICAL/ELECTRONIC COMPONENTS AND SYSTEMS

Figures 17 and 18

General Motors will be complying with the Society of Automotive Engineers (SAE) Recommended Practice J 1930. J 1930, an industry-wide standard that was adopted into government regulations, requires identical

nomenclature for certain electrical/electronic components and systems that have the same function. The standard is also being applied to abbreviations and acronyms and is being used in all 1995 GM service publications.

To make this standard work, some names and abbreviations are being replaced with those recommended by the SAE Standard. Figures 17 and 18 are a listing of former GM names and abbreviations beside the new J 1930 name and abbreviations.



Former GM Name	New SAE Name Term
Absolute Pressure Sensor Aps – APS	Manifold Absolute Pressure Sensor – MAP Sensor
Air Cleaner Assembly	Air Cleaner – ACL
Air Cleaner Filter Element	Air Cleaner Filter – ACL Filter
Air Injection Reaction System – A.I.R. System	Secondary Air Injection System – AIR System
Assembly Line Communication Link – ALCL	Data Link Connector – DLC
Assembly Line Data Link – ALDL	Data Link Connector – DLC
Barometric Pressure Sensor – BARO Sensor	Barometric Pressure Sensor – BARO Sensor
BCM-PCM Data Problem	BCM-PCM Data Link
Calibration Pack – CAL-PAK	Electronically Erasable Programmable Read Only Memory – EEPROM
Calibration Pack – CAL-PAK	Erasable Programmable Read Only Memory – EPROM
Calibration Pack – CAL-PAK	Programmable Read Only Memory – PROM
Camshaft Sensor	Camshaft Position Sensor – CMP Sensor
Canister Purge – CP	Evaporator Emission Canister Purge – EVAP Canister Purge
Catalytic Converter – Cat. Conv.	Oxidation Catalytic Converter – OC
Catalytic Converter – Cat. Conv.	Three Way + Oxidation Catalytic Converter – TWC + OC
Catalytic Converter – Cat. Conv.	Three Way Catalytic Converter – TWC
Catalytic Converter – Cat. Conv.	Warm Up Oxidation Catalytic Converter – WU-OC
Catalytic Converter – Cat. Conv.	Warm Up Three Way Catalytic Converter – WU-TWC
Check Engine Indicator	Malfunction Indicator Lamp – MIL
Code	Diagnostic Trouble Code – DTC
Computer Command Control – CCC	Engine Control Module – ECM
Computer Controlled Coil Ignition – C3I	Electronic Ignition – EI
Controlled Canister Purge – CCP	Evaporative Emission Canister Purge – EVAP Canister Purge
Coolant Temperature Sensor – CTS	Engine Coolant Temperature Sensor – ECT Sensor
Coolant Temperature Switch – CTS	Engine Coolant Temperature Switch – ECT Switch
Detonation Sensor	Knock Sensor – KS
Diagnostic Circuit Check	On-Board Diagnostic System Check – OBD System Check
Digital Electronic Fuel Injection – DEFI	Multiport Fuel Injection – MFI
Digital Electronic Fuel Injection – DEFI	Sequential Multiport Fuel Injection – SFI
Digital Fuel Injection – DFI	Multiport Fuel Injection – MFI
Digital Fuel Injection – DFI	Sequential Multiport Fuel Injection – SFI
Direct Ignition System – DIS	Electronic Ignition System – EI System
Distributor HEI Module	Distributor Ignition Control Module – DI Control Module
Distributorless Ignition System – DIS	Electronic Ignition System – EI System
Dual Bed Monolith – DBM	Oxidation Catalytic Converter – OC
Dual Bed Monolith – DBM	Three Way Catalytic Converter – TWC
Electronic Air Control – EAC	Secondary Air Injection Bypass Valve – AIR Bypass Valve
Electronic Air Switching – EAS	Secondary Air Injection Switching Valve – AIR Switching Valve
Electronic Control Module – ECM	Powertrain Control Module – PCM
Electronic Fuel Injection – EFI	Multiport Fuel Injection – MFI
Electronic Fuel Injection – EFI	Sequential Multiport Fuel Injection – SFI
Electronic Fuel Injection – EFI	Throttle Body Fuel Injection – TBI
Electronic Spark Control Circuit – ESC Circuit	Knock Sensor Circuit – KS Circuit
Electronic Spark Control System – ESC System	Knock Sensor System – KS System

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Figure 17 - Standard Nomenclature for Electrical/Electronic Components and Systems (1 of 2)

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Former GM Name	New SAE Name Term
Electronic Spark Timing – EST	Ignition Control – IC
Electronic Spark Timing Circuit – EST Circuit	Ignition Control Circuit – IC Circuit
Electronic Vacuum Regulator Valve – EVRV	Exhaust Gas Recirculation Electronic Vacuum Regulator Solenoid Valve – EGR Electronic Vacuum Regulator Solenoid Valve
Engine Calibration Unit – ECU	Programmable Read Only Memory – PROM
Evaporative Emission Control System – EECS	Evaporative Emission System – EVAP System
Exhaust Gas Recirculation/Thermostatic Vacuum Switch – EGR/TVS	Exhaust Gas Recirculation Thermal Vacuum Valve – EGR TVV
Fuel CAL-PAK Missing	Programmable Read Only Memory Missing – PROM Missing
High Energy Ignition – HEI	Distributor Ignition – DI
Lean Exhaust	Lean Heated Oxygen Sensor Signal – Lean HO ₂ S
Lean Exhaust	Lean Oxygen Sensor Signal – Lean O ₂ S Signal
Manifold Air Temperature Sensor – MAT Sensor	Intake Air Temperature Sensor – IAT Sensor
MEM-CAL Error	Erasable Programmable Read Only – Only Memory Error – EPROM Error
MEM-CAL Error	Programmable Read Only Memory Error – PROM Error
Memory and Calibration Unit – MEM-CAL	Erasable Programmable Read Only Memory – EPROM
Memory and Calibration Unit – MEM-CAL	Programmable Read Only Memory – PROM
Multi-Port Fuel Injection – MPFI	Multiport Fuel Injection – MFI
Oxygen Sensor – O ₂	Heated Oxygen Sensor – HO ₂ S
Oxygen Sensor – O ₂	Oxygen Sensor – O ₂ S
Park/Neutral Switch – P/N Switch	Park/Neutral Position Switch – PNP Switch
Port Fuel Injection – PFI	Multiport Fuel Injection – MFI
Pulse Air Injection System – PAIR	Pulsed Secondary Air Injection System – PAIR System
Revolutions Per Minute – rpm	Engine Speed – RPM
Rich Exhaust	Rich Heated Oxygen Sensor Signal – Rich HO ₂ S Signal
Rich Exhaust	Rich Oxygen Sensor Signal – Rich O ₂ S Signal
“Scan” Data	Scan Tool Data – ST Data
Service Engine Soon Indicator – SES Indicator	Malfunction Indicator Lamp – MIL
Thermal Vacuum Switch – TVS	Thermal Vacuum Valve – TVV
Thermostatic Air Cleaner – TAC	Air Cleaner – ACL
Throttle Body Injection – TBI	Throttle Body Fuel Injection – TBI
Throttle Position Sensor – TPS	Throttle Position Sensor – TP Sensor
Throttle Position Switch – TPS	Closed Throttle Position Switch – CTP Switch
Throttle Switch	Closed Throttle Position Switch – CTP Switch
Throttle Switch	Wide Open Throttle Switch – WOT Switch
Tuned Port Injection – TPI	Multiport Fuel Injection – MFI
Viscous Converter Clutch – VCC	Torque Converter Clutch – TCC

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Figure 18 - Standard Nomenclature for Electrical/Electronic Components and Systems (2 of 2)

ENGLISH TO SI METRIC CONVERSION CHART

TO CONVERT	INTO	MULTIPLY BY
LENGTH		
Inch	millimeters (mm)	25.4
Foot	meters (m)	0.3048
Yard	meters	0.9144
Mile	Kilometers (km)	1.609
AREA		
Inch ²	millimeters ² (mm ²)	645.2
Inch ²	centimeters ² (cm ²)	6.45
Foot ²	meters ² (m ²)	0.0929
Yard ²	meters ²	0.8361
VOLUME		
Inch ³	mm ³	16387.0
Inch ³	cm ³	16.387
Inch ³	liters (l)	0.0164
Quart	liters	0.9464
Gallon	liters	3.7854
Yard ³	meters ³	0.7646
MASS		
Pound	kilograms (kg)	0.4536
Ton	kilograms (kg)	907.18
Ton	tonne (t)	0.907
FORCE		
Kilogram	newtons (N)	9.807
Ounce	newtons	0.2780
Pound	newtons	4.448

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ENGLISH TO SI METRIC CONVERSION CHART (cont'd)

TO CONVERT	INTO	MULTIPLY BY
TEMPERATURE		
Deg. Fahrenheit	Deg. Celsius (C)	(°F-32) ÷ 1.8
ACCELERATION		
Foot/sec ²	meter/sec ² (m/s ²)	0.3048
Inch/sec ²	meter/sec ²	0.0254
TORQUE		
Pound-inch	newton-meters (N•m)	0.11298
Pound-foot	newton-meters (N•m)	1.3558
POWER		
Horsepower	kilowatts (kW)	0.746
PRESSURE OR STRESS		
Inches of water	kilopascals (kPa)	0.2491
Pounds/sq. in.	kilopascals	6.895
ENERGY OR WORK		
BTU	joules (j)	1055.0
Foot-pound	joules	1.3558
Kilowatt-hour	joules (J=one W/s)	3.6 X 10 ⁶
LIGHT		
Foot candle	lumens/meter ² (lm/m ²)	10.764
FUEL PERFORMANCE		
Miles/gal	kilometers/liter (km/l)	0.4251
Gal/mile	liter/kilometer (l/km)	2.3527
VELOCITY		
Miles/hour	kilometers/hr. (km/h)	1.6093

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0A-16 GENERAL INFORMATION**DECIMAL AND METRIC EQUIVALENTS**

FRACTIONS	DECIMAL IN.	METRIC MM	FRACTIONS	DECIMAL IN.	METRIC MM
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.17500	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.172875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76520	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.64750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82182
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.0	25.40000

T5381

ABBREVIATIONS AND SYMBOLS

The following abbreviations and symbols may appear in this manual.

A

A-6 - Axial 6 Cylinder A/C Compressor
 A/C - Air Conditioning
 A/F - Air/Fuel (A/F Ratio)
 ABDC - After Bottom Dead Center
 ABS - (Body) Acrylonitrile-Butadiene-Styrene
 (Brake) Antilock Brake System
 ac - Alternating current
 AC - A GM Division
 ACC - Automatic Climate Control
 A/D - Analog-to-Digital
 ADF - Air Deflector Valve
 AIR - Air Injection Reaction
 Al - Aluminum
 ALC - Automatic Level Control
 AM/FM - Amplitude Modulation/Frequency
 Modulation
 amp - amperes
 API-GL - American Petroleum
 Institute-Gear Lubricant
 APS - Absolute Pressure Sensor
 APT - Adjustable Part Throttle
 ARS - Automatic Restraint System
 ASM - Assembly
 ASR - Acceleration Slip Regulation
 A/T - Automatic Transmission
 ATC - Automatic Temperature Control
 ATDC - After Top Dead Center
 ATS - Air Temperature Sensor
 Auto - Automatic
 avg - average
 AWD - All Wheel Drive
 AWG - American Wire Gage

B

B + - Battery positive
 BARO - Barometric
 batt - battery
 BBDC - Before Bottom Dead Center
 BCM - Body Control Module
 BHP - Brake Horsepower
 BLM - Block Learn Multiplier
 BP - Back Pressure
 BTDC - Before Top Dead Center
 Btu - British thermal units

C

°C - Celsius
 C LOOP - Closed Loop
 C3I, 3CI - Computer Controlled Coil Ignition
 CAD - Computer Aided Design
 CAM - Computer Aided Manufacturing
 CCOT - Cycling Clutch Orifice Tube

CCP - Controlled Canister Purge
 Cd - Cadmium
 CD - Compact Disc
 CEMF - Counter Electromotive Force
 cfm - cubic feet per minute
 cg - center of gravity
 CID - Cubic Inch Displacement
 ckt - circuit
 cm³ - cubic centimeters
 CO - Carbon Monoxide
 CP - Canister Purge
 CPA - Connector Position Assurance
 CPS - Central Power Supply
 CPU - Central Processing Unit
 CRT - Cathode Ray Tube
 CRTC - Cathode Ray Tube Controller
 CTS - Coolant Temperature Sensor,
 Coolant Temperature Switch,
 cu ft or ft³ - cubic foot, or feet
 cu in or in³ - cubic inch, or inches
 CV - Constant Velocity
 CYL - Cylinder(s)

D

dB - decibels
 dBA - decibels on A-weighted scale
 DBB - Dual Bed Bead
 DBM - Dual Bed Monolith
 dc - direct current
 DEC - Digital Electronic Controller
 dia - diameter
 DIFF - Differential
 DIS - Distributorless Ignition System
 DLC - Data Link Connector
 DRL - Daytime Running Lamps
 DVM - Digital Volt Meter
 DVOM - Digital Volt Ohm Meter

E

E/P - Ethylene/Propylene
 EAC - Electric Air Control
 EAS - Electric Air Switching
 EBCM - Electronic Brake Control Module
 ECC - Electronic Climate Control
 ECI - Extended Compressor at Idle
 ECS - Emission Control System
 ECU - Electronic Control Unit
 EDES - Electric Divert/Electric Air
 Switching Valve
 EEC - Evaporative Emission Control
 EECS - Evaporative Emissions Control System
 EES - Evaporative Emission System
 EEVIR - Evaporator Equalized Values
 in Receiver
 EFE - Early Fuel Evaporation
 EGR - Exhaust Gas Recirculation
 ELC - Electronic Level Control
 EMF - Electromotive Force

0A-18 GENERAL INFORMATION

EOS - Exhaust Oxygen Sensor
EPR - Exhaust Pressure Regulator
EPROM - Erasable Programmable Read
Only Memory
ESC - Electronic Spark Control
EST - Electronic Spark Timing
ETC - Electronic Temperature Control
ETCC - Electronic Touch Climate Control
ETR - Electronically Tuned Receiver
EVRV - Electronic Vacuum Regulator Valve

F

°F - Fahrenheit
FDC - Fuel Data Center
FEC - Fuel Evaporator Control
FED - Federal (all states except California)
FI - Fuel Injection
4WAL - Four Wheel Antilock
ft - foot, feet
FWD - Front Wheel Drive, Four Wheel Drive

G

g - gravitational acceleration, grams
GA - Gage
gal - gallon
gas - gasoline
GCW - Gross Combination Weight
Gen - Generator
GM - General Motors
gnd - ground
GVWR - Gross Vehicle Weight Rating

H

H - Hydrogen
H₂O - Water
H/CMPR - High Compression
HC - Hydrocarbons
HD - Heavy Duty
HDC - Heavy Duty Cooling
HEI - High Energy Ignition
hex - hexagon
Hg - Mercury
Hi Alt - High Altitude
hp - horsepower
HPL - High Pressure Liquid
HPV - High Pressure Vapor
HVAC - Heater-Vent-Air Conditioning
HVACM - Heater-Vent-Air Conditioning Module
Hz - Hertz

I

IAC - Idle Air Control
IC - Integrated Circuit
ID - Inside Diameter, identification
IDI - Integrated Direct Ignition
ign - ignition
ILC - Idle Load Compensator
INJ - Injection
I/P - Instrument Panel
ISC - Idle Speed Control

K

KAM - Keep Alive Memory
kg - kilogram
kHz - kilohertz
km/h - kilometers per hour
km/L - kilometers per liter
kPa - kilopascals
kV - kilovolts

L

L - Liter
lb. ft. - pound feet (torque)
lb. in - pound inch (torque)
LCD - Liquid Crystal Display
LF - Left Front
LH - Left Hand
LR - Left Rear
lt - left

M

M/C - Mixture Control
MAF - Mass Air Flow
Man - Manual
MAP - Manifold Absolute Pressure sensor
MAT - Manifold Air Temperature sensor
Max - Maximum
MDP - Manifold Differential Pressure
MEM-CAL - Memory and Calibration Unit
MFI - Multi-port Fuel Injection
mgd - million gallons per day
mi - miles
MIL - Malfunction Indicator Lamp
min - minimum
ml - milliliters
mm - millimeters
mpg - miles per gallon
mph - miles per hour
ms - millisecond
M/T - Manual Transmission
MV - Megavolt
mV - millivolt
MVSS - Motor Vehicle Safety Standards

N

NC - Normally Closed
NEG - Negative
NEU - Neutral
NLGI - National Lubricating Grease Institute
Ni - Nickel
N.m - Newton-meters (torque)
NO - Normally Open
NO₃ - Oxides of Nitrogen
NPTC - National Pipe Thread Coarse
NPTF - National Pipe Thread Fine

O

O2 - Oxygen
 OC - Oxidizing Converter
 OD - Outside Diameter
 OEM - Original Equipment Manufacturer
 ORC - Oxidizing Reducer Converter
 oz - ounce(s)

P

P/N - Park/Neutral
 PA - Polyamide
 PBT - Polybutylene terephthalate
 PC - Polycarbonate
 PCM - Powertrain Control Module
 PCV - Positive Crankcase Ventilation
 PE - Polyethylene
 PF - Phenol-Formaldehyde
 PM - Permanent Magnet (Generator)
 POA - Pilot Operated Absolute Valve
 POLYE - Polyethylene
 POLYF - Polyfoam
 P - Polypropylene
 POLYU - Polyurethane
 POS - Positive
 POT - Potentiometer (Variable Resistor)
 POM - Polyoxymethylene
 PP - Polypropylene
 PPE - Polyphenylene Ether
 ppm - parts per million
 PROM - Programmable Read Only Memory
 PS - Power Steering
 PSPS - Power Steering Pressure Switch
 psi - pounds per square inch
 psia - pounds per square inch absolute
 psig - pounds per square inch gage
 pt - pint
 PUR - polyurethane (thermoset)
 PWM - Pulse Width Modulated

Q

qt - quart(s)

R

R-4 - Radial Four Cylinder Air Compressor
 R-12 - Refrigerant-12
 R-134A - Refrigerant-R134A
 RAM - Random Access Memory
 (non permanent memory devise, memory
 contents are lost when power is removed)
 Ref - Reference
 RF - Right Front
 RFI - Radio Frequency Interference
 RH - Right Hand
 RIM - Reaction Injection Molded Urethane
 RPM - Revolutions Per Minute
 ROM - Read Only Memory (permanent memory
 devise, memory contents are retained
 when power is removed)

RPO - Regular Production Option
 RR - Right Rear
 RRIM - Reinforced Reaction Injection
 Molded Urethane
 rt - right
 RTV - Room Temperature Vulcanizing (sealer)
 RVB - Rear Vacuum Brake
 RVR - Response Vacuum Reducer
 RWAL - Rear Wheel Antilock
 RWD - Rear Wheel Drive

S

S - Seconds
 SAE - Society of Automotive Engineers
 SDM - Sensing and Diagnostic Module
 SEO - Special Equipment Option
 SES - Service Engine Soon
 SI - System International (modern version
 of metric system)
 Si - Silicone
 SIR - Supplemental Inflatable Restraint
 SMC - Sheet Molded Compound
 SO2 - Sulfur Dioxide
 sq ft, ft2 - square foot(feet)
 sq in, in2 - square inch(es)

T

TCC - Torque Converter Clutch
 TDC - Top Dead Center
 TEMP - Temperature
 THM - Turbo Hydra-Matic
 THERMAC - Thermostatic Air Cleaner
 TPE - Thermo Plastic Elastomer
 TPO - Thermo Plastic Olefin
 TPS - Throttle Position Sensor
 TPU - Polyurethane (Thermoplastic)
 TRANS - Transmission
 Turbo - Turbocharger
 TV - Throttle Valve
 TVRS - Television and Radio Suppression
 TVS - Thermal Vacuum Switch
 TXV - Thermal Expansion Valve

U

U-joint - Universal joint

V

V - Volt(s), Voltage
 V4 - Four Cylinder Engine
 V6 - Six Cylinder Engine
 V8 - Eight Cylinder Engine
 Vac - Vacuum
 VATS - Vehicle Anti-Theft System
 VDV - Vacuum Delay Valve
 vel - velocity
 VF - Vacuum Fluorescent
 VIN - Vehicle Identification Number

0A-20 GENERAL INFORMATION

VIR - Valves In Receiver
VLV - Vacuum Limiting Valve
VMV - Vacuum Modulator Valve
VRV - Vacuum Reducer Valve
VSS - Vehicle Speed Sensor

X

X-valve - Expansion valve

Y

W

yd - yard

W/S - Windshield
WOT - Wide Open Throttle
WSS - Wheel Speed Sensor

Z

Zn - Zinc



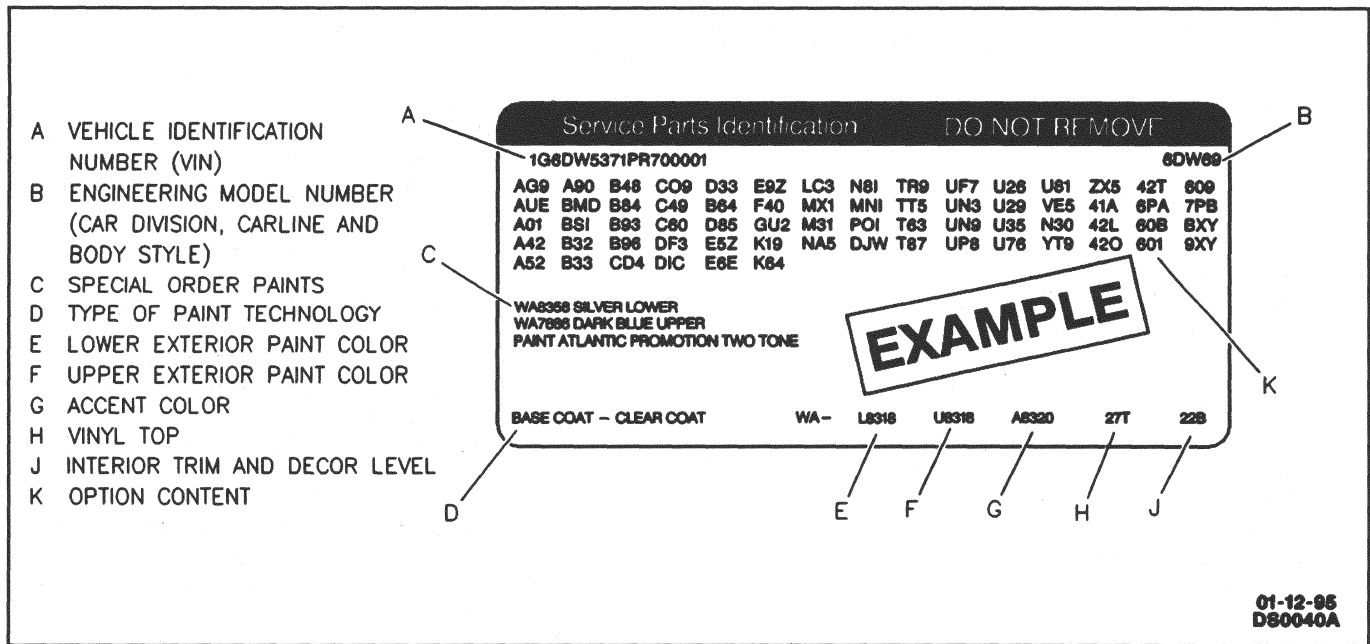


Figure 19 - Service Parts Identification Label

REPLACEMENT LABELS

Replacement labels are available through GM Service Parts Operations for the following:

- Vehicle Emission Control Information (Exhaust Emission Tune Up)
- Spare Wheel Caution
- Jacking
- Spare Tire Storage
- Serpentine Belt Routing (when it is a separate label)
- Engine Fan Caution
- IRS/SIR Service Caution
- Odometer Reset

These and other labels will be found in the Standard Parts Catalog. The Vehicle Certification Label, Tire Pressure Placard and Service Parts Identification Label are NOT available as service parts.

SERVICE PARTS IDENTIFICATION LABEL

Figures 19, 20 and 21

The Service Parts Identification Label has been developed and placed on the vehicle to aid service and parts personnel in identifying parts and options originally installed on the vehicle. The label is located on the underside of the rear compartment lid.

OPTION CODES

Vehicle options are identified on the Service Parts Identification Label by option codes. Option codes are three-digit combinations of letters and numbers. They identify equipment installed on the vehicle, and trim and paint colors. Refer to "Option and Process Codes" in this section.

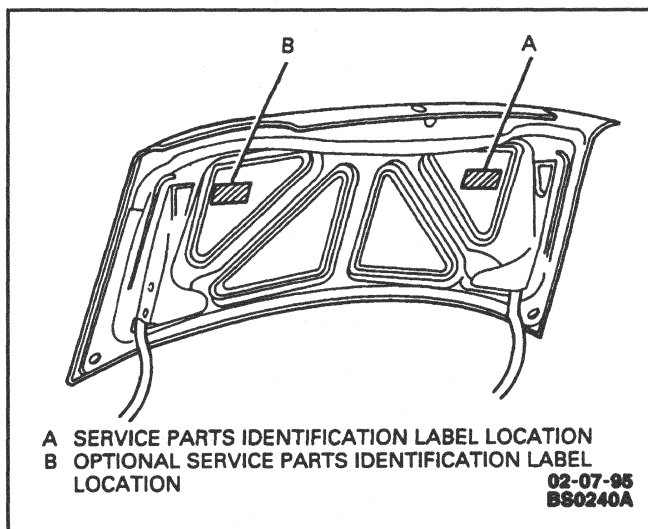


Figure 20 - Service Parts Identification Label Location (Sedan)

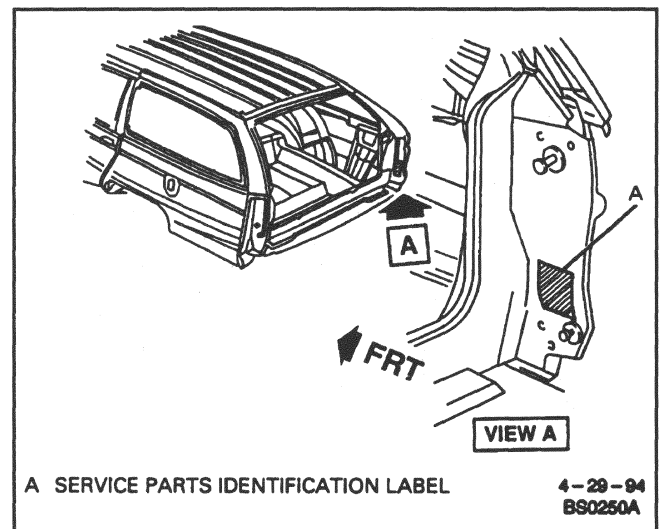


Figure 21 - Service Parts Identification Label Location (Wagon)

OPTION AND PROCESS CODES

- AA7 - Window, Power Operated, Quick Opening
 AG1 - Adjuster, Frt Seat Power, 6 Way Driver, Split Bench
 AG2 - Adjuster, Pass Seat Power, 6 Way, Split Bench
 AG3 - Adjuster, Front Seat Power, 6 Way, 2 Position Memory
 AK5 - Restraint System Front Seat, Inflatable, Driver and Passenger
 AM5 - Seat, Front Split, Driver and Pass 6-Way Power Adj, Power Recline, Power Lumbar, 2-Way
 AM6 - Seat, Front Split With Center Armrest
 AN4 - Restraint Provisions, Child
 AP9 - Net, Convenience
 ARL - Plant Code Arlington, TX
 AS7 - Seat, Front Split
 AU0 - Lock Control, Remote
 AU4 - Lock, Side Door, Electric, Automatic
 A23 - Windshield, Heat Reflective
 A4G - Override Option of Canadian Requirements
 A75 - Seat Cushion, Back Frt, HD (SEO)
 A76 - Seat Cushion, Back Rear, HD (SEO)
 A90 - Lock Control, RR Comp Lid Remote Cont Elect Release
 A91 - Pull Down, RR Comp Lid
 BAG - Parts Pkg, Export
 BA1 - Ornamentation, Extra Hood
 BA5 - Ornamentation, Extra Custom
 BC1 - Ornamentation, Interior I/P
 BC5 - Ornamentation, Interior Load Compartment
 BC9 - Ornamentation, Extra Delete
 BF9 - Covering, Front Floor Mat Delete
 BV2 - Ornamentation, Extra Rear Compartment Lid
 BV8 - Ornamentation, Extra Door Handle, Lock Cylinder, Color
 BX3 - Ornamentation, Extra Wood Grain Side Panel
 BYI - Ornamentation, Exterior Emblem, Body
 B1Z - Export Vehicle Domestic
 B18 - Ornamentation, Interior, Deluxe
 B19 - Ornamentation, Interior, Custom
 B34 - Covering, Front Floor Mats, Carpeted Insert
 B37 - Covering, Floor Mats, Frt & RR Aux
 B4U - Performance Package, Sport
 B42 - Covering, Floor Mat, Luggage Compartment, Fitted
 B43 - Covering, Load Floor, Textured Surface
 B46 - Trim Equipment, Special Order
 B9Q - Model Conversion Hearse
 B92 - Ornamentation, Exterior Front Fender Name
 B93 - Ornamentation, Exterior Molding, Door Edge Guard
 C04 - Roof Covering, Vinyl, Padded, Rear
 C49 - Defogger, RR Window, Electric
 C60 - HVAC System Air Conditioner, Front Manual Controls
 C67 - HVAC System Air Conditioner, Front Electronic Controls
 C68 - HVAC System Air Conditioner, Automatic Electronic Control
 C71 - Lamp, Interior, Front Door Courtesy
 C93 - Lamp, Opera
 C96 - Lamp, Interior, Quarter, Courtesy and Single reading
 DA0 - Arm Rest, Front Seat Storage
 DC4 - Mirror, Inside Rear View Tilt, Dual Reading Lamps
 DC6 - Mirror, O/S LH & RH Rem Cont. Elect LH & RH Defog Foldaway
 DD2 - Mirror, Inside Sunshade, Covered
 DE3 - Mirror, Outside LH & RH Rem Cont, Electric, Folding, Painted
 DE5 - Mirror, O/S LH & RH Rem Cont. Elect Foldaway
 DF6 - Mirror, I/S RR View Tilt, Auto Light Sen, Dual Read Lamps
 DG8 - Mirror, O/S LH Rem Cont, RH Direct Cont, Folding, Painted
 D42 - Shade, rear Compartment Security
 D55 - Console, Front Compartment Floor
 D64 - Mirror, I/S RH Sunshade Illuminated
 D74 - Mirror, I/S LH Sunshade Illuminated
 D84 - Paint, Custom Two-Tone
 D90 - Stripe, Front End, Body side
 EXP - Processing Option Export-I.E.S.
 FE1 - Suspension, Soft Ride
 FE2 - Suspension, Ride & Handling
 FE3 - Suspension, Sport
 FE4 - Suspension, Special Ride & Handling
 FE9 - Certification, Emission, Federal
 F40 - Suspension, Front and Rear HD
 F41 - Suspension, Firm Ride, Handling
 GM8 - Axle, RR 2.56 Ratio
 GU4 - Axle, RR 3.08 Ratio
 GU5 - Axle, RR 3.23 Ratio
 GU6 - Axle, RR 3.42 Ratio
 GW9 - Axle, RR 2.93 Ratio
 G67 - Level Control, Auto, Air
 G80 - Axle, RR Positraction (Limited Slip)
 IDC - Trim Interior Design
 ID3 - Trim Interior Design
 IHD - Trim Interior Design (SEO)
 IHE - Trim Interior Design (SEO)
 IHN - Trim Interior Design (SEO)
 IH3 - Trim Interior Design (SEO)
 IQB - Trim Interior Design
 IQC - Trim Interior Design
 IQD - Trim Interior Design (SEO)
 IQE - Trim Interior Design (SEO)
 IQG - Trim Interior Design (SEO)
 IQN - Trim Interior Design (SEO)
 IQ2 - Trim Interior Design
 JA1 - Brake, Light Weight Disc/Drum
 JA2 - Brake, HD Disc/Drum
 JA9 - Brake, Heavy Weight Disc/Disc
 JB9 - Brake, Light Weight Disc/Disc

- JL9 - Brake System Power, FRT & RR Disc, Antilock, FRT & RR Wheel
 JM4 - Brake System, Pwr, Antilock
 KA1 - Heater Seat
 KC4 - Cooling System, Engine Oil
 KD1 - Cooling System, Trans Oil
 KG9 - Generator, 140 Amp
 KNP - Cooling System, HD, Trans
 K05 - Heater, Engine Block
 K34 - Cruise Cont, Automatic, Electronic
 K68 - Generator, 105 amp
 LT1 - Engine, Gas, 8 Cyl, 5.7L, MFI, HO
 L99 - Engine, Gas, 8 Cyl, 4.3L, MFI
 MXO - Transmission-Automatic, Overdrive
 M30 - Transmission, Auto 4 Spd, 4L60-E, Electronic
 NB6 - Emissions System-California
 NB8 - Emission Override, California System Requirements
 NC7 - Emission Override, Federal System Regulation
 NK4 - Steering Wheel, Sport Leather
 NM8 - Leaded Fuel (Gov't. Order)
 NV7 - Steering, Power, Variable Effort
 N10 - Exhaust System, Dual
 N30 - Steering Wheel, Deluxe
 N40 - Steering Power, Non-Variable Ratio
 N65 - Wheel and Tire, Spare, Space Saver, Steel
 N81 - Tire, Spare (Full Size Radial)
 N91 - Cover, Simulated Wire Wheel, Locking
 N92 - Cover, Wheel, Bolt-on
 N97 - WHEEL 15, HD
 PA3 - Wheel, 15x7, Aluminum, Styled
 PA5 - Hub Caps, Wheel
 PB1 - Wheel Cover, 15 Inch
 PB4 - Lock, Wheel
 PD4 - Wheel, 15x7, Light Metal Alloy, 5 Spokes
 PH1 - Wheel, 15x7, Steel
 PW1 - Wheel, 15x7, Aluminum, 19 Spokes
 P03 - Cover, Wheel
 P42 - Tires, Self Sealing
 QA0 - Wheel, 17x8.5, Aluminum, Styled
 QBJ - Tire, P255/50ZR17, BW, R/PE ST TL ALS
 QCU - Tire, P215/75/R15 BL, R/PE ST TL ALS
 QCV - Tire, P215/75R15 WS2 R/PE ST TL ALS
 QEU - Tire, P225/75R15 WS2 R/PE ST TL ALS
 QMU - Tire, P235/70R15 BW R/PE ST TL AL2 102S
 QMV - Tire, P235/70R15 WS1 R/PE ST TL AL2 102S
 QNP - Tire, P225/70R15 WS1 R/PE ST TL AL2
 QQD - Tire, P235/70R15 WS2 R/PE ST TL ALS 102S
 QRB - Tire, P225/70R15 100V BW PE ST TL AL3 (SEO)
 QRC - Tire, P225/70R15 100V WS2 PE ST TL AL3 (SEO)
 QUK - Tire, P235/70R15 WS2 GOLD R/PE ST TL ALS Sealant
 R4Y - Tire Brand, Goodyear
 R4Z - Tire Brand, General
 T43 - Spoiler, Rear
 T52 - Ornamentation, Exterior Front Fender
 T53 - Lamp Package, Emergency Vehicle RR Compartment Lid (SEO)
 T61 - Lighting-Daytime Running
 T82 - Headlamps, Auto On-Off Control
 T85 - Headlamps, Left Hand Rule of Road
 T87 - Lamps, Cornering
 UA6 - Theft Deterrent System
 UD4 - Alarm-Vehicle Speed, 120 k/m
 UH7 - Cluster Instr, Coolant Temp
 UH8 - Cluster Inst, Coolant Temp, Trip, Odo, Tach
 UL0 - Radio, AM/FM Stereo, Seek/Scan, Auto Rev, Music Search Cass, Auto Tone, Clock, ETR
 UL5 - Radio Delete
 UM6 - Radio, AMFM Stereo, Seek/Scan, Auto Rev, Cass, Clock, ETR
 UM7 - Radio, AM/FM Stereo, Seek/Scan, Clock, ETR.
 UN0 - Radio, AM/FM Stereo, Seek/Scan, CD, Auto Tone, Clock, ETR
 UN6 - Radio, AM/FM Stereo, Seek/Scan, Auto Rev, Music Search Cass, Clock, ETR
 UP0 - Radio, AM/FM Stereo, Seek/Scan, Auto Rev, Music Search Cass, CD Auto Tone, Clock, ETR
 UQ0 - Speaker System, 4, Dual Front Door Mount, Dual Std Range QTR/Shelf
 UQ1 - Radio Provisions For Stereo
 UQ3 - Speaker Sysytem, Performance Enhanced Audio
 UQ5 - Speaker System, 4, Dual Front Door Mounted, Dual Extd Range Qtr Mounted
 UV8 - Telephone Provisions For Mobile
 U1H - Radio, AM/FM Stereo, Seek/Scan, Auto Rev Music Search Cass, CD, Equal, Clock, ETR
 U11 - Cluster Inst, Police Cert Speedometer
 U19 - Speedometer Inst, Kilo & Miles
 U73 - Antena, Fixed
 U75 - Antenna, Power
 VC1 - Label, Price/Fuel Econ, Courtesy Delivery
 VG6 - Label Info, Bumper, Impact, 5 MPH, California
 VG9 - Protector Wax, Exterior Body
 VH3 - Label Info, Bumper, Impact, 5 MPH, Hawaii
 VK3 - License Plate Front Mtg Pkg
 VL7 - Label Info, Bumper Impact, 5 MPH, FT & RR, New York
 VM3 - Label Info, Consumer Bpr Impact FT & RR 5 MPH.
 V03 - Cooling System, Extra Capacity
 V08 - Cooling System, Heavy Duty
 V92 - Trailer Provisions
 WB4 - Woodgrain Applique Delete
 WU1 - Switch Instrumentation Lighting Shut-off
 WX3 - Merchandising Package, Impala SS
 WX7 - Wiring Provisions (SEO)
 X1A - Y2T (SEO Colors)
 Z22 - Merchandising Opt, Roadmaster Limited
 Z27 - Merchandising Opt, Roadmaster Estate Limited

0A-24 GENERAL INFORMATION

- Z49 - Mandatory Equipment, Canadian
- OIL - Secondary Color, Exterior, Special
- OIU - Primary Color, Exterior, Special
- 02A - Stripe Color Accent, Two Tone, Beige/Garnet
- 03L - Secondary Color, Exterior, Marblehead Gray Met
- 03Q - Molding Color, Marblehead Gray Met
- 03T - Top Color, Marblehead Grey Met
- 03U - Primary Color, Exterior, Marblehead Grey Met
- 06A - Stripe Color Accent, Two Tone, DK Royal Blue/Red
- 08A - Stripe Color Accent, Two Tone, DK Royal Blue/White
- 08U - Primary Color, Exterior, Mary Kay Pink
- 1A2 - SEO Vehicle, Public Service
- 1K5 - Lever, Auto Trans Lock Out (SEO)
- 1SZ - Package-Option Discount
- 1T1 - Hose, Radiator & Heater Silicone Rubber
- 11A - Stripe Color Accent, Two Tone, LT Royal Blue/Garnet Red
- 14A - Stripe Color Accent, LT Gray
- 14B - Trim Combination-Cloth, Light Gray
- 14C - Trim Combination-Cloth, Light Gray
- 14D - Trim Combination-Cloth, Light Gray
- 14E - Trim Combination-Cloth, Light Gray
- 14G - Trim Combination-Cloth, Light Gray
- 14I - Interior Trim-Light Gray
- 14N - Trim Combination, Vinyl, Light Gray
- 142 - Trim Combination-Leather, Light Gray
- 143 - Trim Combination-Leather, Light Gray
- 16A - Stripe Color Accent, Two Tone, Black/Garnet Red
- 16Q - Molding Color, Bright White
- 16T - Top Color, Bright White
- 17A - Stripe Color Accent, Two Tone, LT Gray/Gold
- 18Q - Molding Color, Dk Green Gray Met
- 18T - Top Color-Dark Green Gray Metallic
- 18U - Primary Color-Exterior, Dark Green Grey Metallic
- 19A - Stripe Color Accent, LT Royal Blue
- 20A - Stripe Color Accent, DK Royal Blue
- 30B - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30C - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30D - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30E - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30G - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30I - Interior Trim, Medium Dark Adriatic Blue
- 30N - Trim Combination-Cloth, Medium Dark Adriatic Blue
- 30Q - Molding Color, Medium Adriatic Blue
- 30T - Top Color-Medium Adriatic Blue
- 30U - Primary Color-Exterior, Medium Adriatic Blue Metallic
- 302 - Trim Combination-Leather, Medium Dark Adriatic Blue
- 303 - Trim Combination-Leather, Medium Dark Adriatic Blue
- 33Q - Molding Color-Light Driftwood Metallic
- 33T - Top Color-Light Driftwood Metallic
- 33U - Exterior Color-Primary, Light Driftwood Metallic
- 36Q - Molding Color-Light Adriatic Blue
- 36U - Primary Color-Exterior, Light Adriatic Blue
- 37A - Stripe Color Accent, Medium Neutral
- 41Q - Molding Color, Black
- 41T - Top Color-Black
- 41U - Exterior Color-Primary, Black
- 52A - Stripe Color Accent, Two Tone, Black/Beige Met
- 6A2 - Steering Column SEO Keyed
- 6A3 - Covering Floor Mats, HD (SEO)
- 6A4 - Cylinder Unit, Single Key System, No Specific Code
- 6A5 - Cylinder Unit, Single Key System, Coded
- 6B2 - Handle, Rear Door, Inoperative
- 6B4 - Spare Tire Relocation (SEO)
- 6B7 - Wiring Provisions, Roof Panel (SEO)
- 6C7 - Lamp, Dome Passenger
- 6C8 - Cable, Radio Antenna (SEO)
- 6C9 - Conduit, Two Way Radio Control Cable (SEO)
- 6E2 - Cylinder Unit, Single Key System, Coded
- 6E8 - Cylinder Unit, Single Key System, Coded
- 6F5 - Wiring Provisions, Roof (SEO)
- 6F8 - Front Door Ashtray (SEO)
- 6G2 - Reinforcement Roof Panel (SEO)
- 6H6 - Lock Control, RR Compartment Trunk Release LH
- 6H7 - Lock Control, RR Compartment Trunk Release RH
- 6J1 - Wiring Provisions, Ignition and Main Power (SEO)
- 6J3 - Wiring Provisions, Headlight Flasher, Grille Lights and Speakers (SEO)
- 6J4 - Wiring Provisions, Horn and Siren Circuit (SEO)
- 6J5 - Wiring Provisions, Roof Panel Access Hole RH (SEO)
- 6J6 - Lamp Package Emergency Vehicle R/WDO Panel (SEO)
- 6J7 - Flasher, Headlamp
- 6N1 - Handle, Inside LH Door and Lock Release (SEO)
- 6N5 - Handle Inoperative, Rear Window (SEO)
- 6N6 - Lock Control, RR Door Inoperative
- 6N8 - Handle, Rear Seat Assist
- 6SA - Spring-Computer Selected, FRT, LH
- 6SB - Spring-Computer Selected, FRT, LH
- 6SC - Spring-Computer Selected, FRT, LH
- 6SD - Spring-Computer Selected, FRT, LH
- 6TA - Spring-Computer Selected, FRT, LH
- 6TB - Spring-Computer Selected, FRT, LH
- 6TC - Spring-Computer Selected, FRT, LH
- 6TD - Spring-Computer Selected, FRT, LH
- 6TF - Spring-Computer Selected, FRT, LH
- 6TH - Spring-Computer Selected, FRT, LH
- 6TJ - Spring-Computer Selected, FRT, LH
- 6TK - Spring-Computer Selected, FRT, LH
- 6TL - Spring-Computer Selected, FRT, LH
- 6TM - Spring-Computer Selected, FRT, LH

6TN - Spring-Computer Selected, FRT, LH
 6TP - Spring-Computer Selected, FRT, LH
 6TR - Spring-Computer Selected, FRT, LH
 6TS - Spring-Computer Selected, FRT, LH
 6TW - Spring-Computer Selected, FRT, LH
 6TX - Spring-Computer Selected, FRT, LH
 6TY - Spring-Computer Selected, FRT, LH
 6Y1 - Ornamentation, Exterior Door
 Mldg Non-Installed (SEO)
 6Y2 - Seat, Rear, Delete
 6Y5 - Ornamentation, Exterior Emblem Delete
 64B - Trim Combination, Cloth, LT Beige
 64C - Trim Combination, Cloth, LT Beige
 64E - Trim Combination, Cloth, LT Beige
 64G - Trim Combination, Cloth, LT Beige
 64I - Interior Trim, LT Beige
 64N - Trim Combination, Vinyl, LT Beige
 642 - Trim Combination, Leather, LT Beige
 643 - Trim Combination, Leather, LT Beige
 7B3 - Suspension System, Special Handling
 7L9 - Oil Cooler, Steering System
 7P8 - Engine Oil Cooling System (SEO)
 7SA - Spring-Computer Selected, FRT, RH
 7SB - Spring-Computer Selected, FRT, RH
 7SC - Spring-Computer Selected, FRT, RH
 7SD - Spring-Computer Selected, FRT, RH
 7TA - Spring-Computer Selected, FRT, RH
 7TB - Spring-Computer Selected, FRT, RH
 7TC - Spring-Computer Selected, FRT, RH
 7TD - Spring-Computer Selected, FRT, RH
 7TF - Spring-Computer Selected, FRT, RH
 7TH - Spring-Computer Selected, FRT, RH
 7TJ - Spring-Computer Selected, FRT, RH
 7TK - Spring-Computer Selected, FRT, RH
 7TL - Spring-Computer Selected, FRT, RH
 7TM - Spring-Computer Selected, FRT, RH
 7TN - Spring-Computer Selected, FRT, RH
 7TP - Spring-Computer Selected, FRT, RH
 7TR - Spring-Computer Selected, FRT, RH
 7TS - Spring-Computer Selected, FRT, RH
 7TW - Spring-Computer Selected, FRT, RH
 7TX - Spring-Computer Selected, FRT, RH
 7TS - Spring-Computer Selected, FRT, RH
 7TY - Top Color-Medium Garnet Red Metallic
 7X6 - Spotlamp, Left Hand, Pillar
 Mounted (SEO)
 7X7 - Spotlamp, Left and Right Hand,
 Pillar Mounted (SEO)
 7X8 - Spotlamp Provisions, Left Hand (SEO)
 7X9 - Spotlamp Provisions, Left and
 Right Hand (SEO)
 7Y2 - Lamp, Door Opening Warning
 7Y6 - Switch, Dome Lamp Door Jamb,
 Inoperative (SEO)
 7Z5 - Circuit Breakers, Additional,
 12 Volt (SEO)
 72A - Stripe Color Accent, Medium Garnet Red
 72Q - Molding Color, Medium Garnet Red Met.
 72U - Primary Color, Exterior, Medium Garnet
 Red Metallic

73A - Stripe Color Accent, Two Tone,
 LT Auburn/Beige
 74A - Stripe Color Accent, LT Chestnut
 77Q - Molding Color, Dark Maple Red Metallic
 77T - Top Color-Dark Cherry Metallic
 77U - Exterior Color-Primary, Dark Cherry
 Metallic
 79B - Trim Combination, Cloth, Ruby Red
 79C - Trim Combination, Cloth, Ruby Red
 79D - Trim Combination, Cloth, Ruby Red
 79E - Trim Combination, Cloth, Ruby Red
 79G - Trim Combination, Cloth, Ruby Red
 79I - Interior Trim, Ruby Red
 79N - Trim Combination, Vinyl, DK Claret
 792 - Trim Combination, Leather, Ruby Red
 793 - Trim Combination, Leather, Ruby Red
 8HF - Spring-Computer Selected, RR, LH
 8HH - Spring-Computer Selected, RR, LH
 8HJ - Spring-Computer Selected, RR, LH
 8HK - Spring-Computer Selected, RR, LH
 8HL - Spring-Computer Selected, RR, LH
 8JH - Spring-Computer Selected, RR, LH
 8JJ - Spring-Computer Selected, RR, LH
 8RA - Spring-Computer Selected, RR, LH
 8RB - Spring-Computer Selected, RR, LH
 8RC - Spring-Computer Selected, RR, LH
 8RJ - Spring-Computer Selected, RR, LH
 8RK - Spring-Computer Selected, RR, LH
 8RN - Spring-Computer Selected, RR, LH
 8RP - Spring-Computer Selected, RR, LH
 8RR - Spring-Computer Selected, RR, LH
 8RS - Spring-Computer Selected, RR, LH
 8RX - Spring-Computer Selected, RR, LH
 8RZ - Spring-Computer Selected, RR, LH
 8X3 - Shock Absorbers, FRT and
 RR Gas Preloaded, Bilstein (SEO)
 80A - Stripe Color Accent,
 Two Tone, Gunmetal/Red
 87A - Stripe Color Accent, Gunmetal Met.
 9C1 - SEO Vehicle, Police Car
 9C6 - SEO Vehicle, Taxi Cab
 9HF - Spring-Computer Selected, RR, RH
 9HH - Spring-Computer Selected, RR, RH
 9HJ - Spring-Computer Selected, RR, RH
 9HK - Spring-Computer Selected, RR, RH
 9HL - Spring-Computer Selected, RR, RH
 9JH - Spring-Computer Selected, RR, RH
 9JJ - Spring-Computer Selected, RR, RH
 9RA - Spring-Computer Selected, RR, RH
 9RB - Spring-Computer Selected, RR, RH
 9RC - Spring-Computer Selected, RR, RH
 9RK - Spring-Computer Selected, RR, RH
 9RN - Spring-Computer Selected, RR, RH
 9RP - Spring-Computer Selected, RR, RH
 9RS - Spring-Computer Selected, RR, RH
 9RX - Spring-Computer Selected, RR, RH
 9RZ - Spring-Computer Selected, RR, RH
 91A - Stripe Color Accent,
 Two Tone, Beige/Red
 93A - Stripe Color Accent, DK Driftwood



SECTION 0B

MAINTENANCE AND LUBRICATION

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SCHEDULED MAINTENANCE SERVICE

NORMAL VEHICLE USE

The maintenance instructions contained in the Maintenance Schedule are based on the assumption that the vehicle will be used as designed:

- To carry passengers and cargo within the limitation indicated on the Tire Placard located on the edge of the driver's door.
- On reasonable road surfaces within legal operating limits.
- On unleaded gasoline.

SCHEDULE I

Follow Schedule I if none of the driving conditions specified in Schedule II apply. Refer to Schedule I chart.

SCHEDULE I - Light Duty Service

- Use Schedule I if none of the conditions listed under Schedule II apply.

ITEM NO.	WHAT TO SERVICE See "Explanation of Scheduled Maintenance Services."	WHEN TO PERFORM Kilometers (Miles) or Months (Whichever Occurs First).
1.	Engine Oil and Oil Filter Change*	Every 12,500 km (7,500 mi.) or 12 months, or when the "CHANGE OIL" light comes on, whichever occurs first.
2.	Chassis Lubrication	
3.	Tire and Wheel Inspection and Rotation	At 12,500 km (7,500 mi.) and then every 25,000 km (15,000 mi.) or as necessary
4.	Rear Axle Fluid Change (Limited Slip Only, RPO-G80)	At the first 12,500 km (7,500 mi.) of use only.

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SCHEDULE I - Light Duty Service

- Use Schedule I if none of the conditions listed under Schedule II apply.

ITEM NO.	WHAT TO SERVICE See "Explanation of Scheduled Maintenance Services."	WHEN TO PERFORM Kilometers (Miles) or Months (Whichever Occurs First).
5.	Air Cleaner Filter Replacement*	Every 50,000 km (30,000 mi.)
6.	Fuel Tank, Cap and Lines Inspection*†	
7.	Front Wheel Bearing Repack	
8.	Engine Accessory Drive Belt Inspection	Every 100,000 km (60,000 mi.)
9.	Cooling System Service	Every 166,000 km (100,000 mi.)
10.	Sparkplug Replacement	
11.	Sparkplug Wire Inspection	

* = An Emission Control Service.

† = The U.S. Environmental Protection Agency or the California Air Resources Board has determined that the failure to perform maintenance item will not nullify the emission warranty or limit recall liability prior to the completion of vehicle useful life. General Motors, however, urges that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded.

T5762(Cont'd)

Schedule II

Follow Schedule II if the vehicle is operated under one or more of the following conditions:

- When most trips are less than 6 km (4 miles).
- When outside temperatures remain below freezing and when most trips are less than 16 km (10 miles).
- When most trips include extended idling and/or frequent low speed operation as in stop-and-go traffic.

- Towing a trailer. All Chevrolets and Buicks can tow 2000 lbs. (907 kg.). Vehicles equipped with RPO V92 can tow 5000 lbs. (2268 kg.). See the owners manual for more information.

- Operating in dusty areas.

- The vehicle is used in delivery service, as a Police or Taxi vehicle, or other commercial application.

Refer to Schedule II chart.

SCHEDULE II - Heavy Duty Service

Use Schedule I if any of the following conditions apply:

- Most trips are less than 8 to 16 km (5 to 10 miles).

This is particularly important when outside temperatures are below freezing.

- Most trips include extensive idling (such as frequent driving in stop-and-go traffic).
- Most trips are through dusty areas.
- You frequently tow a trailer or use a carrier on top of your vehicle.
- If the vehicle is used for delivery service, police, taxi, or other commercial application.

ITEM NO.	WHAT TO SERVICE See "Explanation of Scheduled Maintenance Services."	WHEN TO PERFORM Kilometers (Miles) or Months (Whichever Occurs First).
1.	Engine Oil and Oil Filter Change*	Every 5,000 km (3,000 mi.) or 3 months, or when the "CHANGE OIL" light comes on, whichever occurs first.
2.	Chassis Lubrication	Every other oil and filter change.
3.	Tire and Wheel Inspection and Rotation	At 12,500 km (7,500 mi.) and then every 25,000 km (15,000 mi.) or as necessary
4.	Rear Axle Fluid Change	See "Explanation of Scheduled Maintenance Services."
5.	Air Cleaner Filter Replacement*	Every 50,000 km (30,000 mi.)
6.	Fuel Tank, Cap and Lines Inspection*†	
7.	Front Wheel Bearing Repack	
8.	Automatic Transmission Service	See "Explanation of Scheduled Maintenance Services."
9.	Engine Accessory Drive Belt Inspection	Every 100,000 km (60,000 mi.)

T5763

SCHEDULE II - Heavy Duty Service

Use Schedule I if any of the following conditions apply:

- Most trips are less than 8 to 16 km (5 to 10 miles).
This is particularly important when outside temperatures are below freezing.
- Most trips include extensive idling (such as frequent driving in stop-and-go traffic).
- Most trips are through dusty areas.
- You frequently tow a trailer or use a carrier on top of your vehicle.
- If the vehicle is used for delivery service, police, taxi, or other commercial application.

ITEM NO.	WHAT TO SERVICE See "Explanation of Scheduled Maintenance Services."	WHEN TO PERFORM Kilometers (Miles) or Months (Whichever Occurs First).
10.	Cooling System Service	Every 166,000 km (100,000 mi.)
11.	Sparkplug Replacement	
12.	Sparkplug Wire Inspection	

* = An Emission Control Service.

† = The U.S. Environmental Protection Agency or the California Air Resources Board has determined that the failure to perform maintenance item will not nullify the emission warranty or limit recall liability prior to the completion of vehicle useful life. General Motors, however, urges that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded.

T5763(Cont'd)

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

Refer to the following chart for the schedule of time and/or mileage intervals. The following text and illustrations (Figures 1, 2 and 3) give details of the required maintenance services.

Engine Oil and Oil Filter Change

Figure 1

Change oil and filter every 12 500 km (7,500 miles) for schedule I, or every 5 000 km (3,000 miles) for schedule II, or when the "CHANGE OIL" light comes on, whichever comes first.

Oils recommended can be identified by looking for the "Starburst" symbol. This symbol indicates that the oil has been certified by the American Petroleum Institute (API). Do not use any oil which does not carry this "Starburst" symbol.

The "Change Oil" indicator on the instrument panel will illuminate when the oil needs to be changed, usually between 5 000 km (3,000 miles) and 12 500 km (7,500 miles) after the last reset. Under severe conditions, the indicator may illuminate before 5 000 km (3,000 miles). The vehicle should not be driven more than 12 500 km (7,500 miles) or twelve months without an oil change.

The system will not detect dust in the oil, so if the vehicle has been driven under dusty conditions, the oil should be changed every 5 000 km (3,000 miles), or sooner if the "Change Oil" indicator lamp illuminates.

Engine oil viscosity (thickness) has an effect on fuel economy and cold-weather operation (starting and oil flow). Lower viscosity engine oils can provide better fuel economy and cold-weather performance. However, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than

those recommended could result in engine damage. When choosing an oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Then, select the recommended oil viscosity (Figure 1).

Engine Oil Life Monitor

After changing engine oil, reset the engine oil life monitor whether the "CHANGE OIL" warning/indicator lamp came on or not. Reset the engine oil life monitor as follows:

1. Turn ignition switch to "ON" position, but don't start engine.
2. Depress accelerator pedal to Wide Open Throttle (WOT) position and release it three times within five seconds.

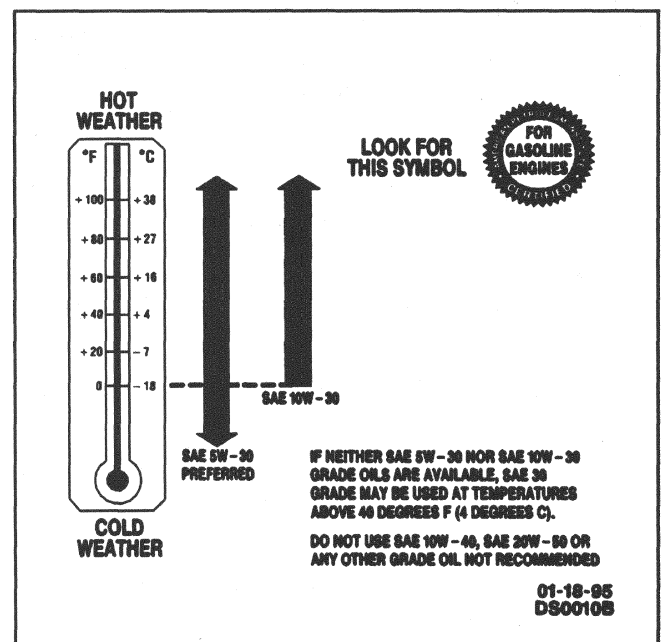


Figure 1 - Engine Oil Viscosity Recommendation

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- The light is controlled by the PCM. The PCM is monitoring the TPS signal for three consecutive signals above 96 %. The PCM will acknowledge, if the reset has been successful by flashing the "Change Oil" light twice, then turning off the light.
- 3. If "CHANGE OIL" warning/indicator lamp goes out, system has been reset.
- 4. If "CHANGE OIL" warning/indicator lamp doesn't reset, turn ignition switch "OFF" and repeat procedure.
- If the engine oil life monitor operates improperly, refer to SECTION 6E3 (DTC 96).

Chassis Lubrication

Chassis lubrication is performed on the transmission shift linkage and the steering linkage and front suspension. Body lubrication should also be performed at least annually. Refer to "Body Lubrication" under "At Least Annually" in this section.

NOTICE: Do not lubricate the parking brake cables. Lubrication destroys the plastic coating on the cables.

Lubricate all grease fittings in the steering linkage and front suspension as described by the following:

Lubricating Joints That Have Grease Fittings

Figure 2

Wipe off all dirt from the grease fitting before lubricating the joint. Ball studs should not be lubricated unless their temperature is -12°C (10°F) or warmer. During cold weather, the ball stud should be allowed to warm up as necessary before being lubricated. Use a low-pressure grease gun on all studs to prevent seal damage.

Steering tie rods - Apply grease until grease flows out between seal and tie rod end housing.

Relay rod - Apply grease until grease flows around seal.

Idler arm - Apply grease while pushing up and pulling down on the idler arm, (this will prevent "grease lock"). Apply grease until grease is seen at the seal.

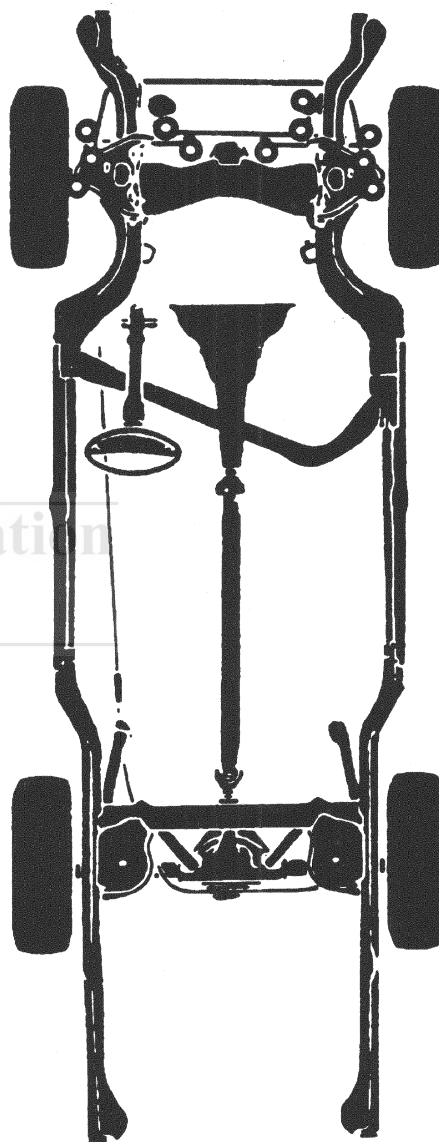
Ball studs - Apply grease slowly while watching grease seal. Apply grease until the seal expands or grease is seen bleeding from the seal. If the seal expands but no grease is seen, do not apply any more grease. Allow time for the grease to bleed from the seal.

All joints - Wipe off all excess grease.

Lubrication Fitting Locations

Refer to Figure 2 for lubrication fitting locations.

11 LUBE FITTINGS ●



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Figure 2 - Lubrication Fitting Locations

Tire and Wheel Inspection and Rotation

Figure 3

Check tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate as shown in Figure 3. If irregular or premature wear exists, check wheel alignment. Also, check for damaged wheels. Do not include the compact spare tire in rotation.

While the tires and wheels are removed, perform the brake systems inspection specified. Refer to "Each Time Oil Is Changed" in this section.

Rear Axle Fluid Change

If the vehicle is equipped with a limited slip rear axle RPO G80, Change the rear axle fluid after the first 10 000 km (6,000 miles) if maintaining vehicle under schedule I, or after the first 12 500 km (7,500 miles) if maintaining vehicle under schedule II. After the fluid has been changed for the first time, the fluid does not have to be changed again unless the vehicle is used to tow a trailer. If the vehicle is used to tow a trailer, then change the fluid every 10 000 km (6,000 miles).

Air Cleaner Filter Replacement

Replace every 50 000 km (30,000 miles) or 36 months, whichever comes first. Replace more often under dusty conditions.

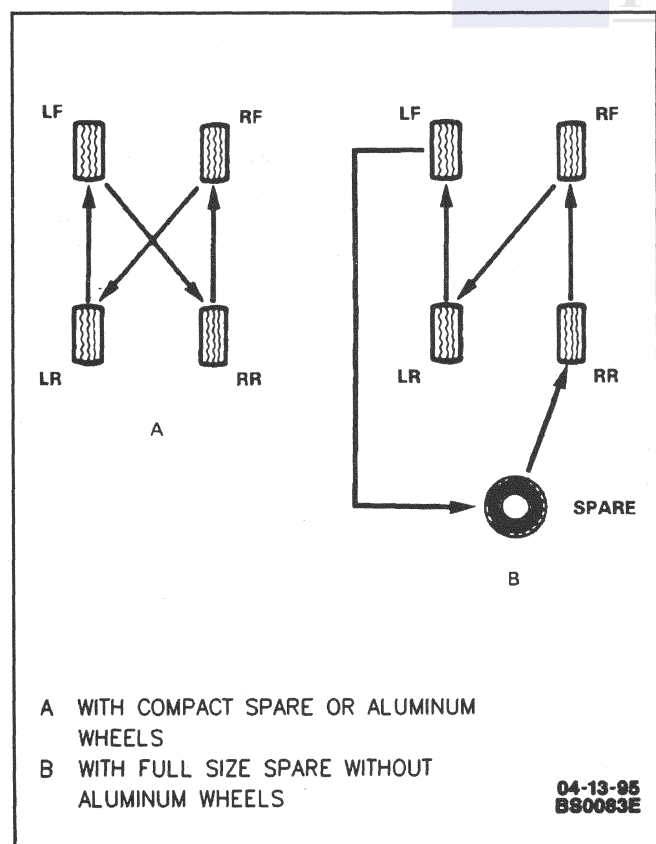


Figure 3 - Recommended Tire Rotation Pattern

Fuel Tank, Cap and Lines Inspection

Inspect fuel tank, cap and lines for damage or leaks. Inspect fuel cap gasket for an even filler neck imprint or any damage. Replace parts as needed.

Front Wheel Bearing Repack

Clean and repack front wheel bearings at each brake relining or 50 000 km (30,000 miles), whichever comes first.

Transmission Service

For the automatic transmission, change both the fluid and the filter every 83 000 km (50,000 miles) if used under one of the following conditions listed below. Use DEXRON® III fluid, GM P/N 12346143. Refer to SECTION 7A for procedure.

- A. In heavy traffic where outside temperature regularly reaches 90° F (32° C) or higher.
- B. In hilly or mountainous terrain.
- C. When doing frequent trailer towing.
- D. Uses such as Taxi, Police, or delivery service.

If vehicle is not used under any of these conditions, the fluid and filter does not require changing.

Serpentine Drive Belt Inspection

Inspect serpentine drive belt for wear. Cracks in the belt ribs will not impair belt performance and are not a basis for belt replacement. If sections of the belt are missing, the belt should be replaced.

Cooling System Service

Drain, and refill system with GM Goodwrench DEX COOL™ coolant conforming to GM specification 6277 - M. When refilling system, add two engine coolant supplement pellets (GM P/N 3634621 or equivalent). Refer to SECTION 6B for procedure.

Spark Plug Replacement

The spark plugs have a platinum tip and need only be replaced every 160 000 km (100,000 miles). Replacement spark plugs are listed in "Maintenance Items" in this section.

Spark Plug Wire Inspection

Clean wires and inspect for burns, cracks or other damage. Check the wire boot fit at the ignition distributor and/or coil, and at the spark plugs. Replace the wires as needed.

OWNER INSPECTION AND SERVICES

Listed below are vehicle inspections and services that should be made by either the owner or a qualified technician at the frequencies indicated to help ensure proper safety, emission systems performance and dependability of the vehicle. Whenever repairs are necessary, have them completed at once. Any safety related or emissions related components that could have been damaged in an accident should be inspected and all needed repairs should be performed before operating the vehicle.

WHILE OPERATING THE VEHICLE

Automatic transmission shift indicator operation - Make sure the indicator points to the gear chosen. Refer to SECTION 7A for adjustment procedure, if necessary.

Horn operation - Blow the horn occasionally to make sure it works. Push down on inflatable restraint steering wheel module (air bag) to operate horn.

Brake system operation - Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning lamp or antilock brake system warning lamp goes on or flashes, something may be wrong with part of the brake system.

Exhaust system operation - Be alert to any abnormal sounds from the exhaust system or any smell of fumes within the passenger compartment. These are signs the system may be leaking or overheating. Inspect and repair at once.

Tires, wheels and alignment - Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight and level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering system operation - Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, has too much free play, or if unusual sounds are noted when turning or parking.

Headlamp capsule aim - Take note of the light pattern. If beams seem to be improperly aimed, headlamps should be checked and adjusted as necessary. Refer to SECTION 8B.

AT EACH FUEL FILL

NOTICE: A fluid loss in any system (except windshield washer) may indicate a problem. Inspect the system and repair at once.

Engine oil level - The "LOW OIL" indicator lamp should be used as a back-up warning system and should not take the place of periodically checking the oil level. Check level and add oil if necessary. The best time to check the engine oil level is when the oil is warm. After stopping the engine with the vehicle on a level surface, wait a few minutes for the oil to drain back to the oil pan. Pull out the oil level indicator (dipstick). Wipe it clean, and push it back down all the way. Pull out the oil level indicator, keeping the tip down, and look at the oil level on it. Add oil, if needed, to keep the oil level above the "ADD" line and within the cross-hatched operating range area. Avoid overfilling as this may cause engine damage. Push the oil level indicator back down all the way after taking the reading. If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain fast enough to give a true oil level.

Engine coolant level and condition - The "LOW COOLANT" indicator lamp will inform the driver when engine coolant level becomes low. This indicator lamp should not take the place of periodically checking the engine coolant. Check engine coolant level in the coolant reservoir and add 50/50 mixture of coolant and water if necessary. Inspect the coolant and replace it if dirty, rusty, or required as normal maintenance.

Windshield washer solvent level - The "LOW WASHER" indicator lamp will inform the driver if the washer solvent is low. Check washer solvent level in reservoir any time the hood is opened and add solvent if necessary.

Hood latch operation - When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. Make sure that the hood closes firmly. Refer to SECTION 10-5 for adjustment procedure.

AT LEAST MONTHLY

Tire and wheel inspection and pressure check - Check tires for abnormal wear or damage, especially if any suspension damage is noted. Also check for damaged wheels. Pressure should be checked when tires are "cold" (include spare tire). Maintain pressures as shown in "Tire Pressure Specifications" in this section, or the Tire Placard on the driver's door.

Lamp operation - Check operation of the license plate lamp, side marker lamps, headlamps (including high beams) taillamps, brake lamps (including the center high-mounted stoplamp), turn signals, backup lamps, hazard warning flasher and interior lamps.

Fluid level check - Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. The cause of fuel leaks or fumes should be found and corrected at once.

AT LEAST TWICE A YEAR

Power steering system reservoir level - Check and keep at proper level. Refer to SECTION 3B.

Brake master cylinder reservoir level - Check fluid. Refer to SECTION 5. Keep fluid at proper level. A low fluid level can indicate worn disc pads which may need to be serviced.

Weatherstrip lubrication - Clean the surface and then apply a thin film of silicone grease, GM P/N 12345579 or equivalent, using a clean cloth.

AT LEAST ANNUALLY

CAUTION: Before checking the holding ability of the parking brake and automatic transmission park mechanism, park on a fairly steep hill with enough room for movement in the downhill direction. To reduce the risk of personal injury or property damage, be prepared to apply the regular brakes promptly if the vehicle begins to move.

Parking brake and transmission park mechanism operation - To check the parking brake, with the engine running, transmission in "NEUTRAL," and parking brake set, slowly remove foot pressure from the regular brake pedal (until the vehicle is held only by the parking brake). To check the automatic transmission park mechanism holding ability, release all brakes after shifting the transmission to "PARK." If vehicle moves, check adjustment of steering column shift control linkage, refer to SECTION 7A. If OK refer to SECTION 7A-14B for transmission internal unit repair procedures.

CAUTION: Before performing the following transmission neutral start switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage.

Transmission neutral start switch operation - Try to start the engine in each gear. The starter should crank only in "PARK" and "NEUTRAL."

Brake transmission shift interlock (BTSI) operation - To check the brake transmission shift interlock (BTSI):

1. Ignition "ON" engine not running.
2. Apply parking brake.
3. Allow room for vehicle movement.
4. Transmission should not be able to shift out of "PARK" without first applying standard brakes.
5. If BTSI is inoperative, refer to SECTION 8A.

Steering column lock operation - While parked, try to turn the key to "LOCK" in each gear range. The key should turn to "LOCK" only when the gear selector is in "PARK." The key should come out only in "LOCK."

Lap and shoulder belts condition and operation - Inspect belt system, including webbing, buckles, latch plates, retractors, guide loops and anchors.

Movable head restraint operation - Make sure movable head restraints stay in the desired position.

Seatback recliner operation - Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.

Spare tire and jack storage - Be alert to rattles in rear of the vehicle. Make sure the spare tire, all jacking equipment and any covers or doors are securely stowed at all times. Oil the jack screw mechanism after each use.

Key lock service - Lubricate the key lock cylinder (except instrument panel compartment lock).

Body lubrication service - Lubricate all body door hinges, including the hood, fuel door and rear compartment hinges with engine oil. The hood latch requires a special lubricant, refer to "Recommended Fluids and Lubricants" in this section.

Underbody flushing - At least every spring, flush from the underbody any corrosive materials used for ice and snow removal and dust control. Use plain water. Take care to thoroughly clean any areas where mud or other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.

Engine cooling system - Inspect coolant and freeze protection. If coolant is dirty or rusty, drain, and refill with GM DEX-COOL™ coolant conforming to GM specification 6277 - M. Add two engine coolant supplement sealant pellets, GM P/N 3634621 or equivalent. Keep coolant at the proper mixture for proper freeze protection. Inspect hoses and replace if cracked, swollen or deteriorated. Clean outside of radiator and air conditioning condenser. Wash filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.

EACH TIME OIL IS CHANGED

Engine oil life monitor ("CHANGE OIL" indicator) - Reset engine oil life monitor. Refer to "Engine Oil Life Monitor" in this section.

Automatic transmission fluid level - Maintain level within operating range on the oil level indicator. Refer to SECTION 7A.

Brake systems inspection - For convenience, the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc., at the same time. Check parking brake adjustment, refer to SECTION 5F. Inspect brakes more often if habit or conditions result in frequent braking.

Steering and suspension inspection - Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc.

Exhaust system inspection - Inspect complete system, including catalytic converter. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections and other

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conditions which could cause a heat buildup in the floor pan or could let exhaust fumes seep into the rear compartment or passenger compartment. Check heat shields for proper clearance. Refer to SECTION 6F for exhaust system-to-body clearance specifications

Accelerator, cruise control and throttle valve cables - Inspect for interference, kinks, binding, damaged or missing parts.

Serpentine drive belt - Inspect serpentine drive belt for cracks, fraying, wear and proper tension. Replace tensioner or belt as needed. Refer to SECTION 6A4.

Rear axle assembly - Check fluid level and add if needed. To check or add fluid, hoist vehicle at suspension contact points. Refer to SECTION 0A. Keep vehicle level. Clean dirt or foreign material from around filler plug opening before removing the filler plug. Maintain fluid level from flush with bottom of opening to no lower than 6 mm (1/4 inch) below opening. Always replace filler plug. Tighten to 35 N.m (26 lb. ft.). If the vehicle is used to pull a trailer, change lubricant every 10 000 km (6,000 miles) of trailer tow use.

Radio power antenna service, three section type - Clean the power antenna as described in SECTION 9A.

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil - GM Goodwrench motor oil or equivalent for API service SG of recommended viscosity.

Engine coolant - Mixture of water and GM DEX-COOL™ antifreeze conforming to GM Specification 6277-M. If coolant is being replaced, add two engine coolant supplement sealant pellets, GM P/N 3634621 or equivalent.

MAINTENANCE ITEMS

Air Cleaner Filter.....	AC Type A1096 C
Engine Oil Filter.....	AC Type PF52
Fuel Filter.....	GM P/N 10253745
Spark Plug.....	AC Delco 41-943
Gap.....	1.27 mm (0.050 inch)

APPROXIMATE FLUID CAPACITIES

Air Conditioning	0.79 kg (1 lb. 12 oz.)
Engine Crankcase	
Without Filter Change	3.8 liters (4.0 qt.)
With Filter Change	4.8 liters (5.0 qt.)
Fuel Tank	
Sedan	87.0 liters (23 gal.)
Wagon	79.5 liters (21 gal.)
Automatic Transmission (4L60 - E)	
Drain & Refill	4.7 liters (10.0 pt.)
Overhaul	10.6 liters (22.4 pt.)
Cooling System	
4.3L Engine	
Without Heavy-Duty Cooling	16.8 liters (17.9 qt.)
With Heavy-Duty Cooling	17.1 liters (18.1 qt.)
5.7L Engine	
Without Heavy-Duty Cooling	15.5 liters (16.4 qt.)
With Heavy-Duty Cooling	15.9 liters (16.9 qt.)

The capacities shown are approximate. Add fluid as necessary to bring to an appropriate level.

Hydraulic brake system - Delco-Supreme 11® brake fluid (GM P/N 1052535) or equivalent DOT-3 brake fluid.

Power steering system - Power steering fluid meeting requirements of GM 9985010 (GM P/N 1050017, GM P/N 1052884 or equivalent). In cold climates GM P/N 12345867, GM P/N 12345866 or equivalent is recommended. (System should be drained and refilled prior to using this fluid).

Automatic transmission - DEXRON®-III automatic transmission fluid (GM P/N 12346143).

Key lock cylinders (except instrument panel compartment lock) - Lubricate lock cylinders with Multi-Purpose Lubricant (GM P/N 12345120) or 5W 30 synthetic motor oil.

Weatherstrips - Silicone grease (GM P/N 12345579 or equivalent).

Chassis lubrication - Chassis lubrication grease meeting requirements of NLGI Grade 2, category LB or GC-LB (or GM P/N 12346003).

Standard differential rear axle assembly - SAE 80W-90 GL-5 gear lubricant or axle lubricant (GM P/N 1052271, GM P/N 1052272 or equivalent).

Windshield washer solvent - GM Optikleen® washer solvent (GM P/N 1051515 or equivalent).

Hood latch and pivots - High temperature, water spray resistant grease (GM P/N 12345996 or equivalent).

Front wheel bearings - Lubricant (GM P/N 1051344 or equivalent).

Hood and door hinges, fuel door hinge, and rear compartment lid hinges - Engine oil or Lubriplate lubricant GM P/N 12346293.

WHEEL NUT TORQUE

Wheel Nut..... 135 N·m (100 lb. ft.)

REAR AXLE FILLER PLUG TORQUE

Rear Axle Filler Plug..... 35 N·m (26 lb. ft.)

BELT TENSION SPECIFICATIONS

Engines equipped with serpentine drive belts have an automatic tensioner. No adjustment of this belt is necessary.

TIRE PRESSURE SPECIFICATIONS

Sedan

Front..... 210 kPa (30 psi)

Rear..... 210 kPa (30 psi)

Compact Spare 420 kPa (60 psi)

Full-Size Spare 240 kPa (35 psi)

Wagon

Front..... 210 kPa (30 psi)

Rear..... 240 kPa (35 psi)

Compact Spare 420 kPa (60 psi)

Full-Size Spare 240 kPa (35 psi)

Police

Front..... 240 kPa (35 psi)

Rear..... 240 kPa (35 psi)

Full-Size Spare 240 kPa (35 psi)

Impala SS

Front..... 210 kPa (30 psi)

Rear..... 210 kPa (30 psi)

Full-Size Spare 240 kPa (35 psi)





SECTION 0C

VIBRATION DIAGNOSIS

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

VIBRATION

Among the problems encountered in the development and servicing of a vehicle, vibration conditions are perhaps the most difficult to identify and correct. This difficulty arises since the vibration the driver feels or hears is generally not the source of the problem, but rather a component responding to some external excitation, e.g., the steering wheel may vibrate due to the unbalance of a wheel, the engine, etc. Also, the source of the excitation may be built into the operation of the vehicle, and therefore cannot be eliminated (vehicle is normal) as in the case of the power pulses from the engine.

Vibration is a back and forth oscillation that can be seen, heard or felt. A vibration results from a system (group of parts) responding to an alternating excitation, the resulting motion being transmitted either visually (can be seen), audibly (can be heard) or physically (can be felt) to the occupants. A vehicle imbalance or misalignment is usually the cause of a vibration.

There are three ways to correct a vibration:

1. Eliminate the source of the vibration.
2. Interrupt the transfer path.
3. Stop the responder from responding.

DIAGNOSIS

REED TACHOMETER

Figures 1 and 2

To aid in the diagnosis of vibrations, a reed tachometer can be used to identify the frequency of a rotational component with a repetitive vibration (Figure 1).

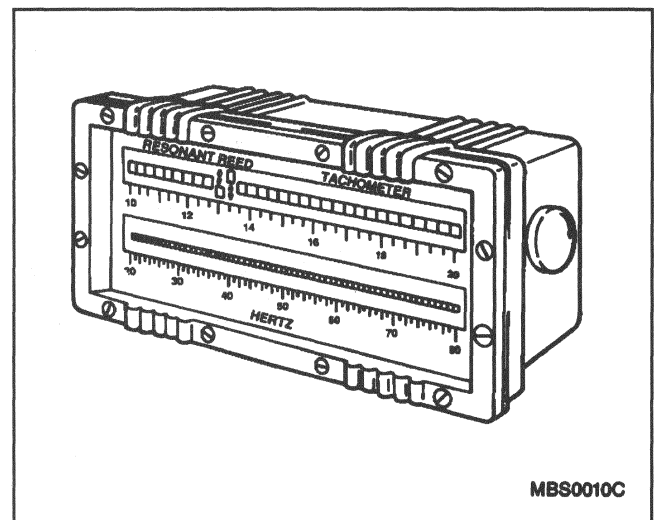


Figure 1—Reed Tachometer

0C-2 VIBRATION DIAGNOSIS

The Biddle Frahm Reed Tachometer, or equivalent, measures vibration in cycles per minute (CPM). It consists of two rows of reeds. Each row is designed to vibrate at a particular frequency.

If you can match the rotational speed of a particular component with the frequency reading of the reed tachometer, you will know in which area to concentrate your efforts for repairs. Each component on a vehicle will vibrate at a natural frequency. This frequency acts like a fingerprint and will identify a component. For a particular component, this frequency will vary with vehicle speed and/or engine speed. These frequency relationships exist for all vibrations that occur in a vehicle, and understanding these relationships can often solve difficult vibration problems.

The reed tachometer should be placed on the top of the instrument panel for ease of viewing and for effective pickup of a vibration.

Some components may induce more than one vibration at a given speed. These multiple vibrations are referred to as the order of vibration. The order of vibration refers to the number of disturbances created by one rotation of a component. For example, a tire with one heavy spot will produce one disturbance each rotation, a first order vibration (Figure 2). An oval-shaped tire will produce two disturbances each rotation, a second order vibration. (Figure 2).

In general, the suspect component should be isolated to verify the cause of a vibration before parts are replaced. For a first order tire vibration, the responsible component can be anything which rotates at wheel and tire speed (i.e., wheels, tires, brake

rotors, brake drums). These can be serviced or replaced with known good parts to identify the component causing the vibration. Once verified, the component can be balanced or replaced as necessary.

Using a reed tachometer in a vehicle will take some practice. One of the more important things to be aware of when using the reed tachometer for the first time is that the reeds are very sensitive and will pick up many low amplitude vibrations. These will appear as slight movements of many reeds, and do not correspond to any particular component. Reed movement that corresponds to a vibrating component will be greater in amplitude, traveling the full range of the viewing area. Reed vibration will also change as engine speed or vehicle speed changes.

ELECTRONIC VIBRATION ANALYZER (EVA)

Figure 3

The Electronic Vibration Analyzer (EVA) J 38792 speeds up the diagnosis of vibrations (Figure 3). The EVA displays three predominant frequencies and their amplitudes in order from the strongest to the weakest.

The EVA is equipped with a vibration sensor that can be plugged into either input A or input B on the front of the EVA. The vibration sensor can be mounted almost anywhere on the vehicle using a magnet or adhesive putty. There is a trigger wire on the front of the EVA that a strobe light can be attached to for driveshaft balancing.

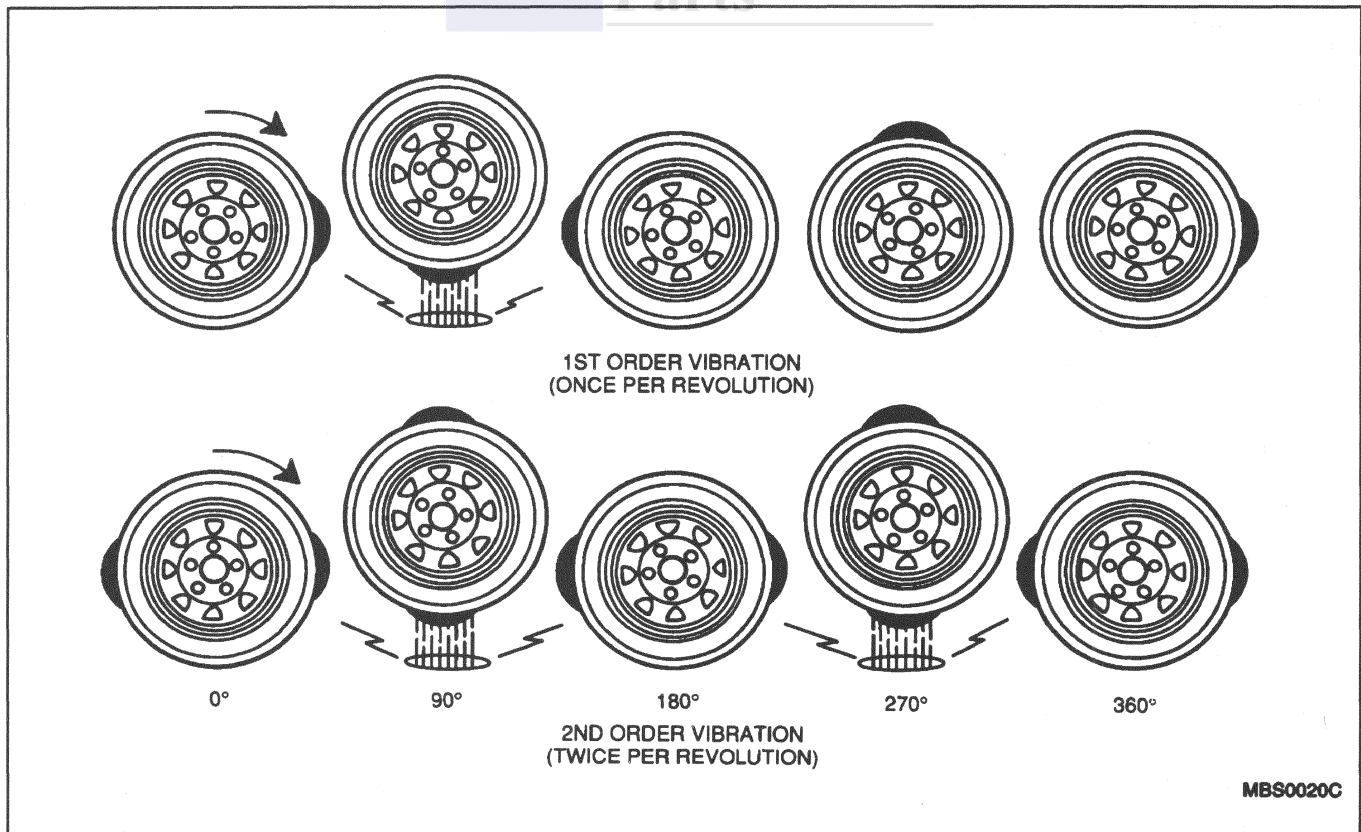


Figure 2—Order of Vibration

! Important

- The vibration sensor is marked with the word "UP" on one side. Mount the sensor in the horizontal position with the "UP" identification facing up. Mount the sensor as close as possible to the source of the vibration. Refer to the EVA instruction manual for information about sensor calibration.

CLASSIFYING A VIBRATION COMPLAINT

There are several excitation sources and many responding systems which may cause an annoying vibration. The first step is to identify the individual vibration complaints by systematically classifying them, during a road test, into one or more of the following categories:

1. Vehicle speed sensitive.
2. Engine speed sensitive.
3. Torque sensitive.
4. Jounce (load) sensitive.

In the process of classifying vibration problems in terms of these four sensitivity categories, you will find that many problems fit more than one of the categories. These four sensitivity categories can be combined into a list of five possible combinations into which a majority of vibration problems will fall:

- A. Engine speed sensitive only.
- B. Vehicle speed sensitive only.
- C. Torque sensitive and vehicle speed sensitive.
- D. Torque sensitive and engine speed sensitive.
- E. Torque sensitive, vehicle speed sensitive and jounce sensitive.

Since each of the categories has specific vibrations associated with it, determining which category(ies) the vibration falls into will give direction to the proper area for analysis of the problem. This will eliminate many components that cannot be the cause, and will focus attention on only those items that can contribute to the specific condition encountered.

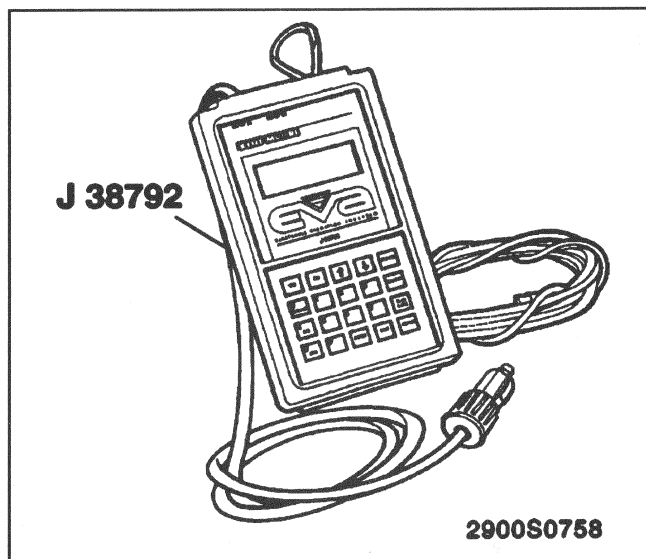


Figure 3—Electronic Vibration Analyzer (EVA)

ROAD TEST

The road test is a very beneficial way to help the technician locate the vibration. If possible, the owner of the vehicle should be present for the road test to help point out the vibration complaint. The importance of riding in the vehicle with the owner cannot be overemphasized. If the condition is normal, and no corrective action is needed, the owner should be told so immediately. A normal condition can be demonstrated with other vehicles, pointing out that similar vehicles have the same condition. To help diagnose and isolate the source of a vibration, it is important to road test the vehicle and use a systematic approach in narrowing down the possible causes of a vibration.

! Important

- Before road testing the vehicle, check the following:
 - A. Tires for correct inflation pressure. Refer to the tire placard affixed to the driver's door jamb for tire inflation specifications.
 - B. Vehicle for correct load conditions. Refer to the tire placard affixed to the driver's door jamb for vehicle load specifications.
 - C. Wheel nuts for proper torque. Refer to SECTION 3E.
 - D. Engine mounts for proper torque. Refer to SECTION 6A4A.
 - E. All universal joint fasteners for tightness and correct torque. Refer to SECTION 4A.
- When did the vibration start?
- Did the vibration start after a repair?
 - Exhaust system
 - Undercoating
 - Tire repair or replacement
 - Wheel alignment
 - Engine repair
 - Other

The following questions should be used as a basic outline during the road test. These questions will enable you to eliminate many components and focus attention on only those items that can be responsible for the vibration complaint.

- Is it a noise? Can it be heard as well as felt?
- What type of noise is it?
 - Buzz
 - Moan
 - Rattle
 - Squeak
 - Shudder
- Where can the vibration be felt?
 - Seat
 - Floor
 - Steering Wheel
- Does the vibration occur on smooth or rough roads?
- When does the vibration occur?

Four major component groups are usually the cause of, or are related to the vibration:

1. Engine and mounts

0C-4 VIBRATION DIAGNOSIS

2. Transmission
3. Tires, wheels, brake drums and rotors
4. Propeller shaft and universal joints

The following list contains items that may cause vibration:

Inspect

1. Wheel alignment. Refer to SECTION 3A for wheel alignment specifications.
2. Tire treads for blisters or separations.
3. Tire or wheel for proper balance. Refer to SECTION 3E for specifications.
4. Wheel stud for excessive runout. Refer to SECTION 3 for specifications.
5. Brake drum or rotor for damage or deformation.
6. Steering linkage for wear. Refer to SECTION 3B3.
7. Trim height. Refer to SECTION 3 for trim height specifications.
8. Lower ball joints for wear or damage.
9. Wheel for excessive runout. Refer to SECTION 3E for wheel runout specifications.
10. Tire and wheel assembly for excessive loaded radial runout. Refer to SECTION 3 for radial runout specifications.
11. Universal joints for looseness or damage.

Coast Test

Drive the vehicle past the vibration speed, shift into neutral and coast back through the vibration speed. In this test two kinds of vibrations normally occur: a shaking or a buzzing. A shaking vibration is usually caused by tires or a wheel and brake drum/disc assembly problem. A buzzing vibration is usually caused by a driveline problem.

VEHICLE SPEED SENSITIVE

Tool Required:

TK-0-A TECH 1 Tester

Most vibration complaints are vehicle speed sensitive. The frequency of the excitation depends on the speed of the vehicle. To determine if a given problem is vehicle speed sensitive:

1. Connect a TECH 1 to the Data Link Connector (DLC) and display engine rpm. Refer to the TECH 1 operator's guide.
2. Drive the vehicle in high gear and record the vehicle speed and the engine speed at which the problem occurs.
3. Shift the vehicle into the next lowest gear and again record the vehicle speed and engine speed at which the problem occurs.
4. If the problem occurs at the same vehicle speed as when the vehicle was in high gear, the vibration is vehicle speed sensitive.

ENGINE SPEED SENSITIVE

Tool Required:

TK-0-A TECH 1 Tester

Another group of vibration complaints are engine speed sensitive. The frequency of the excitation depends only on the speed of the engine, independent of the vehicle speed. To determine if a given problem is engine speed sensitive:

1. Connect a TECH 1 to the Data Link Connector (DLC) and display engine rpm. Refer to the TECH 1 operator's guide.
2. Drive the vehicle in high gear and record the vehicle speed and the engine speed at which the problem occurs.
3. Shift the vehicle into the next lowest gear and again record the vehicle speed and engine speed at which the problem occurs.
4. If the problem occurs at the same engine speed as when the vehicle was in high gear, the vibration is engine speed sensitive.

TORQUE SENSITIVE

Tool Required:

TK-0-A TECH 1 Tester

A torque sensitive problem is one which increases in intensity as the torque (power) output of the engine increases. The intensity of the vibration increases as the throttle opening is increased. To determine if a given problem is torque sensitive:

1. Connect a TECH 1 to the Data Link Connector (DLC) and display engine rpm. Refer to the TECH 1 operator's guide.
2. Drive the vehicle in high gear and record the vehicle speed and the engine speed at which the problem occurs.
3. Observe the disturbance while varying the throttle position. That is, drive the vehicle with steady throttle, slowly increasing to heavy throttle by going uphill or applying the brakes while increasing the throttle opening and then slowly decreasing to minimum throttle by coasting through the disturbance.
4. If the disturbance becomes more severe as the throttle opening is increased, the vibration is torque sensitive.

JOUNCE OR LOAD SENSITIVE

A jounce or load sensitive problem is one which varies in intensity as the height of the vehicle changes with respect to the surface of the road. The intensity varies as the front shocks are extended or compressed. To determine if a given problem is jounce or load sensitive:

1. Drive the vehicle a number of times, changing the load each time and observing the disturbance.
2. Drive the vehicle over a road that dips in such a way that it causes the front of the vehicle to move up and down in relation to the surface of the road. Keeping a constant throttle, observe the disturbance.

3. If the condition varies depending on the passenger load (or varies as the front of the vehicle moves up and down), the problem is jounce or load sensitive.

Jounce sensitive vibrations may also be torque sensitive.

ON-VEHICLE SERVICE

ENGINE SPEED SENSITIVE ONLY

Problems in this category may be duplicated with the vehicle stopped and the transmission in neutral by running the engine at the speed which the disturbance was felt during the road test. All additional appraisals can thus be made under this "free engine" condition.

Engine speed sensitive problems can be due to the belt or engine-driven accessories (generator, A/C compressor, coolant pump, power steering pump). To isolate the offending component, first check the torque on all accessory bracket fasteners. Also, check the condition and tension of the drive belts. If any abnormal conditions are found, correct and retest for the vibration problem.

For generator fastener torque specifications and drive belt tension information, refer to SECTION 6D3. For A/C compressor fastener torque specifications and drive belt tension information, refer to SECTION 1B. For coolant pump fastener torque specifications and drive belt tension information, refer to SECTION 6B. For power steering pump fastener torque specifications and drive belt tension information, refer to SECTION 3B1.

If the vibration occurs after all accessory drive belts and fasteners have been properly adjusted and tightened, the accessory may have an internal problem such as bad bearings, bent shafts or imbalance. Repair or replace unsatisfactory parts until all accessories run smoothly.

If all accessories run smoothly and the vibration problem still exists, check for basic engine imbalance due to a defective or loose flywheel. For flywheel torque specifications, refer to SECTION 6A4A. Also, check for a defective or loose torque converter. For torque converter specifications, refer to SECTION 7A. If the vibration occurred after a major engine overhaul, the crankshaft balancer may be misaligned with the crankshaft, refer to SECTION 6A4A for installation procedure. For engine mechanical diagnosis, refer to SECTION 6.

A/C compressor problems can be diagnosed by turning the compressor off and on while the vibration condition is being experienced. Refer to SECTION 1B for air conditioning service procedures and proper drive belt tension specifications.

VEHICLE SPEED SENSITIVE ONLY

Figure 4

Vehicle speed sensitive vibration problems are usually related to tire and wheel imbalance or runout. Low speed vibrations, those occurring at less than 64 km/h (40 mph), are usually runout related. Highway speed vibrations, those speeds above 64 km/h (40 mph), can be caused by either imbalance

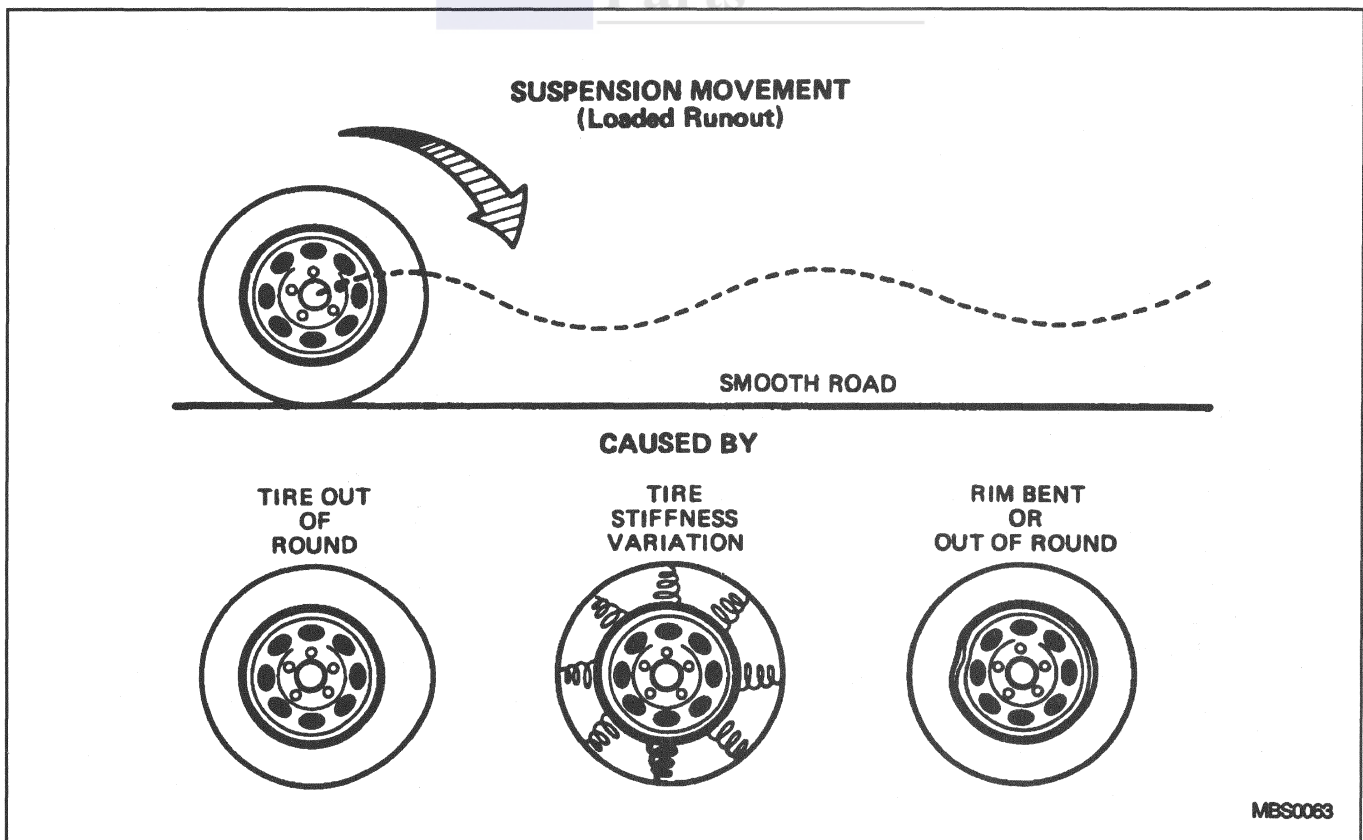


Figure 4—Causes of Vibrations

OC-6 VIBRATION DIAGNOSIS

or runout. For wheel and tire balancing procedures, refer to SECTION 3E. To investigate the possibility of wheel or tire runout, refer to SECTION 3. If a vibration remains after dynamic balancing, it can be caused by three things (Figure 4):

1. Tire runout.
2. Wheel runout.
3. Tire stiffness variations.

For service procedures concerning these three problems, refer to SECTION 3.

Another condition that is vehicle speed sensitive is a problem called "radial tire waddle." This condition is caused by a steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel. The vehicle can be road tested to determine which end of the vehicle has the faulty tire. If the waddle tire is on the rear, the rear end of the vehicle will shake from side to side or "waddle." From the driver's seat it feels as though someone is pushing on the side of the vehicle. For "radial tire waddle" service procedures, refer to SECTION 3.

TORQUE AND VEHICLE SPEED SENSITIVE

The only excitations which are both vehicle speed sensitive and torque sensitive (and possibly jounce sensitive) are disturbances caused by improper driveline angles which are a result of incorrect trim height or faulty universal joints. Check for the following:

- Worn or damaged universal joints. The universal joints should pivot smoothly. If universal joint binds or appears tight, replace the universal joint as an assembly. Refer to SECTION 4A for universal joint service procedures.
- Correct trim height. Refer to SECTION 3.

TORQUE AND ENGINE SPEED SENSITIVE

Vibration problems likely to be encountered in this class are as follows:

- A. Engine-driven accessories (generator, A/C compressor, coolant pump, power steering pump).
 - Engine-driven accessories generally do not present a problem if all fasteners are tightened to specifications and their respective drive belts are in good condition. Visually inspect each accessory to ensure that the brackets installed are complete and properly assembled.
 - For generator fastener torque specifications, refer to SECTION 6D3. For A/C compressor fastener torque specifications, refer to SECTION 1B. For coolant pump fastener torque specifications, refer to SECTION 6A4A. For power steering pump torque specifications, refer to SECTION 3B.
- B. Engine/transmission contacting the frame or body.
 - Inspect the vehicle to be certain that neither the engine or transmission is contacting the frame or body. If any irregularities are revealed during inspection, correct and retest on the road.

C. Exhaust system components.

- Visually inspect the exhaust manifold, intermediate pipe, muffler, catalytic converter and tailpipe for sufficient clearance of all points, refer to SECTION 6F for clearance specifications. Be particularly certain that sufficient clearance exists in all directions during engine torque load.
- A majority of exhaust system problems are due to "bound up" conditions. Loosen all joints in the entire system and rest the pipes on floor stands while each clamp and bolt is tightened to specifications. Refer to SECTION 6F for proper exhaust system torque specifications.
- Be certain that the end of the tailpipe is below the surface of the rear bumper fascia.
- After inspecting the exhaust system and making any corrections, retest on the road.

PROPELLER SHAFT

Driveline vibrations will generally be a high speed vibration associated with a "buzz" or a "shudder" occurring in the 72 to 88 km/h (45 to 55 mph) range. A majority of the vibration is experienced on either acceleration or deceleration. Driveline vibrations emanate from four general areas:

1. Propeller shaft balance.
2. Propeller shaft runout.
3. Driveline angles.
4. Joint phasing.

Most driveline vibrations that are associated with a "buzz" or a "shudder" type vibration will also have a high frequency reading on the reed tachometer or Electronic Vibration Analyzer (EVA). Refer to "Reed Tachometer" or "Electronic Vibration Analyzer (EVA)" earlier in this section.

Propeller Shaft Runout

If a noise vibration is present in the vehicle driveline, the propeller shaft may be bent or out of round due to damage. Inspect the propeller shaft for dents or other damage. The propeller shaft and its components must be "true" or turning with an absolute minimum amount of lateral movement. Refer to SECTION 4A for propeller shaft runout specifications.

Propeller Shaft Balance

If balance weights are loose or missing, the propeller shaft must be balanced or replaced. Refer to SECTION 4A for propeller shaft balance check procedures. Excessive looseness or wear at the propeller shaft sliding yoke splines may also cause a propeller shaft to be unbalanced. For propeller shaft inspections procedures, refer to SECTION 4A. Inspect propeller shaft and universal joints for mud buildup, undercoating buildup or loose fasteners.

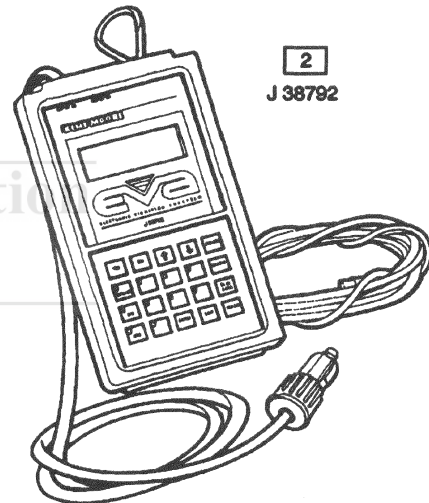
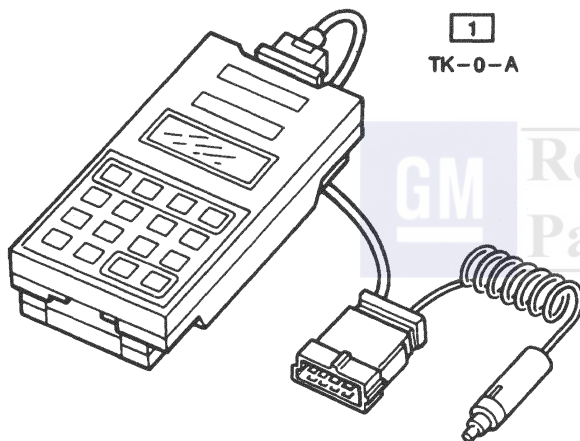
UNIVERSAL JOINTS

Faulty universal joints can be another cause for driveline vibrations. If a universal joint is suspected of producing a rattling or knocking noise, the universal joint may be worn or loose. Make a preliminary inspection by grasping the propeller shaft toward the end near the suspected universal joint and rotate it back and forth, then, move the propeller shaft in an up and down direction while feeling for any looseness. If the propeller shaft shows excessive movement, the universal joint should be removed and inspected for wear or damage. Refer to SECTION 4A for universal joint diagnosis and service procedures.

DRIVELINE ANGLES

Vibrations due to improper driveline angles are caused by either incorrect trim height or faulty universal joints. Incorrect trim height can lead to excessive universal joint angles. Refer to SECTION 3 for trim height specifications. Faulty universal joints can lead to incorrect driveline angles. Refer to SECTION 4A for universal joint angle measurement procedures.

SPECIAL TOOLS



- 1 TECH 1 MODULAR DIAGNOSTIC SYSTEM
- 2 ELECTRONIC VIBRATION ANALYZER

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BT0010C



SECTION 1

HEATING AND AIR CONDITIONING

CONTENTS

Heater, Ventilation and Air Conditioning	Section 1B	Automatic Control Air Conditioning	Section 1C
Manual Control Air Conditioning	Section 1B1	HD6/HRE/HE Air Conditioning	
		Compressor Service or Unit Repair	Section 1D2

SECTION 1B

HEATER, VENTILATION AND AIR CONDITIONING

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

HEATER, VENTILATION, AND AIR CONDITIONING SYSTEM OPERATION

NOTICE: The refrigeration system on this vehicle uses R-134a which is not compatible with refrigerant R-12. Before servicing the system always make sure the proper servicing equipment is used or the system could become severely damaged. Always refer to the service text and manufacturer instructions included with service equipment before proceeding.

The Buick offers two air conditioning systems. The base system is the (C67) semi-automatic system and the optional system is the (C68) automatic system. The Chevrolet offers only one air conditioning system, the (C60) manual control system. The air conditioning system delivers air that has been heated or cooled and dehumidified for occupant comfort. It also provides power ventilation, and windshield and side window defrosting. During most operating conditions, outside air is drawn through the heater and air conditioning module by the blower motor. Additional outside air is also forced into the vehicle by forward movement of the vehicle. Within the heater and air conditioning module, air is pushed by the blower motor through the evaporator, then through the heater core then into the passenger compartment. For air conditioning or defroster operation, the refrigeration system will chill the evaporator to almost freezing. As the air passes through the evaporator, the air temperature drops which causes the moisture in the air to condense on the evaporator core fins. This moisture leaves the vehicle by gravity feed through a drain hose, dehumidifying the vehicle. From the evaporator, some or all of the air may pass through the heater core, which is warmed by engine coolant. Any of the air which is not to be heated will mix with the heated air before entering the passenger compartment. When maximum air conditioning mode is selected, most of

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the air entering the blower motor is taken from the passenger compartment (recirculated) where it is most likely to be cooler than the outside air. Only outside air is used in all other modes.

Air Distributors and Outlets

There are four adjustable high-level air outlets in the instrument panel, two near the center and one at each extreme end of the panel. In addition, there are two side window defogger outlets, one at each end of the instrument panel upper trim pad. All six outlets are fed by the air distributor. Air can also be discharged from a floor air distributor centered on the transmission tunnel just below the instrument panel. This distributor feeds air to the front floor area and to the rear floor area through rear floor air outlets which run under the carpeting and exit through a cut out under the front seats. The windshield defoster nozzle is also fed by the air distributor.

Ventilation

Figure 1

The HVAC system provides fresh air ventilation for the passenger compartment in all operating modes. Even during "MAX A/C" mode, a small amount of air is taken from outside the vehicle. In all other modes, only outside air is used to feed the HVAC system. Even in the "OFF" mode, fresh outside air is forced into the air distribution system by the forward movement of the vehicle.

After being warmed or cooled to the desired temperature, the air is discharged from the outlets appropriate to the selected operating mode. When all windows are closed, the addition of outside air builds a slight positive pressure within the passenger compartment. The pressure forces stale air to leave the vehicle through a pressure relief valve (26) near the base of both body door lock pillars, after it has circulated through the passenger compartment.

REFRIGERATION SYSTEM

Figures 2 through 4

Refrigerant-134a

CAUTION: Avoid breathing A/C Refrigerant-134a and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Like the coolant in the engine cooling system, the refrigerant is the substance in the air conditioning system that absorbs, carries and then releases heat. Although various substances are used as refrigerants in other types of refrigeration systems, past automotive air conditioning systems used a type called Refrigerant 12 (R-12).

This vehicle uses a refrigerant called Refrigerant-134a (R-134a). It is a nontoxic, nonflammable, clear, colorless, liquefied gas. While the R-134a A/C system is very similar to an R-12 A/C system, the differences in the refrigerant, lubricants, and service equipment are important.

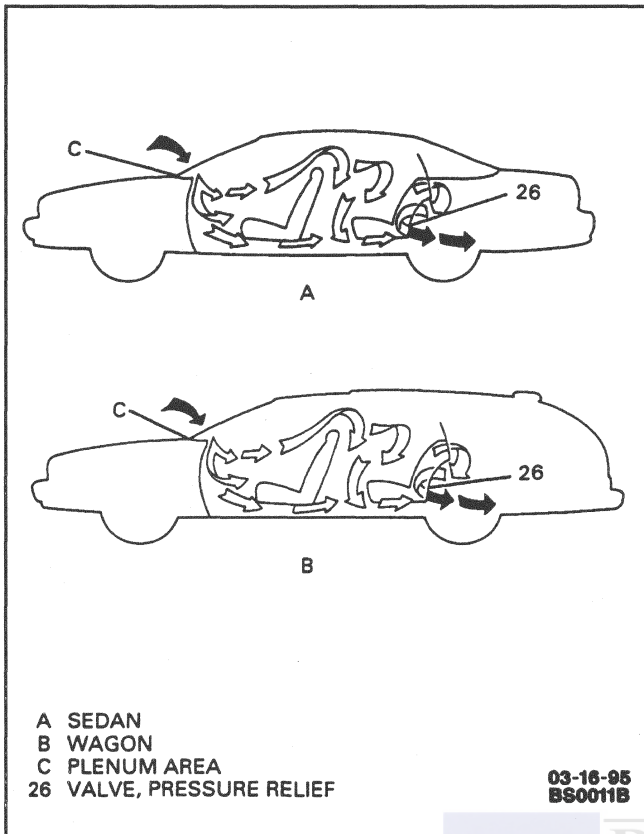


Figure 1 - Ventilation Air Flow

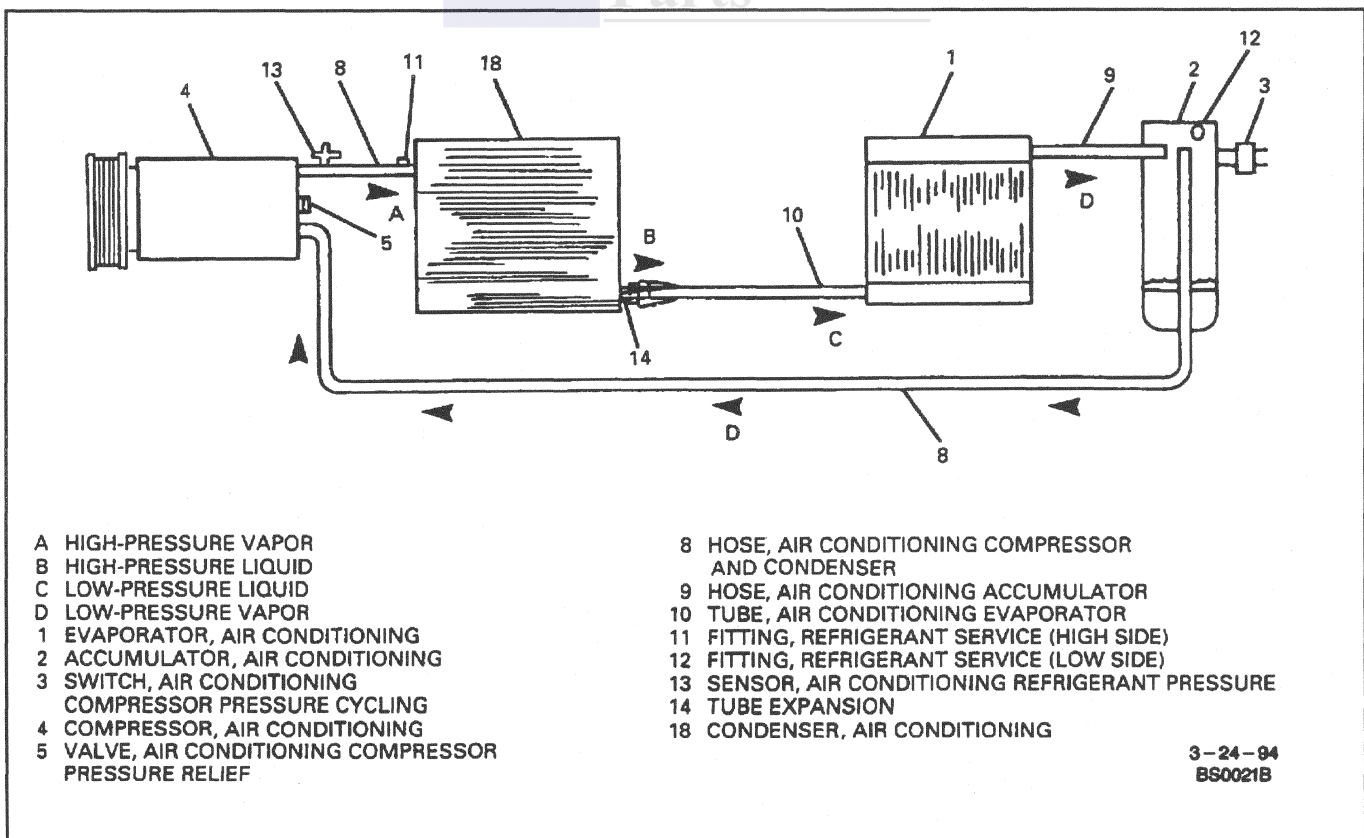


Figure 2 - Refrigeration System Schematic

1B-4 HEATING AND AIR CONDITIONING

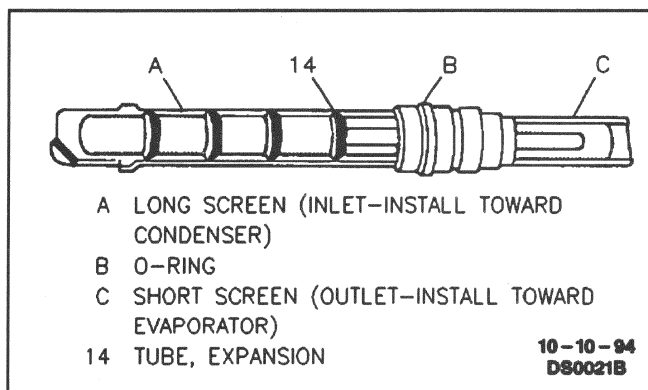


Figure 3 - Expansion Tube

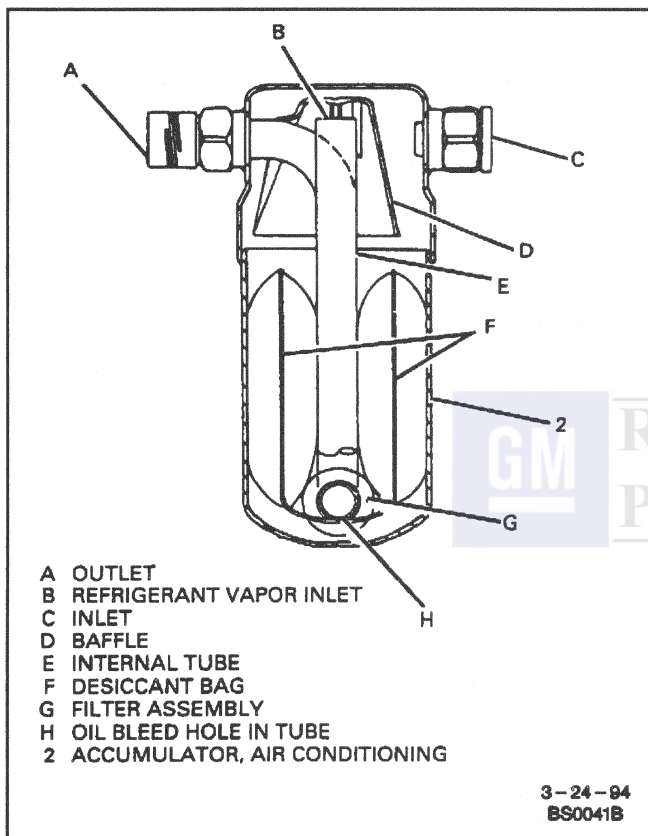


Figure 4 - Air Conditioning Accumulator Components

NOTICE: R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. R-12 in a R-134a system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance.

Refrigerant-134a carries a charge of a special lubricating oil, polyalkylene glycol (PAG) refrigerant oil. GM PAG refrigerant oil will have a slight blue tint. The oil is hygroscopic (absorbs water from the atmosphere) and should be stored in closed containers.

Use only polyalkylene glycol (PAG) synthetic refrigerant oil for internal circulation through the R-134a A/C system and only mineral base 525 viscosity refrigerant oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure is likely to occur.

The air conditioning refrigeration system is designated as a CCOT (cycling clutch orifice tube) system. This designation refers to two components of the refrigeration system. In this system, the compressor clutch is cycled on and off to control compressor operation and cause the evaporator (1) to remain just above freezing temperature for most efficient cooling without icing.

An orifice or restriction within tube (14) is used to cause the refrigerant pressure to decrease which causes it to boil or vaporize inside evaporator (1). When it vaporizes, the refrigerant absorbs heat and cools the air flowing past the evaporator fins.

For heater-only or "ECON" modes, the refrigeration system is shut off so cooling is not provided. The amount of heating is governed by the proportions of the air directed through or around the heater core in the same manner as with air conditioning. The heater, ventilation, and air conditioning (HVAC) control in the instrument panel gives the operator a way to select the desired operating mode, air temperature and blower motor speed when the vehicle's ignition is on and the engine is running.

Air Conditioning Compressor

The compressor (4) is belt driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft is driven, the compressor (4) compresses the low pressure refrigerant vapor from the accumulator into a high pressure, high temperature vapor. Carried with the refrigerant is the refrigerant oil which is used to lubricate the compressor (4).

The compressor (4) has a unique lubrication system. The crankcase suction bleed is routed through the rotating wobbleplate for lubrication of the wobbleplate bearing. The rotation acts as an oil separator, which removes some of the oil from the crankcase suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.

Up to 118 ml (4 fluid ounces) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor (4) that the oil in the old compressor crankcase be drained and measured (discard after recording amount). All service replacement compressors will have 237 ml (8 fluid ounces) of PAG oil in the crankcase. The oil must be drained and retained. After the old compressor is removed, the oil should also be drained, then measured. If less than 30 ml (1 fluid ounce) of oil is drained, add 30 ml (1 fluid ounce) of new oil to new compressor. If more than 30 ml (1 fluid ounce) is drained, add the same amount. For compressor overhaul, refer to SECTION 1D2.

RELATIVE HUMIDITY	AMBIENT AIR TEMP		MAX LOW SIDE PRESSURE		MAX HIGH SIDE PRESSURE		MAX RIGHT CTR AIR OUTLET TEMP	
%	F	C	PSIG	kPaG	PSIG	kPaG	F	C
20	70	21	23	159	190	1313	42	6
	80	27	30	207	250	1728	50	10
	90	32	35	242	300	2074	54	12
	100	38	37	225	330	2281	57	14
30	70	21	23	159	200	1383	42	6
	80	27	30	207	280	1936	51	11
	90	32	35	242	310	2143	55	13
	100	38	37	255	335	2310	58	15
40	70	21	23	159	200	1379	43	6
	80	27	31	214	285	1965	52	11
	90	32	36	248	320	2206	56	14
	100	38	43	296	370	2551	64	18
50	70	21	23	159	200	1379	43	6
	80	27	33	228	300	2068	54	13
	90	32	39	269	340	2344	60	16
	100	38	47	324	385	2654	69	21
60	70	21	23	159	200	1379	43	6
	80	27	36	248	315	2171	56	14
	90	32	43	296	365	2516	64	18
	100	38	55	379	375	2585	78	26
70	70	21	26	179	240	1655	46	8
	80	27	38	262	325	2240	58	15
	90	32	47	324	380	2620	67	20
80	70	21	30	207	260	1792	49	10
	80	27	40	276	340	2344	60	16
	90	32	49	338	380	2620	72	22
90	70	21	32	221	275	1896	52	11
	80	27	41	283	345	2378	62	17

NOTE: PERFORMANCE DATA OBTAINED AT ENGINE SPEED OF 2000 RPM.

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Figure 5 - Refrigerant-134a System Performance Chart

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Air Conditioning Condenser

The high pressure refrigerant vapor from compressor (4) goes to condenser (18) in front of the engine cooling system radiator. The condenser (18) is made up of coils which carry hot refrigerant vapor from the the compressor (4). Thin cooling fins on the coils transfer heat to the air passing through condenser (18). This cools the high pressure refrigerant vapor and causes it to condense into a high pressure liquid.

Expansion Tube

The plastic tube (14), also called the orifice tube, is in the enlarged portion at the forward end of the condenser outlet pipe. Inside tube (14) is a small, precisely sized passage called an orifice that restricts the flow of high pressure liquid refrigerant from condenser (18) on its way to evaporator (1). As a result of this restriction, the refrigerant leaves tube (14) as a low pressure liquid.

An extended plastic screen downstream of the orifice within tube (14) serves to reduce the flow noise associated with the pressure equalization when the system is shut off.

Tube (14) and orifice are protected from contamination by filter screens on both the inlet and outlet sides. Tube (14) cannot be adjusted or repaired and must be replaced as a unit.

Air Conditioning Evaporator

Air passing through evaporator (1) gives off some of its heat to the evaporator core fins when the refrigeration system is operating. The heat is conducted through the thin metal walls of the evaporator core to the low pressure liquid refrigerant flowing through the evaporator core tubes, causing the refrigerant to boil and vaporize. The refrigerant leaves evaporator (1) as a low pressure vapor, carrying off the heat it absorbed from the evaporator surfaces.

Air Conditioning Accumulator

The accumulator (2) is a sealed container mounted on the right front fender inner panel in the engine compartment. The accumulator (2) receives the refrigerant after the evaporator (1), before it is sent to the compressor (4). It serves as a refrigerant storage container and also separates any traces of liquid refrigerant that may be trapped in the vapor coming from the evaporator (1). The accumulator (2) allows no more than a slight trickle of this liquid refrigerant to go to the compressor (4) since any larger amount of liquid entering compressor (4) at one time could damage the compressor (4).

A small oil bleed hole in the outlet tube inside the lower end of the accumulator (2) prevents trapping of refrigerant oil by feeding it into the flow of refrigerant going to the compressor (4). This helps prevent oil starvation that could cause lubrication problems and failure of the compressor (4).

A bag of desiccant (a moisture absorbing material) in the base of the accumulator (2) collects and holds any traces of moisture in the refrigerant that could otherwise create problems such as corrosion or freezing in the refrigeration system.

The accumulator (2) should be replaced only if leaking as a result of perforation, a damaged O-ring seat or damaged threads, or if the system has been opened to outside air for an extended period.

HEATER SYSTEM

The water pump sends a constant supply of engine coolant through the heater core at all times. This supply of engine coolant is sent through a 5 gallon per minute flow restricter, located in the heater inlet hose. The flow restricter is used to prevent excessive rush of engine coolant through the heater core during high engine rpm's, which would result in possible premature heater core failure. This constant supply of engine coolant provides a heat source which is used by the HVAC module, which is controlled by the HVAC control to provide interior heating. For Buick, refer to SECTION 1C for insufficient heating diagnosis, or for Chevrolet, refer to SECTION 1B1 for insufficient heating diagnosis.

RELAYS AND SWITCHES

Air Conditioning Compressor Pressure Cycling Switch

The switch is mounted on the low side of the refrigeration system and is wired into the A/C request circuit to the powertrain control module (PCM). Since low side pressure is directly related to low side temperature, the switch has the ability to prevent the evaporator from freezing by turning off the compressor before low side pressures become too low. It also prevents the compressor from operating during low ambient temperature conditions, or if the system is low on refrigerant.

Air Conditioning Compressor Relay

The air conditioning compressor relay acts as an on/off switch in series circuit to the compressor clutch coil. When the powertrain control module (PCM) receives a signal indicating one or more specific operating conditions such as wide open throttle or excessive engine heat, the PCM opens the relay coil to open the relay contacts and break the compressor clutch circuit. This gives the PCM the ability to interrupt the operation of the air conditioning refrigeration system when necessary. The relay is located inside the underhood electrical center on the right hand fender inner panel.

Idle Speed Control Power Steering Pressure Switch

Engine idle quality is maintained by temporarily shutting off the compressor when high power steering loads are imposed. The switch in the power steering pressure hose closes at approximately 3 447 kPa (500 psi). The hydraulic pressure is an indicator of the load placed on the power steering pump. When the pressure is reduced, the switch opens.

Air Conditioning Refrigerant Pressure Sensor

The A/C refrigerant pressure sensor attached to the air conditioning compressor and condenser hose, senses refrigerant pressure on the air conditioning system high side. The refrigerant pressure status is sent to the PCM. The purpose of this sensor is to inform the PCM of high side pressure status so the PCM can:

1. Control cooling fan operation.
2. Disable the compressor before high side pressure becomes too high.

Refer to SECTION 6E3-C-10 for more information.

DIAGNOSIS

Some conditions which are normal to proper air conditioning system operation may lead an owner to wrongly suspect a problem.

Under conditions of high humidity, the air discharged from the air conditioning system may not feel as cold as expected. This is because the vaporized moisture in humid air holds heat more effectively than dry air, making the humid air harder to cool. In terms of overall comfort, however, the drier dehumidified air coming from the air conditioning system in hot, humid weather will evaporate more moisture on a person's skin and provide more of a cooling effect than might be felt from cooler but more humid air. This fact should be explained to a customer if no mechanical cause can be found for a persistent complaint of insufficient cooling.

The cycling clutch method of controlling evaporator temperature can cause some slight increases and decreases of engine speed and power which may be noticeable under certain conditions. This condition is normal and indicates that the air conditioning system is cycling to maintain full cooling capacity while avoiding icing of the evaporator.

If the engine is turned off with the air conditioning system operating, the refrigerant will flow from the high pressure side of the expansion tube through the orifice to the low pressure side until the pressure is equalized within the refrigeration system. The refrigerant flow may be heard as a hissing sound for as long as a minute after the engine stops. This is a normal condition.

INSUFFICIENT COOLING CHECK

If outside air temperature is above 21° C (70° F), the following procedure can be used to quickly determine whether the air conditioning refrigeration system has the proper charge of Refrigerant-134a. This check can be made in a few minutes, simplifying system diagnosis by localizing the problem to a low refrigerant charge or eliminating that possibility.

The engine must be at normal operating temperature and running at normal idle speed. The hood and all body doors must be open. The HVAC control must be set for maximum air conditioning, high blower motor speed and full cool temperature setting.

When the compressor is operating, feel the temperature of the evaporator inlet tube "downstream" from the expansion tube. Then feel the surface of the accumulator.

Compare and evaluate the temperatures of the two components. Proper operation with an adequate refrigerant charge is indicated if both the evaporator inlet tube and the accumulator feel much colder than the outside air and both seem to be at the same temperature.

If the evaporator inlet tube is cooler than the accumulator, or if the inlet has a coating of frost, a low refrigerant charge is indicated. The technician should leak test the refrigeration system and then recover and recharge system with 0.79 kg (1 pound 12 ounces) of R-134a refrigerant. If charge is correct, refer to SECTION 1C for Buick, or SECTION 1B1 for Chevrolet.

AIR CONDITIONING PERFORMANCE TEST

Figure 5

Tools Required:

J 39183-C R-134a Manifold Gauge Set or
J 39500-GM Air Conditioning Refrigerant Recovery, Recycling and Recharging (ACR-4) System

J 6742-03 Precision Thermometer

Performance testing provides a measure of air conditioning system operating efficiency by measuring and comparing pressures at the high pressure and low pressure sides of the refrigeration system, the temperature of the air being discharged into the passenger compartment, ambient air temperature and relative humidity.

Before making the air conditioning performance test, perform the HVAC system check. Refer to SECTION 1C.

The high-pressure gauge of J 39183-C or J 39500-GM should be connected to the high-pressure side service fitting on the compressor and condenser hose and the low-pressure gage of J 39183-C or J 39500-GM should be connected to the low pressure side service fitting on the accumulator. Both gage valves must be closed while making the connections. The center hose fitting of J 39183-C also must be closed, and must remain closed during the performance test.

The hood should be open and all doors and windows should be closed during the test. The HVAC control must be set for 16° C (60° F), "AUTO" mode and high blower motor speed. A high-volume fan should be placed in front of the radiator grille to ensure an adequate supply of air flow across the condenser. After idling the engine for five minutes, the engine speed should be increased to 2000 rpm for the test.

Just before making the performance test, the temperature and relative humidity of the ambient air (the air being blown against the condenser) should be determined. Then the temperature of the air being discharged from a center instrument panel outlet should be measured and low and high side

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pressures on J 39183-C or J 39500-GM should be read. Record the readings and compare them to the data listed in Figure 5.

If operating temperatures and pressures are within the normal range, the refrigeration system can be considered to be operating properly. Slight variations from the published readings can be considered acceptable if experience has shown that such minor deviations do not indicate a problem.

REFRIGERATION SYSTEM CHECKS

If a faulty air conditioning refrigeration system is suspected because of abnormal refrigeration system pressures, the following items should be checked.

- Clogged fins in the radiator core or condenser core, blocking the airflow. Check between the condenser and the radiator, as well as the outer surfaces of these two components.
- Restrictions or kinks in the evaporator core, condenser core, hoses, tubes and other refrigerant passages.
- Refrigerant leaks.
- Air leaks or restrictions in air ducts. A low airflow rate may indicate a restricted evaporator core.
- Compressor clutch slippage.
- Improper drive belt tension.
- A plugged accumulator or expansion tube.
- Excessive moisture in the refrigeration system.

LEAK TESTING THE REFRIGERATION SYSTEM

A refrigerant leak test should be performed on the system whenever a leak is suspected due to system indication of low charge or after any service operation which disturbs the components, lines or connections. Remember care and diligence are the biggest keys to success.

Electric Halogen Leak Detector

Figures 6 and 7

Tool Required:

J 39400 Halogen Leak Detector

This type of leak detector has been found to be the most useful tool in locating refrigerant leaks. The J 39400 is a small unit which operates on 12 volts DC and provides an audible signal which increases in frequency when leaking refrigerant is detected. There are three settings: one for R-12, one for R-134a, and one for gross leaks. The gross leak setting is for isolating very large leaks already found at one of the other two settings. Care must be taken that the instrument is properly calibrated, per the included instructions, and that it is used at the proper setting for the type of refrigerant in the system being tested.

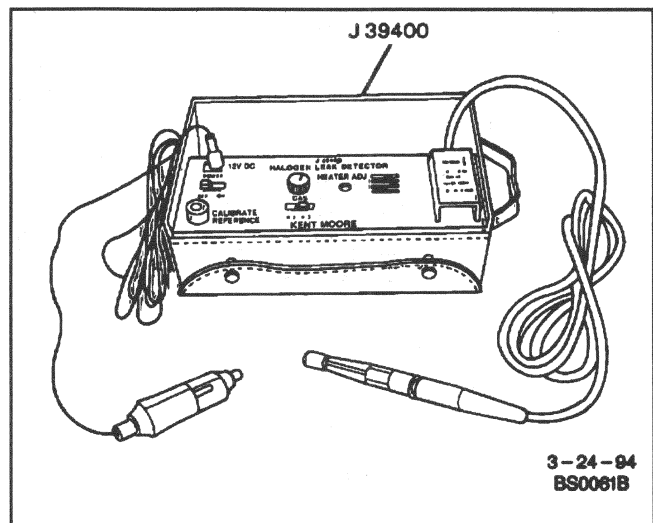


Figure 6 - Electric Halogen Leak Detector

Evaporator Core

Because the evaporator core is contained in a closed module and is inaccessible to leak detectors, it is one of the most difficult parts of the air conditioning system to check for leaks. To leak test the evaporator core:

1. Turn the blower motor on to high for 15 or more seconds then shut it off.
2. Wait 10 minutes.
3. Remove the blower motor resistor on C60 systems or the blower motor control module on C67 or C68 systems. Refer to SECTION 1B1 or 1C.
4. Insert the leak detector probe into the module opening. If the detector goes to a solid alarm, a leak has been found.

Compressor and Block Fitting

1. Blow shop air behind and in front of the compressor clutch/pulley for at least 15 seconds.
2. Probe the compressor area. If the detector goes to a solid alarm, a leak has been found.

Fluorescent Leak Detector

Tools Required:

J 41447 Tracer Dye

J 41436 Tracer Dye Injector

J 28428 High Intensity Black Light

R-134a refrigerant is uniquely different from R-12 refrigerant used in the past and may require additional methods to detect leaks. The R-134a molecule is smaller than the R-12 molecule and can leak through smaller openings. Also, R-134a does not contain chlorine which the electronic leak detectors found easy to identify. The tracer dye method is meant to be used in conjunction with the electronic leak detector and will pinpoint smaller leaks undetected by using the electronic leak detector. R-134a tracer dye requires time. Depending upon the rate of leak, it may take up to 7 days for the leak to become visible.

**Important**

- Tracer dye J 41447 has been developed to be used only with R-134a equipped vehicles or vehicles that have been retrofitted from R-12 to R-134a.
- Only J 41447 tracer dye is recommended for use in the R-134a system. Use of any other products may affect system reliability and cause premature compressor failure.
- Use only a 1/4 oz. charge of tracer dye. Larger amounts may compromise the reliability of the A/C system.
- After adding tracer dye, clean service valves and surfaces of residual dye with GM Engine Degreaser GM P/N 1050436 or equivalent to prevent false diagnosis.

DYE INJECTION

- Charged systems can be injected with tracer dye by using J 41436 Tracer Dye Injector along with the instructions provided.
- Discharged systems can have the tracer dye added to a replaced component, or can be added using the ACR4 unit.

Liquid Leak Detectors and Pressure Testing

Due to their lack of sensitivity, liquid/bubble leak detectors have very limited usefulness and are not recommended.

CAUTION: R-134a service equipment or vehicle A/C systems should not be pressure tested or leak tested with compressed air. Some mixtures of air/R-134a have been shown to be combustible at elevated pressures. These mixtures are potentially dangerous and may result in fire or explosion causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

ELIMINATING AIR CONDITIONING ODOR

Tool Required:

J 36645 A/C Evaporator Cleaning Gun

Some vehicles may experience odors emitted from the air conditioning system primarily at start up in hot, humid climates. This odor may be the result of debris in the evaporator module case and/or microbial growth on the evaporator core. To eliminate this condition, the following equipment and procedure should be used.

CAUTION: This procedure should only be performed on a cold vehicle to prevent the disinfectant from coming in contact with hot engine components which could cause irritating vapors to form.

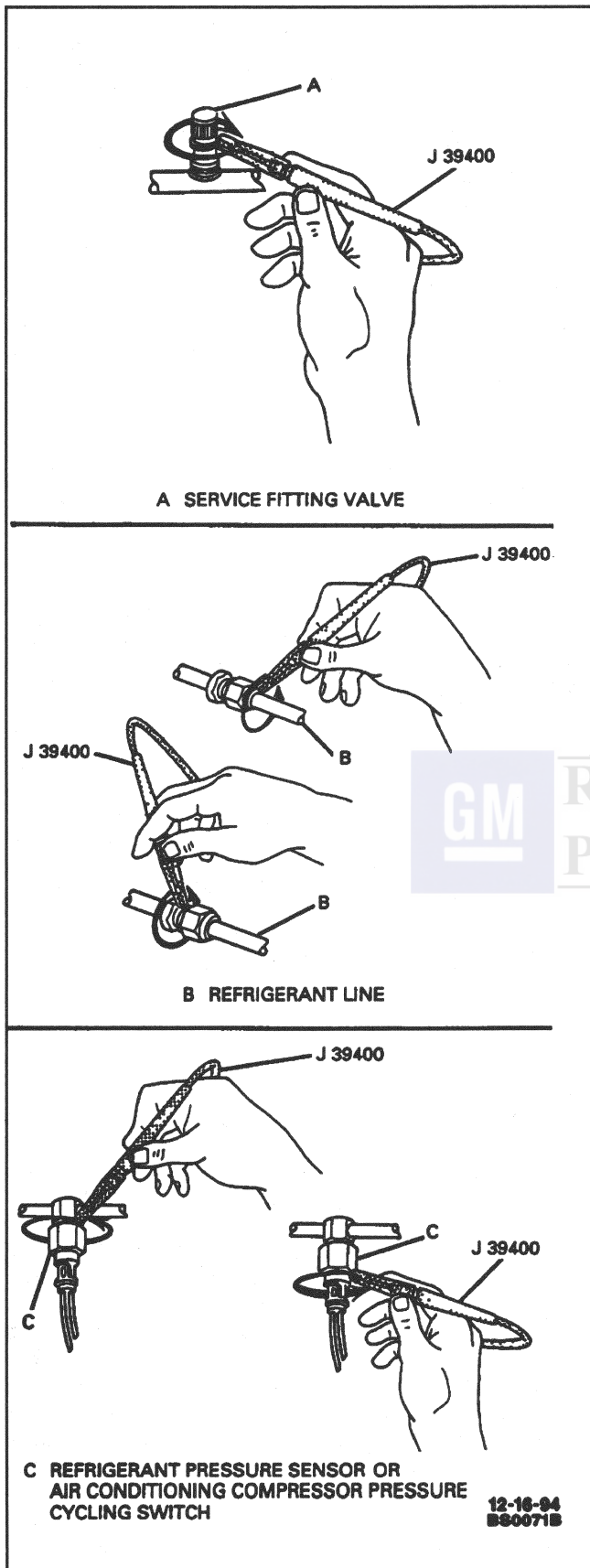


Figure 7 - Checking for Refrigerant Leaks

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Disinfectant can cause substantial, but temporary, eye injury. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling disinfectant. If disinfectant gets into eyes, hold eyelids open and flush with a steady, gentle stream of water for fifteen minutes. Obtain medical attention if irritation persists.



Important

- This procedure will eliminate debris or microbial growth which can cause odors but will not prevent the possibility that debris or microbes present in the environment may return.
1. Pour small bottle of two part GM Goodwrench air conditioning system disinfectant kit, GM P/N 25533404 or equivalent, into large bottle. Seal and invert large container once or twice to mix contents.
 2. Connect battery charger to avoid draining battery during cleaning procedure.
 3. Remove blower motor resistor on (C60 or C67) or control module (C68), leaving electrical connectors attached. Refer to SECTION 1B1 or 1C.
- NOTICE:** Do not allow the metal heat sink of the blower motor control module to become grounded to any metal surface as this may result in internal circuitry damage.
4. Check evaporator module case for debris and remove any debris present through opening. If debris is imbedded into evaporator core face and cannot be removed, the core will have to be removed from vehicle and cleaned. If a large amount of debris is present in evaporator module case, the air inlet screen will require sealing around the windshield wiper post holes and fender edges.
 5. Turn ignition to the "RUN" position, but do not start vehicle.
 6. Set HVAC control to "ECON," 16° C (60° F) and low blower motor speed for C68 systems or "HEATER," full cold and "LOW" blower speed.
 7. Open all windows and doors and exit vehicle.
 8. Place drain pan with at least a two quart capacity below evaporator drain hole to collect disinfectant and rinse water runoff.
 - To prevent liquid from splashing on wiring harness and sound deadener, remove the 90° rubber hose from the evaporator drain pipe and attach a 0.60 m (2 foot) piece of 13 mm (0.5 inch) inside diameter, non reinforced hose to the evaporator drain pipe. Direct hose into drain pan.
 9. Position pedestal fan to provide cross ventilation during cleaning procedure. Turn on high.
 10. Use tool J 36645 or equivalent siphon type parts cleaning spray gun capable of delivering two ounces/minute of liquid when driven with 552 to

621 kPa (80 to 90 psi) of compressed air. Insert nozzle of spray gun through power module opening and insert siphon hose into container of disinfectant. Direct spray toward evaporator face taking extra care to ensure adequate coverage of the corners and edges, completely saturating the entire core. Use entire container of solution.

11. Turn ignition to the "OFF" position and allow core to soak for five minutes.
12. Check underneath vehicle to verify proper drain operation. If necessary, unclog drain hose.
13. Turn ignition to the "RUN" position, but do not start the vehicle.
14. Thoroughly rinse evaporator core with one quart of clean water using spray gun to remove any disinfectant residue.
15. Turn ignition to the "OFF" position and reinstall blower motor resistor (C60 or C67) or blower motor control module (C68). Refer to SECTION 1B1 or 1C.

CAUTION: Blower motor control module heat sink may be hot. To avoid danger of being burned, do not install control module when it is hot.

16. Dispose of disinfectant and rinse water runoff collected in drain pan in an approved manner.
17. Disconnect battery charger.

ON VEHICLE SERVICE

REFRIGERATION SYSTEM SERVICES

Replacing O-Rings (Seals)

Install new GM approved service replacement air conditioning O-rings when a joint or a fitting is installed, except when the O-rings are provided on new replacement components. Unless service replacement O-rings of the specified part numbers are used, excessive leakage of Refrigerant-134a may occur. Refer to the part number for identification, not to the former color coating method of identification, because some formerly color coated service replacement O-rings may be black.

Air conditioning O-rings should be coated with mineral oil 525 viscosity refrigerant oil just before installation and should be slipped onto the flange tube to assure proper locating and sealing. To prevent the possibility of swelling and a reduction in sealing effectiveness, O-rings should not be allowed to soak in refrigerant oil. Do not allow the mineral base 525 viscosity refrigerant oil to enter the refrigeration system, it is only used as an O ring lubricant.

Before installation, the O-rings and the fittings should be examined to insure that they have not been nicked or deformed. Nicked or deformed parts must be replaced or excessive refrigerant leakage may result.

Handling Refrigerant-134a

The air conditioning system in this vehicle contains Refrigerant-134a (R-134a). This chemical mixture requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves, and connections when performing work that involves opening the refrigerant system. Always work in a well ventilated area and avoid breathing any refrigerant fumes. Do not weld or steam clean on or near any vehicle installed air conditioning lines or components.

If R-134a should come in contact with any part of the body, flush the exposed area with water and immediately seek medical attention.

CAUTION: Avoid breathing A/C refrigerant and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 or SAE J2209. If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

- Do not store or heat refrigerant containers above 125° F (52° C).
- Do not heat a refrigerant container with an open flame; if container warming is required, place the bottom of the container in a pail of warm water.
- Do not intentionally drop, puncture, or incinerate refrigerant containers. Refrigerant will displace oxygen, therefore be certain to work in well ventilated areas to prevent suffocation.
- If it is necessary to carry a container of "Dot CFR" Refrigerant-134a in a vehicle, it should not be carried in the passenger compartment. Only containers that meet DOT SPEC 4BA or 4BW should be used.

NOTICE: R-12 refrigerant and R-134a refrigerant must never be mixed, even in the smallest of amounts, as they are incompatible with each other. If the refrigerants are mixed, compressor failure may occur.

Use only polyalkylene glycol (PAG) synthetic refrigerant oil for internal circulation through the R-134a A/C system and only mineral base 525 viscosity refrigerant oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure may occur.

Do not introduce compressed air to any refrigerant container or refrigerant component, because contamination will occur.

Before attempting any service which requires opening refrigeration system lines or components, refer to "Handling Refrigerant Lines and Fittings" and "Maintaining Chemical Stability in the Refrigeration System" that follow.

Carefully follow the instructions for refrigerant recovery and recycling, adding oil, evacuating, and recharging the refrigeration system.

All Refrigerant-134a disposable (colored blue) containers are shipped with a heavy metal screw cap to protect the valve and safety plug of the container from damage. It is good practice to replace the cap after each use of the container to continue protection.

Handling Refrigerant Lines and Fittings

CAUTION: For personal protection, goggles should be worn and a clean cloth wrapped around fittings, valves and connections when doing work that includes opening the refrigeration system. If Refrigerant-134a comes in contact with any part of the body, severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

- All metal tubing lines should be free of dents or kinks to prevent loss of system capacity due to line restriction.
- The flexible hose lines should never be bent to a radius of less than four times the diameter of the hose.
- The unprotected flexible hose lines should never be allowed to come within a distance of 63.5 mm (2.5 inches) of the exhaust manifold, 30 mm (1.2 inches) for protected hoses.
- Flexible hose lines should be inspected regularly for leaks or brittleness and replaced with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all Refrigerant-134a. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
- Once a refrigerant line is opened to the atmosphere, it should be capped or taped immediately to prevent entry of moisture and dirt.
- The use of the proper wrenches when making connections on O-ring fittings is important. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components.
- Tighten all tubing connections to the specified torque for the fitting. Too little or too much torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage and an inoperative air conditioning system. Refer to "Fitting Tightening Specifications" at the end of this section.
- O-rings and seats must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak.

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Install new O-rings that have been lubricated with mineral base 525 viscosity refrigerant oil. Do not use PAG oil.

- Keep polyalkylene glycol (PAG) refrigerant oil off fitting threads. Long term contact of PAG oil on threads may cause future disassembly difficulties. Flush threads of fittings with mineral base 525 viscosity refrigerant oil. Do not use PAG oil. Do not wipe threads with a cloth.

Maintaining Chemical Stability in the Refrigeration System

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system. When foreign materials such as dirt, air, or moisture, contaminate the refrigeration system, the stability of the Refrigerant-134a and polyalkylene glycol (PAG) synthetic refrigerant oil will change. Contaminants will also affect pressure temperature relationship, reduce efficient operation and possibly cause interior corrosion and abnormal wear of moving parts.

The following general practices should be observed to ensure the chemical stability in the system:

- Before breaking a refrigerant connection, wipe away any dirt or oil to reduce the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entry of dirt, foreign material and moisture.
- Keep tools clean and dry. This includes the manifold gage set and replacement parts.
- When adding polyalkylene glycol (PAG) synthetic refrigerant oil, the transfer device and container should be exceptionally clean and dry to assure that refrigerant oil remains as moisturefree as possible.
- When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
- Any time the A/C system has been "opened," it should be properly evacuated before recharging with Refrigerant-134a.
- All service parts are dehydrated and sealed prior to shipping. They should remain sealed until just prior to making connections. All parts should be at room temperature before uncapping. This prevents condensation of moisture from the air entering the system. If for any reason caps are removed but the connections are not made, parts should be resealed as soon as possible.

REFRIGERANT RECOVERY AND RECYCLING, ADDING OIL, EVACUATING AND RECHARGING PROCEDURES

General Description

Figure 8

The J 39500 air conditioning refrigerant recovery, recycling and recharging (ACR-4) system removes Refrigerant-134a from the vehicle A/C system, recycles and recharges all with one hookup.

Single pass filtering during recovery cycle, plus automatic multiple pass filtering during evacuation cycle assures constant supply of clean/dry refrigerant for A/C system charging.

NOTICE: R-12 and R-134a require separate and non interchangeable sets of recovery, recycling, and recharging equipment, because the refrigerants and lubricants are not compatible and cannot be mixed even in the smallest amounts. Do not attempt to use one set of equipment for both R-12 and R-134a, as all equipment contains residual amounts of refrigerant and/or lubricant, which will result in contamination, and damage to the recovery/recycle equipment. Adaptors to convert from one size fitting to the other must never be used; refrigerant/lubricant contamination will occur and system failure may result.

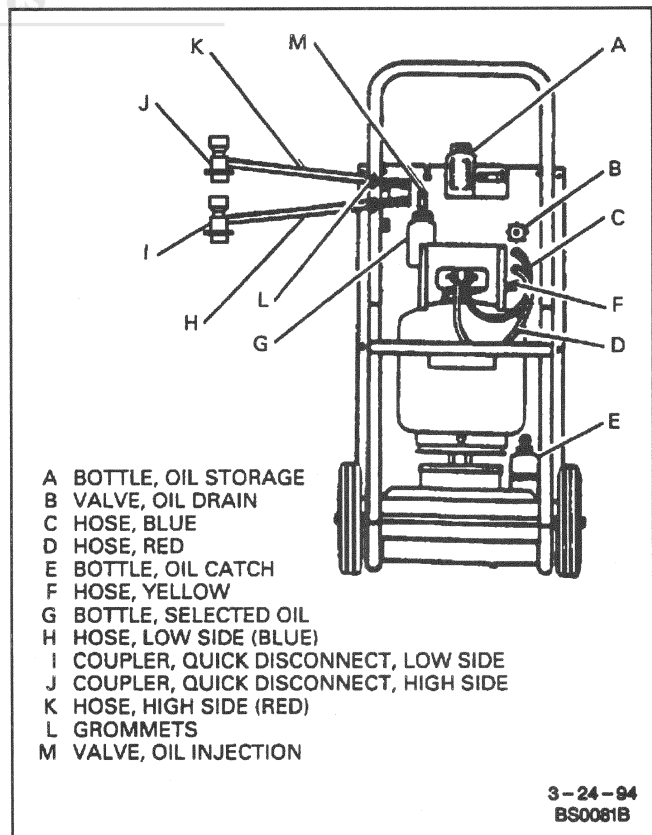


Figure 8 - Complete Operational Setup

STATION (ACR-4) SETUP AND MAINTENANCE**INITIAL SETUP**

Refer to the manufacturer instructions for all initial setup procedures.

OPERATION SETUP**Figure 8**

CAUTION: Always wear goggles and gloves when doing work that involves opening the refrigeration system. If liquid refrigerant comes into contact with the skin or eyes, injury may result.

CAUTION: Use only authorized 23 kg (50 pound) refillable refrigerant tanks (J 39500-50). Use of other tanks could cause personal injury and void the warranty.

NOTICE: Refrigerant-134a systems have special fittings (per SAE specifications) to avoid cross contamination with Refrigerant-12 systems. Do not attempt to adapt this unit to Refrigerant-12 systems as severe system failure will result.

Connect high side (red) and low side (blue) hoses to the ACR-4 unit. Be sure to route hoses through hose reel bracket grommets.

CONTROL PANEL FUNCTIONS**Figures 9 and 10**

This section explains the functions of the various components of the unit control panel (Figure 9).

Main Power Switch - supplies electrical power to the control panel.

Beeper - emits an audible tone to alert the operator to unit operating functions.

Digital Display - shows the time programmed for vacuum and the weight of refrigerant programmed for recharging.

Low Side Manifold Gage - when connected to an A/C system, this gage shows the system low side pressure.

High Side Manifold Gage - when connected to an A/C system, this gage shows the system high side pressure.

Moisture Indicator - shows if the refrigerant is wet or dry.

Low Side Valve - connects the low side of the A/C system to the unit.

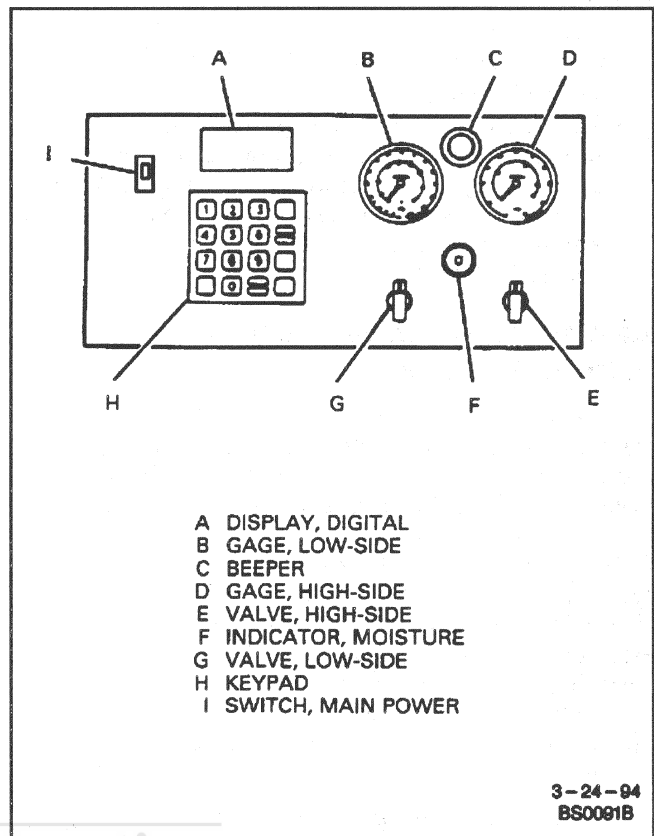
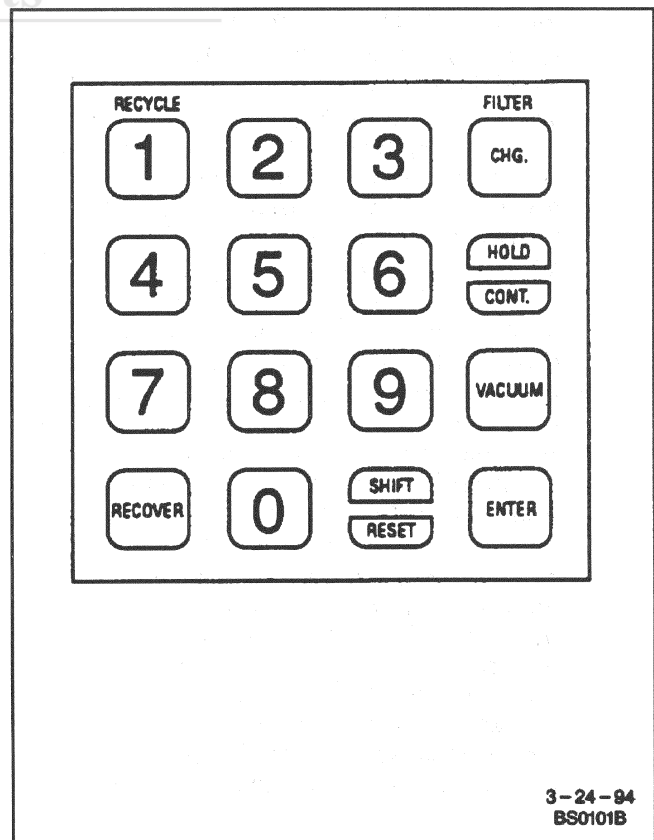
High Side Valve - connects the high side of the A/C system to the unit.

In addition to the number keys, the control panel contains special keys that accomplish specific operating functions (Figure 10).

"RECYCLE" - activates the recycling sequence.

"RECOVER" - activates the recovery sequence.

"SHIFT/RESET" - activates "shifted" position of keys on the keypad and resets the program mode.

**Figure 9 - Control Panel****Figure 10 - Keypad Functions**

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"FILTER" - automatically recovers and evacuates to 57 kPa (17 inches Hg) vacuum from the filter and low side of the unit.

"CHG" - automatically charges the A/C system with the programmed amount of refrigerant.

"HOLD/CONT" - interrupts the automatic cycle in the "HOLD" position, and then resumes functions in the "CONT" position. Press this button once for "HOLD" and again for "CONT."

"VACUUM" - activates the vacuum and automatic recycling sequence.

"ENTER" - enters programmed data into the unit control memory.

DIGITAL DISPLAY FUNCTIONS

For information regarding the functions of the digital display, refer to the manufacturer instructions.

MAINTENANCE

Refer to the manufacturer instructions for all maintenance procedures.

Refrigerant Recovery

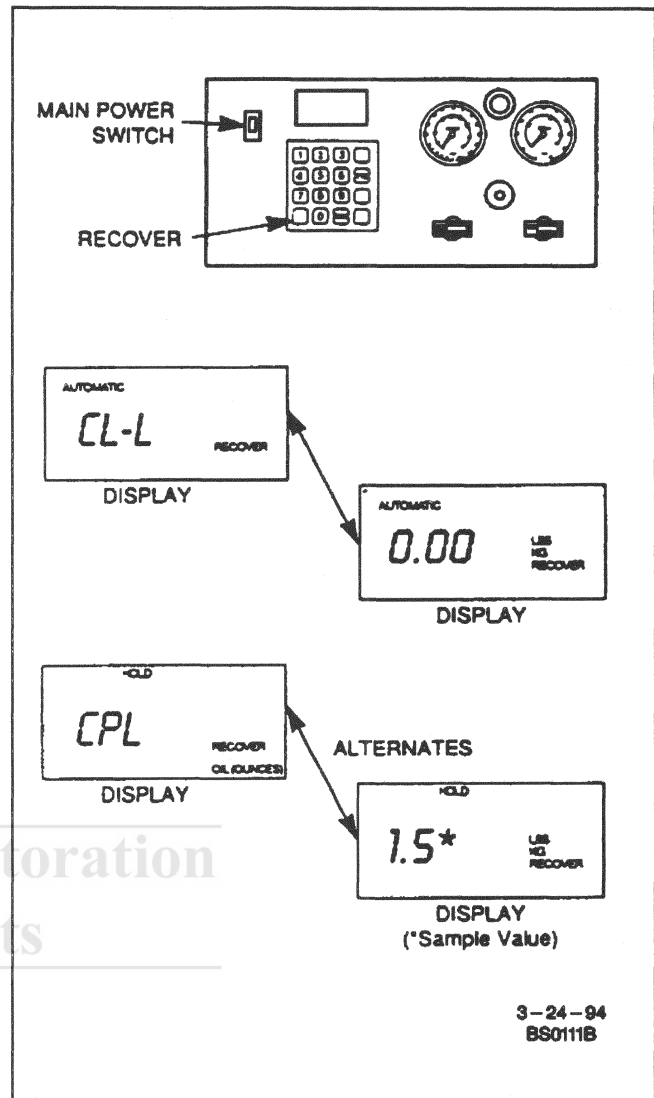
Figures 8 through 11

! Important

- Use only the 23 kg (50 pound) unit refrigerant tank (J 39500-50) designed for the ACR-4. The unit overfill limitation mechanism has been calibrated specifically for use with this tank, and the tank valving is set up specifically for use with the unit.
 - Connect battery charger to vehicle battery to prevent battery drain.
1. Attach the high side (red) hose with the quick disconnect coupler to the high side refrigerant service valve fitting of the vehicle A/C system. This valve is located in the air conditioning compressor and condenser hose, between the air conditioning compressor and the condenser. Open the coupler valve after attachment.
 2. Attach the low side (blue) hose with the quick disconnect coupler to the low side refrigerant charge valve fitting of the vehicle A/C system. This valve is located on the air conditioning accumulator. Open the coupler valve after attachment.
 3. Check the high side and low side gages on the unit control panel to be sure the A/C system has pressure. If there is no pressure, there is no refrigerant in the system to recover.

! Important

- If there is no refrigerant in the A/C system, do not continue with the recovery operation. Air will be drawn into the recovery tank.
4. Open both the high side and the low side valves on the control panel (Figure 9).
 5. Open both the red "GAS" (vapor) and the blue "LIQUID" valves on the tank.



6. Slowly open the oil drain valve to see if the oil separator contains oil (Figure 8).
 - If any oil drains into the catch bottle at the bottom of the unit, allow it to drain until there is no more oil in the separator.
7. Close the oil drain valve.
 - Dispose of the oil in the catch bottle in an appropriate manner and return the bottle to its place on the unit.
8. Plug the unit into the proper voltage outlet and turn on the "MAIN POWER" switch.
9. Turn ignition switch "OFF," then back to "RUN," and blower motor to "HIGH." A battery charger should be connected to prevent battery drain.
10. Press "RECOVER" on the keypad. Before recovery begins, the unit will clear itself of refrigerant. "CLL" will appear on the display. The cleaning process takes from thirty seconds to three minutes to complete (Figure 11).

! Important

- Blower motor setting to "HIGH" will increase the rate at which refrigerant can be recovered.
11. When cleaning is complete. The unit will automatically start recovery, and the control panel display will show the unit is in the "RECOVER" mode of the "AUTOMATIC" cycle. Also, the weight of refrigerant being recovered will be displayed.

! Important

- Maintain A/C blower motor on "HIGH" during recovery operation.
12. The compressor shuts off automatically when initial recovery has occurred, at approximately 57 kPa (17 inches Hg) vacuum.
 13. At the end of the initial recovery process, the display shows "CPL" and then alternately flashes the weight of refrigerant recovered and "OIL/OZ" ("OIL/GMS").

! Important

- A small amount of A/C system lubricating oil polyalkylene glycol (PAG) might be removed with the refrigerant during recovery. The amount of oil removed (often there will be none) will vary greatly depending on a variety of conditions of the vehicle being serviced. The ACR-4 separates the oil from the refrigerant.
 - The "OIL/OZ" ("OIL/GMS") flashing is a reminder to always drain the recovered oil at this time. The same amount of oil must be replaced in to the A/C system later when the system is recharged with refrigerant.
14. Slowly open the oil drain valve and drain the oil into the calibrated oil catch bottle at the bottom of the unit (Figure 8).
 15. After the oil is completely drained, close the valve.
 16. Read and record the amount of oil removed in the catch bottle.
 17. Dispose of the recovered oil in an appropriate manner. Never reuse this oil.
 18. Check the control panel "LOW-SIDE GAGE."
 - If the A/C system has maintained a vacuum, the recovery is complete.
 19. If the "LOW-SIDE GAGE" pressure rises above "0," this indicates the presence of more refrigerant in the system. In this case, press the "HOLD/CONT" key on the keypad to recover the additional refrigerant. Repeat this step as needed until the system maintains vacuum for two minutes.

! Important

- If the display flashes "FULL" during the recovery process, and the unit shuts off, the unit tank is full.

- An empty unit tank (J 39500-50) must be installed to accommodate additional refrigerant, before proceeding to the next step in the recovery operation. Do not use any other kind of tank.
- It is possible to lower the amount of refrigerant in the unit tank by charging other vehicles.

Evacuation**Figures 12 and 13**

Make sure the unit tank has sufficient R-134a refrigerant for charging. Simultaneously press "RESET" and "ENTER" to enter the diagnostic mode, then press "6." The display must show 16 kg (36 pounds) or more. If less than 16 kg (36 pounds) is displayed, add new refrigerant to the tank. Refer to the manufacturer instructions for this procedure.

1. With the high side and low side hoses connected to the vehicle A/C system, open both the high side (red) and the low side (blue) valves on the unit control panel.
2. Open both the red "GAS" (vapor) and the blue "LIQUID" valves on the tank.

! Important

- To remove all the air and properly dry the A/C system, the unit automatically goes to a preprogrammed evacuation time.
 - It is possible to evacuate longer. Press keys to enter time desired. New entry will show on the display. Press "ENTER," the display will blink indicating input of data (Figure 12).
3. Press "VACUUM" to start the vacuum pump. The display counts down the vacuum time to zero to indicate operation time remaining. The display reads "RECYCLE" five seconds after the vacuum pump starts and continues while the process takes place.

! Important

- Automatic refrigerant recycling during each evacuation is a feature of the ACR-4 system. No action is required by the technician.

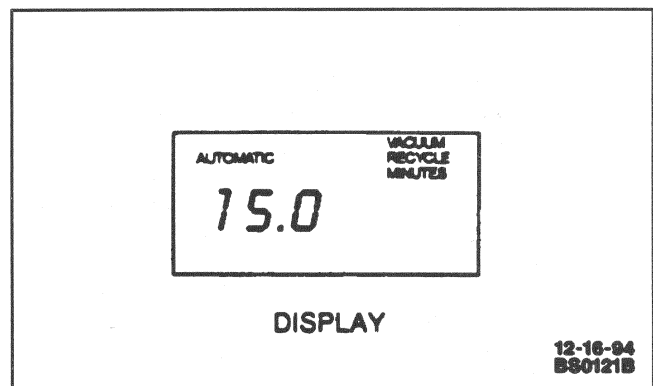


Figure 12 - System Evacuation (1 of 2)

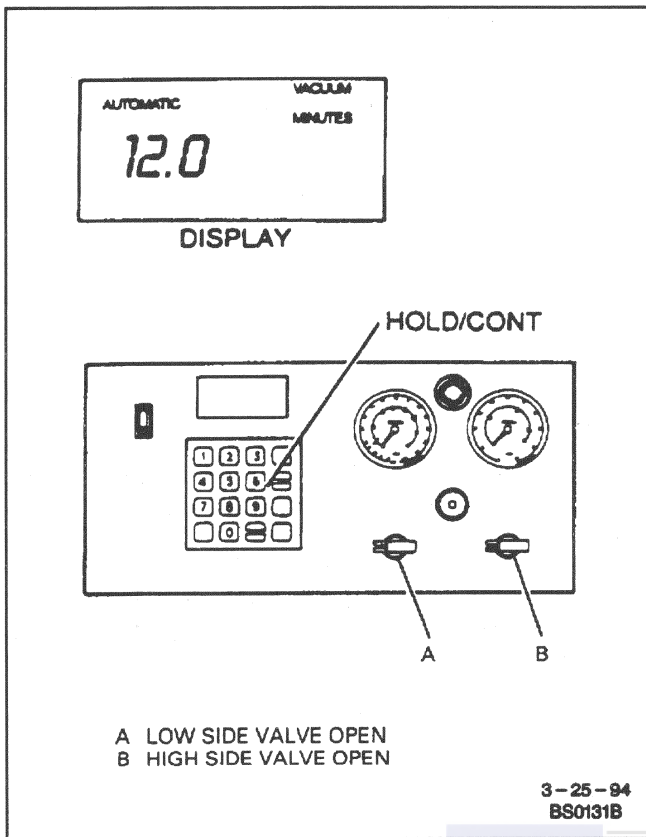


Figure 13 - System Evacuation (2 of 2)

- The control panel “MOISTURE INDICATOR” must be green during recycling verifying refrigerant moisture content is within specifications. Yellow indicates a set condition requiring a filter/drier cartridge change. Refer to the manufacturer instructions for this procedure.
 - Noncondensable gases (mostly air) are automatically vented from the tank during the recycling process. An audible sound of pressure release may be heard as this happens. This is a normal function.
4. At approximately the 12 minute mark on the display (pump has run for three minutes), press “HOLD/CONT” key to stop vacuum pump (Figure 13).
 - A. A “0” vacuum reading indicates a major system leak. Repair leak and restart evacuation procedure.
 - B. If a vacuum reading of 91-101 kPa (27-30 inches of Hg) is indicated, close the low side and high side valves. Observe the vacuum level for a few minutes as a leak check of the A/C system. If vacuum is not maintained, find and repair the A/C system leak before continuing.
 - C. If a vacuum reading of 91-101 kPa (27-30 inches of Hg) is maintained, open the high side and low side valves and press the “HOLD/CONT” key to restart the vacuum pump.

5. When the vacuum sequence has run the programmed time, the display shows “CPL” to indicate that evacuation is complete.

**Important**

- The vacuum pump oil must be changed frequently.
- When the pump has run for a total time of ten hours, the message “OIL” will flash on the control panel display as a reminder to change the oil.
- If the “OIL” warning flashes during operation, press “CONT” and change the oil before the next operation. Refer to the manufacturer instructions for this procedure.

A/C System Oil Charge Replenishing

If oil was removed from the A/C system during the recovery process or due to component replacement, it must be replenished at this time. Refer to “Specifications” at the end of this section for proper oil capacities.

1. Select the graduated bottle of replenishing polyalkylene glycol (PAG) synthetic refrigerant oil (GM P/N 12345923 or equivalent).
2. Adjust the O-ring around the PAG oil bottle to the required oil charge level.
 - Example: If bottle oil level is at 4 ounces and 1/2 ounce of oil is required, adjust O-ring to 3 1/2 ounces as final level mark.
3. Install the bottle on the oil injection system on the back of the unit.

**Important**

- Keep the oil bottles tightly capped at all times to keep out moisture and contamination.
 - Do not open the oil injection valve while there is positive pressure in the A/C system. This will result in oil blowback through the bottle vent. A/C system vacuum is required for this operation.
 - Never let the oil level drop below the pickup tube while charging or replenishing. This will allow air into the A/C system.
4. Open the valve at the top of the plastic container and watch the level of oil being drawn into the system.
 5. Close the valve when the required oil charge has been pulled into the system.

Refrigerant Oil Loss Due to a Large Leak

If the refrigerant charge is abruptly lost due to a large refrigerant leak, approximately 90 ml (3 fluid ounces) of refrigerant oil will be carried out of the system suspended in the refrigerant. Any failure that caused an abrupt refrigerant discharge will experience this oil loss. Failures that allow the refrigerant to seep or bleed off over time do not experience this oil loss.

Upon replacement of a component which caused a large refrigerant leak, add 90 ml (3 fluid ounces) of new polyalkylene glycol (PAG) synthetic refrigerant oil (GM P/N 12345923 or equivalent) plus the required amount of oil for the particular component (as outlined above).

Add the oil directly to the replaced component if possible. If the oil cannot easily be added to the replaced part, add the oil during the recharging procedure.

COMPRESSOR

Up to 120 ml (4 fluid ounces) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor that the oil in the old compressor crankcase be drained and measured (discard the oil after recording the amount). All replacement compressors will be shipped with approximately 240 ml (8 fluid ounces) of oil in the crankcase. The oil must be drained and retained. Then replace the oil in the same amount as previously recorded from the old compressor, if less than 30 ml (1 fluid ounce) of oil is drained from the old compressor add 30 ml (1 fluid ounce) of oil to new compressor.

Charging the A/C System (Engine Off)

Figures 8, 14 and 15

! Important

- The A/C system must be evacuated prior to charging.
 - Check that the "LB/KG" switch on the back of the unit to be sure it is set for the desired units of weight system (operate switch with main power "OFF").
1. Close the low side valve on the control panel.
 2. Open the high side valve on the control panel.
 3. Press "CHG" on the keypad to be sure the unit is in the program mode.
 4. Enter the amount of refrigerant charge to charge the A/C system by pressing the appropriate number keys. Be sure to use correct unit of weight (pounds or Kg).

! Important

- Charge A/C system with 0.79 kg (1 pound 12 ounces). Do not overcharge.
5. Press "ENTER."
 - A blink of the display indicates the charge amount is in the unit memory.
 6. Press "CHG" on the keyboard to begin the charging process.
 7. The display shows "AUTOMATIC" and the amount of refrigerant programmed for charging.
 - The display counts down to zero as the charging process proceeds.
 - At the end of the process, the display shows "CPL."

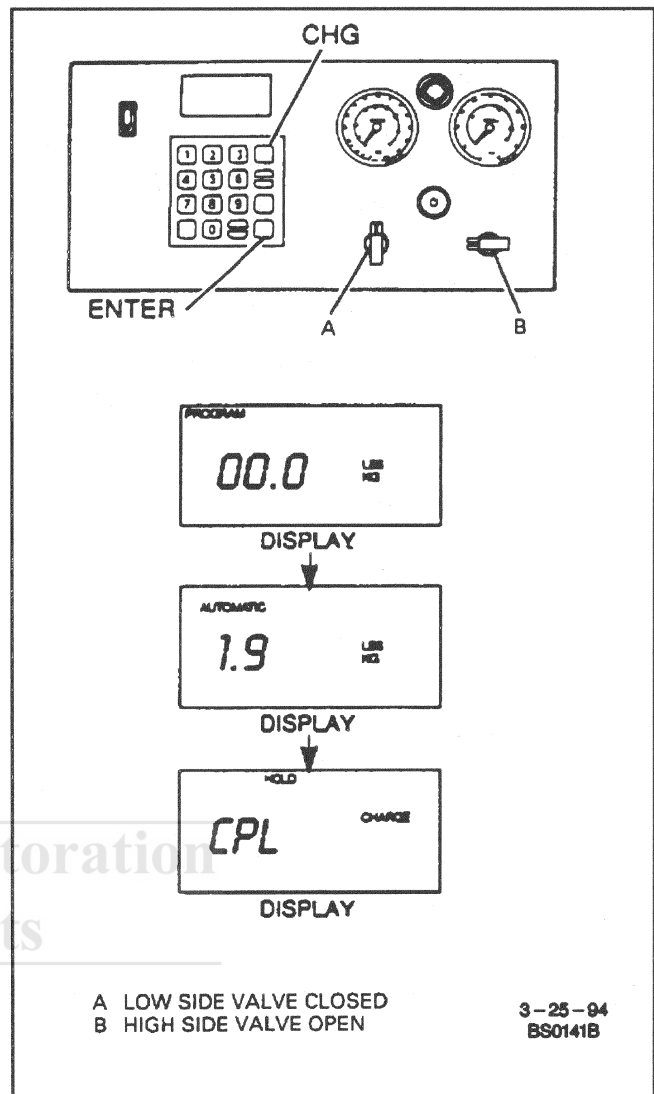


Figure 14 - System Charging (1 of 2)

! Important

- If the transfer of refrigerant stops before complete, refer to "Unsuccessful Transfer" that follows.

SUCCESSFUL TRANSFER COMPLETE

1. Close the high side valve on the unit control panel (both valves should now be closed).
2. Start the vehicle and the A/C system and let run until the readings on the high side and low side gages stabilize. Compare outlet temperature, ambient temperature, and humidity readings to the "Air Conditioning Performance Chart" in this section.
3. With the A/C system running, close the high side coupler valve and disconnect the high side (red) hose from the vehicle.
4. Open both the high side and low side valves on the control panel.

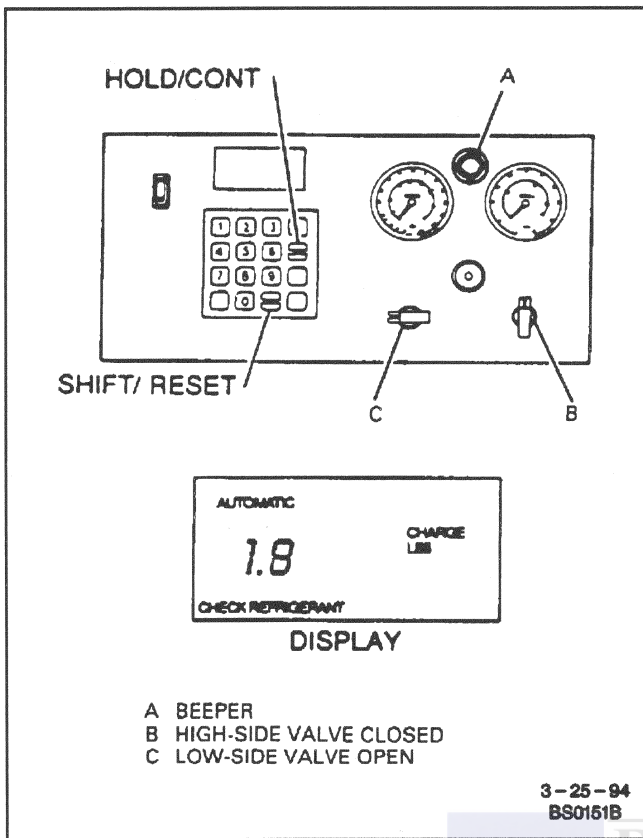


Figure 15 - System Charging (2 of 2)

5. Refrigerant from both hoses will be drawn quickly into the A/C system through the low side (blue) hose.
6. Close the low side coupler valve and disconnect from the vehicle.

UNSUCCESSFUL TRANSFER

On rare occasions, the total charge does not transfer to the vehicle A/C system. There are two reasons why this can occur.

1. If the transfer is too slow because the pressure in the unit tank and the vehicle A/C system are about the same, the unit will emit an audible signal and the display shows the weight remaining for transfer. In this case:
 - A. Close the high side valve (Figure 15).
 - B. Open the low side valve.
 - C. Start the vehicle A/C system, and press "HOLD/CONT" on the keyboard. This will put the remainder of the charge into the A/C system.
 - D. Continue with the previous procedure, "Successful Transfer Complete."
2. If the transfer will not complete and the display shows "CHECK REFRIGERANT," there is not enough refrigerant in the tank to complete the process. This condition requires the recovery of the partial charge of refrigerant in the vehicle A/C system and another complete evacuation and charge procedure.
 - A. Press "HOLD/CONT" on the keypad to interrupt the cycle.

B. Press "RESET" to reset the unit.

C. Recover the refrigerant that has been charged into the system, refer to "Refrigerant Recovery" in this section.

3. Add refrigerant to the tank following the manufacturer instructions, and refer to "Evacuation" in this section.

REPLACEMENT PROCEDURES

CAUTION: For personal protection, goggles should be worn and a clean cloth wrapped around fittings, valves and connections when doing work that includes opening the refrigeration system. If Refrigerant-134a comes in contact with any part of the body, severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

NOTICE: Tighten all hose and tube connections to the specified torque for the fitting. Too little or too much torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage and an inoperative air conditioning system. Refer to "Refrigerant Hose and Tube Tightening Specifications" at the end of this section.

Accumulator

Figure 16

The accumulator (2) should be replaced only if it is leaking from a perforation, damaged O-ring seal or damaged threads. It is not necessary to replace the accumulator (2) if the vehicle has been involved in a collision but no perforation of the outer shell is discovered, even if the outer shell is dented. The accumulator (2) should be replaced only when it is punctured and leaking, or if the refrigeration system has been left open to the outside air for an extended period of time, saturating the desiccant. Desiccant cannot be replaced separately; the complete accumulator (2) must be replaced if the original desiccant becomes saturated.

The service replacement accumulator package includes two new O-ring seals for the inlet and outlet connections.



Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Hose (8) at accumulator (2).
 - A. Seal open end of hose (8) with tape or approved plastic caps to prevent dirt and moisture contamination.
 - B. Discard O-ring seal.
3. Hose (9) at accumulator (2).

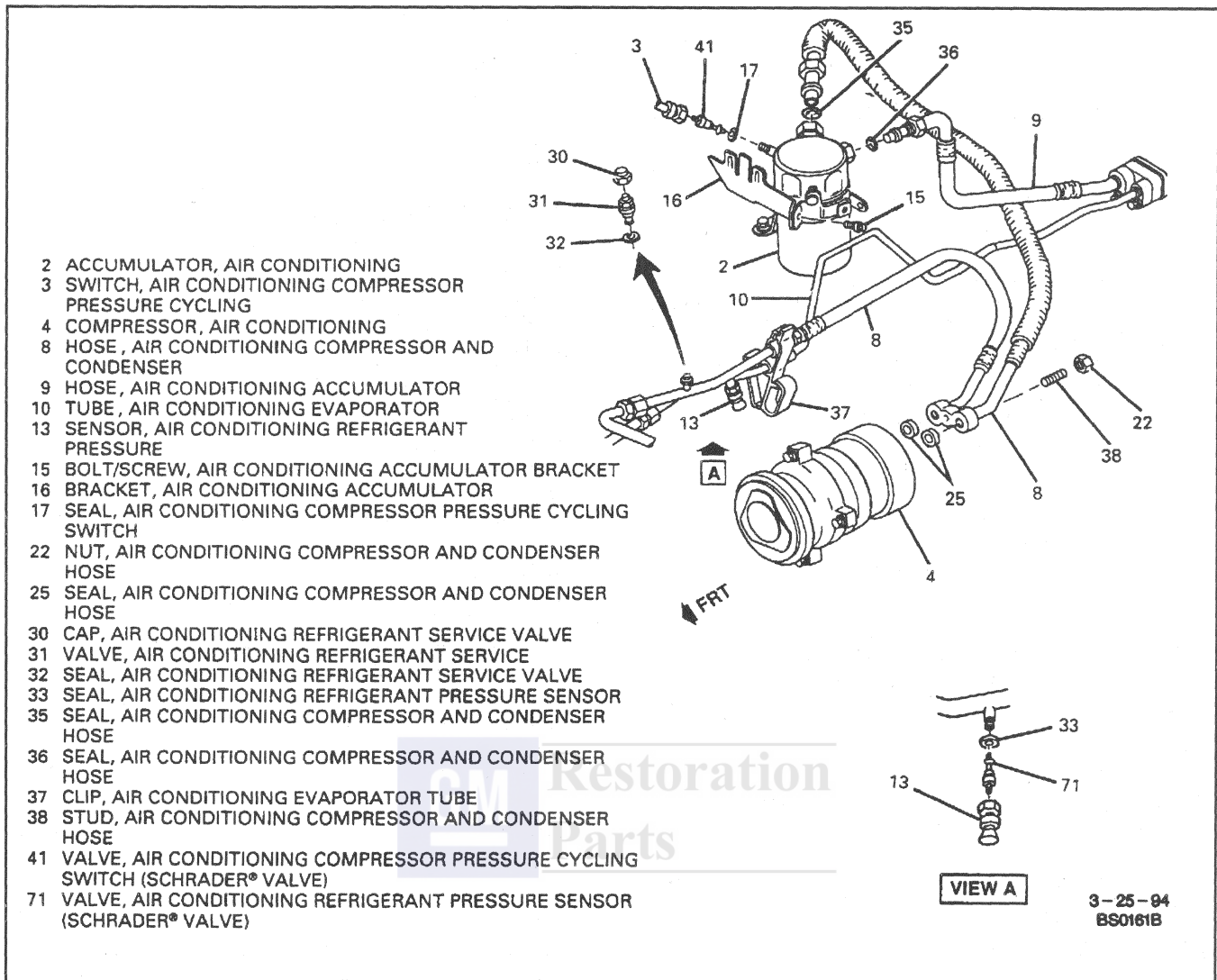


Figure 16 - Refrigerant Lines and Hoses

A. Seal open end of hose (9) with tape or an approved plastic cap to prevent dirt or moisture contamination.

B. Discard O-ring seal.

4. Switch, if replacing accumulator. Refer to "Pressure Cycling Switch" in this section.

5. Accumulator (2).

A. Seal fitting openings with tape or approved plastic caps to prevent system contamination.

B. Loosen bolt/screw (15) enough to remove accumulator (2) from bracket (16).

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Refrigerant oil.

- Add 105 ml (3.5 fluid ounces) of polyalkylene glycol (PAG) oil GM P/N 12345923 to new accumulator (2).

2. Accumulator (2) to bracket (16).

3. Switch (3), if removed. Refer to "Pressure Cycling Switch" in this section.

4. Hose (9) and new O-ring seal to accumulator (2).

- Coat new O-ring seal with mineral base 525 viscosity refrigerant oil GM P/N 5416939 or equivalent just before installation.
- Do not allow oil to enter refrigeration system.



Tighten

- Hose (9) to 41 N-m (30 lb. ft.).
- Use two wrenches when making connection, a calibrated torque wrench and a backup wrench.

5. Hose (8) and new O-ring seal to accumulator (2).

- Coat new O-ring seal with mineral base 525 viscosity refrigerant oil GM P/N 5416939 or equivalent just before installation.
- Do not allow oil to enter refrigeration system.



Tighten

- Hose (8) to 41 N-m (30 lb. ft.).

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- Use two wrenches when making connection, a calibrated torque wrench and a backup wrench.
6. Position accumulator (2) in bracket (16).
 - Position accumulator fittings to provisions on bracket (16).

Tighten

- Bolt/screw (15) to 6 N.m (53 lb. in.).
7. Evacuate and recharge air conditioning system. Refer to “Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures” in this section.
 8. Leak test fittings. Refer to “Leak testing the Refrigeration System” in this section.

Pressure Cycling Switch

Figure 16

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Electrical connector at switch (3).
3. Switch (3) and seal (17).
- Switch (3) is mounted on a Schrader® type valve so it is not necessary to discharge the refrigeration system.
- Discard seal (17).

Install or Connect

NOTICE: Refer to “Notice” on page 1B-1 of this section.

1. New seal (17) to switch fitting on accumulator (2).
- Coat seal (17) with mineral base 525 viscosity refrigerant oil GM P/N 12301108 or equivalent.
2. Switch (3).

Tighten

- Switch (3) to 4.5 N.m (40 lb. in.).
3. Electrical connector to switch (3).
 4. Battery negative cable.

Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).

Air Conditioning Condenser

Figure 17

Remove or Disconnect

1. Recover refrigerant. Refer to “Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures” in this section.
2. Air intake duct and resonators.
3. Upper fan shroud, if vehicle is equipped with a mechanical engine cooling fan. Refer to SECTION 6B.
4. Electric engine cooling fan(s). Refer to SECTION 6B.
5. Radiator upper mounting panel, if vehicle is not equipped with a mechanical engine cooling fan. Refer to SECTION 6B.
6. Compressor and condenser hose-to-condenser fitting and condenser-to-evaporator tube fitting.
 - Discard seals.
 - Plug open fittings.
7. Condenser (18).
 - Tilt top edge of radiator rearward and slide condenser out between radiator and radiator support.
8. Insulators (19) from upper corners of condenser (18).
9. Insulators (20) from radiator support (21), if necessary.
10. Expansion tube from lower condenser fitting. Refer to “Expansion Tube” in this section.

Inspect

- Fittings for nicks, burrs or dents. Fittings must be in perfect condition.
- Expansion tube for contamination. Blow off any metal chips, flakes, slivers or other contaminants with an air hose. If any damage is noted, replace expansion valve.

Install or Connect

NOTICE: Refer to “Notice” on page 1B-1 of this section.

1. PAG refrigerant oil.
 - If condenser (18) is new or drained, add 30 ml (1 fluid ounce) of new PAG refrigerant oil GM/PN 12345923 or equivalent. This can be done before installing the condenser or during the evacuating and recharging procedure.
2. Expansion tube to lower condenser fitting. Refer to “Expansion Tube” in this section.
 - New condensers will have expansion tube installed. Do not reuse old expansion tube if condenser was replaced.
3. Insulators (10) to radiator support (21), if removed.

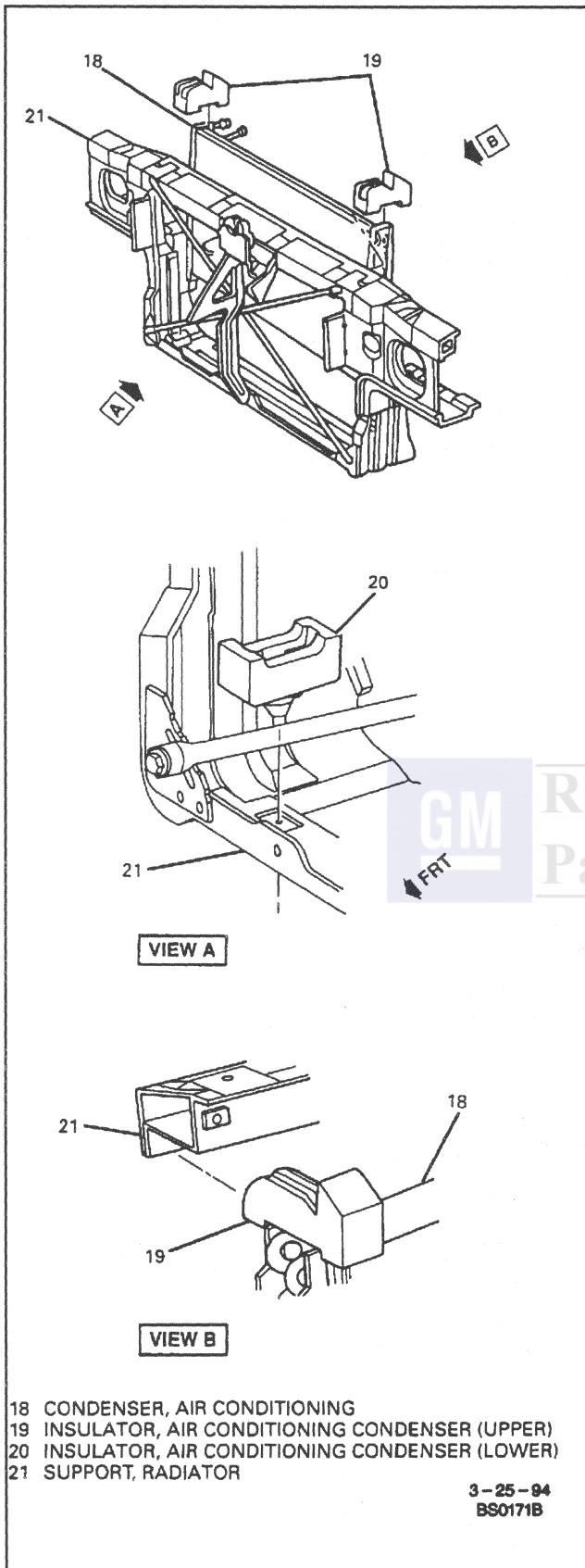


Figure 17 - Air Conditioning Condenser

4. Insulators (19) to upper corners of condenser (18).
 - Position as shown in Figure 17.
 5. Condenser (18).
 - Tilt top edge of radiator rearward and slide condenser (18) between radiator and radiator support.
 - Condenser (18) must seat in insulators (19).
 6. Compressor and condenser hose-to-condenser fitting, and condenser-to-evaporator tube fitting.
 - A. Unplug fittings.
 - B. Lubricate new seals with mineral base 525 viscosity refrigerant oil GM/PN 12301108 and install.
- Tighten**
- Compressor and condenser hose-to-condenser fitting to 24 N.m (18 lb. ft.).
 - Condenser-to-evaporator tube fitting to 24 N.m (18 lb. ft.).
7. Radiator upper mounting panel, if vehicle is not equipped with a mechanical engine cooling fan. Refer to SECTION 6B.
 8. Electric engine cooling fan(s). Refer to SECTION 6B.
 9. Upper fan shroud, if vehicle is equipped with a mechanical engine cooling fan. Refer to SECTION 6B.
 10. Air intake duct and resonators.
 11. Evacuate and recharge air conditioning system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
 12. Leak test fittings. Refer to "Leak testing the Refrigeration System" in this section.

Air Conditioning Compressor

Figures 16 and 18

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Radiator fan upper shroud and radiator outlet hose and pipe, if vehicle is equipped with a mechanical engine cooling fan. Refer to SECTION 6B.
3. Nut (22).
4. Hose (8) from compressor (4).
 - Plug open lines and ports.
 - Discard seals (25).
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Serpentine drive belt. Refer to SECTION 6A4A.
7. Drive belt tensioner. Refer to SECTION 6A4A.
8. Bolts/screws (23 or 24).
9. Nut (27).
 - Use a 9/16 inch deepwell socket and 3/8 drive ratchet.

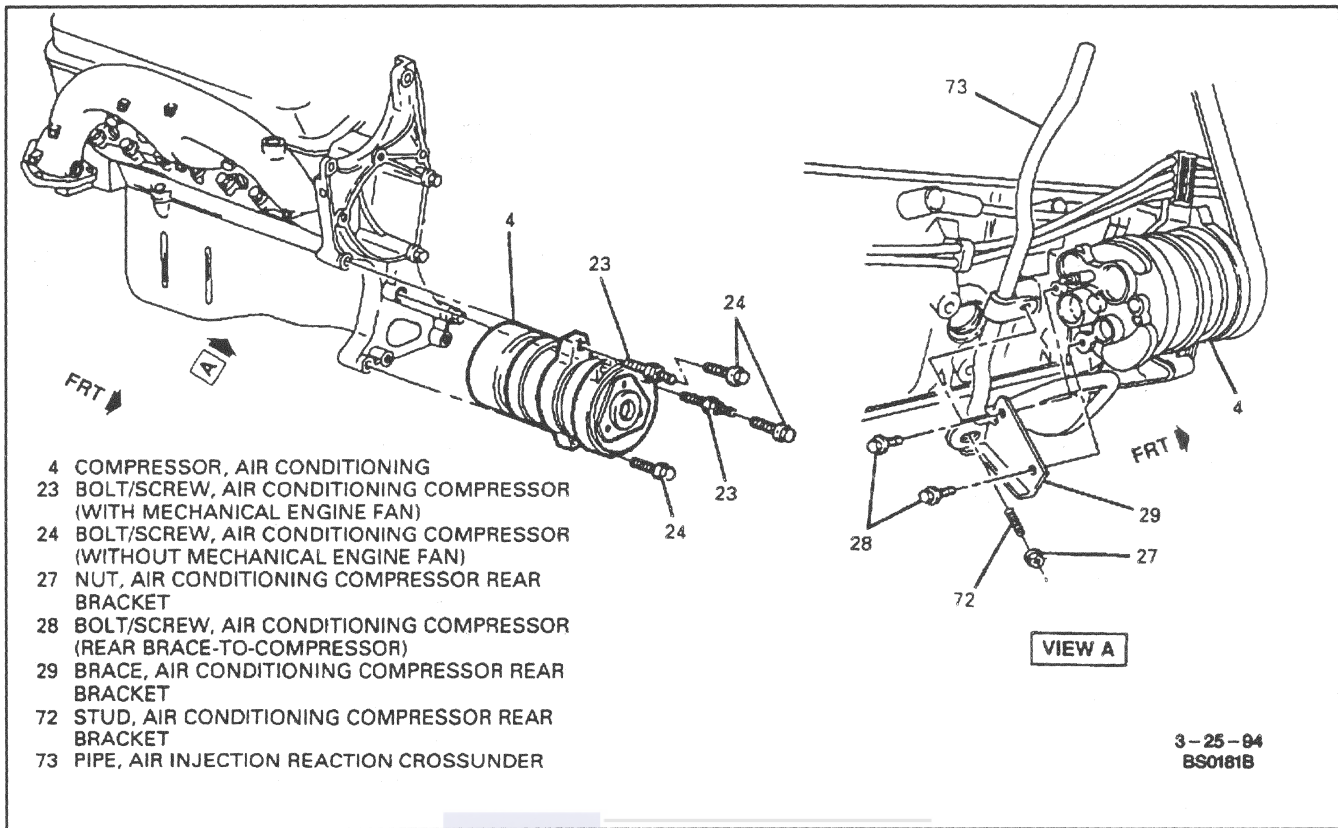


Figure 18 - Air Conditioning Compressor Mounting

- If unsuccessful, remove right engine mount through bolt/screw and slightly raise engine for additional clearance.

- Electrical connector at compressor (4).
- Compressor (4).
- Bolts/screws (28) and brace (29), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

- Polyalkylene glycol (PAG) refrigerant oil.
 - If compressor (4) is being replaced, drain refrigerant oil from both defective compressor and new replacement compressor. Measure amount removed from defective compressor. If measured amount is less than 30 ml (1 fluid ounce), add 30 ml (1 fluid ounce) to new replacement compressor. If more than 30 ml (1 fluid ounce) is drained from defective compressor add same amount to new compressor. Use PAG refrigerant oil GM P/N 12345923 or equivalent.
- Brace (29) and bolts/screws (28), if removed.

Tighten

- Bolts/screws (28) to 25 N.m (18 lb. ft.).
- Compressor (4).
 - Electrical connector at compressor (4).

- Nut (27).
- Do not tighten at this time.
- Bolts/screws (23 or 24).

Tighten

- A. Bolts/screws (23 or 24) to 50 N.m (37 lb. ft.).
- B. Nut (27) to 41 N.m (30 lb. ft.).

- Lower engine, if raised.
- Engine mount through bolt/screw, if removed.

Tighten

- Engine mount through bolt/screw to 95 N.m (70 lb. ft.).
- Drive belt tensioner. Refer to SECTION 6A4A.
 - Serpentine drive belt. Refer to SECTION 6A4A.
 - Lower vehicle.
 - Seals (25) to hose (8).
 - Coat seals (25) with 525 viscosity mineral base refrigerant oil GMP/N 12301108.
 - Hose (8) to compressor (4).
 - Nut (22).

Tighten

- Nut (22) to 35 N.m (26 lb. ft.).
- Radiator outlet hose and pipe, and radiator fan upper shroud, if removed. Refer to SECTION 6B.

16. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
17. Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

Air Conditioning Refrigerant Service Valve

Figure 16

Tool Required:
J 39037 Octagon Socket

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Valve cap (30).
3. Service valve (31).
 - Use J 39037 to remove valve.

Install or Connect

1. Service valve (31).
 - Coat seal (32) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
 - Use J 39037 to install valve.
2. Valve cap (30).
 - Make sure valve cap has seal.
3. Evacuate and recharge the A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
4. Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

Air Conditioning Refrigerant Pressure Sensor

Figure 16

Remove or Disconnect

1. Electrical connector at sensor (13).
2. Sensor (13) and seal (33).
 - Sensor (13) is mounted on a Schrader® type valve so it is not necessary to discharge the refrigeration system.
 - Discard seal (33).

Install or Connect

1. New seal (33) to sensor fitting.
 - Coat seal (33) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
2. Sensor (13).

Tighten

- Sensor (13) to 6 N·m (53 lb. in.).
3. Electrical connector to sensor (13).

Expansion Tube

Figure 19

Tool Required:
J 26549-E Expansion Tube Remover

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

2. Battery negative cable.
3. Condenser-to-evaporator tube fitting.
 - A. Seal open end of evaporator tube with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - B. Discard seal (34).
4. Expansion tube (14) with J 26549-E from condenser outlet pipe.
 - If expansion tube (14) is restricted or plugged, and is difficult to remove, the following procedure is recommended:
 - a. Remove as much residue as possible.
 - b. Carefully apply heat with heat gun, such as a hair dryer or an epoxy dryer near open end of condenser outlet pipe. Do not overheat pipe.
 - c. While applying heat, grip expansion tube (14) with J 26549-E and use a twisting push-pull motion to loosen impacted expansion tube (14) and remove it.

Clean

- Expansion tube (14), if it is to be reused.
 - A. Blow off any metal chips, flakes, slivers and other contaminants with air hose.
 - B. Clean expansion tube (14) in solvent and dry it.

Inspect

- Expansion tube (14), if it is to be reused.
 - a. Discard if plastic frame is broken.
 - b. Discard if filter screen is torn, damaged or plugged with fine gritty material.
 - c. Discard if brass orifice tube is damaged or plugged.

Install or Connect

1. Expansion tube (14).
 - A. Coat expansion tube seal with mineral base 525 viscosity refrigerant oil.
 - B. Insert expansion tube (14) into open end of condenser outlet pipe as shown in Figure 19. Install expansion tube (14) until it stops, indicating proper seal seating.

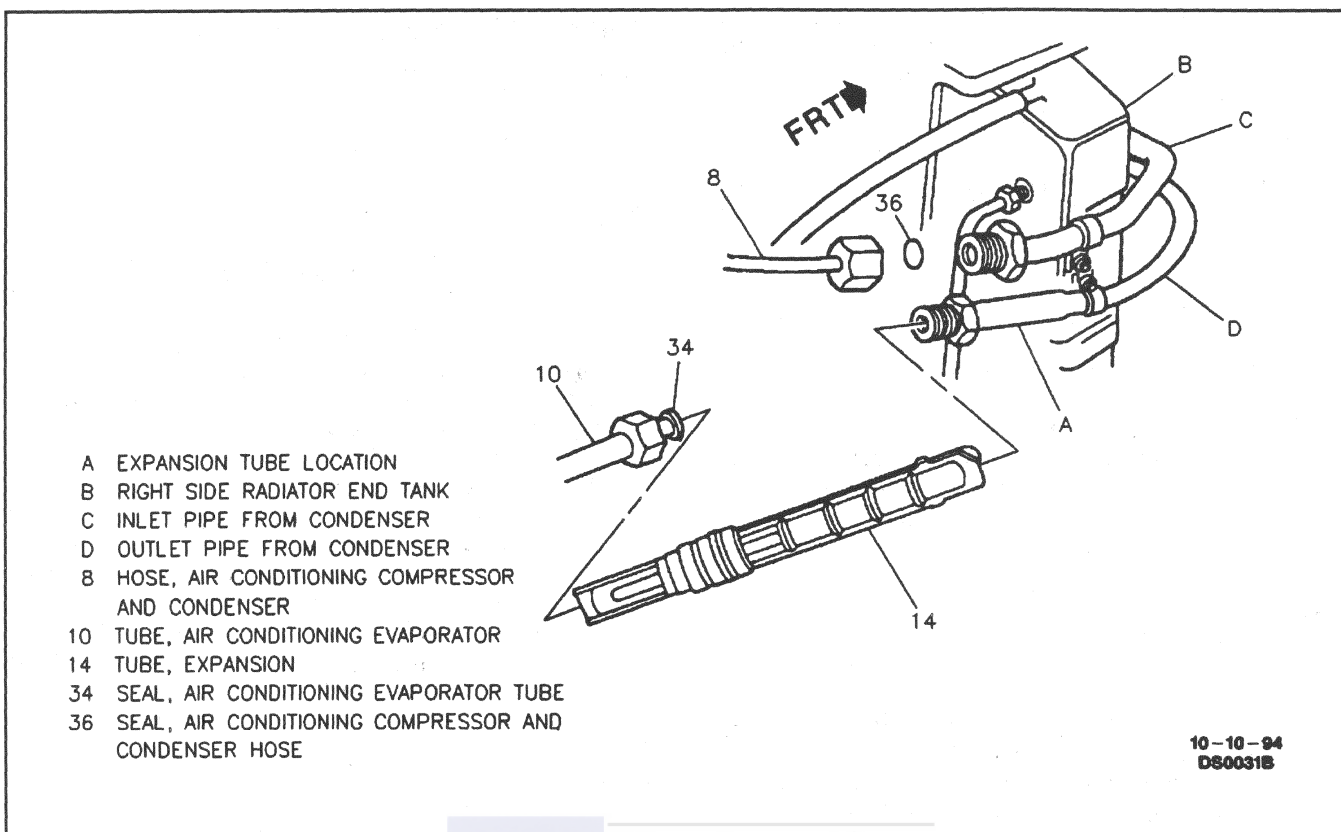


Figure 19 - Expansion Tube

2. Seal (34) to evaporator tube (10).
 - Coat new seal (34) with mineral base 525 viscosity refrigerant oil GM P/N 12301108 and fit onto evaporator tube (10).
3. Condenser-to-evaporator tube fitting.

 Tighten
 - Condenser-to-evaporator tube fitting to 24 N.m (18 lb. ft.).
4. Battery negative cable.
5. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
6. Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

Air Conditioning Compressor and Condenser Hose

Figure 16

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Electrical connector from sensor (13).
3. Clip (37) from compressor and condenser hose (8).
4. Compressor and condenser hose fitting at accumulator (2).

- Discard seal (35).
 - Seal open end of accumulator (2) with tape or an approved plastic cap to prevent dirt or moisture contamination.
5. Compressor and condenser hose fitting-to-condenser fitting.
 - Use a backup wrench to hold condenser fitting while loosening compressor and condenser hose fitting.
 - Discard seal (36).
 6. Nut (22).
 7. Compressor and condenser hose (8).
 - Discard seals (25).

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Clean fittings with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
 - Do not allow refrigerant oil to enter A/C system.
2. Seals (25) to compressor and condenser hose (8).
 - Lightly coat seals (25) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
3. Compressor and condenser hose (8) into position.
4. Nut (22).

**Tighten**

- Nut (22) to 41 N.m (30 lb. ft.).
- Seal (36) to compressor and condenser hose (8).
 - Lightly coat seal (36) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
 - Compressor and condenser hose-to-condenser fitting.

**Tighten**

- Compressor and condenser hose-to-condenser fitting to 24 N.m (18 lb. ft.).
- Seal (35) to compressor and condenser hose fitting.
 - Lightly coat seal (35) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
 - Compressor and condenser hose fitting to accumulator (2).

**Tighten**

- Compressor and condenser hose fitting to 41 N.m (30 lb. ft.).
- Clip (37) to compressor and condenser hose (8).
 - Electrical connector to sensor (13).
 - Evacuate and recharge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
 - Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

Air Conditioning Evaporator Tube**Figures 19 and 20****Remove or Disconnect**

- Refrigerant.
 - Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
- Condenser to evaporator tube fitting.
 - Seal open end of condenser with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - Discard seal (34).
- Evaporator tube (10) at evaporator (1).
 - Remove nut (39) holding evaporator tube (10) to evaporator inlet port.
 - Pull evaporator tube out of evaporator, being careful not to bend tube (10).
 - Seal open evaporator inlet port with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - Discard seal (40).

**Install or Connect****NOTICE:** Refer to "Notice" on page 1B-1 of this section.

- Evaporator tube (10) to evaporator (1).

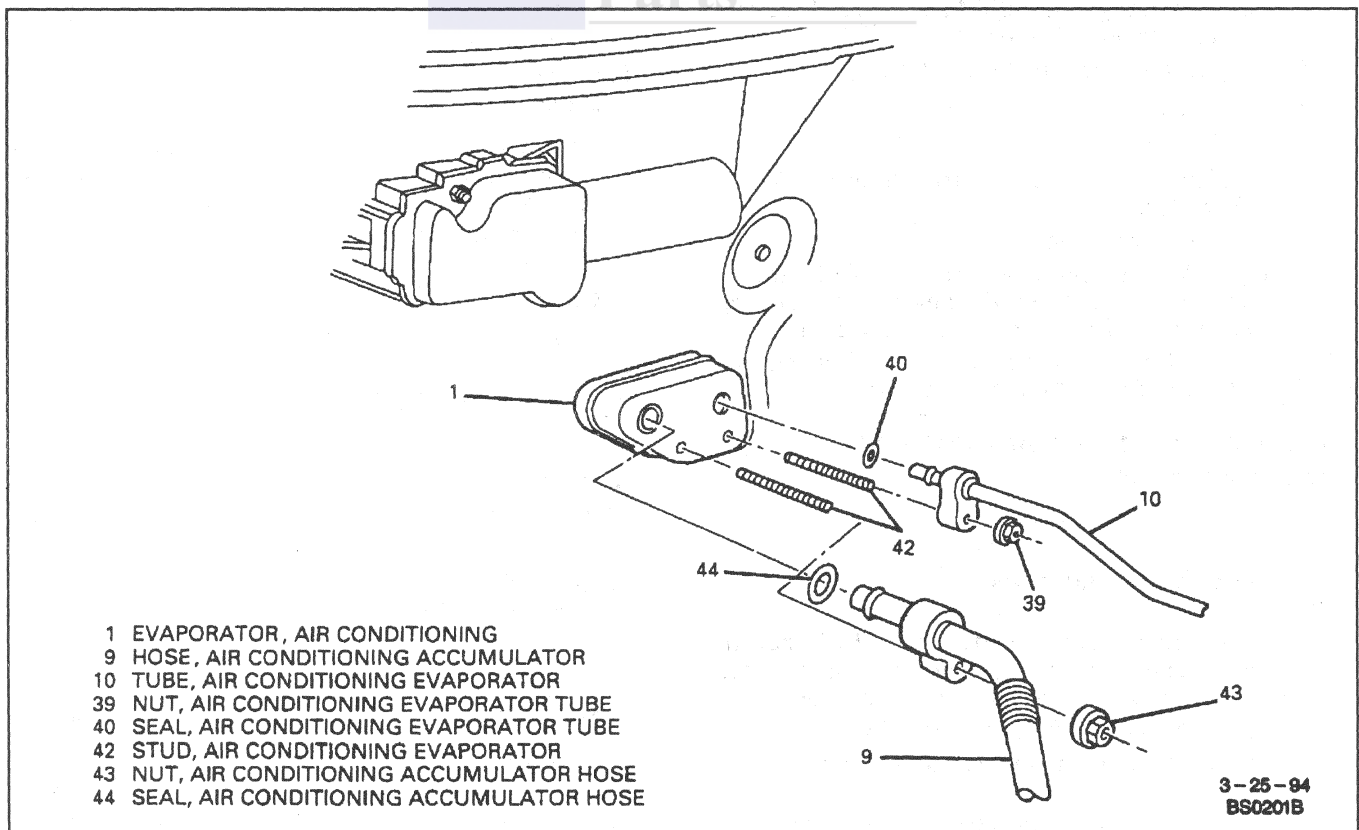


Figure 20 - Tube and Hose Attachment at Evaporator

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- A. Remove tape or cap from open end of evaporator inlet port.
- B. Coat new seal (40) with clean mineral base 525 viscosity refrigerant oil GM P/N 12301108 and install it.
- C. Install evaporator tube (10) to evaporator (1).
- D. Install nut (39) at evaporator inlet port.

Tighten

- Nut (39) to 16 N.m (12 lb. ft.).
2. Condenser-to-evaporator tube fitting.
 - Coat new seal (34) with mineral base 525 viscosity refrigerant oil GM P/N 12301108 and install it.

Tighten

- Condenser-to-evaporator tube fitting to 24 N.m (18 lb. ft.).
3. Refrigerant.
 - Evacuate and recharge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.

Accumulator Hose

Figures 16 and 20

Remove or Disconnect

1. Refrigerant.
 - Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Accumulator hose-to-accumulator fitting.
 - A. Seal accumulator (2) with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - B. Discard seal (36).
3. Accumulator hose (9) at evaporator (1).
 - A. Remove nut (43) holding accumulator hose (9) to evaporator outlet port.
 - B. Pull hose (9) out of evaporator (1).
 - C. Discard seal (44).

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Seal (44) to accumulator hose (9).
 - Coat new seal (44) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
2. Accumulator hose (9) at evaporator (1).
 - A. Push hose (9) into evaporator outlet port.
 - B. Nut (43).

Tighten

- Nut (43) to 16 N.m (12 lb. ft.).

3. Seal (36) to accumulator hose (9).
 - Coat seal (36) with mineral base 525 viscosity refrigerant oil GM P/N 12301108.
4. Accumulator hose-to-accumulator fitting.

Tighten

- Accumulator hose-to-accumulator fitting to 41 N.m (30 lb. ft.).
5. Evacuate and recharge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
 6. Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

Evaporator

Figures 16 & 20

Remove or Disconnect

1. Refrigerant.
 - Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Hose (9) at evaporator (1).
 - A. Remove nut (43) holding hose (9) to evaporator outlet port.
 - B. Pull hose (9) forward to remove it.
 - C. Seal open end of hose (9) with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - D. If you do not intend to proceed immediately to the following step, seal open evaporator outlet port with tape or an approved plastic cap.
 - E. Discard seal (44).
3. Evaporator tube (10) at evaporator (1).
 - A. Remove nut (39) holding tube (10) to evaporator inlet port.
 - B. Pull tube (10) forward to remove it.
 - C. Seal open evaporator inlet port with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - D. Seal opened end of tube (10) with tape or an approved plastic cap to prevent dirt or moisture contamination.
 - E. Discard seal (40).
4. Studs (42) using a female E7 TORX® socket.
5. Heater core cover. Refer to "Heater Core Cover" in this section.
6. Evaporator mounting bracket bolt/screw and bracket.
7. Evaporator (1).
 - Slide evaporator (1) rearward, then down, to remove it.

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Evaporator (1).
 - Studs (42) must be removed during installation.
2. Evaporator mounting bracket and bolt/screw.

**Tighten**

- Bolt/screw to 1.9 N·m (17 lb. in.).
3. Heater core cover. Refer to “Heater Core Cover” in this section.
 4. Refrigerant oil.
 - Add 90 ml (3 fluid ounces) of fresh polyalkylene glycol (PAG) refrigerant oil GM P/N 12345923, if evaporator (1) was replaced.
 5. Studs (42) using a female E7 TORX® socket.
 6. Tube (10) to evaporator inlet port.
 - A. Remove tape or cap from the open end of evaporator inlet port and tube (10).
 - B. Coat a new seal (40) with clean mineral base 525 viscosity refrigerant oil GM P/N 12301108 or equivalent and install it.
 - C. Install tube (10) to evaporator inlet port.
 - D. Install nut (39) at evaporator inlet port.

**Tighten**

- Nut (39) to 16 N·m (12 lb. ft.).
7. Hose (9) to evaporator outlet port.
 - A. Remove tape or cap from open end of evaporator outlet port and hose (9).
 - B. Coat a new seal (44) with clean mineral base 525 viscosity refrigerant oil GM P/N 12301108 or equivalent and install it.
 - C. Install hose (9) to evaporator outlet port.
 - D. Install accumulator hose nut (43) at the evaporator outlet port.

**Tighten**

- Accumulator hose nut (43) to 16 N·m (12 lb. ft.).
8. Evacuate and recharge A/C system. Refer to “Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures” in this section.
 9. Leak test fittings. Refer to “Leak Testing the Refrigeration System” in this section.

Blower Motor**Figure 21****Remove or Disconnect**

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Right hand instrument panel insulator. Refer to SECTION 8C.
3. Blower motor electrical connector.

4. Right hand body hinge pillar trim panel by pulling it away from front body hinge pillar.
5. Bolts/screws (45) and blower motor cover.
 - A. Remove two bolts/screws (45), allowing third bolt/screw (45), nearest right hand rear corner of module to remain in place.
 - B. Remove third bolt/screw (45) while supporting motor (46).
6. Motor (46).
 - Remove isolator (47) from blower motor flange, if necessary.

**Install or Connect**

NOTICE: Refer to “Notice” on page 1B-1 of this section.

**Important**

- The impeller is part of a blower motor service kit. The kit is preassembled and balanced. Therefore, do not attempt to separate the impeller from the blower motor.

1. Motor (46).
 - Position isolator (47) on blower motor flange.
 - Align motor (46) with opening in bottom of module and carefully move motor (46) up and into position.
2. Bolts/screws (45).

**Tighten**

- Bolt/screw (45) to 1.9 N·m (17 lb. in.).
3. Right hand body hinge pillar trim panel by pressing it into position until retainers snap into place.
 4. Blower motor electrical connector.
 5. Right hand instrument panel insulator. Refer to SECTION 8C.
 6. Battery negative cable.

**Tighten**

- Battery negative cable to 17 N·m (13 lb. ft.).

Rear Defogger Relay**Figure 21****Remove or Disconnect**

CAUTION: Refer to “Caution” under “Disconnecting Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Right hand instrument panel insulator. Refer to SECTION 8C.
3. Electrical connector at relay (48).
4. Bolt/screw (49).
5. Relay (48).

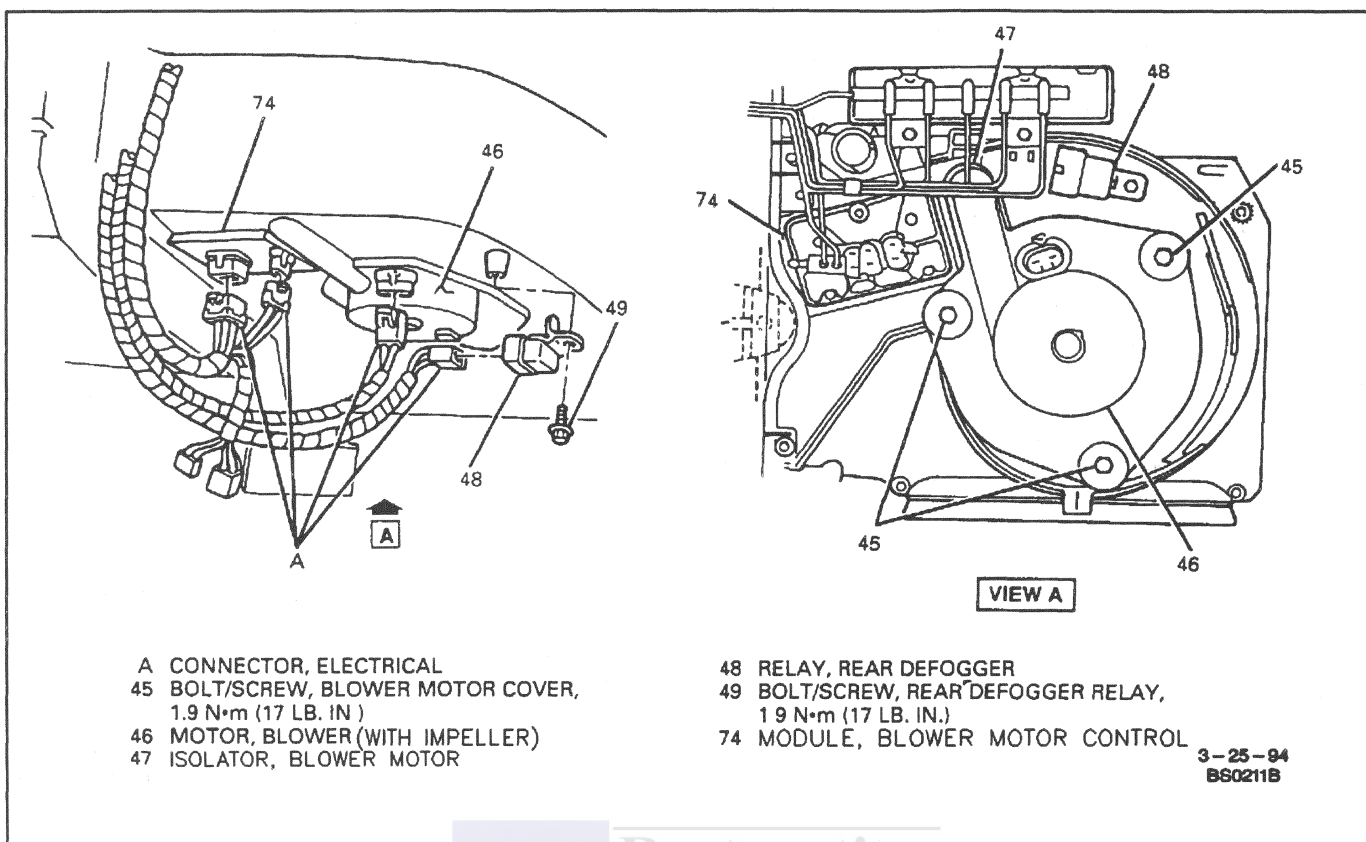


Figure 21 - Blower Motor Area from Below

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Relay (48).
2. Bolt/screw (49).

Tighten

- Bolt/screw (49) to 1.9 N·m (17 lb. in.).
3. Electrical connector to relay (48).
 4. Right hand instrument panel insulator. Refer to SECTION 8C.
 5. Battery negative cable.

Tighten

- Battery negative cable to 17 N·m (13 lb. ft.).

Heater Inlet and Outlet Hoses

Figure 22

Remove or Disconnect

1. Drain engine cooling system. Refer to SECTION 6B.
2. Bolts/screws (50).
3. Radiator fan upper shroud, if vehicle is equipped with a mechanical cooling fan.

4. Fan belt, if vehicle is equipped with a mechanical fan.
5. Clamps (51) at water pump.
6. Hoses (52 and 53) at water pump.
7. Coolant recovery reservoir hose at hose tee.
8. Clamps (51) at heater core ports.
9. Heater outlet and inlet hoses (52 and 53).

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Heater outlet and inlet hoses (52 and 53).
2. Clamps (51) at heater core ports.
3. Coolant recovery reservoir hose at hose tee.
4. Hoses (52 and 53) to water pump.
5. Clamps (51) at water pump.
6. Fan belt, if removed.
7. Radiator fan upper shroud, if removed. Refer to SECTION 6B.
8. Bolts/screws (50).

Tighten

- Bolts/screws (50) to 1.9 N·m (17 lb. in.).
9. Refill and bleed engine cooling system. Refer to SECTION 6B.

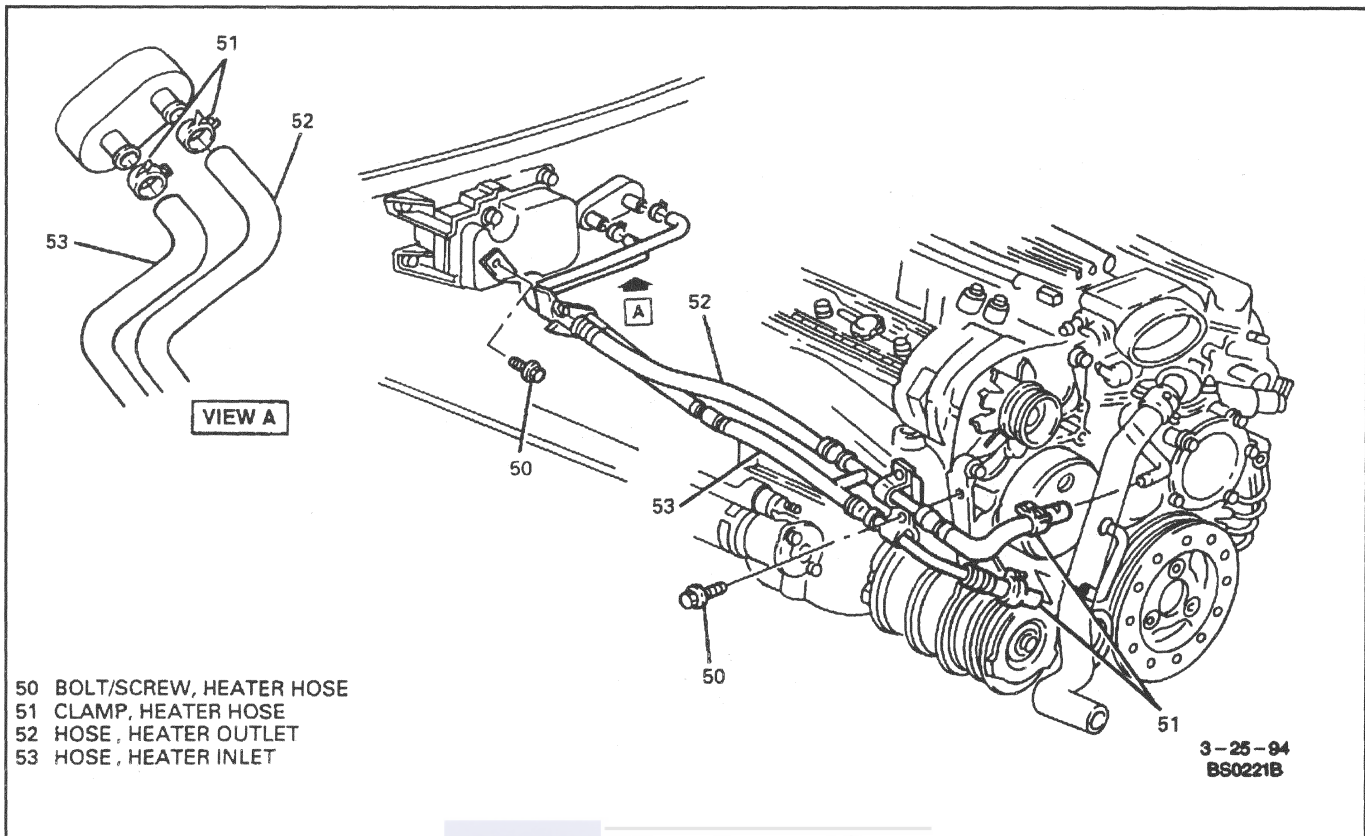


Figure 22 - Heater Hoses

Heater Core

Figures 22 & 25

↔ Remove or Disconnect

1. Drain engine coolant. Refer to SECTION 6B.
2. Heater inlet and outlet hose clamps (51) from heater core inlet and outlet tubes.
3. Heater outlet and inlet hoses (52 or 53) from heater core.
4. Heater core cover. Refer to "Heater Core Cover" in this section.
5. Heater core.
 - A. Remove heater core mounting straps and bolts/screws.
 - B. Pull heater core rearward, working heater core inlet and outlet tubes out of seal.

→← Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Heater core.
 - A. Move heater core into position, carefully guiding heater core inlet and outlet tubes through round holes in tube seal at cowl panel.
 - B. Install heater core mounting straps and bolts/screws.
2. Heater core cover. Refer to "Heater Core Cover" in this section.

3. Heater outlet and inlet hoses (52 or 53) to heater core.
4. Heater inlet and outlet clamps (51) to heater core inlet and outlet tubes.
5. Refill and bleed engine coolant. Refer to SECTION 6B.

🔍 Inspect

- With engine warmed up and running, and with HVAC control set for maximum heating, inspect heater outlet and inlet hoses (52 and 53) for leaks.
- Also carefully feel hoses (52 and 53) to ensure that warm engine coolant is flowing through heater core.

Heater and Air Conditioning Module

Figure 23

Heater and air conditioning module (57) must be removed to permit removal of vacuum tank.

↔ Remove or Disconnect

1. Refrigerant.
 - Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Drain engine coolant. Refer to SECTION 6B.

1B-30 HEATING AND AIR CONDITIONING

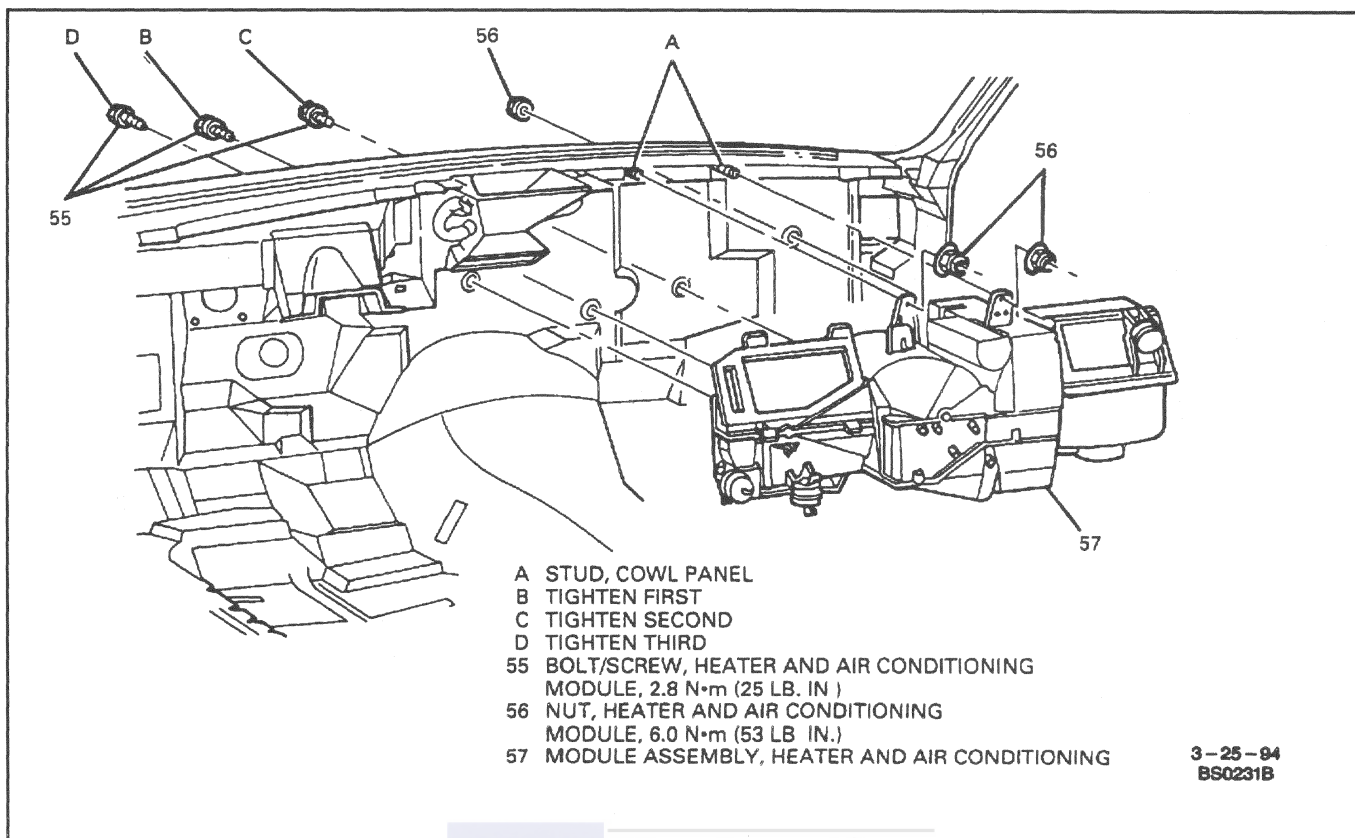


Figure 23 - Heater and Air Conditioning Module

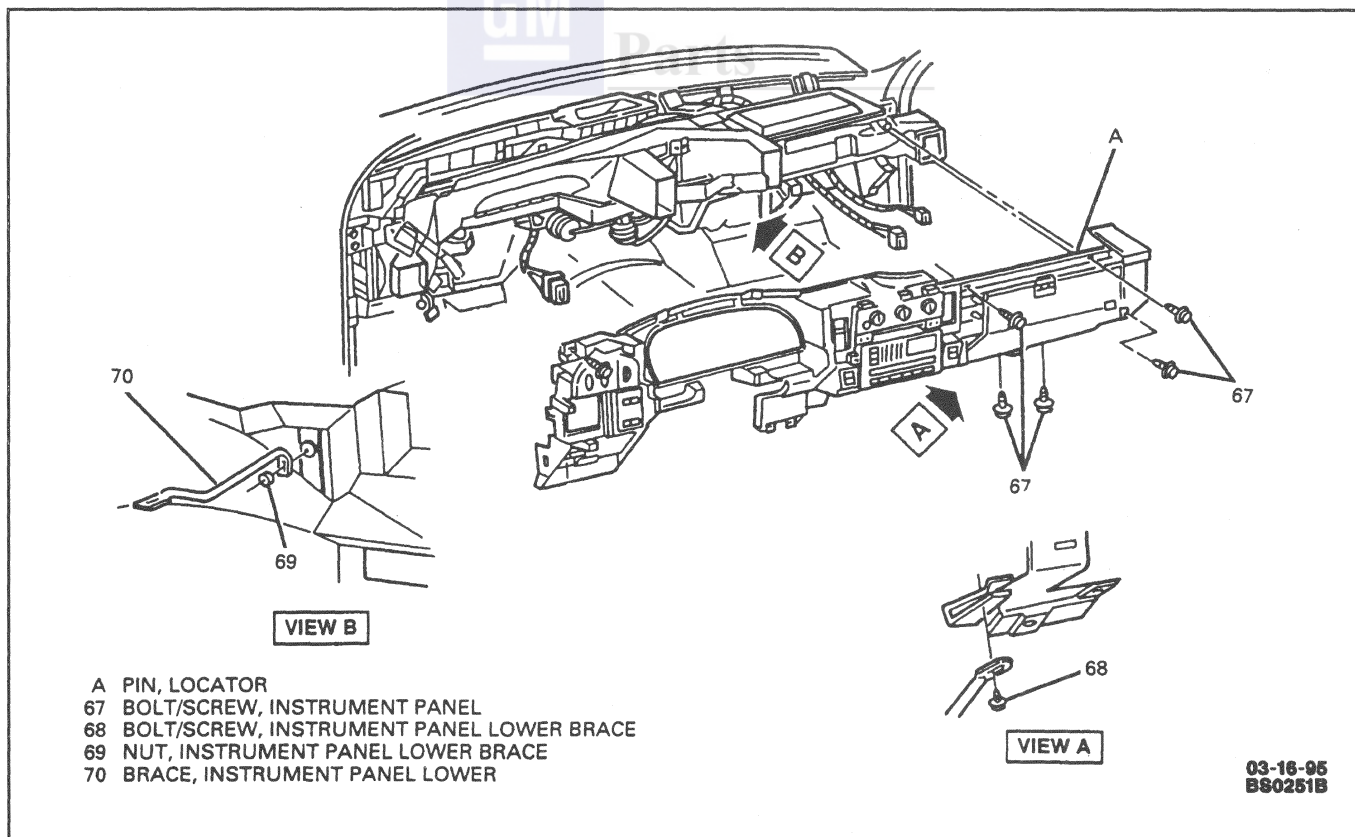


Figure 24 - Instrument Panel - (Chevrolet)

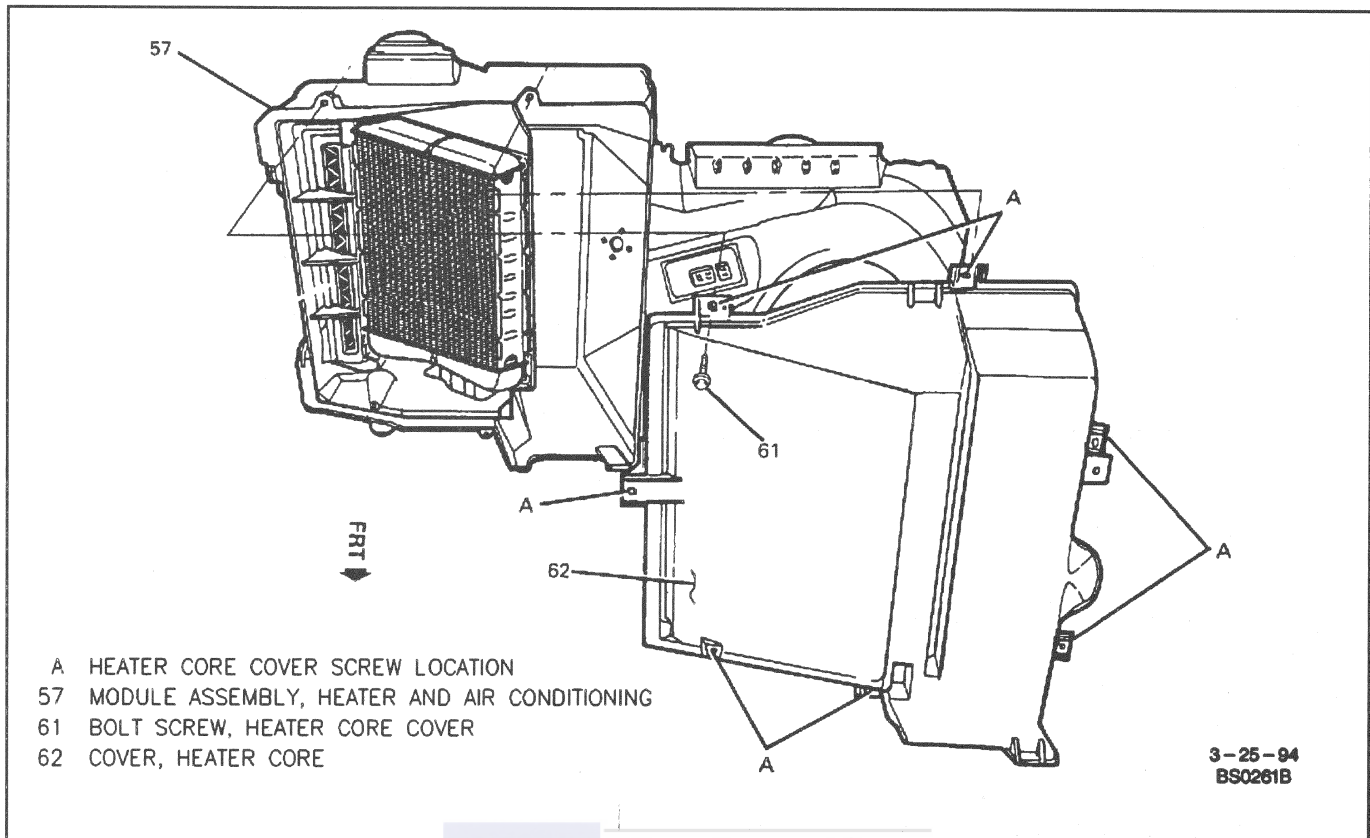


Figure 25 - Heater Core Cover

3. Heater outlet and inlet hoses (52 and 53) from heater core.
4. Accumulator hose (9) and evaporator tube (10) from evaporator (1).
 - A. Remove accumulator hose and evaporator tube nuts (39 and 43) and slide hose (9) and tube (10) forward and off studs (42).
 - B. Discard seals (40 and 44).
 - C. Seal open ends of both accumulator hose (9) and tube (10) with tape or an approved plastic cap to prevent dirt or moisture contamination.
5. Instrument panel. Refer to SECTION 8C.
6. Air distributor and tie bar. Refer to SECTION 8C.
7. Floor air distributor. Refer to SECTION 8C.
8. Windshield defroster nozzle. Refer to SECTION 8C.
9. Air inlet grille panels. Refer to SECTION 10-5.
10. Windshield wiper transmission access hole cover bolts/screws and cover.
11. Vacuum supply hose connector at bottom of module (57).
12. Bolts/screws (55) and nuts (56).
 - Remove three bolts/screws (55) and one nut (56) from the engine compartment first, then remove two nuts (56) from the passenger compartment.
13. Module (57).
 - Slide module (57) rearward, tilting it as necessary to be sure heater core tubes and evaporator refrigerant line connections are clear of holes in cowl panel before removing module (57) from two cowl panel studs.

**Install or Connect**

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Module (57) and two nuts (56).
 - A. Move module (57) forward, positioning two upper tabs onto cowl panel studs for support.
 - B. Carefully guide heater core tubes, evaporator refrigerant line connections and stud near refrigerant line connections through appropriate holes in cowl panel.
 - C. Install two nuts (56) onto two dash panel studs, but do not tighten them.
2. Bolts/screws (55) and nut (56).
 - A. From engine compartment, verify that heater core tubes, evaporator refrigerant line connections and module mounting stud are properly positioned and holes for bolts/screws (55) are aligned.
 - B. Install three bolts/screws (55). Tighten in proper sequence.



Tighten

- Bolts/screws (55) to 2.8 N.m (25 lb. in.).
- C. Install stud nut (56).



Tighten

- Nut (56) to 6 N.m (53 lb. in.).

3. Dash panel nuts (56).



Tighten

- Nuts (56) to 6 N.m (53 lb. in.).

- Vacuum supply hose connector.
- Windshield wiper transmission access hole cover and bolts/screws.
- Air inlet grille panels. Refer to SECTION 10-5.
- Windshield defroster nozzle. Refer to SECTION 8C.
- Floor air distributor. Refer to SECTION 8C.
- Air distributor and tie bar. Refer to SECTION 8C.
- Instrument panel. Refer to SECTION 8C.
- Accumulator hose (9) and evaporator tube (10) to evaporator (1).
 - Remove tape or plastic caps from open ends of hose (9), tube (10) and both evaporator ports.
 - Coat seals (40 and 44) with clean mineral base 525 viscosity refrigerant oil GM P/N 12301108 just before installation.
 - Slide hose (9) and tube (10) into position onto mounting studs (42), then install accumulator hose fitting and evaporator tube fitting nuts (39 and 43).



Tighten

- Accumulator hose and evaporator tube fitting nuts (39 and 43) to 16 N.m (12 lb. ft.).

- Heater outlet and inlet hoses (52 and 53) to heater core.
- Refill and bleed engine cooling system. Refer to SECTION 6B.



Inspect

- With engine warmed up and running, and with HVAC control set for maximum heating, inspect heater outlet and inlet hoses (52 and 53) for leakage.
- Evacuate and recharge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
 - Leak test fittings. Refer to "Leak Testing the Refrigeration System" in this section.

HEATER CORE COVER

Figure 25

The heater core cover must be removed from the module to gain access to the evaporator and heater core.



Remove or Disconnect

- Right hand instrument panel insulator and instrument panel lower reinforcement. Refer to SECTION 8C.
- Right-Hand floor carpet retainer. Refer to SECTION 10-6.
- Instrument panel trim plate for Chevrolet or instrument panel lower trim plate for Buick. Refer to SECTION 8C.
- Instrument panel upper trim pad for Chevrolet. Refer to SECTION 8C.
- Bolts/screws (67) for Chevrolet.
- Bolt/Screw (68), nut (69), and brace (70) for Chevrolet.
- Pull right lower corner of instrument away from dash [approximately 25 mm (1 inch)] and support for Chevrolet.
- Vacuum harness connectors at heater core cover (62).
 - Disconnect both connectors, then remove connector halves from heater core cover.
 - Position vacuum harnesses out of the way.
- Roll floor carpet back to provide access to forward lower area of module (57).
- Heater core cover bolts/screws (61).
 - There are seven bolts/screws (61) attaching the flange of the heater core to the rest of the shell of the module.
 - The bolt/screw (61) near the center of the flange next to the cowl panel (the forward flange) may be difficult to locate. The bolt/screw head is straight down from the vacuum tank and almost directly below the lower righthand heater core tube. The bolt/screw can be reached for removal or installation with a 7 mm socket attached to a universal joint adapter and a short extension to a ratchet handle.
- Heater core cover (62).



Clean

- Original sealer from mating surfaces of exposed flanges.



Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

- New sealer to cover mounting flanges.
- Heater core cover (62).
 - Guide heater core cover (62) into place, taking care to avoid scraping away any sealer from flanges.
- Heater core cover bolts/screws (61).
 - Install at least two bolts/screws (61) while holding cover in position. Tighten both bolts/screws finger tight.

- B. Install remaining bolts/screws (61) fingertight.
- C. Tighten all seven bolts/screws (61) evenly to compress flange sealer.

**Tighten**

- Bolts/screws (61) to 1.9 N.m (17 lb. in.).
- 4. Fit floor carpet in place under module (57) and against cowl panel.
- 5. Vacuum harness connectors.
 - A. Connect both connector halves.
 - B. Install assembled connectors to case.
- 6. Right hand body hinge pillar trim panel by seating retainer into front body hinge pillar.
- 7. Instrument panel support and position instrument panel to dash.
- 8. Brace (70), nut (69), and bolt/screw (68), for Chevrolet.

**Tighten**

- Nut (69) to 10 N.m (89 lb. in.).
- Bolt/Screw (68) to 1.9 N.m (17 lb. in.).
- 9. Bolts/Screws (67) for Chevrolet or bolts/screws (58) for Buick.

**Tighten**

- Bolts/screws (67) to 10 N.m (89 lb. in.).
- Bolts/screws (58) to 10 N.m (89 lb. in.).
- 10. Instrument Panel upper trim pad. Refer to SECTION 8C.
- 11. Instrument panel lower trim plate for Buick or instrument panel trim plate for Chevrolet. Refer to SECTION 8C.
- 12. Right-hand floor carpet retainer. Refer to SECTION 10-6.
- 13. Instrument panel lower reinforcement and right-hand instrument panel insulator. Refer to SECTION 8C.

Schrader® Valve Core

Tool Required:

J 22132-02 Access Valve Core Remover and Installer

A Schrader® valve core is located under the following components:

- Pressure cycling switch.
- Air conditioning refrigerant pressure sensor.
- Low side refrigerant service valve fitting.

**Remove or Disconnect**

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Valve cap and seal or pressure cycling switch or air conditioning refrigerant pressure sensor, refer to "Pressure Cycling Switch" or "Air Conditioning Refrigerant Pressure Sensor" in this section.

3. Valve core.

- A. J 22132-02 may be used to remove valve core.
- B. Discard valve core.

**Install or Connect**

1. New valve core and seal.
 - A. J 22132-02 may be used to install valve core.
 - B. Do not overtighten valve core.
2. Pressure cycling switch or air conditioning refrigerant pressure sensor, if removed. Refer to "Pressure Cycling Switch" or "Air Conditioning Refrigerant Pressure Sensor" in this section.

NOTICE: Valve caps must be properly tightened to prevent a refrigerant leak.

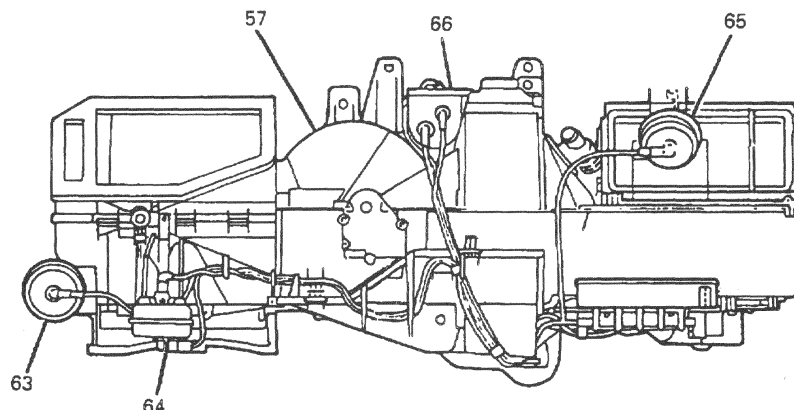
3. Valve cap and seal, if removed.
 - Tighten valve cap until the seal in valve cap is compressed against the service valve fitting.
4. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
5. Leak test fitting. Refer to "Leak Testing the Refrigeration System" in this section.

Vacuum Actuators**HEATER AND DEFROST VALVE VACUUM ACTUATOR****Figure 26****Remove or Disconnect**

1. Instrument panel steering column opening filler. Refer to SECTION 8C.
2. Blue and gray vacuum hoses.
 - Disconnect vacuum hose connectors at actuator (63) by sliding tabs of connector retainers past L-shaped bends in vacuum tubes. Slide connectors off tubes while continuing to hold tabs back against body of connectors.
3. Actuator (63).
 - A. With thin-blade screwdriver, disengage tab locking actuator (63) to module (57) and slide actuator (63) away to remove it.
 - B. Unhook actuator arm from the valve crank.

**Install or Connect**

1. Actuator (63).
 - A. Engage slot in actuator arm with hook of valve crank.
 - B. Slide actuator (63) into place until tab clicks to lock actuator (63) to module (57).
2. Blue and grey vacuum hoses.
 - Bend retaining tabs of vacuum hose connectors back flush against end of connectors and hold it there while slipping tabs and connectors onto vacuum tubes. When connectors are fully seated, pull retaining tabs over Lshaped bends in tubes to hold connectors in place.
3. Instrument panel steering column opening filler. Refer to SECTION 8C.



- 57 MODULE ASSEMBLY, HEATER AND AIR CONDITIONING
63 ACTUATOR, HEATER AND DEFROST VALVE VACUUM
64 ACTUATOR, MODE VALVE VACUUM
65 ACTUATOR, AIR INLET VALVE VACUUM
66 TANK, VACUUM

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Figure 26 - Vacuum Actuator Locations

MODE VALVE VACUUM ACTUATOR

Figure 26

Remove or Disconnect

1. Right hand instrument panel sound insulator. Refer to SECTION 8C.
2. Vacuum hoses.
 - Disconnect tan vacuum hose connector at actuator (64) by sliding tab of connector retainer past Lshaped bend in vacuum tube. Slide connector off tube while continuing to hold tab back against body of connector.
 - Disconnect red vacuum hose connector by lifting tab off "arrow" and sliding connector off of vacuum tube.
3. Actuator (64).
 - A. With thin-blade screwdriver, disengage tab locking actuator (64) to module (57) and slide actuator (64) away to remove it.
 - B. Unhook actuator arm from valve crank.

Install or Connect

1. Actuator (64).
 - A. Engage slot in actuator arm with hook of valve crank.
 - B. Slide actuator (64) into place until tab clicks to lock actuator (64) to module (57).
2. Vacuum hoses.
 - A. Install red-coded hose to upper fitting of actuator (64) and tan-coded hose to lower fitting.

- B. To connect tan vacuum hose, bend retaining tab of hose connector back flush against end of connector and hold it there while slipping tab and connector onto vacuum tube. When connector is fully seated, pull retaining tab over L-shaped bend in tube to hold connector in place.
- C. Connect red vacuum hose by sliding connector onto tube and pulling tab over "arrow."
3. Right hand sound insulator. Refer to SECTION 8C.

AIR INLET VALVE VACUUM ACTUATOR

Figure 26

Remove or Disconnect

1. Instrument panel. Refer to SECTION 8C.
2. Orange vacuum hose.
 - Disconnect vacuum hose connector at actuator (65) by sliding tab of connector retainer past L-shaped bend in vacuum tube. Slide connector off tube while continuing to hold tab back against body of connector.
3. Actuator (65).
 - A. With thinblade screwdriver, disengage tab locking actuator (65) to module (57) and slide actuator (65) away to remove it.
 - B. Unhook actuator arm from valve crank.

Install or Connect

1. Actuator (65).
 - A. Engage slot in actuator arm with hook of air inlet valve arm.
 - B. Slide actuator (65) into place until tab clicks to lock actuator (65) to module (57).

2. Orange vacuum hose.
 - Bend retaining tab of vacuum hose connector back flush against end of connector and hold it there while slipping tab and connector onto vacuum tube. When connector is fully seated, pull retaining tab over L-shaped bend in tube to hold connector in place.
3. Instrument panel. Refer to SECTION 8C.

Vacuum Tank

Figure 26

Remove or Disconnect

1. Module. Refer to "Heater and Air Conditioning Module" in this section.
2. Vacuum hoses at tank (66).
 - Note position of both hoses for reference during installation.
3. Vacuum tank bolts/screws.
4. Tank (66).

Install or Connect

NOTICE: Refer to "Notice" on page 1B-1 of this section.

1. Tank (66).
2. Vacuum tank.

Tighten

- Bolts/screws to 1.9 N.m (17 lb. in.).
3. Vacuum hoses at tank (66).
 - Install violet hose to right of black hose.
 4. Module. Refer to "Heater and Air Conditioning Module" in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

A/C System R-134a Capacity	0.79 kg (1 lb. 12 oz.)
A/C System Seal and Fitting Lubricant Mineral Base 525 Viscosity Refrigerant Oil, GM P/N 12301108 or Equivalent	
A/C System Internal Lubricant (Including A/C Compressor) Polyalkylene Glycol (PAG) Synthetic Refrigerant Oil, GM P/N 12345923 or Equivalent	
Oil Distribution	
A/C Compressor	
Drain old compressor:	
*If less than 30 ml (1 oz.), add 30 ml (1 oz.).	
*If more than 30 ml (1 oz.), add same amount.	
A/C Condenser 30 ml (1 oz.)	
A/C Evaporator 90 ml (3 oz.)	
A/C Accumulator 105 ml (3.5 oz.)	

REFRIGERANT HOSE AND TUBE CONNECTION TIGHTENING SPECIFICATIONS

Accumulator Hose-to-Accumulator Fitting	41 N.m (30 lb. ft.)
Compressor and Condenser Hose-to-Accumulator Fitting	41 N.m (30 lb. ft.)
Compressor and Condenser Hose-to-Condenser Fitting	24 N.m (18 lb. ft.)
Condenser-to-Evaporator Tube Fitting	24 N.m (18 lb. ft.)

COMPONENT TIGHTENING SPECIFICATIONS

Air Conditioning Compressor Pressure Cycling Switch	4.5 N.m (40 lb. in.)
Air Conditioning Refrigerant Pressure Sensor	6 N.m (53 lb. in.)

FASTENER TIGHTENING SPECIFICATIONS

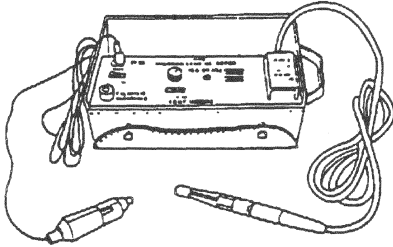
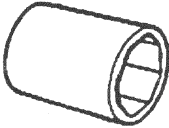
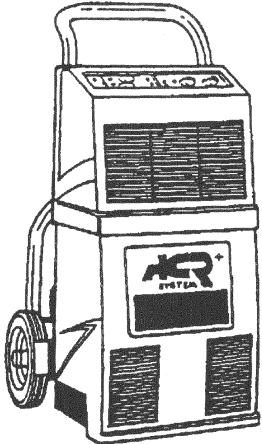
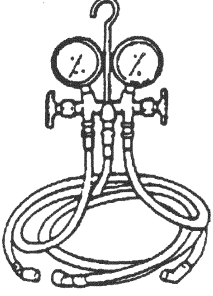
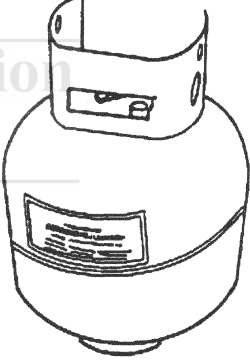
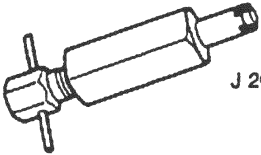
Air Conditioning Accumulator Bracket Bolt/Screw	6 N.m (53 lb. in.)
Air Conditioning Accumulator Hose Nut	16 N.m (12 lb. ft.)
Air Conditioning Compressor and Condenser Hose Nut (at Back of Compressor)	35 N.m (26 lb. ft.)
Air Conditioning Compressor Bolt/Screw	50 N.m (37 lb. ft.)
Air Conditioning Compressor Bolt/Screw (Rear Brace-to-Compressor)	25 N.m (18 lb. ft.)
Air Conditioning Compressor Rear Bracket Nut	41 N.m (30 lb. ft.)
Air Conditioning Evaporator Tube Nut	16 N.m (12 lb. ft.)
Battery Negative Cable	17 N.m (13 lb. ft.)
Blower Motor Cover Bolt/Screw	1.9 N.m (17 lb. in.)
Engine Mount Through Bolt/Screw	95 N.m (70 lb. ft.)
Evaporator Mounting Bracket Bolt/Screw	1.9 N.m (17 lb. in.)

1B-36 HEATING AND AIR CONDITIONING

Heater and Air Conditioning Evaporator Module Bolt/Screw	2.8 N.m (25 lb. in.)
Heater and Air Conditioning Evaporator Module Nut	6 N.m (53 lb. in.)
Heater Core Cover Bolt/Screw	1.9 N.m (17 lb. in.)
Heater Hose Bolt/Screw	1.9 N.m (17 lb. in.)
Instrument Panel Bolt/Screw (Chevrolet Only)	10 N.m (89 lb. in.)
Instrument Panel Lower Brace Bolt/Screw (Chevrolet Only)	1.9 N.m (17 lb. in.)
Instrument Panel Lower Brace Nut (Chevrolet Only)	10 N.m (89 lb. in.)
Rear Defogger Relay Bolt/Screw	1.9 N.m (17 lb. in.)
Vacuum Tank Bolt/Screw	1.9 N.m (17 lb. in.)



SPECIAL TOOLS

1.  J 39400
2.  J 39037
3.  J 6742-03
4.  J 39500-GM
5.  J 36645
6.  J 39183-C
7.  J 39500-50
8.  J 22132-02
9.  J 26549-E

1. HALOGEN LEAK DETECTOR
2. OCTAGON SOCKET
3. PRECISION THERMOMETER
4. AIR CONDITIONING REFRIGERANT RECOVERY, RECYCLING AND RECHARGING (ACR*) SYSTEM
5. AIR CONDITIONING EVAPORATOR CLEANING GUN
6. R-134a MANIFOLD GAUGE SET
7. 50 LB. REFILLABLE RECOVERY TANK
8. ACCESS VALVE CORE REMOVER AND INSTALLER
9. EXPANSION TUBE REMOVER



SECTION 1B1

MANUAL CONTROL AIR CONDITIONING

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out those fasteners that require a thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

OVERVIEW

Figures 1 and 2

The air conditioning system (C60) delivers air that has been heated or cooled and dehumidified for occupant comfort. It also provides power ventilation, and windshield and side window defrosting. During most operating conditions, outside air is drawn through the heater and air conditioning module by the blower motor. Additional outside air is also forced into the vehicle by forward movement of the vehicle.

Within the heater and air conditioning module, air is pushed by the blower motor through the evaporator, then through the heater core and into the passenger compartment. For air conditioning or defroster operation at ambient temperatures above 7° C (45° F) refrigeration system will chill the evaporator to almost freezing. As the air passes through the evaporator, the air temperature drops which causes moisture in the air to condense on the evaporator core fins. This moisture leaves the vehicle by gravity feed through a drain hole, dehumidifying the vehicle.

1B1-2 MANUAL CONTROL AIR CONDITIONING

From the evaporator, some or all of the air may pass through the heater core, which is warmed by engine coolant. Any of the air which is not to be heated will mix with the heated air before entering the passenger compartment.

When maximum air conditioning mode is selected, most of the air entering the blower motor is taken from the passenger compartment recirculated where it is most likely to be cooler than the outside air. Only outside air is used in all other modes.

HVAC CONTROL

Temperature Control

Figure 1

The temperature control is mechanically linked to the air temperature valve (door) by a temperature control cable. Rotating the temperature control clockwise allows more of the incoming or recirculated air to flow through the heater core, thus increasing the air temperature entering the vehicle. Rotating the temperature control counterclockwise decreases air flow through the heater core, thus decreasing the air temperature entering the vehicle.

Mode Control

The mode control has eight settings: "OFF," "MAX," "A/C," "B/L" (BI-LEVEL) A/C, "VENT," "HEAT," "BLEND," and "DEFROST." Each setting is described below.

"OFF" MODE

At the "OFF" setting, electrical power is not supplied to the blower motor and A/C is not requested to the powertrain control module (PCM). A small amount of air which is forced into the heater and air conditioning module by forward movement of the vehicle will still be discharged through the air outlets. This is the only mode in which the blower motor does not operate.

"MAX" A/C MODE

The "MAX" A/C setting is one of five settings which requests A/C operation to the PCM. At this setting the blower motor will operate in one of the four blower motor speed control settings and air will be discharged from the instrument panel air outlets only.

To provide maximum air conditioning, most of the air entering the heater and air conditioning module is taken from the vehicle interior (recirculated) where it is most likely cooler than the outside air. This is the only mode in which air is recirculated, all other modes use outside air only. This setting would be most useful during conditions of high temperature and humidity, or when the outside air may have an objectionable odor.

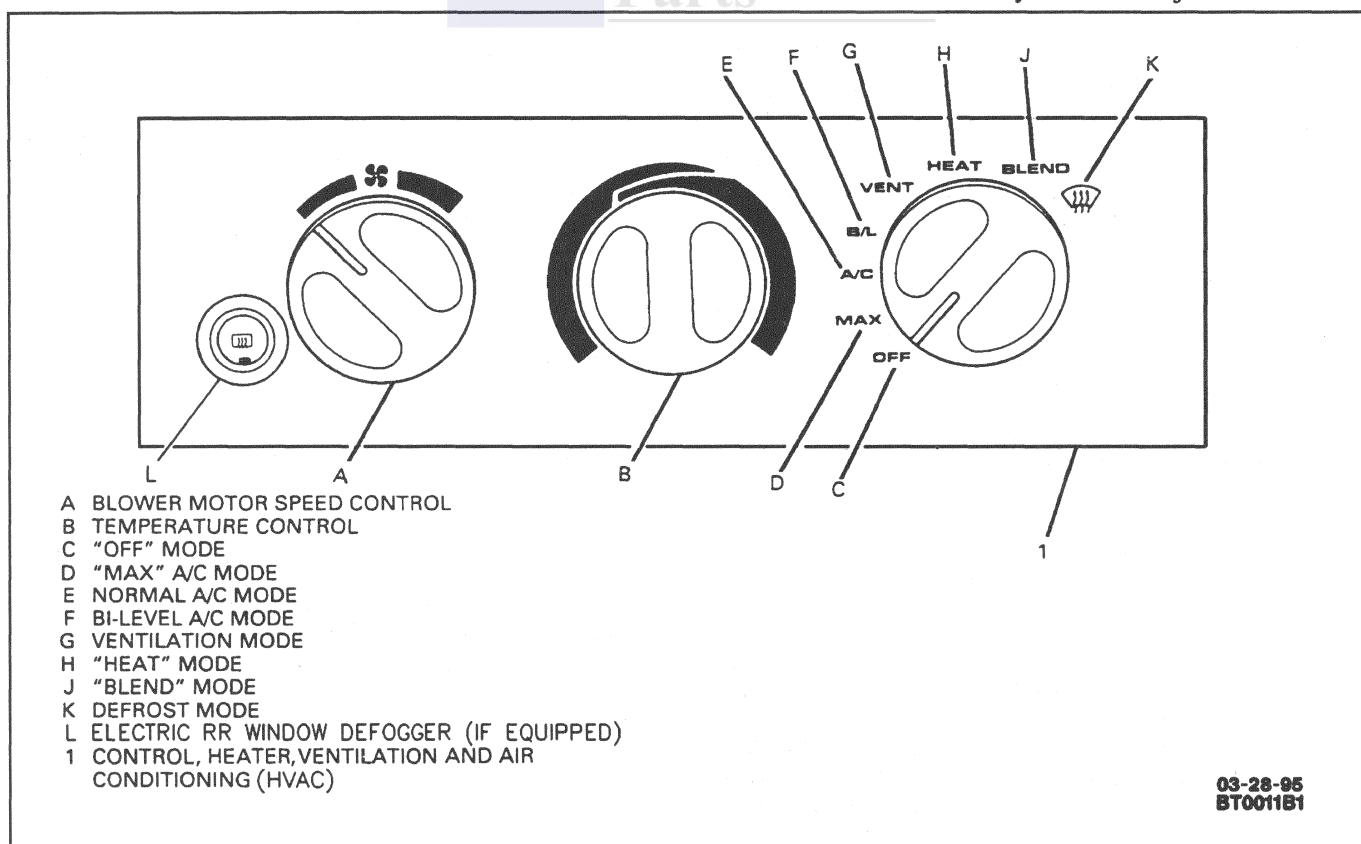


Figure 1 - Heater Ventilation and Air Conditioning HVAC Control

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Normal "A/C" MODE

The normal "A/C" setting functions the same as "MAX" A/C setting, except only outside air enters the module. There may be a slight reduction of blower noise compared to "MAX" A/C mode because the recirculation valve (door) is closed.

"B/L" (BI-LEVEL) A/C MODE

The "B/L" (BI-LEVEL) A/C setting requests A/C to the PCM and allows the blower motor to operate in one of four settings similar to "MAX" A/C, except only outside air enters the module and air is distributed through the instrument panel outlets and the floor air outlets.

"VENT" MODE

The "VENT" setting does not request A/C to the PCM but allows the blower motor to operate normally. This is one of two economy modes (other than "OFF") in which A/C is not requested. Air is discharged through the instrument panel outlets only.

"HEAT" MODE

The "HEAT" setting functions the same as the "VENT" setting, except most of the air is discharged through the floor outlets with a small amount discharged through the defroster outlets. The "HEAT" mode is the normal selection for cold weather operation unless windshield or side window defrosting is required.

"BLEND" MODE

The "BLEND" setting allows operation of the blower motor and sends an A/C request signal to the PCM for compressor operation. During this setting, air is discharged through the defroster and floor air outlets. This setting allows greater passenger comfort than "DEFROST" but is not as effective in defrosting the windshield and side windows.

"DEFROST" MODE

The "DEFROST" setting functions the same as "BLEND" setting except all air is discharged through the defroster outlets.

Blower Motor Speed Control**Figure 1**

With the ignition switch in the "RUN" position, the blower motor runs in all mode control positions except "OFF". Blower motor speed is controlled by a four-position electrical blower motor speed control switch at the left side of the HVAC control. The blower motor speed control switch provides a choice of a low blower motor speed, two medium speeds, and a high speed.

Electrical power is routed from the HVAC fuse number 17 in the instrument panel fuse block to the mode control switch. The mode control switch breaks the circuit when it is in the "OFF" position, and closes the circuit in all other positions.

From the mode control switch, the circuit then goes to the blower motor speed control switch. When the blower motor speed control switch is in "LOW," current is conducted to the resistor. At the resistor, the current passes through all three resistors and is reduced to provide the low blower motor speed.

When the blower switch is in either of the two "MEDIUM" speed positions, it closes to send current through either two or one of the resistors in the resistor assembly. Because the current follows the path of least resistance, the circuit branch leading directly to all three resistors becomes ineffective and the current bypasses either one or two resistors, depending upon which "MEDIUM" speed position is selected. The reduced resistance increases current flow and blower motor speed.

When the blower motor speed control switch is in the "HIGH" position, it energizes the high blower relay and power is taken from a separate circuit that is protected by a maxi-fuse. This separate power circuit is "hot" at all times and has the capacity to handle the current demands of the blower motor at high speed.

The circuit to the blower motor is completed to ground through the instrument panel harness at the body, just below the left side of the instrument panel. Refer to SECTION 8A for more electrical information.

AIR DISTRIBUTION SYSTEM**Figures 2 and 3**

Air enters the heater and air conditioning module where it may be cooled for air conditioning or defrost modes, and then heated as necessary before being sent to the proper outlets for discharge into the passenger compartment. Within the heater and air conditioning module, valves (doors) guide the airflow in response to the position of the mode control.

Vacuum System

All valves in the heater and air conditioning module except the temperature valve are controlled by engine vacuum drawn from the vacuum tank, mounted below and to the left of the passenger-side inflator module. The vacuum is routed by a vacuum selector valve in the HVAC control to spring-loaded vacuum actuators on the heater and air conditioning module. Vacuum stored in the vacuum tank is prevented from bleeding back to its source during conditions of low engine manifold vacuum (acceleration, hard pulling, etc.) by a check valve in the vacuum source hose.

The vacuum selector valve in the HVAC control is controlled by the mode control. For each mode control position, the vacuum selector valve directs vacuum to specific hoses to overcome the force of the springs within the appropriate vacuum actuators. The vacuum selector valve also vents the hoses to each remaining vacuum actuator to normal air pressure, allowing the actuator spring to expand. This results in the valves (doors) being properly positioned for the selected operating mode.

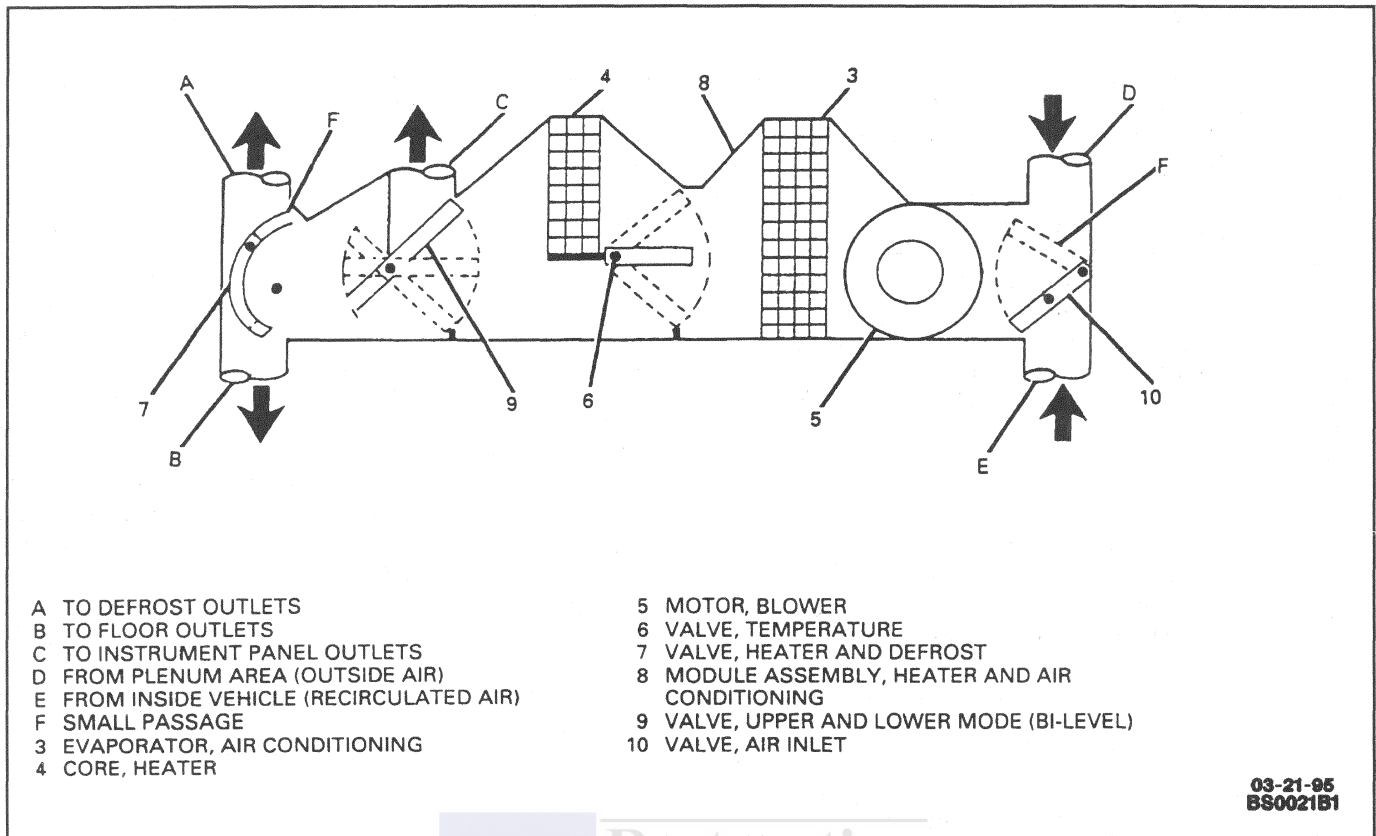


Figure 2 - Air Distribution System

The heater and defrost valve uses a three-position vacuum actuator. A three-position vacuum actuator has a diaphragm with a spring on both sides. At rest (no vacuum applied) the diaphragm will be in a mid-position, allowing for a "BLEND" mode. When vacuum is applied to either end of the diaphragm, the diaphragm will move the heater and defrost valve to either stop, which will direct airflow to either the defroster outlets or the floor outlets.

When air is directed to the floor outlets, as in "HEAT" mode, a small amount of air still bleeds through the defroster outlets to help eliminate re-frosting of the windshield.

Other Components

Other components of the air distribution system include the plenum, the blower motor, the evaporator, and the heater core. The plenum provides a source of outside air to the system. The blower motor draws air from the plenum or from the vehicle interior into the heater and air conditioning module and forces it through the air distribution system to the outlets.

Air Inlet Valve

The first valve in the air distribution system is the air inlet valve. This two-position valve controls the two air entrances which feed air to the blower motor. When "MAX" A/C mode is selected, vacuum is applied to the air inlet vacuum actuator and the air inlet valve opens the entrance which supplies inside air from the passenger compartment. In this position, the air inlet valve partially closes the entrance for outside air so only a slight amount can enter.

Recirculating the cooled air inside the passenger compartment when outside temperature is very high gives a faster cool down to a more comfortable temperature.

When any other operating mode (including "OFF") is selected, the air inlet vacuum actuator is vented to normal air pressure and the air inlet valve completely closes off the entrance for inside air. Only fresh outside air is used in the system in these modes.

Blower Motor and Evaporator

In any operating mode except "OFF," the blower motor draws in air from the plenum and pushes it through the evaporator. When any air conditioning or defrost mode is selected, the air conditioning refrigeration system chills the core of the evaporator to slightly above freezing temperature. This cools the airflow and causes excess humidity to condense on the fins of the evaporator. The condensed moisture drips to the bottom of the case and drains out through a hose that lets the water fall on the road surface below the vehicle. From the evaporator, the air flows toward the temperature valve and heater core.

Temperature Valve and Heater Core

The temperature control in the HVAC control is linked to the temperature valve by a flexible control cable. When the temperature control is rotated fully counterclockwise to the full "COOL" position, the temperature valve is held snugly against the air entrance to the heater core. This causes all of the airflow from the evaporator to bypass the heater core and there is no heat transfer.

Figure 3 - Air Distribution Components

1B1-6 MANUAL CONTROL AIR CONDITIONING

and defrost vacuum actuator causing the heater and defrost valve to direct all airflow to the floor outlets with a small bleed to the defroster outlets.

Ducts and Outlets

There are four adjustable high-level outlets in the instrument panel, two near the center and one at each extreme end of the panel. In addition, there are two side window defrost outlets, one at each end of the instrument panel upper trim pad. All six outlets are fed by the air distributor.

Heated or cooled air can be directed to the windshield through the windshield defroster nozzle.

Ventilation

The air distribution system provides fresh air ventilation for the passenger compartment in all operating modes. A small amount of the air circulated within the passenger compartment in the "MAX" A/C mode is taken from outside the vehicle, and all of the

air circulated in the other modes is from outside. Even in the "OFF" mode, fresh outside air is forced into the air distribution system by the forward movement of the vehicle. It then exits the pressure relief valve.

DIAGNOSIS

FUNCTIONAL TEST

The following operational test sequence will aid in determining whether the air conditioning electrical, air, vacuum and refrigeration systems are working properly. Temperature of the air should be at least 16°C (60°F). The air conditioning system cannot be properly tested unless it is at least this warm.

The engine should be started and allowed to idle until the engine cooling system thermostat is open.

Perform steps 1-9 on Chart and compare vehicle response to the normal system response shown on the chart. If vehicle does not respond correctly during any of these steps, begin diagnosis as noted below:



FUNCTIONAL TEST

HEATER VENTILATION AND AIR CONDITIONING CONTROL SETTING					SYSTEM RESPONSE				
STEP	Mode Control Lever Setting	Temperature Control Lever Setting	Blower Motor Switch	Blower Motor Speed	Heater Outlets	A/C Outlets	Defroster Outlets	Comments	Outlet Temperature
1.	Off	Cold	Low	Off	No Air Flow	No Air Flow	No Air Flow		Ambient
2.	Max/AC	Cold	Low	Low	No Air Flow	Air Flow	No Air Flow	A, E	At least 11°C (20°F) cooler than ambient
3.	Max/AC	Cold	Low to High	Low to High	No Air Flow	Air Flow	No Air Flow	B, E	At least 11°C (20°F) cooler than ambient
4.	Normal	Mid-range	High	High	No Air Flow	Air Flow	Minimum Air Flow	A	Cool to slightly warm
5.	Bi-level A/C	Cold	High	High	Air Flow	Air Flow	Minimum Air Flow	A	At least 11°C (20°F) cooler than ambient
6.	Vent	Cold	High	High	No Air Flow	Air Flow	No Air Flow	A	Ambient
7.	Heater	Hot	High	High	Air Flow	No Air Flow	Minimum Air Flow	A, C, D	At least 49°C (120°F)
8.	Blend (Defrost)	Hot	High	High	Air Flow	No Air Flow	Air Flow	A, D	At least 49°C (120°F)
9.	Defrost	Hot	High	High	Minimum Air Flow	No Air Flow	Air Flow	A, D	At least 49°C (120°F)

A. Engagement of detent must be felt in each mode control lever setting.

B. A noticeable blower motor speed increase must occur from low, medium low, medium high and high.

C. Temperature lever must travel from full cold to full hot.

D. Air flow must also be present at side window defogger outlets.

E. Instrument panel outlets must hold their position during high blower motor speed but should be moveable by hand.

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- Insufficient heating. Refer to “Insufficient or No Heating” in this section.
- Insufficient cooling. Refer to “Insufficient or No Cooling” in this section.

- Improper air delivery. Refer to “Improper Air Delivery” in this section.
- Blower motor inoperative or incorrect speed. Refer to SECTION 8A.

INSUFFICIENT OR NO HEATING DIAGNOSTIC CHART

- PERFORM PRELIMINARY INSPECTION.
- MAINTAIN PROPER ENGINE OPERATING TEMPERATURE.
- DISCONNECT TEMPERATURE CONTROL CABLE AT MODULE.
- ROTATE TEMPERATURE CONTROL KNOB. INSPECT OPERATION OF KNOB AND CABLE. REPLACE IF NECESSARY.
- SET IGNITION SWITCH TO "RUN" POSITION.
- ROTATE TEMPERATURE VALVE (APPROXIMATELY 65 DEGREES) TO FULL HOT POSITION.
- SET BLOWER MOTOR SWITCH TO HI—FAN POSITION.
- IS DISCHARGED AIR TEMPERATURE AT LEAST 49°C (120°F)?

YES

- CONNECT CABLE AT MODULE.
- INSPECT FOR PROPER OPERATION.

NO

ARE THERE RESTRICTIONS
THROUGH FINS ON HEATER CORE?

YES

REPLACE HEATER CORE.

NO

REPLACE HEATER AND
AIR CONDITIONING
MODULE ASSEMBLY.

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INSUFFICIENT OR NO HEATING DIAGNOSTIC CHART

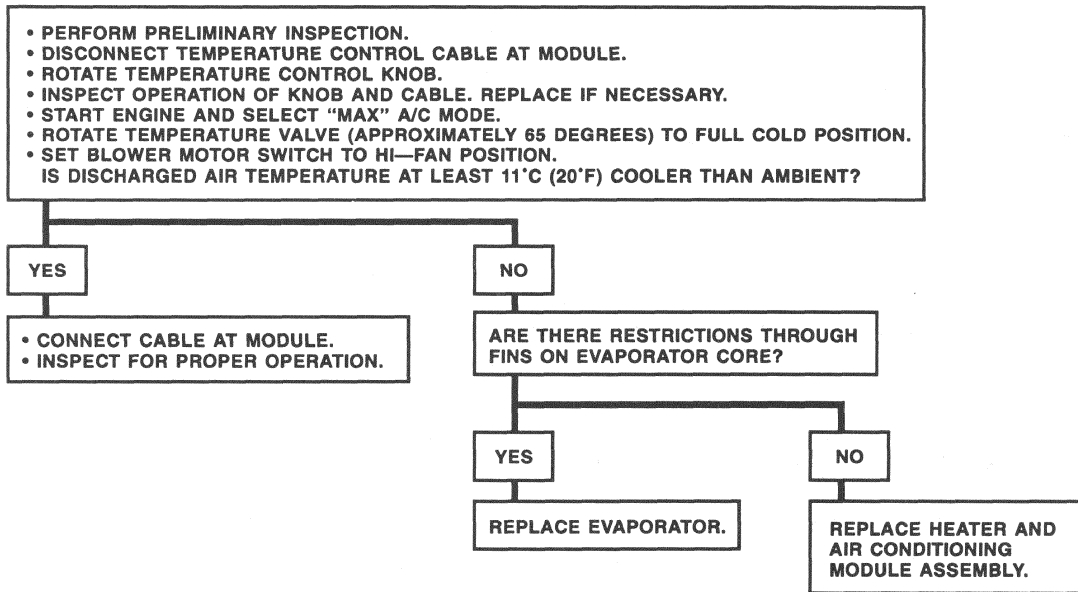
INSUFFICIENT OR NO HEATING

Preliminary Inspection:

1. Check for proper engine coolant level.
2. Check engine for proper operating temperature [approximately 91° C (195° F)]. If engine does not reach 91° C (195° F), replace thermostat. Refer to SECTION 6B.
3. With engine at normal operating temperature, check heater inlet and outlet hose temperature.
 - Heater inlet hose temperature should be at or near engine operating temperature.

- Heater outlet hose temperature should be slightly cooler than the heater inlet hose.
 - If heater hose temperatures are incorrect, replace heater core.
4. Inspect plenum area (at base of windshield) for debris or anything that may cause airflow restriction.
 5. Refer to "Insufficient or No Heating" diagnostic chart.

INSUFFICIENT OR NO COOLING DIAGNOSTIC CHART



C9243

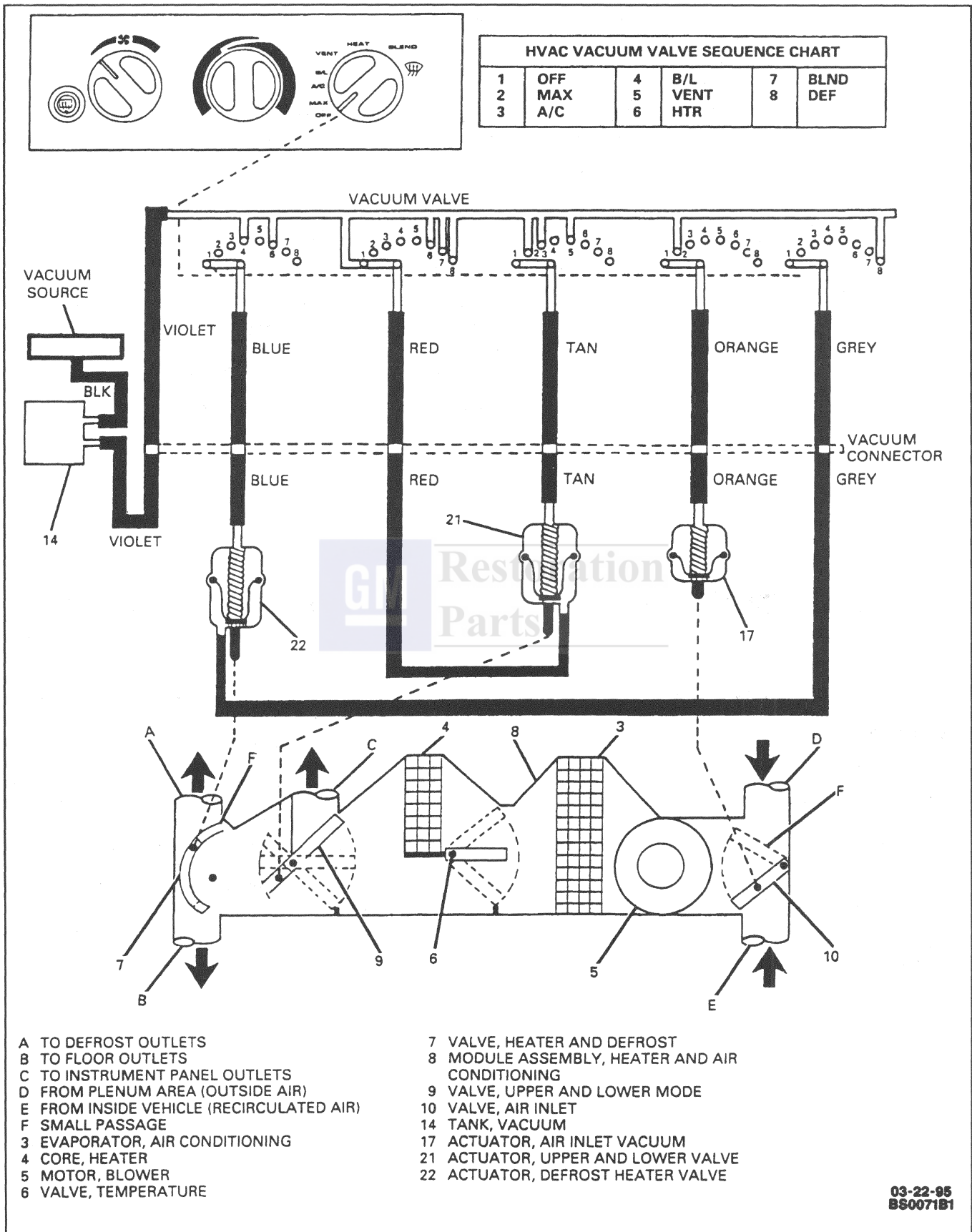
INSUFFICIENT OR NO COOLING DIAGNOSTIC CHART

INSUFFICIENT OR NO COOLING

Preliminary Inspection:

1. If A/C compressor is inoperative, refer to SECTION 6E3-C10.
2. Check to make sure instrument panel outlets are open.
3. If vehicle is not equipped with engine-driven cooling fan, check primary (left-hand) cooling fan for operation during air conditioning operation. If fan is inoperative, refer to SECTION 6E3-C12 for diagnosis.
4. Check the condenser for debris which may obstruct airflow through the fins.
5. Check the plenum area (at base of windshield) for any debris which may prevent proper airflow into the vehicle interior.
6. With air conditioning system operating, check accumulator temperature. Accumulator temperature should be near freezing (cold to touch). If this is not true, service the refrigeration system. Refer to SECTION 1B.
7. Check the air conditioning system for overcharge. If system is overcharged, recover, recycle and recharge air conditioning system. There should be 0.79 kg (1 lb. 12 ounces) of R-134a refrigerant.
8. Refer to "Insufficient or No Cooling" diagnostic chart.

1B1-10 MANUAL CONTROL AIR CONDITIONING



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Figure 4 - Improper Air Delivery Vacuum Diagram

IMPROPER AIR DELIVERY DIAGNOSTIC CHART

IMPROPER AIR DELIVERY DIAGNOSTIC CHART

- PERFORM PRELIMINARY INSPECTION.
- SET MODE SELECTOR VALVE IN THE "OFF" POSITION.
- DISCONNECT VACUUM LINE AT CHECK VALVE (RIGHT SIDE OF INTAKE MANIFOLD). USING A HAND VACUUM PUMP, APPLY VACUUM TO BLACK VACUUM LINE LEADING TO VACUUM TANK. DOES VACUUM HOLD?

NO

CHECK BLACK VACUUM LINE LEADING TO VACUUM TANK. IF LINE IS CONNECTED AND WORKING PROPERLY CHECK VIOLET VACUUM LINE AND VACUUM TANK FOR LEAKS BEFORE REPLACING MODE SELECTOR VALVE.

YES

- DISCONNECT VACUUM LINE MULTI-CONNECTOR AT MODE SELECTOR VALVE.
- TURN IGNITION SWITCH TO "RUN" POSITION (ENGINE NOT RUNNING).
- SELECT "HIGH" BLOWER MOTOR SPEED.
- APPLY VACUUM TO EACH VACUUM LINE INDIVIDUALLY (EXCEPT VIOLET AND ORANGE LINES) AND CHECK FOR AIR FLOW AT THE PROPER OUTLETS. REFER TO "DIAGNOSTIC AID CHART" BELOW. DOES AIR FLOW AT PROPER OUTLETS?

YES

- APPLY VACUUM TO ORANGE VACUUM LINE. DOES BLOWER MOTOR AIR FLOW NOISE INCREASE?

YES

SYSTEM OK.

NO

REPAIR OR REPLACE AIR INLET VACUUM ACTUATOR LINKAGE AND/OR AIR INLET VALVE.

NO

REPAIR OR REPLACE ACTUATOR LINKAGE AND/OR AIR VALVE (DOOR).

YES

- APPLY VACUUM TO VACUUM LINE LEADING TO MODE SELECTOR VALVE AND CHECK IN EACH SETTING ("MAX" A/C TO "DEFROST"). DOES VACUUM HOLD IN EVERY SETTING?

NO

- DISCONNECT VACUUM LINE MULTI-CONNECTOR AT MODE SELECTOR VALVE.
- APPLY VACUUM TO EACH LINE AT MULTI-CONNECTOR CONTROLLED BY THE MODE SELECTOR VALVE AT A SETTING WHERE VACUUM DID NOT HOLD. IS VACUUM LEAK PRESENT AT ONE OR MORE LINES?

YES

REPAIR OR REPLACE VACUUM LINE AND/OR VACUUM ACTUATOR.

NO

REPLACE MODE SELECTOR VALVE.

DIAGNOSTIC AID CHART

APPLY VACUUM TO:	AIR FLOW SHOULD BE DIVERTED TO:
TAN VACUUM LINE	INSTRUMENT PANEL OUTLETS ONLY
RED VACUUM LINE	WINDSHIELD, AND SIDE WINDOW DEFOGGER OUTLETS
GREY VACUUM LINE	WINDSHIELD AND SIDE WINDOW DEFOGGER, FLOOR AND INSTRUMENT PANEL OUTLETS
BLUE VACUUM LINE	FLOOR AND INSTRUMENT PANEL OUTLETS
ORANGE VACUUM LINE	BLOWER MOTOR AIR NOISE INCREASE
NO VACUUM LINES (ALL LINES VENTED TO ATMOSPHERE)	ALL OUTLETS

IMPROPER AIR DELIVERY

Figure 4

System Description

This system is operated completely by vacuum, except for the electrically powered blower motor. Engine vacuum is routed through a vacuum check valve then to the HVAC control vacuum selector valve and to the vacuum tank. The vacuum check valve is used to prevent vacuum loss due to heavy acceleration or steep uphill traveling when the engine is under a heavy load.

When vacuum is applied to a vacuum actuator, the vacuum actuator will apply sufficient force to overcome any resistance due to air flow from the blower motor and from the actuator internal spring, and move the air valve (door) to its correct position.

ON-VEHICLE SERVICE

TEMPERATURE CONTROL CABLE ADJUSTMENT

The temperature control cable cannot be adjusted. If the diagnosis determines improper operation, then the cable must be replaced.

REPLACEMENT PROCEDURES

HVAC Control and Temperature Control Cable

Figures 5 through 7

Remove or Disconnect

1. Instrument panel trim plate, I/P insulator, and I/P compartment. Refer to SECTION 8C.
2. Cable (12) at HVAC module (8).
3. Bolts/screws (34)
4. Pull HVAC control (1) away from instrument panel.
5. Electrical connectors from HVAC control (1).
6. Vacuum harness (60) from HVAC control (1).
7. HVAC control (1) with cable (12) attached.
 - Note cable routing.
8. Cable (12) from HVAC control (1).
 - Open tangs and separate cable (12).

Install or Connect

NOTICE: Refer to "Notice" on page 1B1-1 of this section.

Preliminary Inspection

1. Inspect vacuum lines at engine and vacuum check valve for proper connection.
2. Disconnect vacuum line at vacuum check valve. Start engine and check for presence of vacuum, if no vacuum is present, replace vacuum check valve.
3. Disconnect vacuum line leading to HVAC control at vacuum check valve. Apply vacuum to check valve port. If vacuum does not hold, replace vacuum check valve.
4. Make sure vacuum line multi-connector under instrument panel insulator is fully connected.
5. Refer to "Improper Air Delivery" diagnostic chart.

1. Cable (12) to HVAC control (1).
 - Align and snap cable (12) into place.
 2. Align HVAC control (1) with cable (12) attached to instrument panel.
 - Route cable properly.
 3. Vacuum harness (60) to HVAC control (1).
 4. Electrical connectors to HVAC control (1).
 5. Seat HVAC control (1) to instrument panel.
 6. Bolts/screws (34).
-  **Tighten**
- Bolts/screws (34) to 1.9 N·m (17 lb. in.).
7. Cable (12) to module (8).
 8. Instrument panel trim plate, I/P insulator, and I/P compartment. Refer to SECTION 8C.

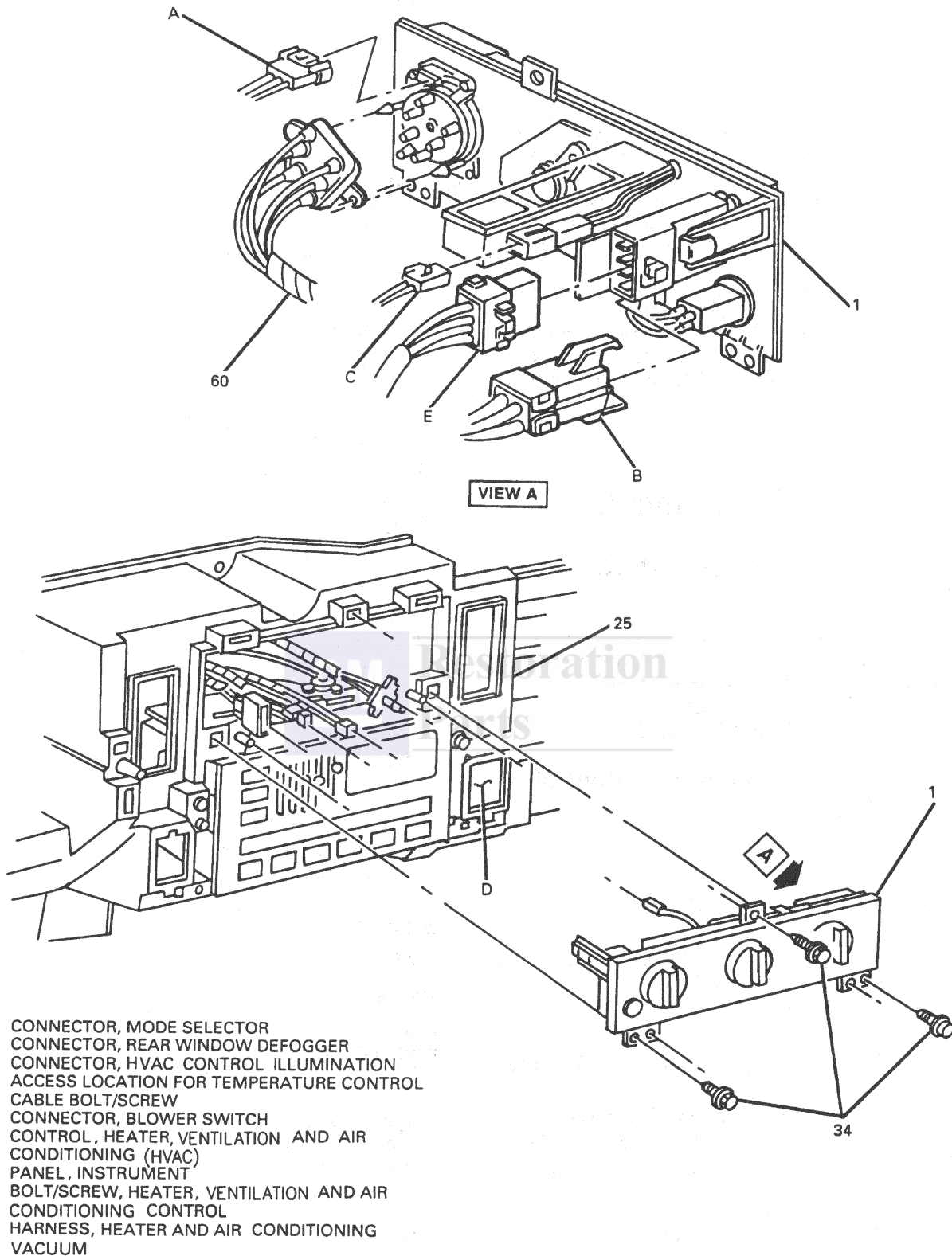
Blower Motor Resistor and Blower Motor Relay

Figure 8

Remove or Disconnect

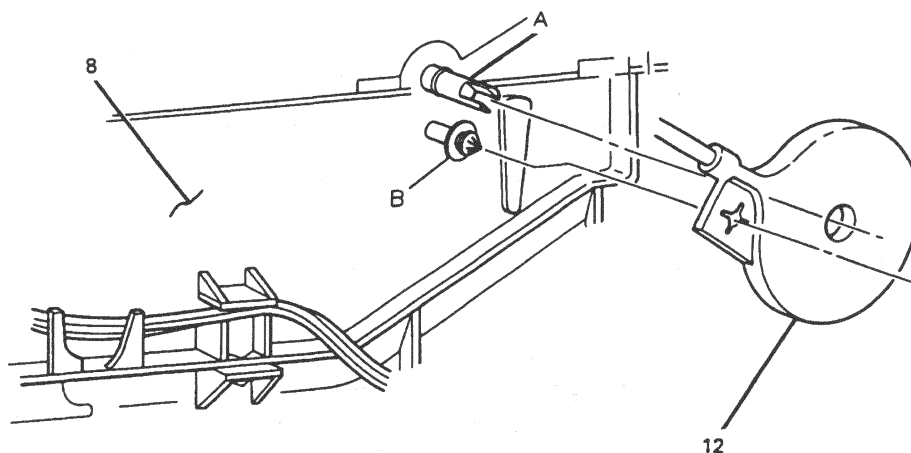
CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Instrument panel insulator. Refer to SECTION 8C.
3. Resistor (39), if required.
 - A. Disconnect blower motor resistor electrical connector.
 - B. Remove three bolts/screws (78) and guide resistor (39) out of bottom of heater and air conditioning module (8).



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Figure 5 - Heater Ventilation and Air Conditioning (HVAC) Control Removal



- A SHAFT, TEMPERATURE VALVE
- B STUD, TEMPERATURE CONTROL CABLE
- 8 MODULE, HEATER AND AIR CONDITIONING
- 12 CABLE, TEMPERATURE CONTROL

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Figure 7 - Temperature Control Cable-to-Module

4. Relay (40), if required.
 - A. Disconnect relay electrical connector.
 - B. Remove relay retaining bolt/screw and remove relay (40) from bottom of heater and air conditioning module.

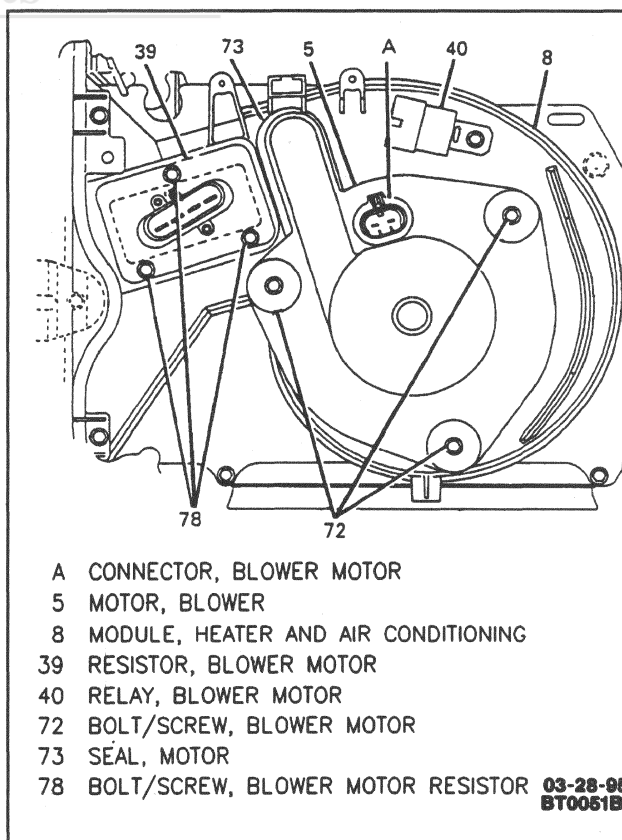
Install or Connect

NOTICE: Refer to "Notice" on page 1B1-1 of this section.

1. Relay (40), if removed.
 - A. Position relay (40) to bottom of heater and air conditioning module (8) and install retaining bolt/screw.
 - B. Connect relay electrical connector.
2. Resistor (39), if removed.
 - A. Insert resistor (39) into place in bottom of heater and air conditioning module (8).
 - B. Install three bolts/screws (78).

Tighten

- Bolts/screws (78) to 1.9 N·m (17 lb. in.).
- C. Connect resistor electrical connector.
- 3. Instrument panel insulator. Refer to SECTION 8C.
- 4. Battery negative cable.



- A CONNECTOR, BLOWER MOTOR
- 5 MOTOR, BLOWER
- 8 MODULE, HEATER AND AIR CONDITIONING
- 39 RESISTOR, BLOWER MOTOR
- 40 RELAY, BLOWER MOTOR
- 72 BOLT/SCREW, BLOWER MOTOR
- 73 SEAL, MOTOR
- 78 BOLT/SCREW, BLOWER MOTOR RESISTOR

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Figure 8 - Blower Motor Housing Area from Below

Air Conditioning Compressor Relay

The air conditioning compressor relay acts as an on/off switch in series in the circuit to the compressor clutch. When the powertrain control module (PCM) receives a signal indicating one or more specific operating conditions such as a wide-open throttle or excessive engine heat, the PCM opens the relay coil to open the relay contacts and to break the compressor clutch circuit.

This gives the PCM the ability to interrupt the operation of the air conditioning refrigeration system when necessary.

The relay is located inside the underhood electrical center on the right-hand front fender inner panel.

Vacuum Hose Harnesses**Figures 3 and 4**

It is not necessary to replace an entire vacuum harness in case of a localized leakage or hose collapse. A repair can be made by cutting the hose and inserting a plastic connector.

If an entire hose must be replaced, the entire HVAC module must be removed, Refer to SECTION 1B.

SPECIFICATIONS**GENERAL SPECIFICATIONS**

A/C System R-134a Capacity	0.79 kg (1 lb. 12 oz.)
A/C System Seal and Fitting	
Lubricant	Mineral Base 525 Viscosity Refrigerant Oil, GM P/N 12301108 or equivalent
A/C System Internal Lubricant (Including Compressor Assembly).....	Polyalkylene Glycol (PAG) Synthetic Refrigerant Oil, GM P/N 12345923 or equivalent

Oil Distribution

A/C Compressor Oil Capacity	Drain old compressor.
If less than 30 ml (1 oz.), add 30 ml (1 oz.).	
If more than 30 ml (1 oz.), add same amount.	
A/C Condenser Oil Capacity.....	30 ml (1 oz.)
A/C Evaporator Oil Capacity.....	90 ml (3 oz.)
A/C Accumulator Oil Capacity.....	105 ml (3.5 oz.)

FASTENER TIGHTENING SPECIFICATIONS

Blower Motor Bolt/Screw	1.9 N·m (17 lb. in.)
Blower Motor Resistor Bolt/Screw	1.9 N·m (17 lb. in.)
Heater, Ventilation and Air Conditioning/(HVAC) Control Bolt/Screw.....	1.9 N·m (17 lb. in.)

SECTION 1C

ELECTRONIC CONTROL AIR CONDITIONING (C67) AUTOMATIC CONTROL AIR CONDITIONING (C68)

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR), refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before doing any work on the A/C system, review the precautions on handling Refrigerant R134A. Also review the refrigerant recovery and recycling, adding oil, evacuating and charging procedures in HEATING AND AIR CONDITIONING (SECTION 1B).

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



Restoration

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DEFINITIONS (C67)

Several abbreviations and terms are commonly used throughout this section. They are presented here for reference and clarification.

- A/C - Air Conditioning.
- AIR DELIVERY MODE - Manner or place from which the air enters the passenger compartment.
- AMBIENT - What is immediately surrounding; for example, ambient air temperature is the temperature of the surrounding air.
- B + - Battery voltage.
- CCOT - Cycling Clutch Orifice Tube.
- CKT - Circuit.
- Electric Actuator - (air mix motor).

- GND - Ground.
- H-A/C Control - Heater and Air Conditioning Control.
- HVAC - Heater, Ventilation and Air Conditioning.
- IGN - Ignition.
- I/P - Instrument Panel.
- MODE VALVE - A vacuum controlled airflow-directing door that is installed in the heater, ventilation and air conditioning system.
- PCM - Powertrain Control Module.
- POT - Potentiometer.
- SIR - Supplemental Inflatable Restraint.
- TEMPERATURE VALVE - An airflow-directing device that blends heated and cooled air to obtain a desired interior temperature.

- **VACUUM ACTUATOR** - A device that when vacuum is applied to it, will move a mechanical arm. For example, a mode valve actuator.
- **VACUUM/ELECTRIC SOLENOID** - An electrical device that controls vacuum to a vacuum actuator or vacuum controlled device.

GENERAL DESCRIPTION (C67)

SYSTEM OVERVIEW

The electronic control air conditioning system is a manually select system with four blower motor speeds, eight mode setting and a "slide" type temperature lever. Although the electronic control air conditioning system is a manual select system, the vacuum actuators are used for air delivery, and the temperature valve is controlled electronically.

GENERAL OPERATION

BLOWER MOTOR SPEED SETTING

Blower motor speed is controlled by a four position switch in the H-A/C control which uses a low blower relay and blower motor resistor for all speeds except "HIGH." For "HIGH" speed operation, the H-A/C control uses a high blower relay which, when energized, sends direct battery voltage to the blower motor. For more information, refer to CHART 1C-7.

TEMPERATURE SETTINGS

Figure 1C-1

The temperature setting is adjusted using the temperature slide lever. The H-A/C control sends voltage to the electric actuator corresponding to the position of the temperature slide lever. The H-A/C control sends 0 volts or a voltage proportional to any intermediate setting. The electric actuator will then move the temperature valve to the appropriate position.

"OFF" Setting

When the off switch is activated, the blower motor will remain off, however, any air which enters as the vehicle is moving will be directed to the floor outlets. The discharge air temperature will continue to be controlled by the temperature valve.

"RECIRC" Setting

The "RECIRC" (recirculation) setting will activate the A/C setting, and also close the air inlet (recirculation) valve so most of the air entering the module is taken from the vehicle's interior.

"MIDDLE" Setting

The "MIDDLE" setting is an air delivery setting. When activated, air will be discharged through the instrument panel outlets. This setting will self-activate when either A/C or RECIRC switch is pressed.

"DEFOG" Setting

The "DEFOG" setting provides a 50/50 blend of air between the defroster outlet and the floor outlet. This setting also requests A/C to the PCM.

"FLOOR" Setting

The "FLOOR" setting, like "MIDDLE" and "BLEND," is an air delivery setting. When activated, air will be discharged through the floor outlet.

Defrost Setting

The defrost setting provides airflow to the defroster outlet with a small bleed to the floor outlets. This setting also requests A/C to the PCM.

REAR WINDOW DEFOGGER

Figure 1C-1

The rear window defogger on the C67 system operates the same as the C68 system. For information on the rear window defogger, refer to "Rear Window Defogger" under "Automatic Air Conditioning (C68)" in this section.

AIR DELIVERY SYSTEM

Figure 1C-2

Proper air delivery is achieved using a vacuum/electric solenoid which is controlled by manual input of the operator on the H-A/C control. For information and diagnostic procedures, refer to "Improper Air Delivery," CHART 1C-3.

REFRIGERATION SYSTEM

The refrigeration system functions the same as the automatic control air conditioning (C68) system. For diagnosis, refer to SECTION 1B.

IDLE SPEED CONTROL

In order to minimize the effects of compressor clutch operation on engine idle speed, the PCM is able to modify the engine idle speed during air conditioning mode operation. When the PCM receives the clutch engagement signal from the H-A/C control, in anticipation of the engine load, the PCM makes an adjustment in the idle speed before allowing the compressor to engage.

IDLE SPEED CONTROL POWER STEERING PRESSURE SWITCH

When the power steering pressure switch senses a heavy load of approximately 4827 kPa (700 psi), it sends a signal to the PCM. The PCM then de-energizes the air conditioning compressor relay to cut out use of the compressor. This will most likely happen when the operator of the vehicle makes a parking maneuver.

1C-4 AUTOMATIC CONTROL AIR CONDITIONING

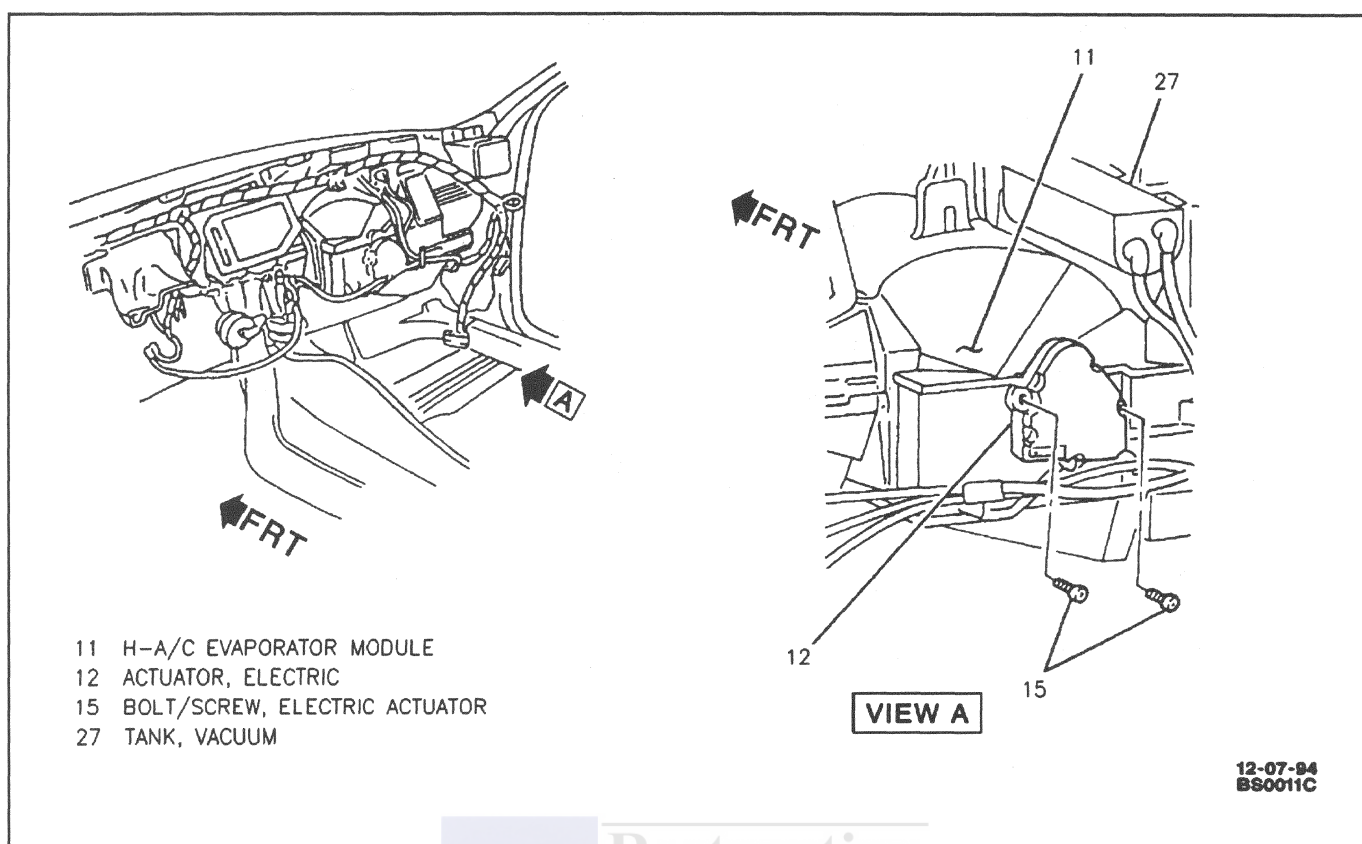


Figure 1C-1 - H-A/c Control (C67)

DIAGNOSIS (C67)

OVERVIEW

The electronic control air conditioning (C67) system does not have the ability to set diagnostic trouble codes or display any system parameters. Diagnosis must begin with the "System Response Chart (C67)." Refer to Figure 1C-2.

SYSTEM RESPONSE CHART (C67)

BLANK



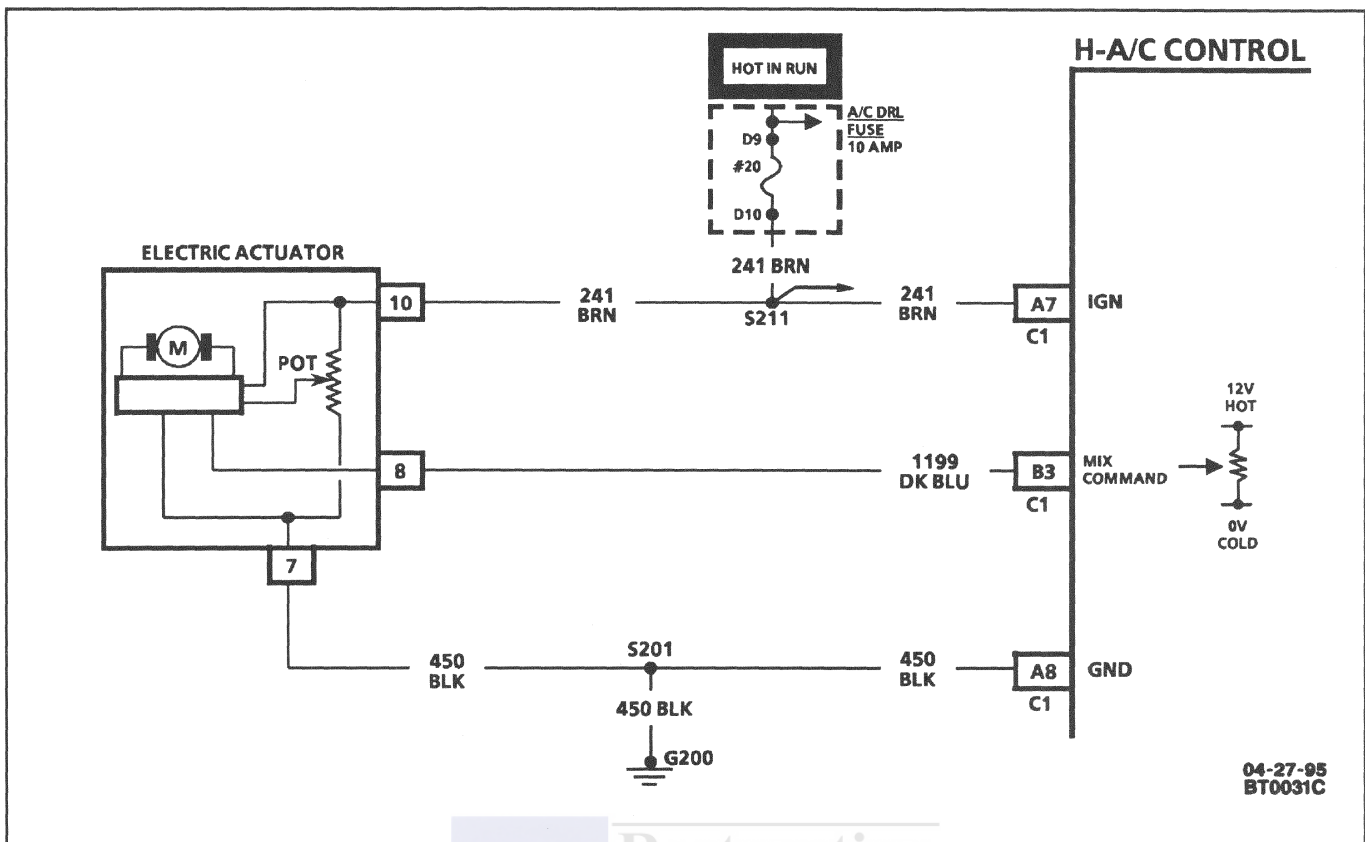


CHART 1C-1

INSUFFICIENT OR NO HEATING (C67)

Circuit Description:

The H-A/C control sends a voltage through CKT 1199 corresponding to the position of the temperature slide lever. The H-A/C sends 0 volts in the extreme cold position, 12 volts in the extreme hot position or a voltage proportional to any intermediate setting. The electric actuator has an internal potentiometer in it. Using internal feedback from the "POT," the electric actuator can move the temperature valve to its command.

Diagnostic Aids:

1. Check for proper engine coolant level.
2. Check engine for proper operating temperature (approximately 91°C (195°F)). If engine does not reach 91°C (195°F), replace thermostat.
3. With engine at normal operating temperature, check heater inlet and outlet hose temperature.
 - Heater inlet hose temperature should be at or near engine operating temperature.
 - Heater outlet hose temperature should be slightly cooler than the heater inlet hose.
 - If heater hose temperatures are incorrect, replace heater core.
4. Inspect plenum area (at base of windshield) for debris or anything that may cause airflow restriction.

CHART 1C-1 **INSUFFICIENT OR NO** **HEATING (C67)**

- PERFORM PRELIMINARY INSPECTION FIRST.
 - REMOVE RIGHT HAND TRIM PANEL.
 - OPEN GLOVE BOX PAST STOPS.
 - WITH IGNITION IN THE "RUN" POSITION, SLOWLY MOVE TEMPERATURE SLIDE FROM FULL HOT TO FULL COLD AND BACK TO FULL HOT.
- DOES ELECTRIC ACTUATOR DRIVE SHAFT ROTATE WHILE TEMPERATURE SLIDE IS MOVED?

YES

- REMOVE ELECTRIC ACTUATOR.
 - WITH ENGINE RUNNING AT NORMAL OPERATING TEMPERATURE, MANUALLY ROTATE TEMPERATURE VALVE SHAFT (ABOUT 65°) FROM STOP TO STOP.
- DOES TEMPERATURE VALVE SEAT IN BOTH DIRECTIONS WITH DISCHARGED AIR TEMPERATURE CHANGING FROM ABOUT AMBIENT TO AT LEAST 49°C (120°F).

YES

- REINSTALL ELECTRIC ACTUATOR WITH TEMPERATURE SLIDE LEVER IN THE FULL HOT POSITION.
- IS DISCHARGED AIR TEMPERATURE AT LEAST 60°C (140°F)?

YES

NO TROUBLE FOUND.

NO

REPLACE H-A/C MODULE.

NO

- DISCONNECT ELECTRIC ACTUATOR ELECTRICAL CONN.
 - WITH IGNITION IN THE "RUN" POSITION USING A DVM, CHECK FOR B+ AT TERM "10."
- IS B+ PRESENT AT TERM "10"?

YES

- CHECK TERM "7" FOR GROUND.
- IS GROUND PRESENT?

YES

- USING A DVM, MONITOR VOLTAGE AT TERM "8" WHILE MOVING TEMPERATURE SLIDE LEVER FROM FULL HOT TO FULL COLD.
- DOES VOLTAGE CHANGE FROM 12V TO 0V?

YES

REPLACE ELECTRIC ACTUATOR.

NO

REPAIR OPEN IN CKT 241 BETWEEN TERM "10" AND S211.

NO

REPAIR OPEN IN CKT 450 BETWEEN TERM "7" AND S201.

NO

- CHECK FOR AN OPEN OR SHORT TO GROUND IN CKT 1199.
- IF OK, REPLACE H-A/C CONTROL.

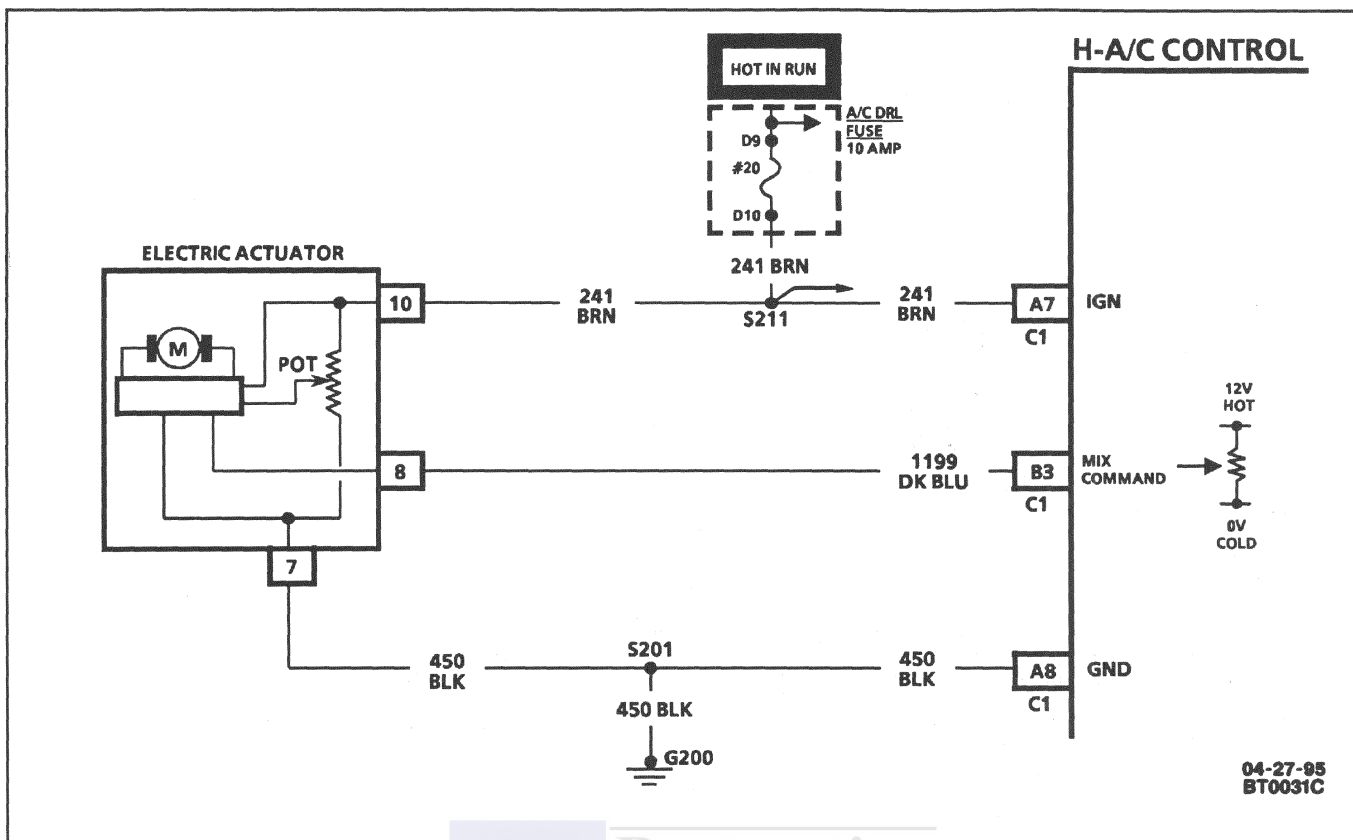


CHART 1C-2

INSUFFICIENT OR NO COOLING (C67)

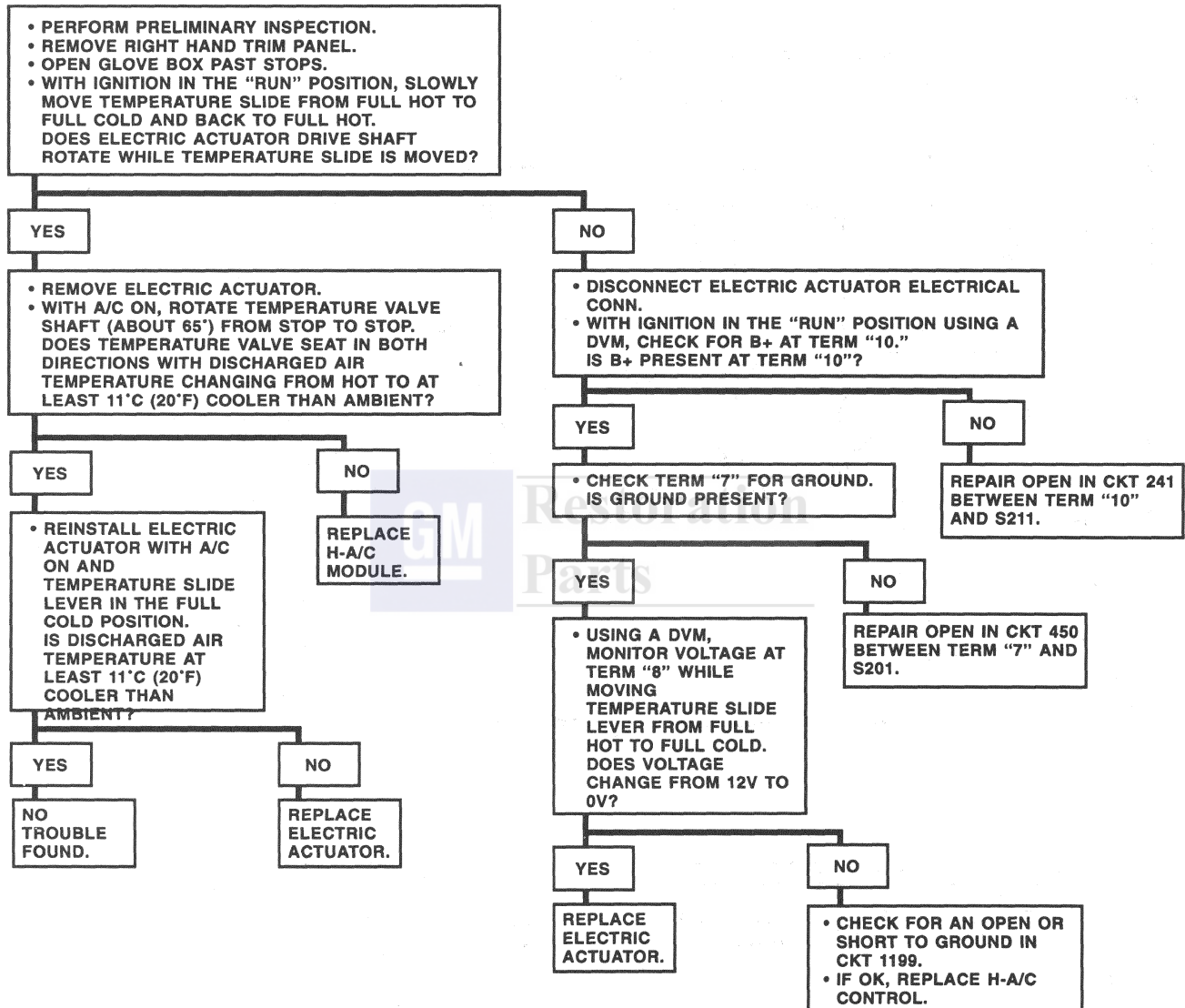
Circuit Description:

The H-A/C control sends a voltage through CKT 1199 corresponding to the position of the temperature slide lever. The H-A/C sends 0 volts in the extreme cold position, 12 volts in the extreme hot position or a voltage proportional to any intermediate setting. The electric actuator has an internal potentiometer in it. Using internal feedback from the "POT," the electric actuator can move the temperature valve to its command.

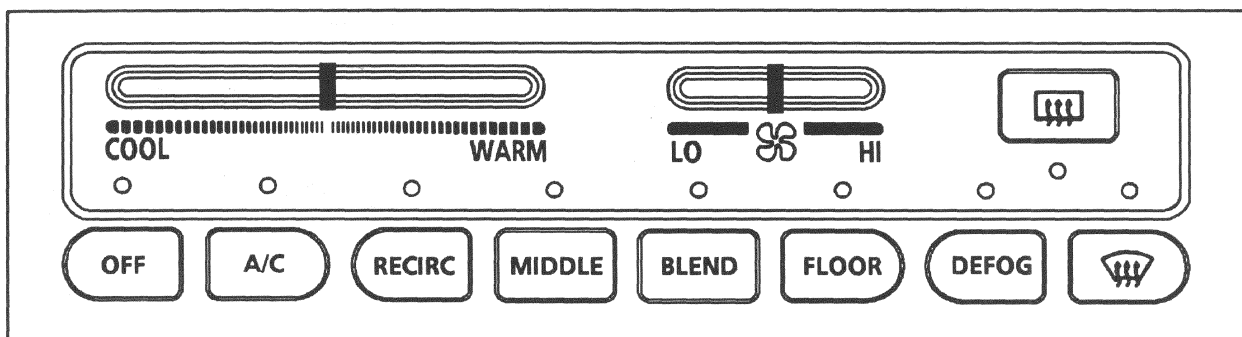
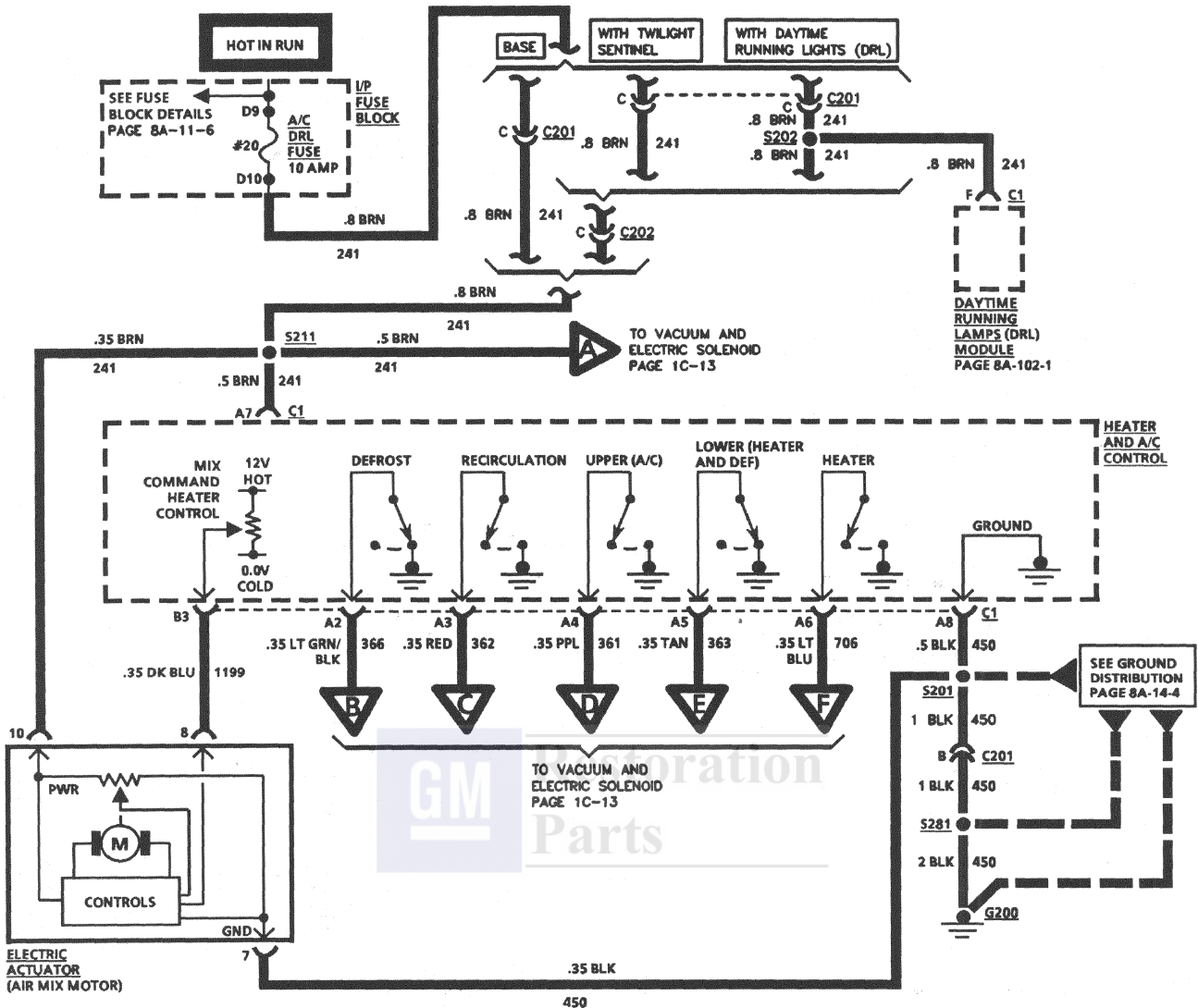
Diagnostic Aids:

1. Check to make sure instrument panel outlets are open by sliding levers to the left.
2. If vehicle is not equipped with engine driven cooling fan, check primary (right-hand) cooling fan for operation during air conditioning operation. If fan is inoperative, refer to SECTION 6E3-C12 for diagnosis.
3. Check the condenser for debris which may obstruct airflow through the fins.
4. Check the plenum area (at base of windshield) for any debris which may prevent proper airflow into the vehicle interior.
5. With air conditioning system operating, check accumulator temperature. Accumulator temperature should be near freezing (cold to touch). If this is not true, service the refrigeration system. Refer to SECTION 1B and "Refrigerant System Check," CHART 1C-6 in this section.
6. Check the air conditioning system for overcharge. If system is overcharged, recover, recycle, and recharge air conditioning system. There should be 0.8 kg (1 pound 12 ounces) of R-134a refrigerant.

CHART 1C-2 INSUFFICIENT OR NO COOLING (C67)



1C-10 AUTOMATIC CONTROL AIR CONDITIONING



HEATER AND A/C CONTROL

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Figure 1C-3-Air Delivery Schematic (C67)

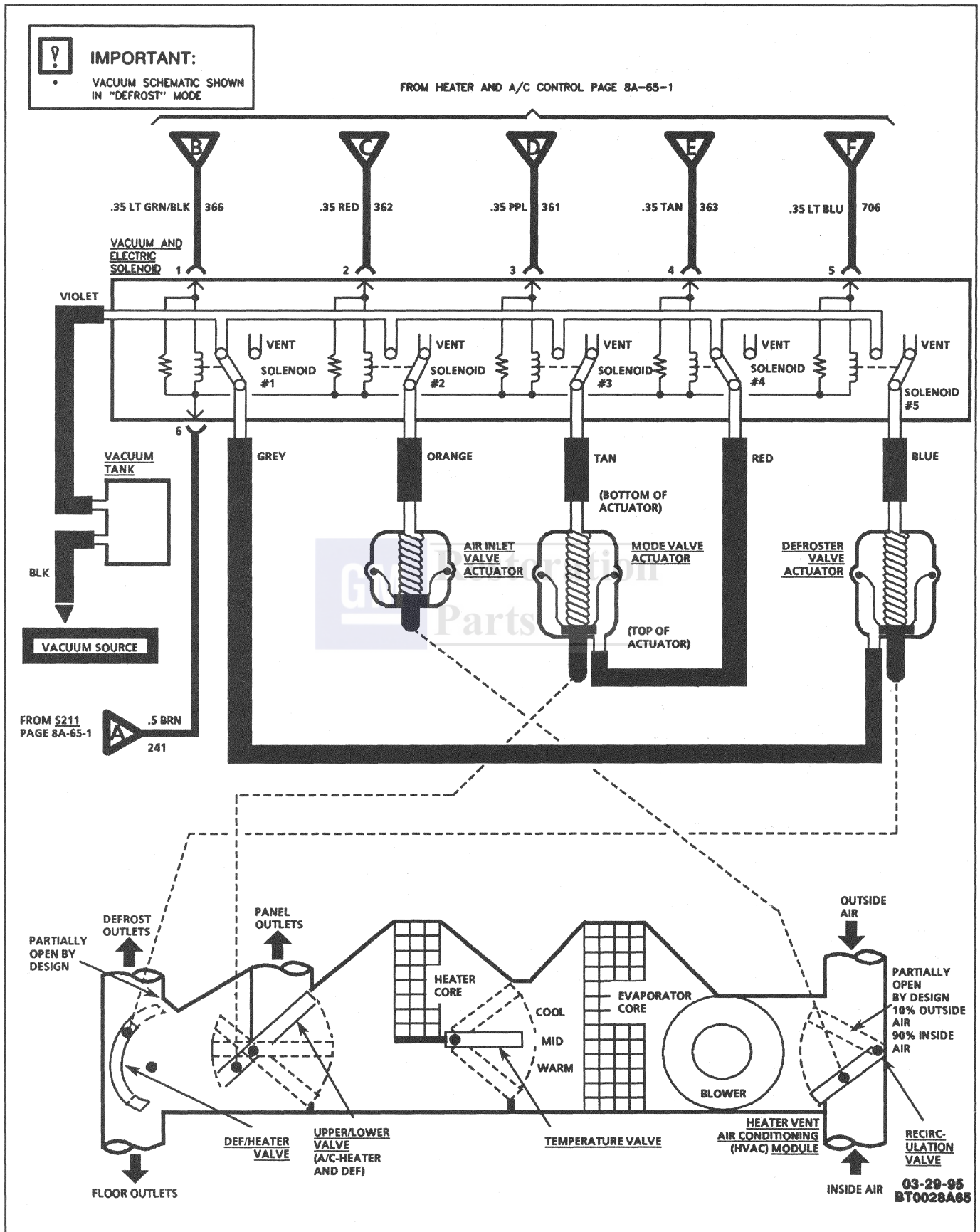


Figure 1C-4-Vacuum Schematic (C67)

1C-12 AUTOMATIC CONTROL AIR CONDITIONING

VACUUM HOSE COLOR - VACUUM/ ELECTRIC SOLENOID #	GRY - SOLENOID #1	ORN - SOLENOID #2	TAN - SOLENOID #3	RED - SOLENOID #4	BLU - SOLENOID #5
H-A/C CONTROL	DEFROSTER VALVE ACTUATOR (DEFROST)	AIR INLET VALVE ACTUATOR	MODE VALVE ACTUATOR (UPPER)	MODE VALVE ACTUATOR (LOWER)	DEFROSTER VALVE ACTUATOR (HEATER)
"AUTO/ECON" 16°C (60°F)	No VACUUM	VACUUM	VACUUM	No VACUUM	No VACUUM
"AUTO/ECON" 32°C (90°F)	No VACUUM	No VACUUM	No VACUUM	VACUUM	VACUUM
"OFF"	No VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM
DEF	VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM
"DEFOG"	No VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM
"BLEND"	No VACUUM	No VACUUM	No VACUUM	No VACUUM	VACUUM

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CHART 1C-3 IMPROPER AIR DELIVERY (C67)

Circuit Description:

Air Delivery

With the ignition switch in "RUN," voltage is applied through I/P fuse #20 to the H-A/C control. The operating mode of the system is determined by buttons on the front panel. Ground signals determine which air valves are to be operated as well as the position of the temperature valve.

The vacuum/electric solenoid contains the solenoid valves that control the vacuum actuators. When the solenoids are de-energized, the valves vent the vacuum actuators, allowing the vacuum actuator to return to the vent position.

Air Delivery

H-A/C Control

With the ignition switch in "RUN," voltage is applied through I/P fuse #20 to the H-A/C control. The operating mode of the system is determined by buttons on the front panel. Ground signals determine which air valves are to be operated as well as the position of the temperature valve.

Vacuum/Electric Solenoid

The vacuum/electric solenoid contains the solenoid valves that control the vacuum actuators. When the solenoids are de-energized, the valves vent the vacuum actuators, allowing the vacuum actuator to return to the vent position.

Recirculation Valve

The recirculation valve closes off most of the outside air inlet, so that the air from the inside of the vehicle is re-circulated through the A/C system for maximum cooling. The outside air inlet is partially closed when vacuum is applied to the actuator. When the air inlet valve actuator is vented, the recirculation valves close off the in-car air inlet which allows outside air to be drawn into the vehicle.

Temperature Valve

The temperature valve determines how much air flows through the heater core, which determines the temperature of the air to the outlets. It is moved by the temperature valve electric actuator. The position of the valve is determined by the temperature selected at the H-A/C control.

DEF/Heater

The DEF/heater valve determines whether air flow will be directed to the windshield defrost outlets. With vacuum applied to the gray hose at the defroster valve actuator, the valve is positioned to allow air flow to the windshield defrost outlets, with some bleed to the heater outlet.

Upper/Lower Mode

The upper/lower mode valve can assume three positions and is operated by a bi-directional vacuum port which can move the valve to either of two positions. If no vacuum is applied to either vacuum port, the valve is in mid-position. Air flow with the valve in mid-position will be delivered to the panel outlets and the floor outlets (Bi-Level). When the

upper/lower solenoid (#3) (tan vacuum hose) is operated, the valve is positioned to direct air flow to the A/C outlets. When the upper/lower solenoid (#4) (red vacuum hose) is operated, the valve is positioned to direct air flow to the heater outlets and defroster outlets.

Diagnostic Aids:

1. Make sure that ground G200 is clean and tight.
2. Check I/P fuse 20. If open, check for a short to ground in CKT 241.
3. Check for normal operation of engine vacuum check valve.

With engine warm and running in idle:

4. Check manifold vacuum at the violet hose from the vacuum tank to the electric solenoid.
5. Check for vacuum at the violet hose from the vacuum tank to the electric solenoid.
6. Check that the vacuum hoses from the electric solenoid to the vacuum actuators are connected and in good condition.
7. Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity/voltage check. Refer to SECTION 8A.
8. Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to SECTION 8A.

Vacuum Diagnosis

1. Check vacuum supply to vacuum/electric solenoid (black vacuum hose) while engine is running.
 - Vacuum should be approximately 38 to 43 cm Hg (15 to 16 inch Hg) with engine running.
 - Vacuum should remain at approximately 38 to 43 cm Hg (15 to 16 inch Hg) when engine is turned off.
2. Test each vacuum actuator by disconnecting the vacuum hose and applying vacuum directly to the actuator. Repair or replace as necessary.
3. Reconnect all vacuum and electrical connections. Run engine and cycle through the operating modes and full temperature range of the H-A/C control while observing the vacuum actuators.
 - Check for vacuum to the vacuum actuators by noting vacuum actuator position. When vacuum is applied, the actuator will retract refer to the top of page 1C-14.
 - If a vacuum actuator retracts when it should not, replace the H-A/C control, after performing the diagnostics on page 1C-16.
 - If a vacuum actuator does not retract when it should, check for vacuum leaks, collapsed vacuum hoses, binding valves or bad connections at the vacuum/electric solenoid. If OK, replace the vacuum/electric solenoid.



REFER TO FIGURES 1C-3 AND 1C-4.

CHART 1C-3

(Page 1 of 2)
IMPROPER AIR DELIVERY
(C67)

- TURN IGNITION SWITCH TO "RUN."
- WITH A DVM TO GROUND, BACKPROBE TERM "6" OF THE VACUUM ELECTRIC SOLENOID CONNECTOR. IS B+ INDICATED?

YES

NO

- TURN IGNITION "OFF."
- DISCONNECT THE VACUUM ELECTRIC SOLENOID CONNECTOR.
- USING A DVM, CHECK RESISTANCE OF THE VACUUM ELECTRIC SOLENOID TERMINALS "6" TO "1," "2," "3," "4" AND "5."
- IS RESISTANCE BETWEEN 70 TO 120 OHMS FOR ALL TERMINALS?

REPAIR OPEN OR SHORT TO GROUND IN CKT 241.

YES

NO

- RECONNECT THE VACUUM ELECTRIC SOLENOID CONNECTOR.
- TURN IGNITION TO "RUN."
- SET H-A/C CONTROL SWITCH TO "OFF."
- WITH A DVM TO B+, BACKPROBE TERMINALS "1," "2," "3," "4" AND "5" OF THE VACUUM ELECTRIC SOLENOID. B+ SHOULD BE INDICATED FOR TERMINAL "4" AND 0 VOLTS FOR TERMINALS "1," "2," "3," AND "5." IS IT?

- CHECK CONNECTIONS AT VACUUM ELECTRIC SOLENOID.
- IF OK, REPLACE VACUUM ELECTRIC SOLENOID.

YES

NO

- CHECK FOR SHORT TO GROUND IN CKT 363.
- IF OK, PROCEED WITH DIAGNOSIS.
- SET H-A/C CONTROL SWITCH TO "RECIRC."
- WITH A DVM TO B+, BACKPROBE TERMINALS "1," "2," "3," "4" AND "5" OF THE VACUUM ELECTRIC SOLENOID. B+ SHOULD BE INDICATED FOR TERMINAL "2," "3," AND 0 VOLTS FOR TERMINALS "4," "5," AND "1." IS IT?

- CHECK FOR OPEN OR SHORT TO B+ ON CKT 363.
- CHECK FOR SHORT TO GROUND IN CKTS 366, 362, 361, AND 706.
- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

YES

NO

- CHECK FOR SHORT TO GROUND IN CKT 362 AND 361.
- IF OK, PROCEED WITH DIAGNOSIS.
- SET H-A/C CONTROL SWITCH TO "MIDDLE."
- WITH A DVM TO B+, BACKPROBE TERMINALS "1," "2," "3," "4" AND "5" OF THE VACUUM ELECTRIC SOLENOID. B+ SHOULD BE INDICATED FOR TERMINAL "3" AND 0 VOLTS FOR TERMINALS "1," "2," "4," AND "5." IS IT?

- CHECK FOR OPEN OR SHORT TO B+ ON CKT 362 AND 361.
- CHECK FOR SHORT TO GROUND IN CKTS 706, 363, AND 366.
- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

YES

NO

- SET H-A/C CONTROL SWITCH TO "BLEND."
- WITH A DVM TO B+, BACKPROBE TERMINALS "1," "2," "3," "4" AND "5" OF THE VACUUM ELECTRIC SOLENOID. B+ SHOULD BE INDICATED FOR TERMINAL "5" AND 0 VOLTS FOR TERMINALS "1," "2," "3," AND "4." IS IT?

- CHECK FOR OPEN OR SHORT TO B+ IN CKT 361.
- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

A

(CONTINUED ON NEXT PAGE)

CHART 1C-3 **(Page 2 of 2)** **IMPROPER AIR DELIVERY** **(C67)**

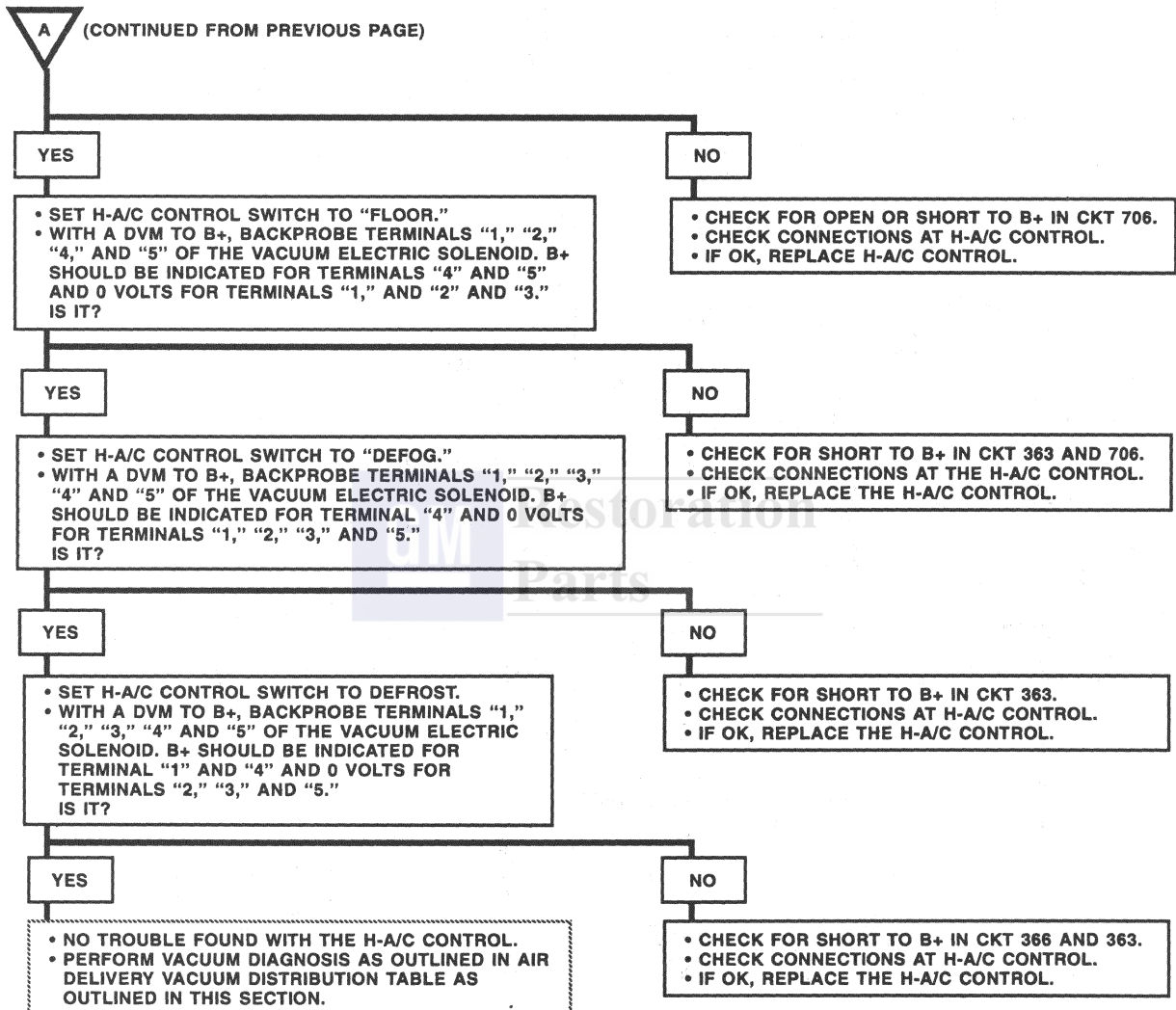


Figure 1C-5-Blower Control Schematic (C67)

Circuit Description:

The blower motor is a variable speed motor, which runs at a speed proportional to the applied voltage. The higher the voltage applied to the motor, the faster the speed.

While the ignition switch is in the "Run" position, battery voltage is applied to the H-A/C control through fuse #17. With the H-A/C control in the "OFF" position, no voltage is supplied to the blower motor.

When any other mode position is selected, voltage is applied to the H-A/C control blower switch and blower motor resistor, if not in "HI."

With the H-A/C control "ON," the low blower relay contacts will be closed, current will flow through CKT 60 to S264 through CKT 60 to terminal "A" of the blower motor resistor.

As the H-A/C control blower switch is moved through positions "M1" and "M2", the switch bypasses part of the blower resistor allowing more voltage to be applied to the blower motor, which will increase its speed.

When the H-A/C control blower switch is in the "HI" position, voltage is applied through CKT 52 to the coil of the high blower relay. The high blower relay energizes, removing the blower resistor from the circuit. Battery voltage is then applied directly to the blower motor through the high blower relay contacts. The motor runs at maximum speed.

Diagnostic Aids:

1. Check I/P fuse 17. If open, check for a short to ground in CKT 641.
2. Check Underhood maxifuse 10 for open. If open, check for short to ground through CKT 42.
3. Check G200 by noting normal operation of the underhood lamp or license lamp.
4. If blower motor is "ON" with ignition switch in "OFF," check for short to B+ on CKT 60, CKT 52, CKT 63, CKT 64, CKT 65, CKT 72 and CKT 101. If OK, replace high blower relay.
5. If blower motor is "ON" at all times with ignition switch in "RUN" and H-A/C selector switch is "OFF," check for short to ignition voltage on CKT 60, CKT 52, CKT 63, CKT 64, CKT 65, CKT 72 and CKT 101. If OK, replace H-A/C selector switch.
6. Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity/voltage check. Refer to SECTION 8A.
7. Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to SECTION 8A.



CHART 1C-4 **BLOWER INOPERATIVE AT** **ANY SPEED (C67)**

REFER TO FIGURE 1C-5.

- IGNITION SWITCH IN "RUN."
- HEATER-A/C CONTROL IN "RECIRC."
- HEATER-A/C CONTROL BLOWER SWITCH IN "HI."
- USING A TEST LIGHT, BACKPROBE BLOWER MOTOR HIGH SPEED RELAY CONN BETWEEN TERM "30" AND GROUND. IS TEST LIGHT "ON"?

NO

- BACKPROBE BLOWER MOTOR LOW SPEED RELAY CONN TERM "87" WITH A TEST LIGHT TO GROUND. IS TEST LIGHT "ON"?

NO

- BACKPROBE BLOWER MOTOR LOW SPEED RELAY CONN TERM "85" WITH A TEST LIGHT TO GROUND. DOES TEST LIGHT "LIGHT"?

YES

- BACKPROBE BLOWER MOTOR LOW SPEED RELAY CONN TERM "30" WITH A TEST LIGHT TO GROUND. DOES TEST LIGHT "LIGHT"?

YES

- CHECK GROUND CKT 450 FOR AN OPEN.
- IF OK, REPLACE BLOWER MOTOR LOW SPEED RELAY.

YES

- CHECK FOR OPEN IN CKT 65.
- CHECK FOR OPEN IN CKT 1150.
- CHECK FOR POOR CONNECTION AT BLOWER MOTOR.
- IF OK, REPLACE BLOWER MOTOR.

YES

- CHECK FOR POOR CONNECTIONS AT BLOWER MOTOR HIGH SPEED RELAY.
- IF OK, REPLACE BLOWER MOTOR HIGH SPEED RELAY.

NO

- CHECK CKT 64 FOR AN OPEN.
- IF OK, REPLACE HEATER-A/C CONTROL.

NO

- REPAIR OPEN OR SHORT TO GROUND IN CKT 641 TO 1/P FUSE 20.

CHART 1C-5

LOW SPEED INOPERATIVE, MEDIUM AND HIGH SPEEDS OPERATE NORMALLY (C67)

REFER TO FIGURE 1C-5.

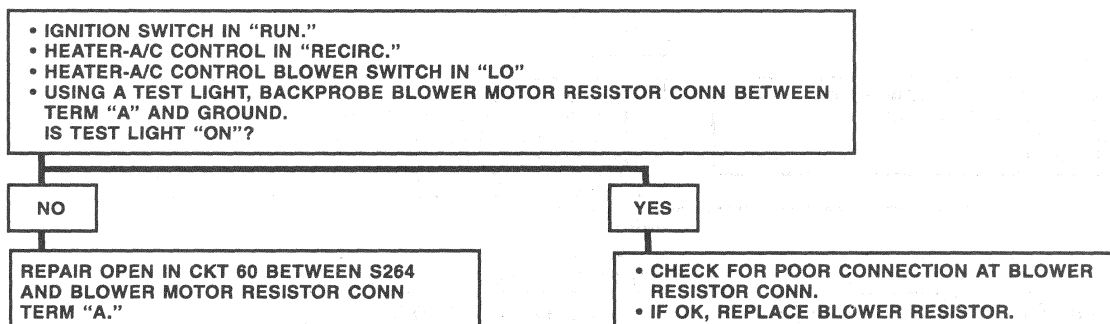


CHART 1C-6 **MEDIUM SPEED(S) INOPERATIVE, LOW** **AND HIGH SPEEDS OPERATE** **NORMALLY (C67)**

REFER TO FIGURE 1C-5.

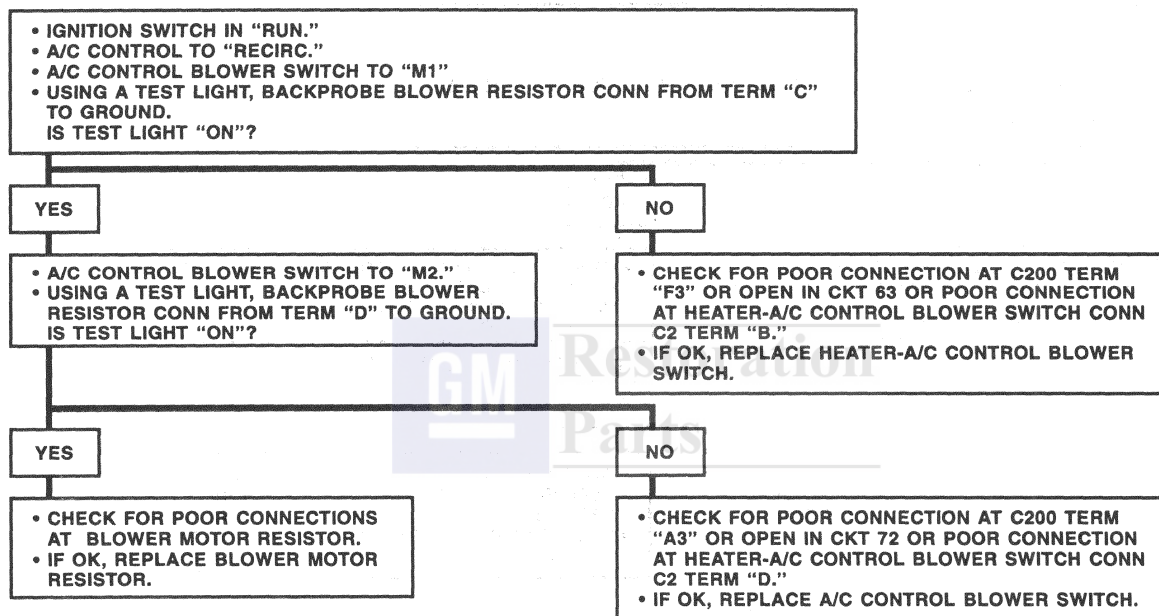
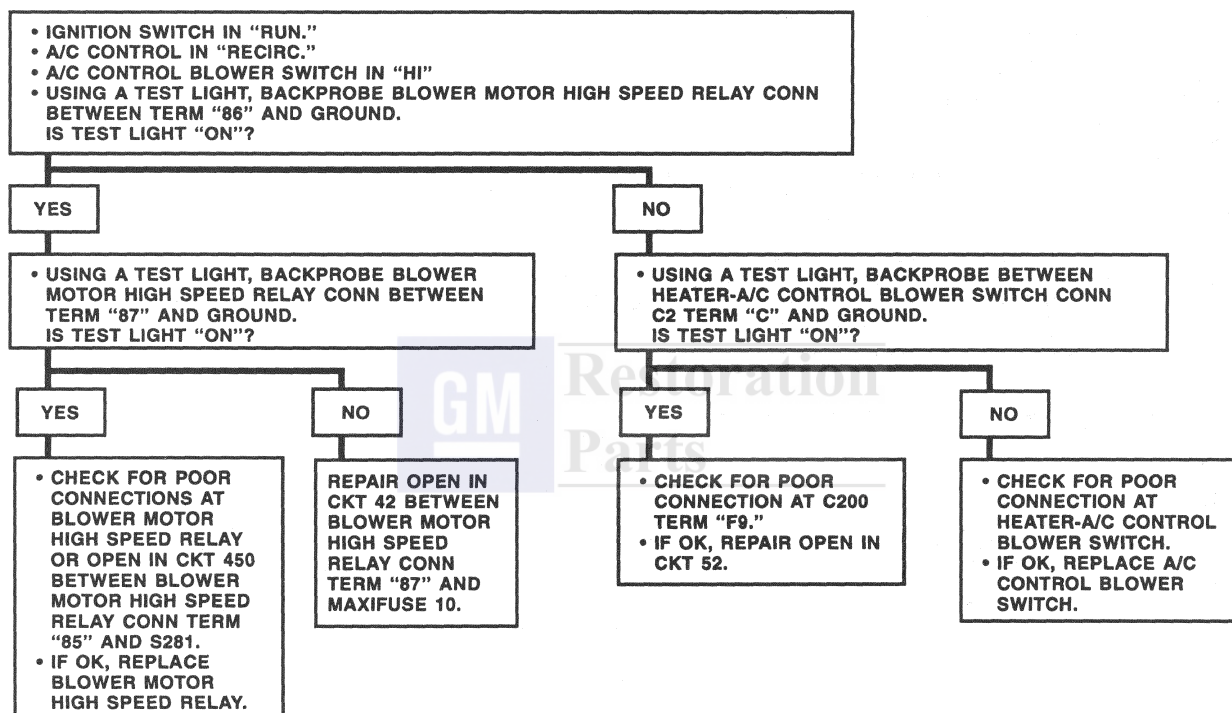


CHART 1C-7 HIGH SPEED INOPERATIVE, LOW AND MEDIUM SPEEDS OPERATE NORMALLY (C67)

REFER TO FIGURE 1C-5.



DEFINITIONS (C68)

Several abbreviations and terms are commonly used throughout this section. They are presented here for reference and clarification.

- ACAC - Automatic Control Air Conditioning.
- A/C - Air Conditioning.
- AIR DELIVERY MODE - Manner or place from which the air enters the passenger compartment.
- AMBIENT - What is immediately surrounding; for example, ambient air temperature is the temperature of the surrounding air.
- B + - Battery voltage.
- CCOT - Cycling Clutch Orifice Tube.
- CKT - Circuit.
- DLC - Data Link Connector.
- DTC - Diagnostic Trouble Code.
- Electric Actuator - (air mix motor).
- GND - Ground.
- H-A/C Control - Heater and Air Conditioning Control.
- HVAC - Heater, Ventilation and Air Conditioning.
- IGN - Ignition.
- I/P - Instrument Panel.
- MODE VALVE - A vacuum controlled airflow-directing door that is installed in the heater, ventilation and air conditioning system.
- PCM - Powertrain Control Module.
- POT - Potentiometer.
- PROGRAM NUMBER - A number calculated by the H-A/C control microprocessor, based on various inputs, that relates to the amount of heating and cooling required to maintain the set temperature. A program number of 0 indicates full cooling and 255 indicates full heating.
- RAM - Random Access Memory.
- SET TEMPERATURE - The desired interior temperature chosen by the operator.
- SDL - Serial Data Link.
- SIR - Supplemental Inflatable Restraint.
- TEMPERATURE VALVE - An airflow-directing device that blends heated and cooled air to obtain a desired interior temperature.
- THERMISTOR - An electrical device that changes resistance as temperature changes. When temperature increases, resistance decreases and when temperature decreases resistance increases.
- VACUUM ACTUATOR - A device that when vacuum is applied to it, will move a mechanical arm. For example, a mode valve actuator.
- VACUUM/ELECTRIC SOLENOID - An electrical device that controls vacuum to a vacuum actuator or vacuum controlled device.
- VF - Vacuum Fluorescent.

GENERAL DESCRIPTION (C68)

SYSTEM OVERVIEW

The automatic control air conditioning system can be used as a fully automatic interior climate control system, or as a partially automatic system that provides manual control of blower motor speed, compressor operation and/or air mode selection while temperature continues to be controlled automatically.

The main components that comprise this system are the heater and air conditioning control, powertrain control module (PCM), blower motor control module, air temperature sensors, heater and air conditioning evaporator module, and the refrigeration system.

The automatic control air conditioning system is more easily understood if it is divided into four categories. These are:

1. General Operation
2. Air Delivery System
3. Refrigeration System
4. Temperature Control System

In order to fully understand the automatic control air conditioning system you should first have a thorough understanding of the general operation, air delivery refrigeration system and temperature control system. If necessary, refer to SECTION 1B.

GENERAL OPERATION (C68)

BLOWER MOTOR CONTROL

Blower motor speed is controlled through a blower motor control module. The blower motor control module receives blower motor speed input from the H-A/C control. Power is supplied from a 30 ampere fuse (H-A/C MOD I/P fuse 40) in the fuse block and a "hot at all times" circuit that serves only the blower motor control module. For fuse location, refer to ELECTRICAL DIAGNOSIS 8A-11.

The blower motor control module will either transmit the full voltage of the circuit to the blower motor for high speed operation, or it will electronically reduce the voltage to provide a variable blower motor speed in automatic operation. For full manual blower motor control, two blower motor speeds are provided, high and low. For automatic control, three settings are provided; auto low, auto and auto high.

A branch circuit from the power feed line to the blower motor brings a voltage signal to the heater and air conditioning control. This provides the H-A/C control with feedback input on the actual blower motor speed.

When heating is required, blower motor operation after start-up will be delayed until engine coolant had reached a temperature adequate to provide heat unless defrost operation or blower motor speed is manually selected.

TEMPERATURE SETTINGS

Figure 1C-6

The various temperature settings work much the same way as a house thermostat. Settings are spaced out between 18°C (65°F) and 29°C (85°F). To change temperature settings, press the "TEMP" up or "TEMP" down switch until the desired temperature setting is displayed. Touching the same switch a second time after reaching the extreme will cause the setting to jump down to 16°C (60°F) or up to 32°C (90°F) and the system will deliver either maximum cooling or maximum heating, as appropriate. This selected temperature will continue until another temperature setting is selected. Air conditioning cannot occur if the mode selected is "OFF" or "VENT," as in these settings the compressor will not run.

"OFF" Setting

The "EXT TEMP" graphic will be displayed. With this setting selected the system will not let the blower motor or compressor run. The system will, however, still try to reach the set temperature. For example, if 21°C (70°F) is selected and it is a cold day, the vehicle may eventually reach the 21°C (70°F) range, but over a long period of time due to the blower motor not running. If it is a hot day, it can only cool the vehicle to around outside (ambient) air temperature since in this mode, the blower motor and compressor will not run. In this selection all air coming out of the evaporator module will be diverted to the floor outlets.

"VENT" Setting

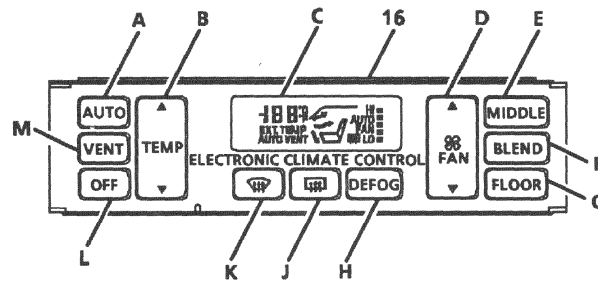
This switch provides an input to the H-A/C control, which controls the A/C compressor. Touching the "VENT" switch will interrupt the A/C request signal to the PCM. This prevents the added fuel consumption caused by the power drag of compressor operation. When operating in this mode, the H-A/C control graphic display will light "VENT" and the set temperature. Touching the "VENT" switch again will allow compressor operation.

While in the "VENT" mode, the system performs in the same manner as in "AUTO," with the exception that the A/C compressor is not enabled. When the "VENT" button is pushed, the set temp will be displayed for five seconds.

"AUTO" Setting

This switch, when touched, provides fully automatic operation. The compressor circuit is energized, providing all criteria is met, as described in SECTION 6E3-C-10, and temperature is controlled automatically to deliver air at the desired temperature setting. The air distribution mode and the speed of the blower motor will adjust to provide optimum interior comfort. The graphic display will show "AUTO" along with the set temperature (for five seconds) when automatic operation is selected.

In this mode, the system has the capability of any blower motor speed, any air inlet position, and any air outlet position to reach and maintain the set temperature. Depending on the heating or cooling requirements, most of the air will enter the passenger compartment from one or a combination of the



- A "AUTO" SWITCH
- B "TEMP" SWITCH
- C GRAPHIC DISPLAY
- D "FAN" (BLOWER MOTOR) SWITCH
- E "MIDDLE" SWITCH
- F "BLEND" SWITCH
- G "FLOOR" SWITCH
- H "DEFOG" SWITCH
- J REAR WINDOW DEFOGGER SWITCH
- K DEFROST SWITCH
- L "OFF" SWITCH
- M "VENT" SWITCH
- 16 H-A/C CONTROL

Figure 1C-6 - H-A/C Control (C68)

following four positions:

1. Out the floor outlets.
2. Out the instrument panel outlets.
3. Out the defroster outlet.
4. Defroster and floor outlets.

Defrost Setting

Touching this switch will direct most of the air to the windshield and some air to the heater outlet. The blower motor will be controlled automatically with no delay. The compressor will run whenever defrost is selected. Unless the low pressure cycling switch is open [below 165 kPa (24 psi)] or outside air temperature is below 2°C (35°F). This provides a dehumidifying effect that helps to remove frost faster. After start-up, the blower motor speed can be reduced by touching the FAN down switch. The set temp will display for five seconds.

"DEFOG" Setting

This switch, when touched, will provide a 50/50 air delivery blend between the defroster outlet and the floor outlets. During this setting, the blower motor will also be controlled automatically with no delay. The compressor will also be controlled automatically. This setting provides greater passenger comfort than defrost, but is not as effective in defrosting the windshield. The set temp will display for five seconds.

MANUAL MODE

If the "MIDDLE," "BLEND," "FLOOR" or "DEFOG" button is pushed, the automatic control air conditioning system will revert to manual operation until "AUTO" is pushed again. If the fan switch is

pushed at anytime, the blower control will also be in manual mode. Pushing "AUTO" or defrost will put the blower control back in "AUTO" mode.

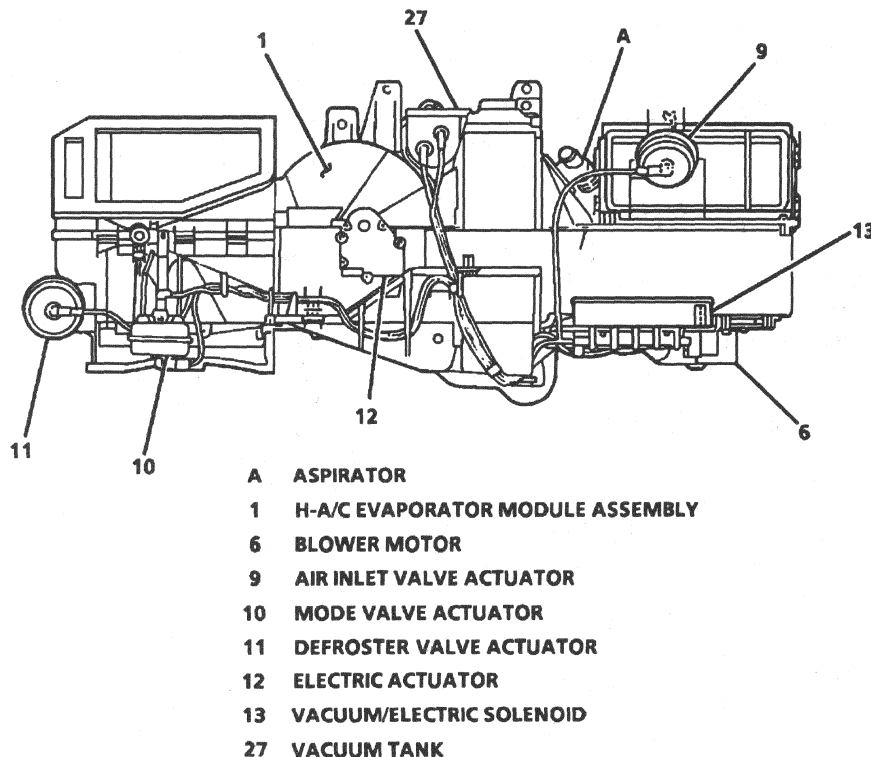
AIR DELIVERY SYSTEM

Figure 1C-7

The heater and air conditioning evaporator module incorporates most of the air conditioning components into one assembly. The function of the air delivery system is to distribute air flow through the vehicle. The major components are the air inlet valve, blower motor, evaporator, temperature valve, heater core, defroster valve, and the mode valve. For a description of operation, along with diagnostics and repair procedures, refer to CHART 1C-3 "Improper Air Delivery," in this section.

REFRIGERATION SYSTEM

The sole function of the refrigeration system is to maintain the evaporator temperature near freezing when air conditioning is requested. The major components, interconnected by hose and tube, that accomplish this are the A/C compressor, the condenser, the expansion (orifice) tube, the evaporator and the accumulators. For diagnosis, refer to "Chart 6: Refrigerant System Check," in this section. The location of the components and a description of operation, along with repair procedures and further diagnostics, are found in SECTION 1B.



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Figure 1C-7 - Heater and Air Conditioning Evaporator Module Assembly

TEMPERATURE CONTROL SYSTEM

The temperature control system is dependent upon the interaction of many electronic components. In the following paragraphs the location of these components, as well as a brief description of operation, are given.

CONTROL SYSTEM COMPONENTS

Heater and Air Conditioning Control (H-A/C Control)

The H-A/C control accomplishes automatic temperature control via a microprocessor that accepts input from momentary contact push buttons and external sensors to provide customer temperature control, as needed.

The H-A/C control will send signals to the electric actuator (air mix motor), vacuum/electric solenoid and blower motor control module. The H-A/C control will also display DTCs and ACAC data when used in diagnosing an ACAC complaint.

Powertrain Control Module (PCM)

The PCM contains a microprocessor that receives diagnostic mode and air conditioning requests from the H-A/C control. The H-A/C control receives engine coolant temperature, vehicle speed, engine rpm, air conditioning clutch status, and PCM system diagnostic trouble codes from the PCM. For additional information, refer to SECTION 6E3.

Sensor Inputs

Three sensor inputs are monitored by the H-A/C control to control the climate control system. Two temperature values and one sun load value are sent to the H-A/C control via thermistors and a reverse bias photo diode. Each of these sensors is described below.

Inside (In-Car) Air Temperature Sensor

The inside air temperature sensor is a thermistor. It is mounted at the top of the instrument panel, just above the instrument panel compartment. The sensor fits within a short horizontal tube connected to an aspirator on the evaporator module. Airflow from the blower motor tends to draw a continual stream of air through the aspirator and the sensor. This forced flow of inside air over the thermistor provides a constantly updated inside air temperature signal to the H-A/C control.

Resistance of the inside air temperature sensor thermistor varies from 100,701 ohms at -40°C (-40°F) to 282 ohms at 85°C (185°F). The H-A/C control supplies a 5-volt reference voltage to the thermistor and measures the voltage drop in the circuit to tell whether the mode, blower motor speed, or the temperature valve position must be changed. Refer to "Temperature Valve Position" in this section.

Outside Air Temperature Sensor

The outside air temperature sensor is mounted to the radiator center support, just below the hood latch. In this position, it is exposed to airflow through the grille before the air enters the radiator. This provides a sample of outside (ambient) air temperature.

Resistance of the sensor varies from 100,701 ohms at -40°C (-40°F) to 667 ohms at 60°C (140°F). The H-A/C control supplies a constant 5 volt reference voltage to the thermistor and measures the voltage drop in circuit to obtain a temperature signal.

This signal is an input that tells the H-A/C control how much cooling or heating will be required to deliver air at the desired temperature to the passenger compartment. It also affects the mode and blower motor speed.

Sun Load Temperature Sensor

The sun load sensor is in the left side of the windshield defroster nozzle grille in the instrument panel upper trim pad, close to the windshield. The sensor is a reverse bias photo diode - a dome type sensor that responds to varying degrees of sunlight by permitting more or less of the 5-volt reference voltage to flow through the circuit. The effect of the sensor in bright sunlight is as if the temperature setting was lowered by as much as 3 degrees.

Blower Motor Control Module

The blower motor control module controls the operation of the blower motor, and is attached to the bottom of the evaporator module, just to the left of the blower motor. Two multi-connectors from the body wiring harness are connected to terminals on the bottom of the blower motor control module. The blower motor control module receives blower drive signals from the H-A/C control which are amplified into strong output signals proportional to the input. The blower motor control module is transistorized and it provides variable blower motor speeds. A large heat sink, attached to the blower motor control module, protrudes into the evaporator air stream as a means of dissipating the heat which the blower motor control module generates. Commanded blower motor speed can be monitored under pointer number "-07." Refer to "Diagnostic Parameters" in this section.

Rear Window Defogger

Figure 1C-6

The rear window defogger is energized by pressing the defogger switch. Current flows from the rear defogger circuit breaker through the rear defogger relay to the rear window. Electrically conductive horizontal grid lines are bonded to the inside of the rear window. When the grid lines are subjected to current flow, the rear window is heated and the surface is defogged. The outside rearview mirrors (if equipped) are defogged at the same time.

When the defogger switch is pressed, a signal is sent to the H-A/C control. The H-A/C control grounds the rear defogger relay to allow current to flow. The H-A/C control will de-energize the relay after ten minutes. Additional five minute periods of heating can be obtained each time the switch is pressed until a new ignition cycle occurs. The defogger can be manually shut off at anytime during its operating cycle by pressing the defogger switch or turning off the

ignition. The small defogger symbol will appear near the lower right corner of the graphic display area when the rear window defogger is operating.

CLIMATE CONTROL FEATURES

Program Number

The program number is a number calculated by the H-A/C control to express the amount of heating and cooling required to meet the desired inside temperature. This number is based upon the following variables:

- Set temperature.
- Outside temperature.
- Inside temperature.
- Sun load.

The calculated program number is used to determine the proper air delivery mode and blower motor speed, and is a factor in determining the temperature valve position. A program number of 0 represents maximum system cooling and 255 represents maximum system heating. As the inside temperature nears the set temperature, the program number changes to maintain the set temperature.

The program number can be observed while in the diagnostic model, refer to "ACAC Diagnostic System Check" in this section. A self-diagnostic feature allows the service technician to manually override the calculation of the program number to observe system operation throughout the working range.

Temperature Valve Position (Mix Door)

The proper temperature valve position is determined by the H-A/C control. In order to provide the proper mix of warm and cool air, the H-A/C control monitors the program number.

When inputs indicate a need to move the temperature valve, the H-A/C control sends a voltage signal to the electrical actuator motor of the temperature valve on the evaporator module. The motor is a reversible drive motor. Temperature valve movement is commanded through CKT 1199 from the H-A/C Control (PIN C7) to the actuator (PIN 6). Zero volts means move to hot position, 2.5 volts mean stop and 5 volts mean move to cold (all reading ± 0.5 volts). In this manner, the H-A/C control moves the temperature valve to its proper position.

A feedback potentiometer (a variable rheostat) built into the electric actuator motor monitors the temperature valve and sends a reference signal corresponding to the position of the valve. This signal is transmitted to the H-A/C control indicating the present position of the valve. From this input, the H-A/C control determines exactly where to stop moving the valve. Commanded Temperature Valve Position can be seen at pointer -25. Actual can be seen at pointer -20. This signal is in A/D counts. 5 A/D counts means maximum heating. 255 A/D counts means maximum cooling.

Air Delivery Mode Control

The various temperature settings discussed under "Temperature Settings" in this section are used in order to provide comfortable heating or cooling. The H-A/C control will direct the blended air in one of several air delivery modes. The air is directed to the outlets by commanding the vacuum/electric solenoid to energize specific vacuum actuators controlling the appropriate combination of valves. The H-A/C control determines the proper air delivery mode based upon the current program number, set temperature and selected mode. Air delivery mode can be observed in pointer number "-27". Refer to "Diagnostic Pointers and Parameters" in this section.

In addition, the H-A/C control will remember the last previous temperature setting (and the blower motor speed setting if operating in "AUTO") and display the same setting the next time the ignition is turned "ON."

The vacuum/electric solenoid is attached to a vacuum manifold that is supplied by a hose from the vacuum tank on the top of the heater and air conditioning evaporator module. In the vacuum/electric solenoid, five individual solenoids each control a vacuum valve within the solenoid. When its solenoid is energized, each valve feeds vacuum to a hose leading to its associated vacuum actuator. When its solenoid is de-energized, the valve vents the hose to normal air pressure.

Off Mode

When the "OFF" switch is activated the blower motor will remain off, however, any air which enters as the vehicle is moving will be directed to the floor outlets. The discharge air temperature will continue to be controlled by the temperature valve.

Recirculation Mode (RECIRC) Mode

When in this mode, air is delivered to the instrument panel outlets and the air inlet valve closes to force interior air to recirculate through the evaporator for maximum cooling.

Air Conditioning Mode (MIDDLE)

Air inlet valve is open to provide outside air to the instrument panel outlets.

Bi-Level Mode (BLEND)

Provides outside air to floor outlet with a bleed to defroster outlet.

Heat Mode (FLOOR)

Provides outside air to floor outlet with a bleed to defroster outlet.

Defog Mode

Air will be split equally between the defroster and heater outlets.

Defrost Mode

Provides outside air to defroster outlet with a bleed to floor outlets.

Delay Mode

A delay mode is needed for cool climates in which the vehicle will be going through a cold start. During a cold weather start, warm moisture from the breath of the vehicle occupant(s) may condense as a fog on the windshield. When conditions are likely to cause this problem, a delay mode program sets the air valves to deliver airflow to the windshield through the defroster outlet. With the "AUTO" switch set for automatic operation, a low blower speed is automatically selected to minimize windshield frost or fogging. When engine temperature reaches 35°C (95°F) or within 3 minutes, whichever comes first, the automatic control air conditioning system will revert to its normal operating mode.

Purge Mode (Cold Purge)

During a start in cool weather with a still warm engine, the humid air which collects around the heater core inside the evaporator module could cause windshield fogging. To prevent this, a purge routine is programmed into the H-A/C control. With coolant temperature at least 16°C (60°F) and the blower motor and air distribution in the "AUTO" mode, the air valves will move to guide the airflow away from the windshield. During the first 5 seconds, while the air valves are moving into position, the blower motor will not run. Then for the next 15 seconds, a low blower motor speed purges the moist air from the system. After that, the system goes to the normal operating mode.

AIR CONDITIONING PURGE MODE

During a start in warm weather, warm moist air can accumulate around the evaporator (from previous air conditioning operation and heat soak from the sun). To divert this undesirable air from the driver's face, the H-A/C control will disable the blower motor for five seconds while the mode valves position to divert the air to the floor outlets. After positioning the mode valves, the heater and air conditioning control will set the blower motor on low for 10 seconds to "purge" the air from the module before returning to "AUTO" mode.

COMPRESSOR CLUTCH CONTROL

The H-A/C control will request the air conditioning compressor clutch to be enabled for all modes when "AUTO," "DEFOG" or "DEFROST" is selected. For ambient temperatures above 2°C (35°F), the H-A/C control will request the compressor clutch to be enabled. For ambient temperatures below 2°C (35°F), the H-A/C control will not request the compressor clutch to be enabled. Once it has been determined that this condition exists, the ambient temperature must rise above 4°C (40°F) in order for the H-A/C control to request the compressor clutch to be enabled. When the system is in the "OFF" or "VENT" mode, the H-A/C control will not request the clutch to be enabled.

IDLE SPEED CONTROL

In order to minimize the effects of compressor clutch operation on engine idle speed, the PCM is able to modify the engine idle speed during air

conditioning mode operation. When the PCM receives the clutch engagement signal from the H-A/C control, in anticipation of the engine load, the PCM makes an adjustment in the idle speed before allowing the compressor to engage.

IDLE SPEED CONTROL POWER STEERING PRESSURE SWITCH

When the power steering pressure switch senses a heavy load of approximately 4827 kPa (700 psi), it sends a signal to the PCM. The PCM de-energizes the air conditioning compressor relay to cut out use of the compressor. This will most likely happen when the operator of the vehicle makes a parking maneuver.

DIAGNOSIS**OVERVIEW**

To diagnose the climate control system in the shortest time, it is important to know how a properly functioning system will perform.

**Important**

- Diagnosis of all climate control functions must begin with the "ACAC System Check." in this section. This quick test can save time and lead to the correct diagnosis procedure to repair the problem.

ACAC DIAGNOSTIC SYSTEM CHECK

Figures 1C-8, 1C-9, and 1C-12

If the ACAC system detects an error within the HVAC system, a current and history diagnostic trouble code (DTC) will be set. Once the failure is no longer detected, the DTC will be stored only as history trouble code. A two-digit code is a current DTC and the same two-digit code preceded by a "1" is a history DTC. History codes will be stored for 199 ignition cycles. When the counter gets to 199, all history trouble codes will be cleared and the counter will be set back to zero. There will not be any indication to the operator that a failure has been detected or that a current or history trouble code is stored in the H-A/C control memory unless the self-diagnostic mode is entered.

If an HVAC DTC is set, the H-A/C control will use a "default value" until the DTC has been cleared or repaired. To enter the "ACAC Diagnostic System Check," press the "TEMP" up switch and the "OFF" switch on the control panel at the same time. Upon entry, a segment check will be performed and then the graphic display will show pointer number "-00". If the compressor clutch is being requested, the "EXT TEMP" graphics will be displayed. The fan up and fan down switch can be used to increase and decrease the pointer number. The "MIDDLE" switch can be used to change from pointer number -02 to DTC or parameter values for pointers "05-31."

ACAC SYSTEM CHECK

! IMPORTANT:

- IF YOU HAVE NOT REVIEWED THE BASIC INFORMATION ON HOW TO USE THE COMPUTER SELF-DIAGNOSTICS, REFER TO "ON-BOARD DIAGNOSTIC SYSTEM CHECK" IN THIS SECTION.

- TURN IGNITION TO "RUN" AND ENTER DIAGNOSTICS.
- ARE ANY HVAC DIAGNOSTIC TROUBLE CODES (DTC) DISPLAYED?
(IF H-A/C CONTROL DISPLAY IS BLANK, REFER TO "CHART 8; INOPERATIVE H-A/C CONTROL" IN THIS SECTION.)

NO DTC DISPLAYED.

- DTC DISPLAYED.
- REFER TO "DIAGNOSTIC TROUBLE CODES (DTC)" IN THIS SECTION.

H-A/C CONTROL OPERATIVE BUT WILL NOT ENTER DIAGNOSTICS.

REPLACE H-A/C CONTROL.

- EXIT DIAGNOSTICS.
- START ENGINE.
- SELECT 16°C (60°F) AND "HI" BLOWER MOTOR ASSEMBLY SPEED.
- AMBIENT TEMPERATURE MUST BE ABOVE 10°C (50°F).
- DO BLOWER MOTOR AND COMPRESSOR OPERATE?

BOTH BLOWER MOTOR AND COMPRESSOR OPERATE.

NO COMPRESSOR OPERATION.

BLOWER MOTOR DOES NOT OPERATE.

BOTH BLOWER MOTOR AND COMPRESSOR DO NOT OPERATE.

INSTALL GAGE SET IS A/C LOW SIDE PRESSURE ABOVE 55 psi?

REFER TO CHART 1 IN THIS SECTION.

REFER TO CHART 1 IN THIS SECTION AND SECTION 6E3-C10.

YES

NO

REFER TO SECTION 6E3-C10.

LEAK CHECK A/C SYSTEM. REFER TO SECTION 1B.

• IF COMPLAINT IS:

- | | |
|--|-----------------|
| - IMPROPER AIR DELIVERY | SEE CHART 1C-3. |
| - INSUFFICIENT OR NOT HEATING | SEE CHART 1C-4. |
| - INSUFFICIENT OR NO COOLING | SEE CHART 1C-5. |
| - IMPROPER DEFOGGER OR HEATED MIRROR OPERATION | SEE CHART 1C-7. |
| - INCORRECT OUTSIDE AIR TEMPERATURE DISPLAY | SEE CHART 1C-9. |

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Figure 1C-8 - ACAC Diagnostic System Check Operation Flow Chart

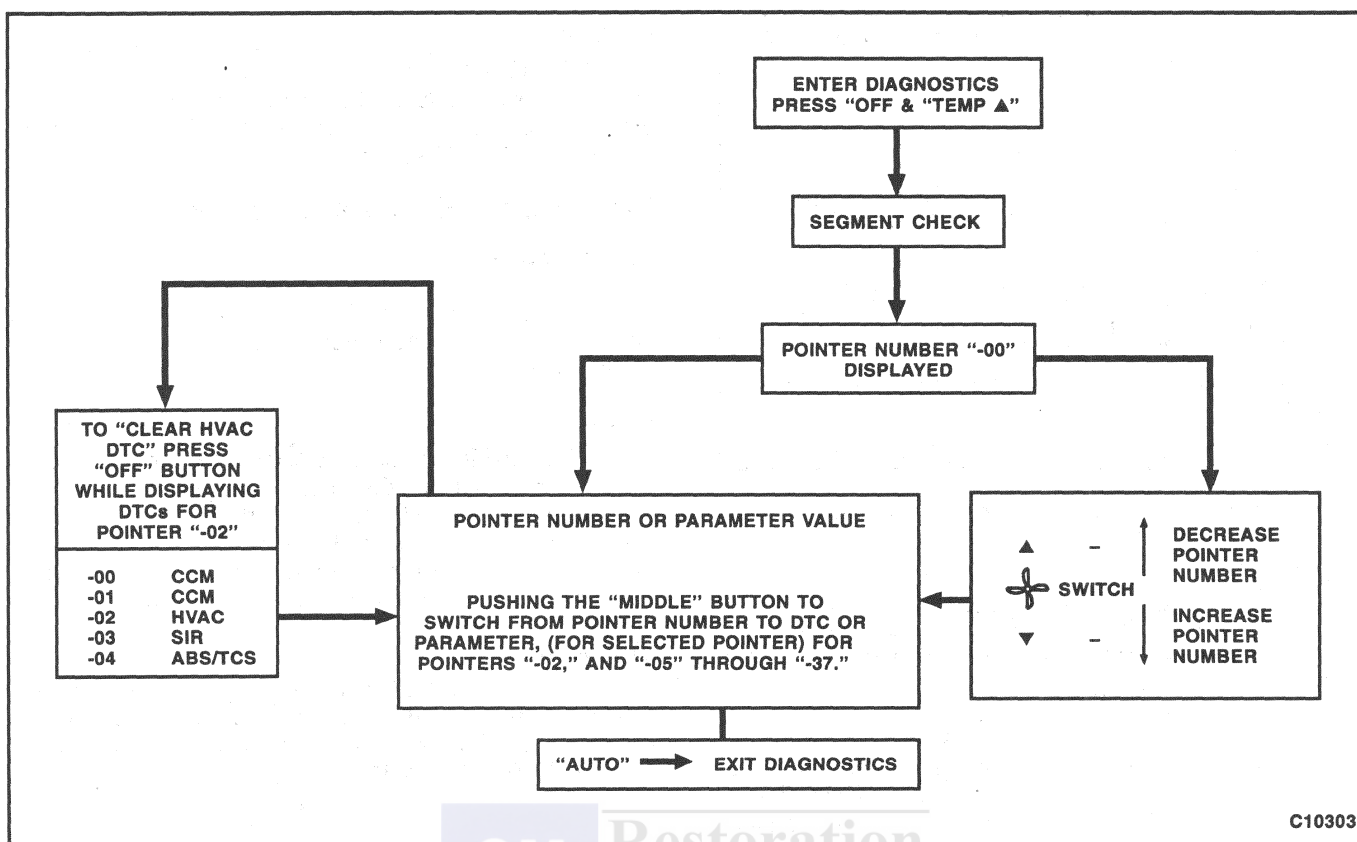


Figure 1C-9 - On-board Diagnostic System Check Operation Flow Chart

To display HVAC DTCs, select pointer number “-02”, and press the “MIDDLE” switch. At this time any current and history trouble codes will be displayed. A failure indicates that the control has detected an open, short to ground or faulty component in that circuit. While that failure is detected, the control will use a default value. When the graphic display is displaying numbers 200 to 299, they appear as numbers 100 through 199 with a “-” in front of them. For example, the value of 200 would be displayed as “-100.”

HVAC DTCs can be cleared from H-A/C control by pressing the “OFF” button while in diagnostic pointer number “-02” while the HVAC DTCs are displaying.

To exit the self-diagnostic mode, press the “AUTO” switch.

TECH 1

The **Tech 1** can also be used to display HVAC DTCs, clear HVAC DTCs and display HVAC data.

HVAC DTCs in the Tech 1 will display as a three digit number. The H-A/C control HVAC DTC 01 (current) [DTC 101 (history)] will display in the Tech 1 as 001C (current) and DTC 001H (history). The remaining HVAC DTCs will display in a like manner.

Looking at other systems on CKT 800 (with a scan tool) and returning to the “HVAC” selection can cause an HVAC DTC 26 to set in the H-A/C control. When diagnosing an HVAC DTC 26, clear the DTC and check for HVAC DTCs again.

The **Tech 1** cartridge used for the **Tech 1** is mass storage cartridge #3000003. Refer to the **Tech 1** operators manual for further information on Tech 1 use and procedures. Below is a list of HVAC data that can be read in the Tech 1.

HVAC Program No.	0-255
Air Delivery Mode	See table
Blower Duty Cycle	0%-50%
A/C Comp On Time	0 = OFF, 1 = ON
Mix Door Com	0-255
Mix Door FDBK	0-255
In-car Air Temp	(Temp display in) C°/F°
Ambient Air Temp	(Temp display in) C°/F°
Sun Load Input	A/D counts
HVAC Program No.	A/D counts
Full Cold Pos.	A/D counts
Full Hot Pos.	A/D counts

"ON-BOARD" DISPLAY	TECH 1 DISPLAY
00 = OFF	OFF
01 = RECIRC	RECIRC
02 = AC (MIDDLE)	AC (MIDDLE)
03 = BI-LEVEL (BLEND)	BI-LEVEL (BLEND)
04 = DEFOG	DEFOG
05 = HEAT (FLOOR)	HEAT (FLOOR)
06 = DEFROST	DEFROST
07 = DELAY	DELAY
08 = PURGE	PURGE
09 = A/C PURGE	A/C PURGE

Diagnostic Pointers and Parameters

Figure 1C-9

Refer to Figure 1C-9 for a list diagnostic pointers and parameters with their display ranges and default values.

Inputs

The inside, outside temperature, and sun load sensors are inputs to the H-A/C control. These inputs along with the feedback from the electric actuator potentiometer are used by the H-A/C control to determine the correct temperature valve position, blower motor speed and air delivery mode.

Outputs

The H-A/C control sends outputs to the blower motor control module, the rear defogger relay, PCM, electric actuator and vacuum/electric solenoid to control the ACAC system.

Diagnostic Pointers and Parameters

Figure 1C-4

Refer to Figure 1C-4 for a list diagnostic pointers and parameters with their display ranges and default values.

Inputs

The inside, outside temperature, and sun load sensors are inputs to the H-A/C control. These inputs along with the feedback from the electric actuator potentiometer are used by the H-A/C control to determine the correct temperature valve position, blower motor speed and air delivery mode.

Outputs

The H-A/C control sends outputs to the blower motor control module, the rear defogger relay, PCM, electric actuator and vacuum/electric solenoid to control the ACAC system.

DIAGNOSTIC POINTERS AND PARAMETERS			
Pointer #		Display Range	Default Value
-02	ACAC (HVAC) System Diagnostic Trouble Codes	In this section.	
		Parameters	
-05	Program Number	0-255 Parameters	—
-07	Commanded Blower Motor Speed	0-128	—
-14	Vehicle Speed	In mph	25 (mph)
-15	HVAC Learn Mode (Temperature Calibration Offset)	-5° to 5° (F)	—
-18	Sun Load Temperature Sensor	0-255	240
-20	Current Temperature Valve Position	0-255	—
-22	Temperature Valve Position (Full Cold)	180-250	180
-23	Temperature Valve Position (Full Hot)	5-60	60
-24	Coolant Temperature	In °C	91°C
-25	Commanded Temperature Valve Position	0-255	128
-27	Air Delivery Mode. Refer to Chart 3, "Improper Air Delivery" for diagnosis.	See HVAC Air Delivery Mode Table on page 1C-9.	—
-28	Inside Air Temperature Sensor	Value increases as temperature decreases. Refer to DTC 03 and DTC 04 for more information.	128 (75°F)
-31	Outside Air Temperature Sensor	Value increases as temperature decreases. Refer to DTC 01 and DTC 02 for more information.	128 (49°F)
-37	EEPROM revision #	—	—

Figure 1C-10 - Diagnostic Pointers and Parameters

Overrides

The program number (pointer number "-05") is displayed as a number between 0 and 255 in the diagnostic mode. It is shown where the climate control set temperature is normally displayed. This number represents various levels of heating and cooling effort. As it first appears, the number displayed is the program number currently being used by the ACAC system. As operating conditions and other inputs change, this number will automatically change to control the desired temperature setting.

The automatic calculation of program number can be bypassed by manual override using the "TEMP UP" and "TEMP DOWN" switch on the H-A/C control panel. Pressing the "TEMP UP" switch will force the program number to increase at a three increment rate until a value of "253 to 255" is reached. "255" represents the maximum amount of heat the ACAC system can produce at that given engine temperature.

Pressing the "TEMP DOWN" switch will force the program number to decrease until the value of "0 to 2" is reached which represents the maximum amount of air conditioning the system can produce. This override has a wrap-around feature, if the program number sequence is continued past either end.

HVAC LEARN MODE (TEMPERATURE CALIBRATION OFFSET)

Figure 1C-5

This feature allows the ACAC system to be custom calibrated to the desire of the operator. This is done by programming an offset value in the memory to increase or decrease the actual interior temperature above or below the set temperature. During the calibration offset procedure, the procedure can be aborted any time before the new calibration is locked in by pressing the "AUTO" switch.

CLIMATE CONTROL IN DIAGNOSTIC MODE

Upon entering the diagnostic mode, the climate control will operate in whatever mode was being commanded just prior to depressing the "TEMP" up and the "OFF" switches. Though the display may change just as the switches are depressed, the prior operating mode is remembered and will resume after the diagnostic mode is entered.

SYSTEM RESPONSE PROCEDURE

Diagnostic Pointers and Parameters

Figure 1C-4

Refer to Figure 1C-4 for a list diagnostic pointers and parameters with their display ranges and default values.

Inputs

The inside, outside temperature, and sun load sensors are inputs to the H-A/C control. These inputs along with the feedback from the electric actuator potentiometer are used by the H-A/C control to determine the correct temperature valve position, blower motor speed and air delivery mode.

Outputs

The H-A/C control sends outputs to the blower motor control module, the rear defogger relay, PCM, electric actuator and vacuum/electric solenoid to control the ACAC system.

SYSTEM RESPONSE PROCEDURE

Figure 1C-11

1. Enter diagnostic mode.
 - Press "OFF" and "TEMP" up switches at the same time.
2. Select pointer number "-15".
 - Use fan up and fan down switches.
3. Show current "LEARN VALUE."
 - Press "MIDDLE" switch.
4. Enter "LEARN MODE."
 - Press "TEMP" down and "VENT" switches at the same time. (°C/°F will illuminate).
5. Change temperature calibration test offset.
 - Press the "TEMP" up or "TEMP" down switches to change value.
 - The "LEARN VALUE" can be changed $\pm 3^{\circ}\text{C}$ ($\pm 5^{\circ}\text{F}$).
6. Lock in "LEARN VALUE."
 - Press "VENT" and front defrost switches for five seconds. Value will blink off then on indicating new "LEARN VALUE" HAS BEEN LOCKED INTO MEMORY.
 - "LEARN MODE" WILL EXIT.

Refer to Figure 1C-11 in this section for proper system response to H-A/C control settings.

ACAC SYSTEM CHECK

Figure 1C-12

Refer to Figure 1C-12 for the ACAC Diagnostic System Check. This chart should be used first when diagnosing a customer HVAC complaint.

DIAGNOSTIC AIDS

CONNECTOR VIEW

Figure 1C-13

Refer to Figures 1C-13 for connector view of the H-A/C control connector.

CIRCUIT DIAGRAMS

Figures 1C-14 and 1C-15

Refer to Figures 1C-14 and 1C-15 for a complete wiring diagram overview of the automatic control air conditioning circuits.

COMPONENTS LOCATION

Figures 1C-16 and 1C-17

VACUUM SYSTEM DIAGRAM

Refer to "Improper Air Delivery," CHART 1C-3 for a diagram of the automatic control air conditioning vacuum system.

H-A/C CONTROL SETTINGS	EXPECTED RESULTS
• "OFF"	• "EXT TEMP" will display temperature. • Blower motor does not run.
• "AUTO" 16°C (60°F)	• System is in "RECIRCULATION" mode. • Blower motor runs at maximum speed. • Air flows from instrument panel outlets. • Engine idle speed increases. • A/C compressor turns on (ambient temp above 35°F). • Air flow becomes cold.
• "LO" (Fan)	• Blower motor speed reduces as long as button is pressed. • Blower motor speed is displayed while button is pressed. • Blower motor runs at speed attained when button is released.
• "HI" (Fan)	• Blower motor speed increases as long as button was depressed. • Blower motor speed is displayed. • Blower motor runs at speed attained when button was released.
• "ECON"	• A/C compressor turns off. • Air flow may start to warm.
• "AUTO" 36°C (90°F)	• System is in "HEATER" mode. • Blower motor runs at maximum speed. • Air flows from floor outlets with some bleed to front and side window defroster outlets. • Air flow becomes warm.
• "AUTO" 24°C (75°F)	• Blower motor speed reduces as in-car temperature approached 24°C (75°F). • A/C system maintains in-car temperature at approximately 24°C (75°F).
• "DEFOG"	• Manual Mode. • Air flows from windshield outlet, side window outlets with a 50% bleed to the floor outlets.
• DEF (Front)	• Some bleed to heater outlets. • Air flows from windshield outlet and side window outlets.
• "REAR DEFOGGER"	• Rear defogger operation for 10 minutes will occur after button is pushed. Pushing the button again (during same ignition cycle) will allow 5 additional minutes of operation.
• "BLEND"	• Manual mode. • Fifty percent of airflow will be out of the I/P outlets. • Fifty percent of airflow out of floor outlets.
• "MIDDLE"	• Manual mode. • One hundred percent of airflow will be out of the I/P outlets.
• "FLOOR"	• Manual mode. • One hundred percent of airflow will be out of the floor outlets.

Figure 1C-11 - System Response Chart (C68)

ACAC SYSTEM CHECK

- TURN IGNITION TO "RUN" AND ENTER DIAGNOSTICS.
- ARE ANY HVAC DIAGNOSTIC TROUBLE CODES (DTC) DISPLAYED? (SEE FIGURE 1C-8.) (IF H-A/C CONTROL DISPLAY IS BLANK, REFER TO "CHART 8; INOPERATIVE H-A/C CONTROL" IN THIS SECTION.)

NO DTC DISPLAYED.

- DTC DISPLAYED.
- REFER TO "DIAGNOSTIC TROUBLE CODES (DTC)" IN THIS SECTION.

H-A/C CONTROL OPERATIVE BUT WILL NOT ENTER DIAGNOSTICS.

REPLACE H-A/C CONTROL.

- EXIT DIAGNOSTICS.
- START ENGINE.
- SELECT 16°C (60°F) AND "HI" BLOWER MOTOR ASSEMBLY SPEED.
- AMBIENT TEMPERATURE MUST BE ABOVE 10°C (50°F).
- DO BLOWER MOTOR AND COMPRESSOR OPERATE?

BOTH BLOWER MOTOR AND COMPRESSOR OPERATE.

NO COMPRESSOR OPERATION.

BLOWER MOTOR DOES NOT OPERATE.

BOTH BLOWER MOTOR AND COMPRESSOR DO NOT OPERATE.

INSTALL GAGE SET IS A/C LOW SIDE PRESSURE ABOVE 55 psi?

REFER TO CHART 1 IN THIS SECTION.

REFER TO CHART 1 IN THIS SECTION AND SECTION 6E3-C10.

YES

NO

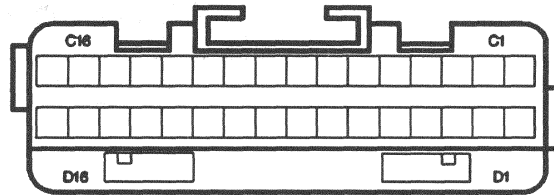
REFER TO SECTION. 6E3-C10.

LEAK CHECK A/C SYSTEM. REFER TO SECTION 1B.

- IF COMPLAINT IS:
 - IMPROPER AIR DELIVERY SEE CHART 1C-3.
 - INSUFFICIENT OR NOT HEATING SEE CHART 1C-4.
 - INSUFFICIENT OR NO COOLING SEE CHART 1C-5.
 - IMPROPER DEFOGGER OR HEATED MIRROR OPERATION SEE CHART 1C-7.
 - INCORRECT OUTSIDE AIR TEMPERATURE DISPLAY SEE CHART 1C-9.

Figure 1C-12 ACAC System Check

(WIRE ENTRY VIEW)



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FIGURE 1C-13 H-A/C CONTROL CONNECTOR

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
C1	BLK/WHT	351	GROUND	8A-66-0
C2	LT BLU/BLK	590	SUN LOAD TEMPERATURE SENSOR INPUT	8A-68-0
C5	BRN	241	IGNITION CONTROLLED FEED THRU I/P #20 FUSE	8A-68-0
C7	DK BLU	1199	ELECTRIC ACTUATOR DRIVE FEED	8A-68-0
C8	BRN/WHT	1218	TEMPERATURE VALVE POSITION FEEDBACK	8A-68-0
C9	PPL	65	BLOWER MOTOR FEEDBACK	8A-66-0
C10	LT BLU	1217	+5V REFERENCE TO TEMPERATURE VALVE ACTUATOR	8A-68-0
C11	GRY/BLK	754	BLOWER SPEED CONTROL SIGNAL	8A-66-0
C12	ORN	40	BATTERY FEED THRU I/P #33 FUSE	8A-66-0
C16	GRY	8	ILLUMINATION LAMPS FEED FROM HEADLAMP SWITCH	8A-117-2
D1	LT GRN/BLK	198	ANALOG GROUND FOR TEMPERATURE SENSORS	8A-68-0
D2	DK GRN	734	INSIDE AIR TEMPERATURE SENSOR INPUT	8A-68-0
D3	LT GRN/BLK	735	OUTSIDE AIR TEMPERATURE SENSOR INPUT	8A-68-0

*CAVITIES NOT LISTED ARE NOT USED

1C-36 AUTOMATIC CONTROL AIR CONDITIONING

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
D4	PPL/WHT	724	VACUUM FLUORESCENT DIMMING INPUT SIGNAL	8A-150-2
D7	BLK	450	ENGLISH/METRIC GROUND	8A-68-0
D8	TAN	363	LOWER (HEATER AND DEFROSTER) SOLENOID SIGNAL	8A-68-1
D9	PPL	361	UPPER (A/C) SOLENOID SIGNAL	8A-68-1
D10	RED	362	RECIRCULATION SOLENOID SIGNAL	8A-68-1
D11	LT GRN/BLK	366	DEFROST SOLENOID SIGNAL	8A-68-1
D12	TAN	800	DLC DATA LINK	8A-50-0
D13	LT BLU	706	HEATER SOLENOID SIGNAL	8A-68-1
D14	DK GRN/WHT	762	A/C REQUEST LINE TO PCM	8A-67-0
D15	LT BLU/BLK	71	REAR DEFOGGER RELAY COIL CONTROLLED GROUND	8A-61-1

*CAVITIES NOT LISTED ARE NOT USED(Cont'd)



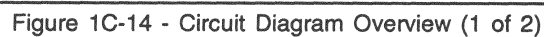


Figure 1C-14 - Circuit Diagram Overview (1 of 2)

BLOWER MOTOR

1150 BLK → S266 → 1150 BLK → A → M → B → 65 PPL → S267 → 65 PPL → F1 → C200 → 65 PPL → C9

BLOWER MOTOR CONTROL MODULE

30 AMP → HOT AT ALL TIMES → I/P FUSE #38 → 2740 ORN → B → C2

BLOWER MOTOR SPEED OUTPUT

A → C1 → 1150 → TO S266

BLOWER MOTOR SPEED INPUT

B → C1 → F2 → C200 → 754 GRY/BLK → C11

ELECTRIC ACTUATOR

1791 YEL → 7 → POT → M → 5 → 241 BRN → TO S211

6 → 1199 DK BLU → C7

10 → 1217 LT BLU → C10

9 → 1218 BRN/WHT → C8

INSIDE AIR TEMPERATURE SENSOR

1791 YEL → B → REF LO → A → 734 DK GRN → D2

OUTSIDE AIR TEMPERATURE SENSOR

1791 YEL → B → REF LO → A → J → F4 → 735 LT GRN/BLK → D3

SUN LOAD TEMPERATURE SENSOR

1791 YEL → B → REF LO → A → F3 → 590 LT BLU/BLK → C2

REAR WINDOW DEFOGGER GRID

B+ → GND → BLK → 293 PPL → S282

REAR WINDOW DEFOGGER RELAY

293 PPL → 87 → 30 → 1640 ORN → G8 → 86 → C200

REAR WINDOW DEFOGGER CIRCUIT BREAKER

1640 ORN → G8 → C200

REAR WINDOW DEFOGGER

TO G202 → S200 → C1

BATTERY

B+ → I/P FUSE #33 → 10 AMP → S231 → E6 → C200 → S213 → 39 PNK → 10 AMP → I/P FUSE #11

HEADLAMP SWITCH

A → 8 GRY → C16

INCANDESCENT DIMMING

TO "C1" TERMINAL → 04-28-86 BT0101C

Figure 1C-15 - Circuit Diagram Overview (2 of 2)

AUTOMATIC CONTROL AIR CONDITIONING 1C-39

COMPONENT	LOCATION	8A-201-PG	FIG.	8A-202-PG
A/C Compressor Clutch	RH side of Engine, part of A/C Compressor.....	39.....	62	
A/C Compressor Clutch Diode	Engine Harn, near A/C Compressor Clutch Conn			
A/C Compressor Pressure Cycling Switch.....	RH Rear Engine Compartment, attached to A/C Accumulator	6.....	13	
A/C Compressor Relay.....	In Underhood Electrical Center	6.....	13	
Air Inlet Valve Actuator.....	Attached to top RH side of HVAC Module, forward of and above I/P Compartment	20.....	33	
Blower Motor.....	Under RH I/P	20.....	33	
Blower Motor Control Module.....	RH I/P, near Blower Motor	20.....	33	
Defroster Actuator Valve.....	Attached to the lower LH side of HVAC Module, left of Floor Ducts.....	13.....	21	
Electric Actuator	Behind Center I/P, on HVAC Module	20.....	32	
H-A/C Control	Center I/P			
High Blower Relay (C67).....	Under RH I/P, above Blower Motor	20.....	33.....	202-6
HVAC Module	Near center I/P, next to Vacuum/Electric Solenoid..	20.....	32	
I/P Fuse Block	Mounted to LH I/P, accessible with LH front door open.....	11.....	19	
Idle Speed Control Power Steering Pressure Switch.....	In Power Steering Line, Near Power Steering Unit.....	37.....	33	
Inside Temperature Sensor	I/P Carrier, above I/P Compartment			
LH Outside Rearview Mirror.....	LH Front Door			
Low Blower Relay (C67).....	RH I/P, above Blower Motor.....	20.....	33	
Mode Valve Actuator	Attached to LH Front of HVAC Module, above Floor Ducts			
Outside Temperature Sensor ..	Attached to Hood Latch Support			
Powertrain Control Module (PCM).....	Engine Compartment, near LH fender, below Air Cleaner.....	9.....	16.....	20-10, 13
Rear Defogger Grid.....	Attached to Rear Window			
Rear Defogger Relay (C67 and C68).....	Lower RH I/P, near Blower Motor	20.....	33	
RH Outside Rearview Mirror.....	RH Front Door			
Sun Load Temperature Sensor.....	Near Center of I/P, Upper Trim Pad (in Defroster Grille)			
Underhood Electrical Center..	RH Rear Engine Compartment.....	6.....	13	
Vacuum Check Valve	Front of Engine Intake			
Vacuum/Electric Solenoid.....	Lower RH I/P, below Blower Motor	20.....	32	
Vacuum Tank	Attached to plenum, left of evaporator housing			
C200 (57 Cavities)	I/P Harn to Body Harn, bolted above accelerator pedal.....	13.....	21.....	202-1
C201 (6 Cavities)	I/P Harn to Body Harn, near C200.....	13.....	21.....	202-4
C202 (6 cavities)	I/P Harn to Twilight Sentinel or DRL Harn, next to C200.....	13.....	21.....	202-4

1C-40 AUTOMATIC CONTROL AIR CONDITIONING

COMPONENT	LOCATION	8A-201-PG	FIG.	8A-202-PG
C204 (37 cavities)	Body Harn to Engine Harn, behind RH I/P between Blower Motor and I/P Compartment.....	17.....	28.....	202-3
C205 (10 cavities)	Engine Harn to Body Harn, right of I/P Compartment	17.....	28.....	202-4
C207.....	Body Harn to Engine Harn, near base of RH "A" pillar, behind kickpad	17.....	28.....	202-4
C302 (10 Cavities).....	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" pillar	24.....	37.....	202-4
C304 (8 Cavities).....	Cross Car Harn to RH Power Heated Mirror, upper RH side of RH door	25.....	38	
C305 (8 Cavities).....	Cross Car Harn to LH Power Heated Mirror, upper RH side of LH door	24.....	37	
G104	Engine Compartment, on front of LH Cylinder Head	40.....	63	
G200	Base of LH "A" pillar	24.....	37	
G201	Base of LH "A" pillar, behind kickpad	24.....	37	
G202	Base of RH "A" pillar, behind kickpad	25.....	38	
G300	LH rear wheelhouse, in Luggage Compartment			
G400	Near center of RH "D" pillar	31.....	47	
P100	Through dash panel, below Windshield Wiper Motor	17.....	28	
P102	Visible from Engine Compartment, behind LH wheelhouse.....	34.....	54	
P500	Between LH front door and "A" pillar	24.....	37	
P600	Between RH front door and "A" pillar	35.....	38	
S109.....	Forward Lamp Harn, approx 33 cm from G106 breakout			
S115	Engine Harn, approx 4 cm from Transmission Connector breakout			
S120	Engine Harn, approx, 3 cm from Fuel Injector #1 breakout			
S201	I.P. Harn, approx 4 cm from I.P. Cluster #2 breakout			
S202	I.P. Harn, approx 7 cm from Radio breakout			
S213	Body Harn, approx 42 cm from Inflatable Restraint breakout			
S216.....	Body Harn, approx 13 cm from Steering Column breakout			
S231	Body Harn, approx 11 cm from Convenience Center breakout			
S232	Body Harn, approx 6 cm from Convenience Center breakout			
S264.....	Body Harn, approx 10 cm from Inflatable Restraint breakout			
S266	Body Harn, approx 20 cm from Inflatable Restraint breakout			
S281	Body Harn, approx 29 cm from Fuse Block Circuit Breaker			
S303	Crosscar Harn, approx 32 cm from G200 breakout			

BLANK



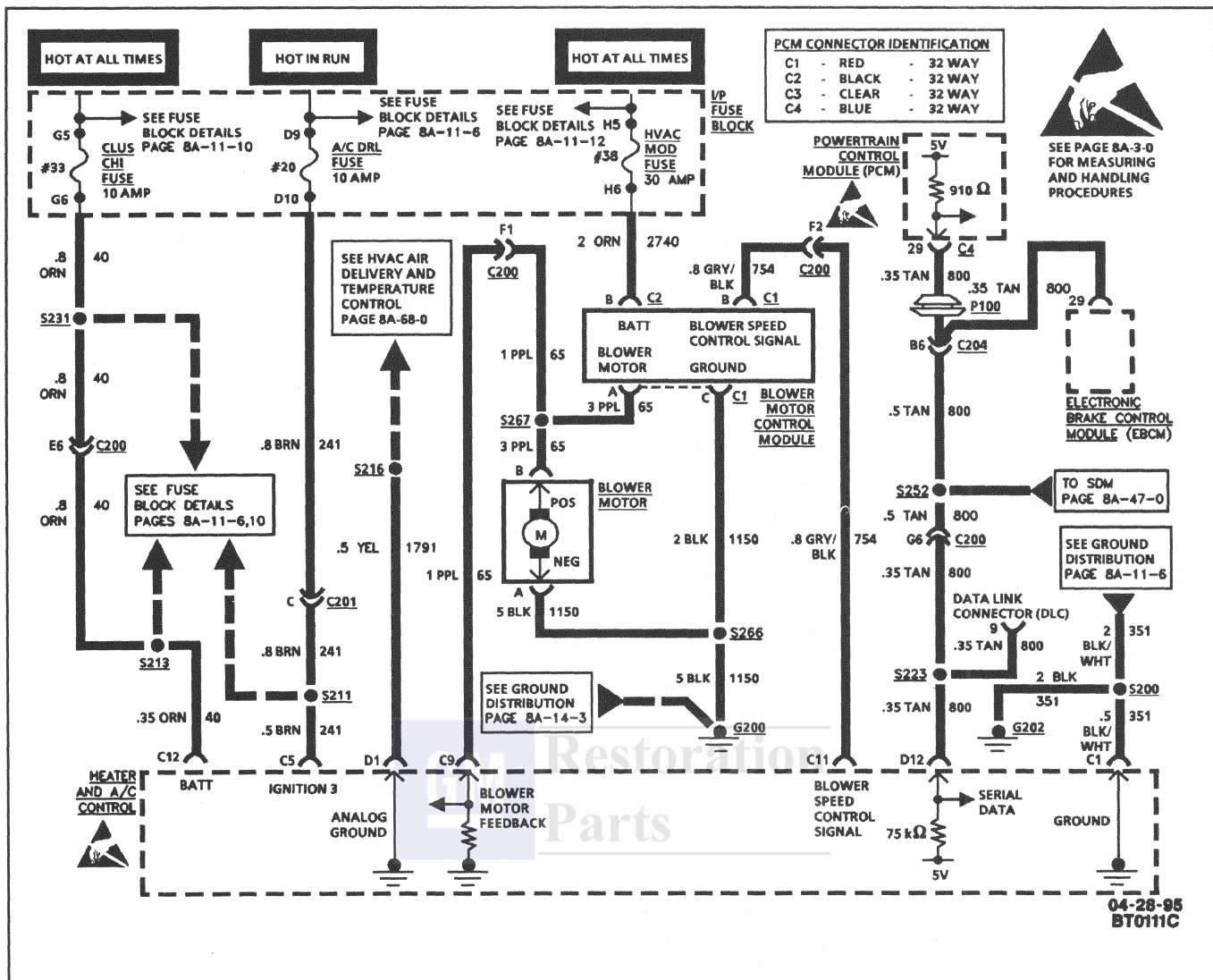


CHART 1C-1

BLOWER MOTOR WILL NOT RUN IN ANY MODE (C68)

Circuit Description:

Blower motor speed is determined by the amount of voltage applied to the motor. This voltage varies from approximately 4 volts (low speed) to approximately 12 volts (high speed).

The speed at which the blower motor operates is governed by the H-A/C control. The blower motor speed can be adjusted manually by pressing the blower control "UP" or "DOWN" switches or automatically by placing the H-A/C control in the "AUTO" mode.

The H-A/C control sends blower request information to the blower motor control module in the form of a variable voltage signal. This voltage signal ranges from approximately 2.5 volts, for minimum blower motor speed, to approximately 7 volts, for maximum blower motor speed. An amplifier and

driver circuit in the blower motor control module supplies between 4 and 12 volts to the blower motor according to the request signal from the H-A/C control. Blower motor voltage is also sent back to the H-A/C control to insure blower speed stability and the indicate any failure in the blower motor circuitry.

Diagnostic Aids:

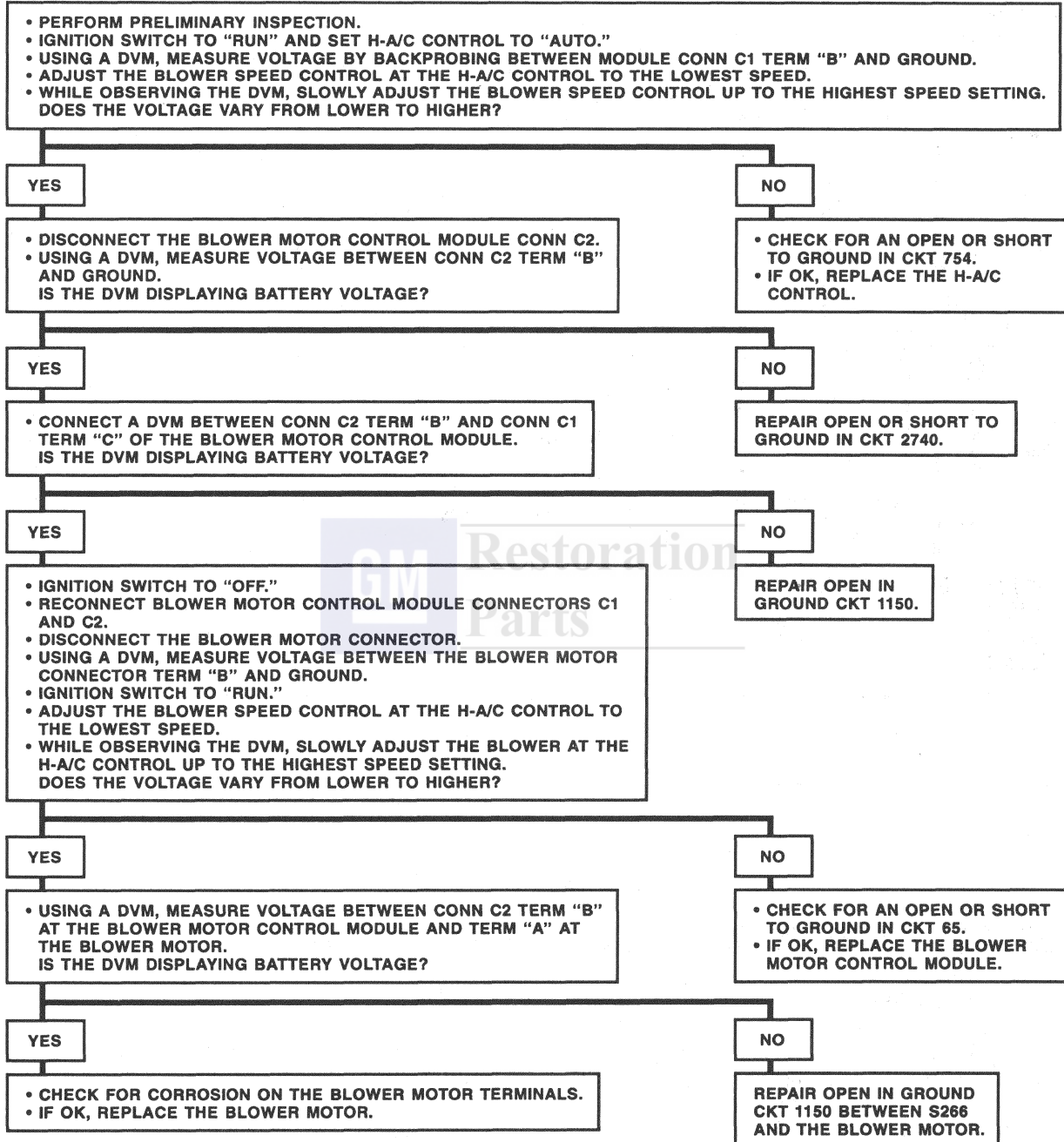
1. Check for an open in I/P fuse 38. If open, repair short to ground in CKT 940.
2. Make sure grounds G200 and G202 are clean and tight.
3. If blower motor can be controlled in either the manual mode or the auto mode but not in both, replace the H-A/C control.

CHART 1C-1 BLOWER MOTOR WILL NOT RUN IN ANY MODE (C68)



IMPORTANT:

- ACAC SYSTEM CHECK MUST BE PERFORMED FIRST.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10305

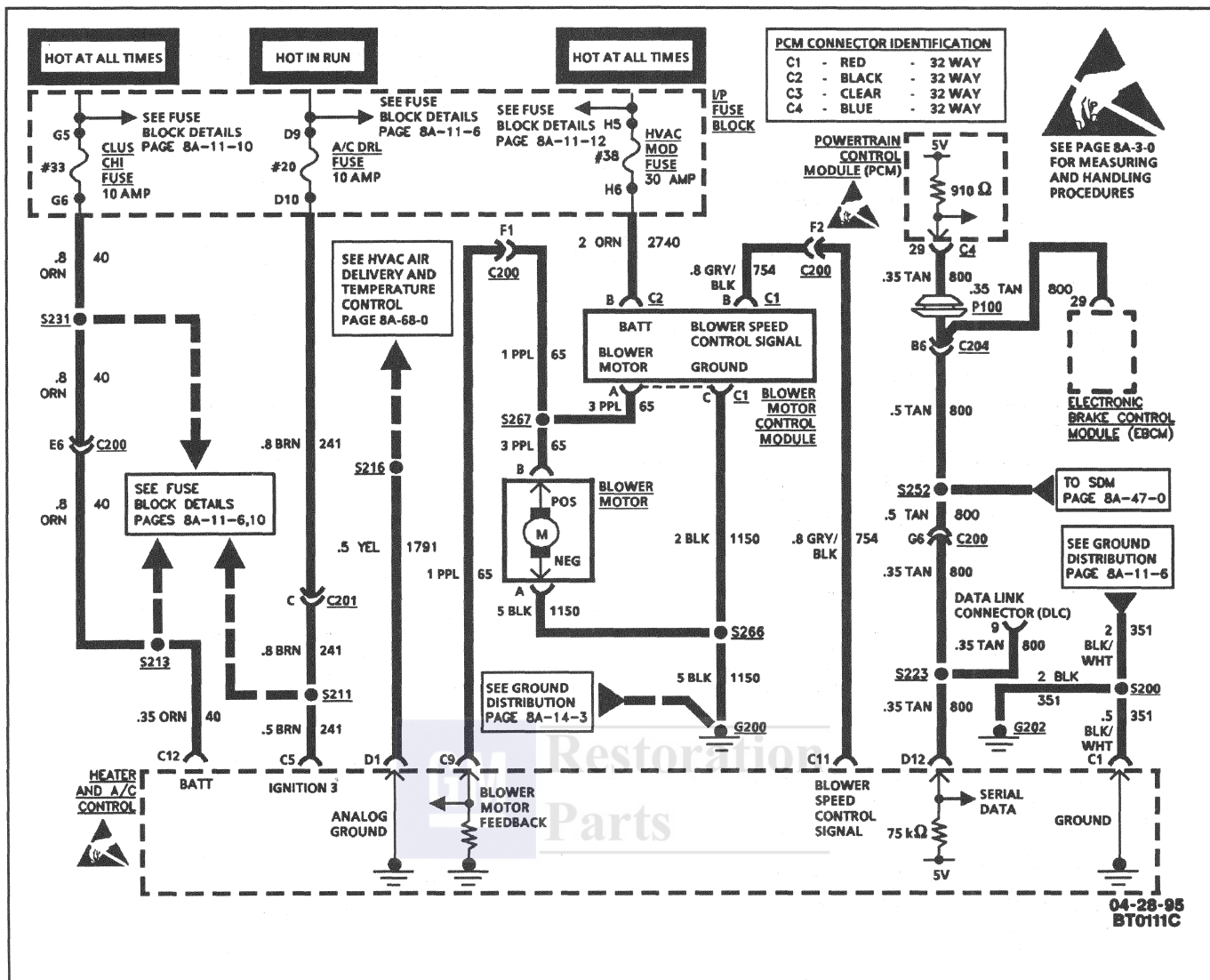


CHART 1C-2

BLOWER MOTOR RUNS ALL OF THE TIME OR HIGH SPEED ONLY (C68)

Circuit Description:

Blower motor speed is determined by the amount of voltage applied to the blower motor. This voltage varies from approximately 4 volts (low speed) to approximately 12 volts (high speed).

The speed at which the blower motor operates is governed by the H-A/C control. The blower motor speed can be adjusted manually by pressing the blower control "UP" or "DOWN" switches or automatically by placing the H-A/C control in the "AUTO" mode.

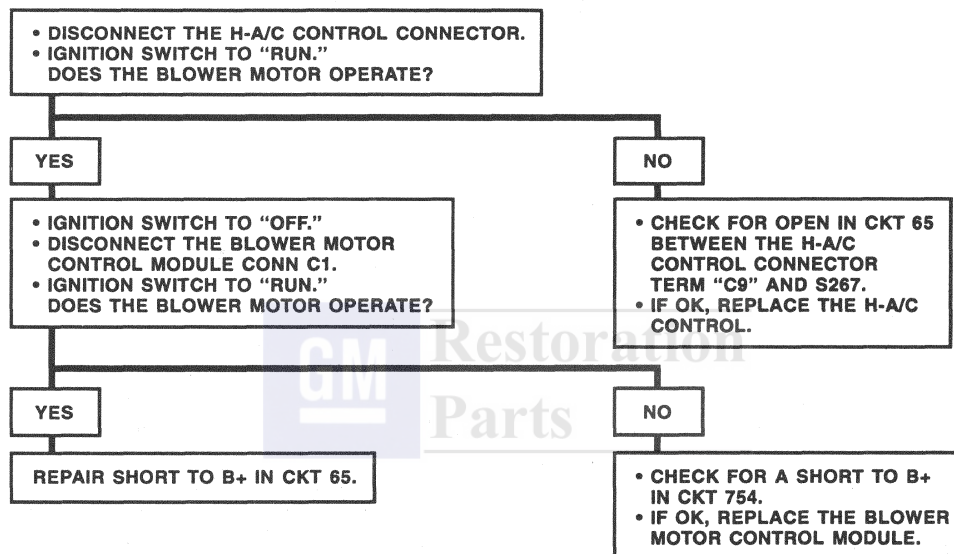
The H-A/C control sends blower request information to the blower motor control module in the form of a variable voltage signal. This voltage signal ranges from approximately 2.5 volts, for minimum blower speed, to approximately 7 volts, for maximum blower speed. An amplifier and driver circuit in the blower motor control module supplies between 4 and 12 volts to the blower motor according to the request signal from the H-A/C control. Blower motor voltage is also sent back to the H-A/C control to insure blower speed stability and to indicate any failure in the blower motor circuitry.

CHART 1C-2

BLOWER MOTOR RUNS ALL OF THE TIME OR HIGH SPEED ONLY (C68)

**IMPORTANT:**

- ACAC SYSTEM CHECK MUST BE PERFORMED FIRST.



1C-46 AUTOMATIC CONTROL AIR CONDITIONING

VACUUM HOSE COLOR - VACUUM/ ELECTRIC SOLENOID #	GRY - SOLENOID #1	ORN - SOLENOID #2	TAN - SOLENOID #3	RED - SOLENOID #4	BLU - SOLENOID #5
HEATER AND A/C CONTROL SWITCHES OFF	DEFROSTER VALVE ACTUATOR (DEFROST)	AIR INLET VALVE ACTUATOR	MODE VALVE ACTUATOR (MIDDLE)	MODE VALVE ACTUATOR (HEATER/DEF)	DEFROSTER VALVE ACTUATOR (HEATER)
"OFF"	No VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM
"RECIRC"	No VACUUM	VACUUM	VACUUM	No VACUUM	No VACUUM
"MIDDLE"	No VACUUM	No VACUUM	VACUUM	No VACUUM	No VACUUM
"BLEND"	No VACUUM	No VACUUM	No VACUUM	No VACUUM	VACUUM
"FLOOR"	No VACUUM	No VACUUM	No VACUUM	VACUUM	VACUUM
"DEFOG"	No VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM
DEFROST	VACUUM	No VACUUM	No VACUUM	VACUUM	No VACUUM

T5747

CHART 1C-3 IMPROPER AIR DELIVERY

Circuit Description:

Air Delivery

With the ignition switch in "RUN," voltage is applied through I/P fuses #20 and #33 to the H-A/C control. The operating mode of the system is determined by buttons on the front panel. Ground signals determine which air valves are to be operated as well as the position of the temperature valve.

The vacuum/electric solenoid contains the solenoid valves that control the vacuum actuators. When the solenoids are de-energized, the valves vent the vacuum actuators, allowing the vacuum actuator to return to the vent position.

Air Delivery

H-A/C Control

With the ignition switch in "RUN," voltage is applied through I/P fuses #20 and #33 to the H-A/C control. The operating mode of the system is determined by buttons on the front panel. Ground signals determine which air valves are to be operated as well as the position of the temperature valve.

Vacuum/Electric Solenoid

The vacuum/electric solenoid contains the solenoid valves that control the vacuum actuators. When the solenoids are de-energized, the valves vent the vacuum actuators, allowing the vacuum actuator to return to the vent position.

Recirculation Valve

The recirculation valve closes off most of the outside air inlet, so that the air from the inside of the vehicle is re-circulated through the A/C system for

maximum cooling. The outside air inlet is partially closed when vacuum is applied to the actuator. When the air inlet valve actuator is vented, the recirculation valves close off the in-car air inlet which allows outside air to be drawn into the vehicle.

Temperature Valve

The temperature valve determines how much air flows through the heater core, which determines the temperature of the air to the outlets. It is moved by the temperature valve electric actuator. The position of the valve is determined by the temperature selected at the H-A/C control.

DEF/Heater

The DEF/heater valve determines whether air flow will be directed to the windshield defrost outlets. With vacuum applied to the gray hose at the defroster valve actuator, the valve is positioned to allow air flow to the windshield defrost outlets, with some bleed to the heater outlet.

Upper/Lower Mode

The upper/lower mode valve can assume three positions and is operated by a bi-directional vacuum port which can move the valve to either of two positions. If no vacuum is applied to either vacuum port, the valve is in mid-position. Air flow with the valve in mid-position will be delivered to the panel outlets and the floor outlets (Bi-Level). When the upper/lower solenoid (#3) (tan vacuum hose) is operated, the valve is positioned to direct air flow to the A/C outlets. When the upper/lower solenoid (#4) (red vacuum hose) is operated, the valve is positioned to direct air flow to the heater outlets and defroster outlets.

Temperature Control

Two temperature variable resistors (sensors) are connected to the H-A/C control to provide in-car and outside temperature information. These devices are thermistors which decrease in resistance as the temperature of the device increases. The one exception to this is the solar sensor, which is a photo diode. The photo diode output decreases with increasing light intensity.

Circuits within the H-A/C control use the input from the in-car sensor and the sun load sensor and the set temperature selected by the driver to determine whether the air should be heated or cooled to bring the inside of the vehicle to the selected temperature. The input from the ambient temperature sensor is used to determine the amount of heating or cooling required to bring the temperature inside the vehicle to the selected value as quickly as possible.

Diagnostic Aids:

1. If the temperature valve electric actuator is displaced from its proper position, it will automatically calibrate itself to the proper position if the battery power is removed from the H-A/C control. To recalibrate the temperature valve actuator, remove and install I/P fuse 33.
2. Make sure that ground G202 is clean and tight.
3. Check I/P fuse 33. If open, check for a short to ground in CKT 40.
4. Check I/P fuse 20. If open, check for a short to ground in CKT 241.
5. Check for normal operation of engine vacuum check valve.

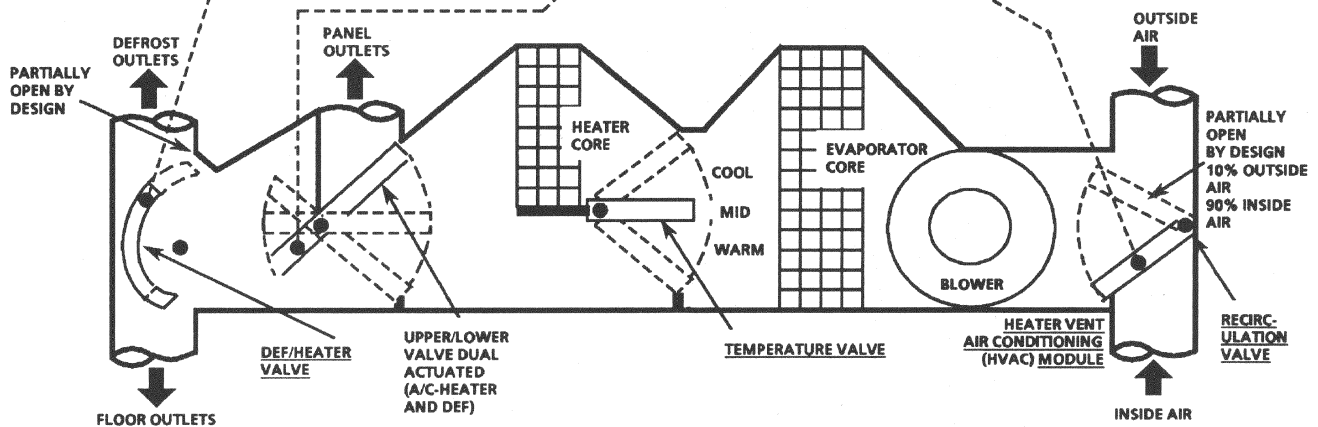
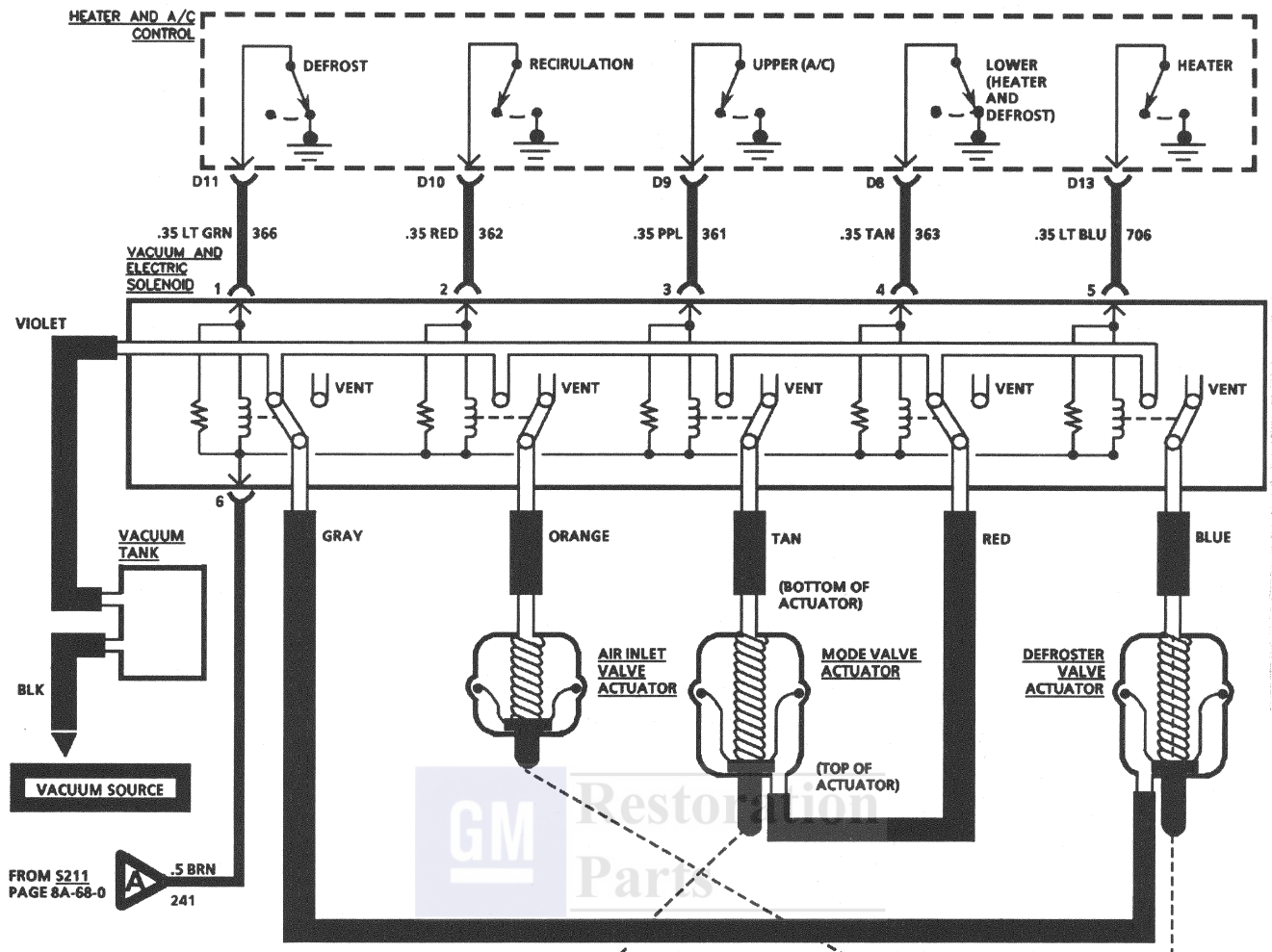
With engine warm and running in idle:

6. Check manifold vacuum at the violet hose from the vacuum tank to the electric solenoid.
7. Check for vacuum at the violet hose from the vacuum tank to the electric solenoid.

8. Check that the vacuum hoses from the electric solenoid to the vacuum actuators are connected and in good condition.
9. Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity/voltage check. Refer to SECTION 8A.
10. Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to SECTION 8A.

Vacuum Diagnosis

1. Check vacuum supply to vacuum/electric solenoid (black vacuum hose) while engine is running.
 - Vacuum should be approximately 38 to 43 cm Hg (15 to 16 inch Hg) with engine running.
 - Vacuum should remain at approximately 38 to 43 cm Hg (15 to 16 inch Hg) when engine is turned off.
2. Test each vacuum actuator by disconnecting the vacuum hose and applying vacuum directly to the actuator. Repair or replace as necessary.
3. Reconnect all vacuum and electrical connections. Run engine and cycle through the operating modes and full temperature range of the H-A/C control while observing the vacuum actuators.
 - Check for vacuum to the vacuum actuators by noting vacuum actuator position. When vacuum is applied, the actuator will retract refer to the top of page 1C-48.
 - If a vacuum actuator retracts when it should not, replace the H-A/C control, after performing the diagnostics on page 1C-53.
 - If a vacuum actuator does not retract when it should, check for vacuum leaks, collapsed vacuum hoses, binding valves or bad connections at the vacuum/electric solenoid. If OK, replace the vacuum/electric solenoid.



! IMPORTANT:

- FOR SOLENOID/VACUUM CONTROL, REFER TO "AIR DELIVERY VACUUM DISTRIBUTION TABLE," IN SECTION 1C. VACUUM IS ROUTED TO THE CORRESPONDING ACTUATOR WHEN THE SOLENOID IS ENERGIZED. VACUUM IS SHOWN IN "DEFROST" MODE.



CHART 1C-3 IMPROPER AIR DELIVERY (C68)

- TURN IGNITION SWITCH TO "RUN."
- SET H-A/C CONTROL TO "AUTO" 24°C (75°F).
- WITH A TEST LIGHT TO GROUND, BACKPROBE TERM "6" OF THE VACUUM/ELECTRIC SOLENOID. IS TEST LIGHT "ON"?

YES

- TURN IGNITION "OFF."
- DISCONNECT THE VACUUM/ELECTRIC SOLENOID CONNECTOR.
- USING A DVM, CHECK RESISTANCE OF VACUUM/ELECTRIC SOLENOID TERMINALS "6" TO "1", "2", "3", "4" AND "5". IS RESISTANCE BETWEEN 70 TO 120 OHMS FOR ALL TERMINALS?

YES

- RECONNECT VACUUM/ELECTRIC SOLENOID CONNECTOR.
- TURN IGNITION TO "RUN."
- SET H-A/C CONTROL TO "OFF."
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5" OF THE VACUUM/ELECTRIC SOLENOID.
- TEST LIGHT SHOULD BE "ON" FOR TERMINAL "4" AND "OFF" FOR TERMINALS "1", "2", "3" AND "5". IS IT?

YES

- CHECK FOR SHORT TO GROUND IN CKT 363.
- IF OK, PROCEED WITH DIAGNOSIS.
- SET H-A/C CONTROL TO "AUTO" 16°C (60°F).
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5" OF THE VACUUM/ELECTRIC SOLENOID.
- TEST LIGHT SHOULD BE "ON" FOR TERMINALS "2" AND "3" AND "OFF" FOR TERMINALS "1", "4" AND "5". IS IT?

YES

- CHECK FOR SHORT TO GROUND IN CKTS 362 AND 361.
- IF OK, PROCEED WITH DIAGNOSIS.
- SET H-A/C CONTROL TO "AUTO" 32°C (90°F).
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5" OF THE VACUUM/ELECTRIC SOLENOID.
- TEST LIGHT SHOULD BE "ON" FOR TERMINALS "4" AND "5" ONLY. IS IT?

YES

- CHECK FOR SHORT TO GROUND IN CKT 706.
- IF OK, PROCEED WITH DIAGNOSIS.
- PUSH THE H-A/C CONTROL BUTTON FOR "BLEND."
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5".
- TEST LIGHT SHOULD BE "ON" FOR TERM "5" ONLY. IS IT?

YES

- PUSH THE H-A/C CONTROL BUTTON FOR THE FRONT DEFROSTER MODE.
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5".
- TEST LIGHT SHOULD BE "ON" FOR TERMINALS "1" AND "4" ONLY. IS IT?

YES

- CHECK FOR SHORT TO GROUND IN CKT 366.
- IF OK, PROCEED WITH DIAGNOSIS.
- PUSH THE H-A/C CONTROL BUTTON FOR THE DEFOG MODE.
- WITH A TEST LIGHT TO B+, BACKPROBE TERMINALS "1", "2", "3", "4" AND "5".
- TEST LIGHT SHOULD BE "ON" FOR TERM "4" ONLY. IS IT?

YES

- NO TROUBLE FOUND WITH THE H-A/C CONTROL.
- PERFORM VACUUM DIAGNOSIS AS OUTLINED IN THIS SECTION.

NO

- REPAIR OPEN OR SHORT TO GROUND IN CKT 241.

NO

- CHECK CONNECTIONS AT VACUUM/ELECTRIC SOLENOID.
- IF OK, REPLACE VACUUM/ELECTRIC SOLENOID.

NO

- IF TEST LIGHT DOESN'T GO "ON" FOR TERMINAL "4", CHECK FOR OPEN OR SHORT TO B+ IN CKT 363.
- IF TEST LIGHT GOES "ON" FOR TERMINALS "1", "2", "3" AND "5", CHECK FOR SHORT TO GROUND IN CKTS 362, 366, 706 AND 361.
- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

NO

- IF TEST LIGHT DOESN'T GO "ON" FOR TERMINALS "2" AND "3", CHECK FOR OPEN OR SHORT TO B+ IN CKTS 362 AND 361.
- IF TEST LIGHT GOES "ON" FOR TERMINALS "1", "4" AND "5", CHECK FOR SHORT TO GROUND IN CKTS 706, 363 AND 366.
- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

NO

- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

NO

- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

NO

- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

NO

- CHECK CONNECTIONS AT H-A/C CONTROL.
- IF OK, REPLACE H-A/C CONTROL.

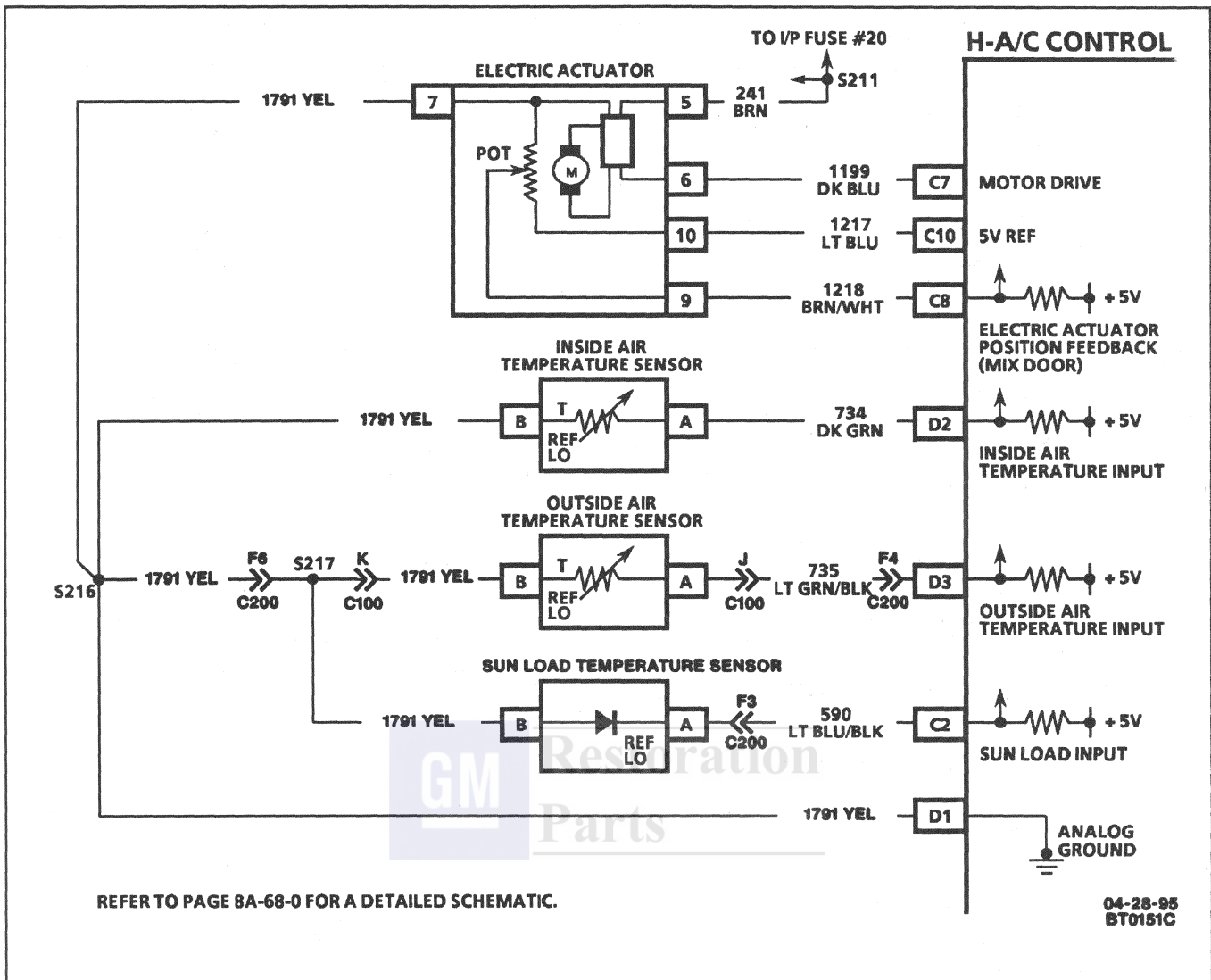


CHART 1C-4

INSUFFICIENT OR NO HEATING (C68)

Circuit Description:

Based on the various temperature sensor inputs, sun load sensor input, input from the PCM and the set temperature, the H-A/C control determines the required temperature and delivery mode to achieve and maintain the selected comfort level.

Diagnostic Aids:

1. Check for proper engine coolant level.
2. Check engine for proper operating temperature (approximately 91°C (195°F)). If engine does not reach 91°C (195°F), replace thermostat.
3. With engine at normal operating temperature, check heater inlet and outlet hose temperature.
 - Heater inlet hose temperature should be at or near engine operating temperature.
 - Heater outlet hose temperature should be slightly cooler than the heater inlet hose.
 - If heater hose temperatures are incorrect, replace heater core.
4. Inspect plenum area (at base of windshield) for debris or anything that may cause airflow restriction.

**IMPORTANT:**

- ACAC SYSTEM CHECK MUST BE PERFORMED FIRST.

CHART 1C-4

(Page 1 of 2)
INSUFFICIENT OR NO HEATING
(C68)

- PERFORM PRELIMINARY INSPECTION.
- START ENGINE AND ALLOW IT TO REACH NORMAL OPERATING TEMPERATURE.
- SELECT "AUTO" MODE AND SET TEMPERATURE TO 32°C (90°F). BLOWER MOTOR SHOULD BE IN HIGH SPEED AND A LARGE VOLUME OF AIR SHOULD BE DISCHARGED FROM FLOOR OUTLETS AT APPROXIMATELY 60°C (140°F).

IMPROPER
AIR
DELIVERY

REFER TO
CHART 1C-3.

IMPROPER AIR TEMPERATURE

- ENTER DIAGNOSTICS.
 - SELECT POINTER NUMBER "-20" (CURRENT TEMPERATURE VALVE POSITION). DISPLAY AND RECORD VALUE.
 - SELECT POINTER NUMBER "-25" (COMMANDED TEMPERATURE VALVE POSITION). DISPLAY AND RECORD VALUE.
- ARE THE VALUES OF POINTER NUMBERS "-20" AND "-25" EQUAL TO ± 5 OF EACH OTHER?

YES

- EXIT DIAGNOSTICS.
- SELECT "AUTO" AND SET TEMPERATURE TO 32°C (90°F).
- IGNITION "OFF."
- DISCONNECT ELECTRICAL CONNECTOR FROM ELECTRIC ACTUATOR AND REMOVE ELECTRIC ACTUATOR.

NOTICE: DO NOT ATTEMPT TO OPERATE THE TEMPERATURE VALVE ELECTRIC ACTUATOR WHEN IT IS DISCONNECTED FROM THE HEATER AND AIR CONDITIONING MODULE OR DAMAGE TO THE ELECTRIC ACTUATOR MAY RESULT.

- START ENGINE.
- SELECT "AUTO" AND SET TEMPERATURE TO 32°C (90°F), MAKING SURE THAT THE BLOWER MOTOR IS OPERATING ON "HI FAN."
- MANUALLY ROTATE THE TEMPERATURE VALVE FROM ONE STOP TO THE OTHER STOP (APPROXIMATELY 65 DEGREES OF ANGLE) AND NOTE AIR TEMPERATURE AND VALVE POSITION. DOES AIR TEMPERATURE CHANGE FROM AMBIENT (OUTSIDE) TEMPERATURE TO AT LEAST 49°C (120°F)?

YES

- REINSTALL ELECTRIC ACTUATOR.
- RECALIBRATE SYSTEM BY REMOVING I/P 10 AMP FUSE 33 FOR ONE MINUTE. REINSTALL FUSE AND TURN IGNITION TO "RUN" POSITION FOR FUSE LOCATION. REFER TO ELECTRICAL DIAGNOSIS 8A-11.
- IF PROBLEM STILL EXISTS, REPLACE ELECTRIC ACTUATOR.

NO

INSPECT HEATER CORE FOR AIR RESTRICTIONS THROUGH FINS.

NO RESTRICTIONS

REPLACE HEATER AND EVAPORATOR MODULE ASSEMBLY.

RESTRICTIONS

REPLACE HEATER CORE.

IMPROPER BLOWER MOTOR SPEED

REFER TO
CHART 1C-1
OR 1C-2.

PROPER AIR TEMPERATURE
AND AIR DELIVERY

CONTINUED ON
PAGE 2 OF 2

NO

- DISCONNECT ELECTRIC ACTUATOR ELECTRICAL CONNECTOR.
- WITH IGNITION IN "RUN" POSITION USING A DVM, CHECK FOR BATTERY VOLTAGE AT TERM "5". IS BATTERY VOLTAGE PRESENT AT TERM "5"?

YES

- WITH TEMPERATURE SET AT 32°C (90°F) USING A DVM, MEASURE VOLTAGE AT TERM "6". IS VOLTAGE LESS THAN .5V?

YES

REPLACE ELECTRICAL ACTUATOR.

NO

REPAIR OPEN IN CKT 241 BETWEEN TERM "5" AND S211.

NO

- CHECK FOR A SHORT TO B+ IN CKT 1199.
- IF OK, REPLACE H-A/C CONTROL.

CHART 1C-4

(Page 2 of 2)

INSUFFICIENT OR NO HEATING (C68)

INSIDE AIR TEMPERATURE SENSOR TEMPERATURE VS. OHMS CHART		
INSIDE AIR TEMPERATURE*	OHMS	INSIDE AIR TEMPERATURE INPUT (POINTER NUMBER "-28")
-5°C (23°F)	12,282	208
0°C (32°F)	9,407	197
5°C (41°F)	7,273	184
10°C (50°F)	5,666	171
15°C (59°F)	4,447	156
20°C (68°F)	3,514	142
25°C (77°F)	2,795	127
30°C (86°F)	2,237	113
35°C (95°F)	1,802	100
40°C (104°F)	1,459	87

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$

CONTINUED FROM PAGE 1 OF 2

• SET HEATER AND A/C CONTROL ASSEMBLY TO 24°C (75°F) "AUTO."
DOES INTERIOR TEMPERATURE STABILIZE AT 24°C (75°F) $\pm 5^{\circ}$?

YES

NO TROUBLE FOUND

NO

• REMOVE RIGHT-HAND INSTRUMENT PANEL MOLDING ASSEMBLY.
• SELECT "HIGH" BLOWER MOTOR SPEED.
• CHECK FOR PROPER AIR FLOW THROUGH INSIDE AIR TEMPERATURE
SENSOR ASSEMBLY BY PLACING A SMALL PIECE OF PAPER [5 BY 5 cm
(2 BY 2 INCHES)] IN FRONT OF SENSOR ASSEMBLY.
DID PAPER STICK TO SENSOR ASSEMBLY? (IS AIR FLOWING THROUGH
THE SENSOR ASSEMBLY?)

YES

CHECK AIR PASSAGES IN I/P MOLDING
FOR RESTRICTIONS.

NO RESTRICTIONS FOUND

• OPEN I/P COMPARTMENT PAST STOPS.
• DISCONNECT INSIDE AIR TEMPERATURE
SENSOR CONNECTOR.
• MEASURE SENSOR RESISTANCE AND
INSIDE VEHICLE AIR TEMPERATURE
AND COMPARE WITH CHART ABOVE.
IS INSIDE AIR TEMPERATURE SENSOR
WITHIN SPECIFICATIONS?

YES

REPLACE THE HEATER AND AIR
CONDITIONING CONTROL.

NO

REPAIR OR REPLACE INSIDE AIR
TEMPERATURE SENSOR DUCT.

RESTRICTIONS FOUND

REPLACE MOLDING ASSEMBLY.

NO

REPLACE INSIDE AIR
TEMPERATURE SENSOR.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10315

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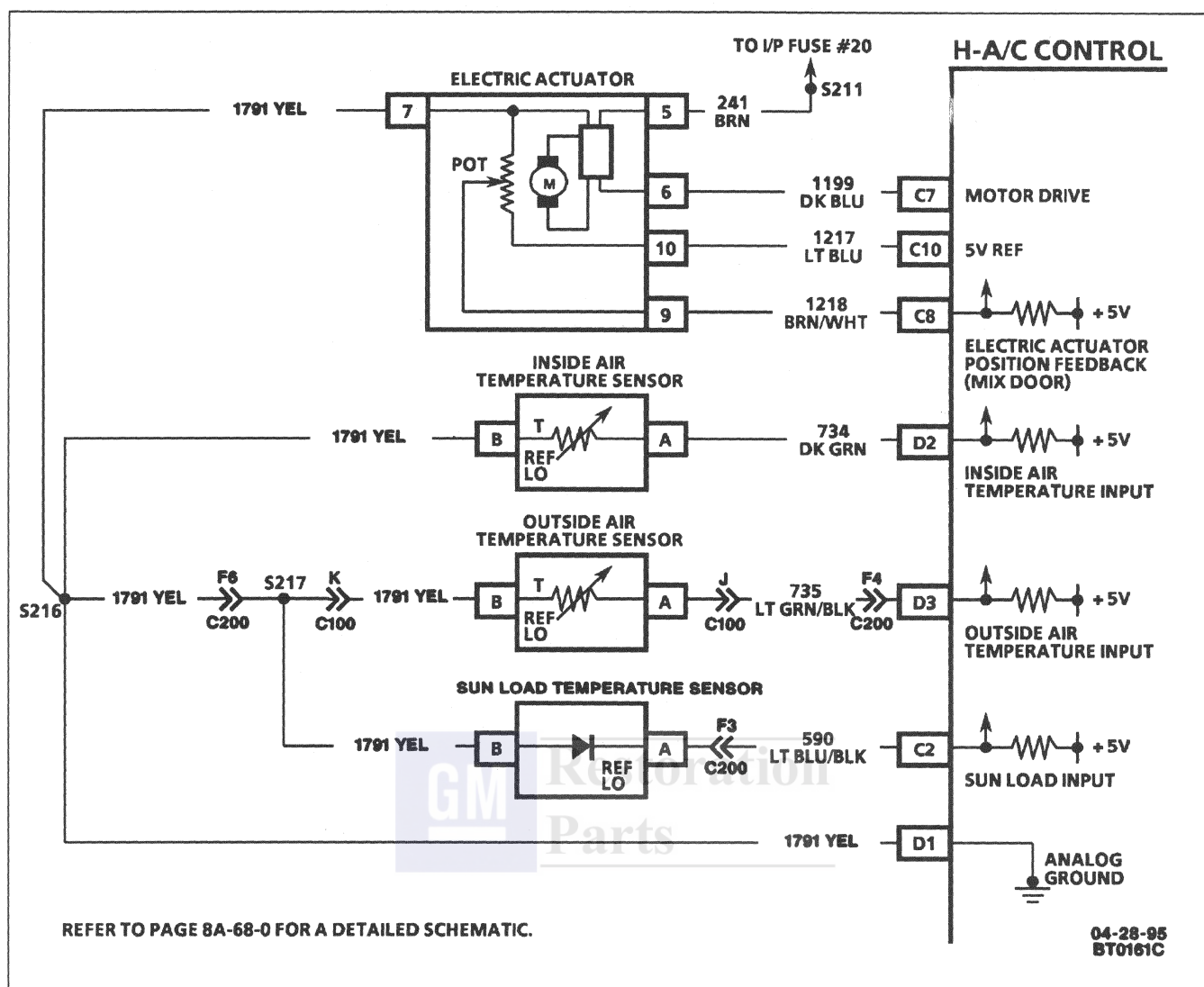


CHART 1C-5

INSUFFICIENT OR NO COOLING (C68)

Circuit Description:

Based on the various temperature sensor inputs, sun load sensor input, input from the PCM and the set temperature, the H-A/C control determines the required temperature and delivery mode to achieve and maintain the selected comfort level.

Diagnostic Aids:

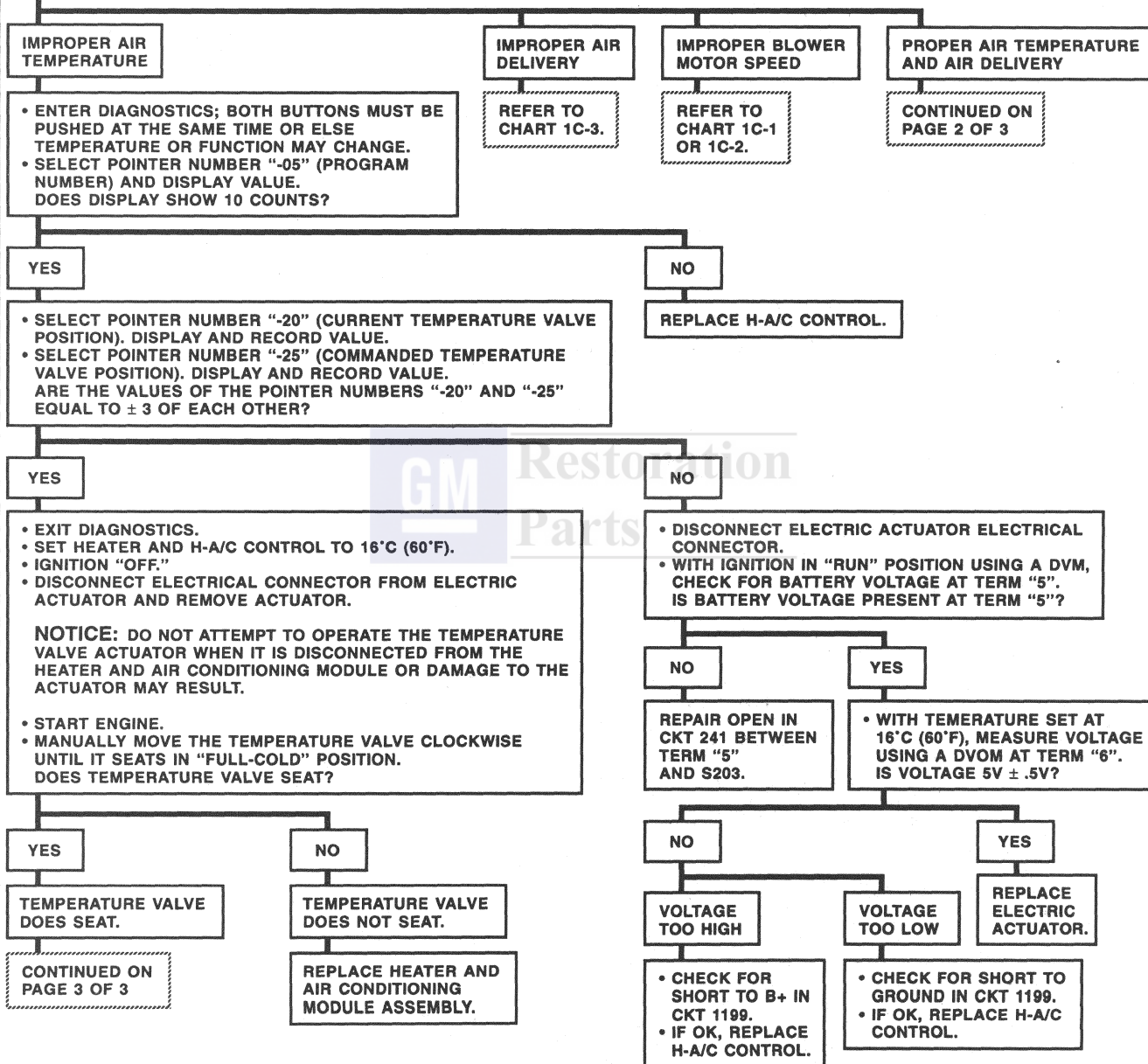
1. Check to make sure instrument panel outlets are open by sliding levers to the left.
2. If vehicle is not equipped with engine driven cooling fan, check primary (right-hand) cooling fan for operation during air conditioning operation. If fan is inoperative, refer to SECTION 6E3-C12 for diagnosis.
3. Check the condenser for debris which may obstruct airflow through the fins.
4. Check the plenum area (at base of windshield) for any debris which may prevent proper airflow into the vehicle interior.
5. With air conditioning system operating, check accumulator temperature. Accumulator temperature should be near freezing (cold to touch). If this is not true, service the refrigeration system. Refer to SECTION 1B and "Refrigerant System Check," CHART 1C-6 in this section.
6. Check the air conditioning system for overcharge. If system is overcharged, recover, recycle, and recharge air conditioning system. There should be 0.8 kg (1 pound 12 ounces) of R-134a refrigerant.

! IMPORTANT:

• ACAC SYSTEM CHECK MUST BE PERFORMED FIRST.

- PERFORM PRELIMINARY INSPECTION.
- AMBIENT TEMPERATURE MUST BE ABOVE 10°C (50°F).
- IF VEHICLE IS NOT EQUIPPED WITH ENGINE DRIVEN FAN, PLACE AUXILIARY FAN IN FRONT OF CONDENSER ASSEMBLY.
- START ENGINE.
- SELECT "AUTO" MODE AND SET TEMPERATURE TO 16°C (60°F). BLOWER MOTOR ASSEMBLY SHOULD BE IN HIGH SPEED AFTER THREE MINUTES OF OPERATION, A LARGE VOLUME OF AIR SHOULD BE DISCHARGED FROM INSTRUMENT PANEL OUTLETS AT LEAST 11°C (20°F) COOLER THAN AMBIENT TEMPERATURE.

CHART 1C-5
(Page 1 of 3)
INSUFFICIENT OR NO COOLING
(C68)



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

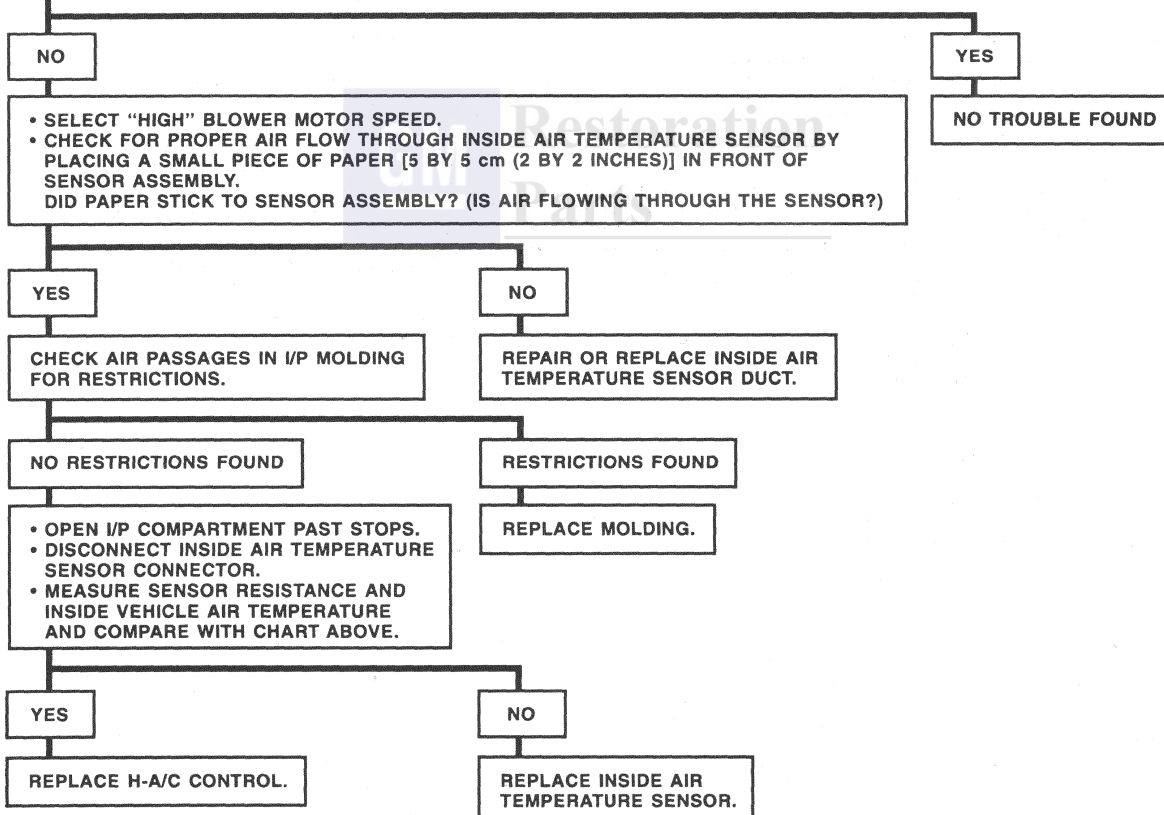
C10316

CHART 1C-5 (Page 2 of 3) **INSUFFICIENT OR NO COOLING** (C68)

INSIDE AIR TEMPERATURE SENSOR TEMPERATURE VS. OHMS CHART		
INSIDE AIR TEMPERATURE*	OHMS	INSIDE AIR TEMPERATURE INPUT (POINTER NUMBER "-28")
-5°C (23°F)	12,282	208
0°C (32°F)	9,407	197
5°C (41°F)	7,273	184
10°C (50°F)	5,666	171
15°C (59°F)	4,447	156
20°C (68°F)	3,514	142
25°C (77°F)	2,795	127
30°C (86°F)	2,237	113
35°C (95°F)	1,802	100
40°C (104°F)	1,459	87

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$

CONTINUED FROM PAGE 1 OF 3



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10317

CHART 1C-5
(Page 3 of 3)
INSUFFICIENT OR NO COOLING
(C68)

CONTINUED FROM PAGE 1 OF 3

• CHECK AIR OUTLET TEMPERATURE.
IS TEMPERATURE AT LEAST 11°C (20°F) COOLER THAN AMBIENT TEMPERATURE?

NO

CHECK FOR EVAPORATOR RESTRICTIONS.

IF RESTRICTIONS, REPAIR OR
REPLACE EVAPORATOR.

IF NO RESTRICTIONS, REPLACE
HEATER AND AIR CONDITIONING
EVAPORATOR MODULE ASSEMBLY.

YES

- REINSTALL TEMPERATURE VALVE ACTUATOR.
- RECALIBRATE SYSTEM BY REMOVING I/P HVAC BAT FUSE #33 FOR ONE MINUTE. REINSTALL FUSE AND TURN IGNITION TO "RUN" POSITION.
- FOR FUSE LOCATION, REFER TO SECTION 8A-11.
- IF A PROBLEM STILL EXISTS, REPLACE ELECTRIC ACTUATOR.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10318

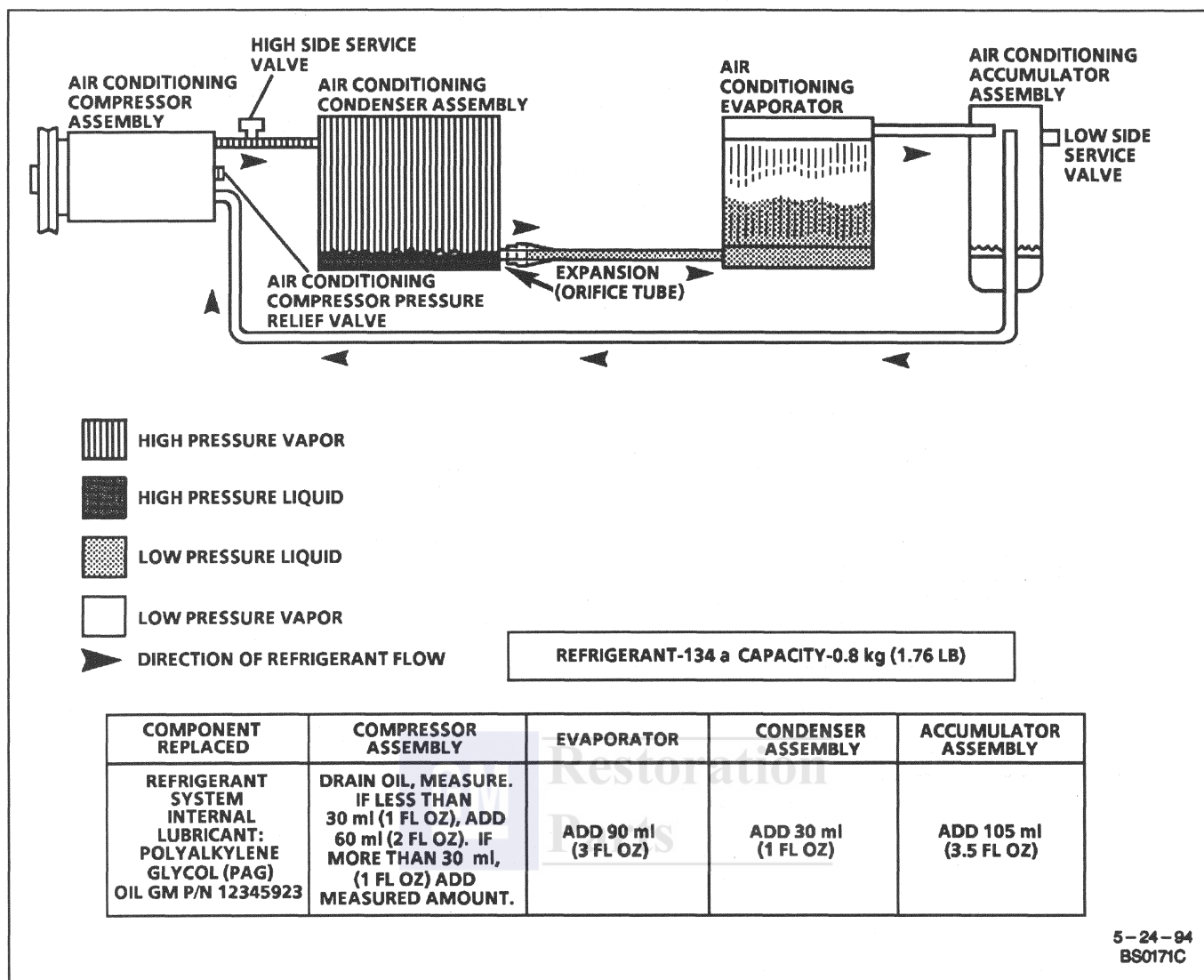


CHART 1C-6

REFRIGERANT SYSTEM CHECK (C68)

System Description:

Under normal conditions, liquid refrigerant passes through the orifice tube in the condenser outlet pipe and expands in the evaporator. Expansion occurs due to restricted flow caused by the orifice tube, which reduces pressure in the evaporator. The refrigerant absorbs large amounts of heat from the air passing through the evaporator, and gradually begins to boil as it passes through the evaporator. It is almost completely vaporized as it enters the accumulator. Liquid refrigerant is prevented from entering the compressor by the accumulator.

If a low charge or a partially plugged orifice tube exists, the compressor will cycle rapidly because the evaporator pressure is so low that the refrigerant boils almost immediately instead of gradually. Relatively warm air will come out of the instrument panel outlets under such conditions.

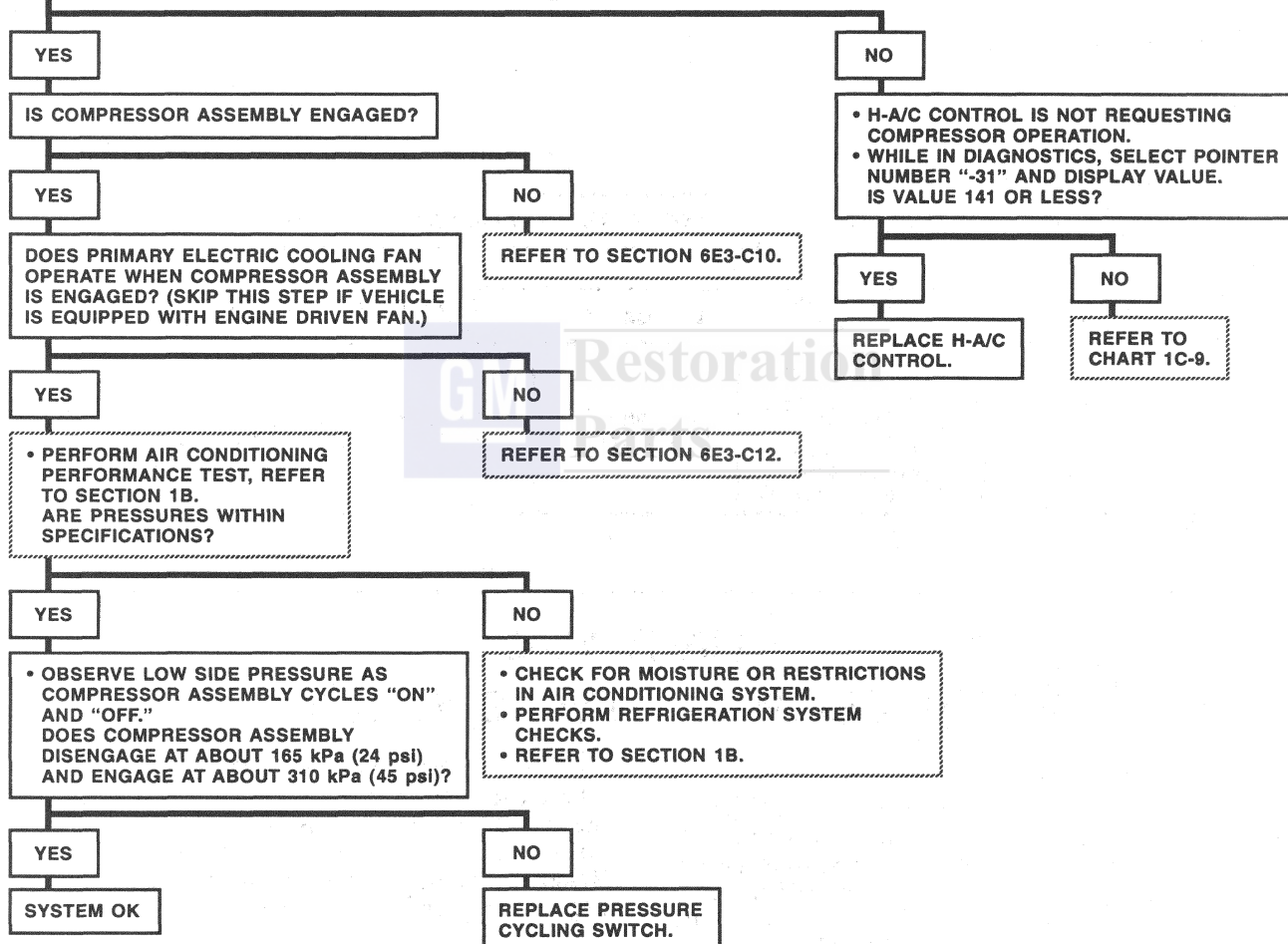
CHART 1C-6 REFRIGERANT SYSTEM CHECK (C68)



IMPORTANT:

- ACAC DIAGNOSTIC SYSTEM CHECK MUST BE PERFORMED FIRST.
- AMBIENT TEMPERATURE MUST BE ABOVE 10°C (50°F).
- CHECK FOR RESTRICTED AIR FLOW AT CONDENSER ASSEMBLY.

- START ENGINE.
- USE AUXILIARY FAN IN FRONT OF RADIATOR (IF VEHICLE IS NOT EQUIPPED WITH ENGINE DRIVEN FAN).
- WITH ENGINE AT 2000 rpm, SELECT "AUTO" MODE AND SET TEMPERATURE TO 16°C (60°F).
- ENTER DIAGNOSTICS AND SELECT POINTER NUMBER "-02". IS "EXT TEMP" GRAPHIC DISPLAYED ON H-A/C CONTROL?



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10319

CHART 1C-7

IMPROPER DEFOGGER OR HEATED MIRROR OPERATION (C67 AND C68)

Circuit Description:

When the ignition switch is turned to "RUN," voltage is applied from I/P Fuse Block Fuses 33 (C68) and 20 to the H-A/C control. When the rear defogger switch is pressed to "ON," voltage is momentarily applied to the defog request input of the solid state timer. Once requested, the timer will close the internal contacts from terminal "D15" to terminal "C1" (C68) or terminal "A1" to terminal "A8" (C67) of the H-A/C control, lighting the "ON" indicator and energizing the coil of the rear defogger relay with voltage applied from I/P Fuse Block Circuit Breaker 4 and CKT 1640 to CKT 293, and I/P Fuse Block Fuse 1 to the heated mirrors.

The solid state timer with the H-A/C control will control the time the internal contacts are closed. When the ignition switch is turned to "RUN" and the rear defogger switch is turned to "ON" for the first time, the defog cycle lasts 10 minutes. Further operation will result in 5 minute defog cycles. The defog cycle is reset to 10 minutes when the ignition switch is turned to "OFF" and back to "RUN."

Diagnostic Aids:

1. Check I/P Circuit Breaker 4. If open, check for short to ground in CKT 1640.
2. Check the rear defogger grid for opens.
3. Check that grounds G201, G202, or G300 and G400 are clean and tight.
4. If both mirror defoggers are inoperative but rear defogger operates normally, check I/P fuse 44. If open, check for a short to ground in CKT 676.
5. Check I/P fuse 11. If open, check for a short to ground in CKT 39.
6. Check I/P fuse 33 (C68). If open, check for a short to ground in CKT 40.
7. Check I/P fuse 20. If open, check for a short to ground in CKT 241.
8. Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity voltage check. Refer to SECTION 8A.
9. Check for proper installation of after market electronic equipment which may affect the integrity of other systems. Refer to SECTION 8A.



Restor
Parts

CHART 1C-7

(Page 1 of 3)
 IMPROPER DEFOGGER
 OR HEATED MIRROR
 OPERATION
 (C67 AND C68)

- TURN IGNITION SWITCH TO "RUN."
- REAR WINDOW DEFOGGER SWITCH "ON."
- DOES REAR DEFOGGER AND MIRROR DEFOGGER OPERATE?

REAR WINDOW DEFOGGER (AND IF EQUIPPED MOTOR DEFOGGER) INOPERATIVE.

CONTINUED ON
 PAGE 1-C-68

REFER TO PAGES 1C-64 AND 1C-65.

BACKPROBE WITH A DVM THE REAR WINDOW DEFOGGER RELAY BETWEEN TERM "30" AND GROUND.

B+

0 VOLTS

- TURN IGNITION TO "RUN."
- BACKPROBE THE REAR WINDOW DEFOGGER RELAY WITH A DVM BETWEEN TERM "85" AND GROUND.

REPAIR OPEN OR SHORT TO GROUND IN CKT 1640 BETWEEN I/P CIRCUIT BREAKER #4 AND REAR WINDOW DEFOGGER RELAY TERM "30".

B+

0 VOLTS

- PRESS REAR WINDOW DEFOGGER SWITCH TO "ON."
- BACKPROBE THE REAR WINDOW DEFOGGER RELAY WITH A DVM BETWEEN TERM "85" AND TERM "86".

REPAIR OPEN OR SHORT TO GROUND IN CKT 39 BETWEEN I/P FUSE 11 AND REAR DEFOGGER RELAY TERM "85".

B+

0 VOLTS

BACKPROBE THE REAR WINDOW DEFOGGER RELAY WITH A DVM BETWEEN TERM "87" AND TERM "86".

- IF VEHICLE HAS C67 ELECTRONIC AIR CONDITIONING, SKIP THIS STEP.
- BACKPROBE THE H-A/C CONTROL CONN WITH A DVM BETWEEN THE TERMINAL AT CKT 40 AND GROUND.

B+

0 VOLTS

IS VEHICLE EQUIPPED WITH MIRROR DEFOGGER?

- CHECK FOR POOR CONNECTION.
- IF OK, REPLACE REAR WINDOW DEFOGGER RELAY.

NO

YES

BACKPROBE WITH A DVM FROM REAR WINDOW DEFOGGER GRID CONN (CKT 293 SIDE), (C411 FOR WAGON) TO GROUND.

REPAIR OPEN IN CKT 293 BETWEEN REAR WINDOW DEFOGGER RELAY TERM "87" AND S282.



(CONTINUED ON NEXT PAGE)



(CONTINUED ON NEXT PAGE)

CHART 1C-7 **(Page 2 of 3)** **IMPROPER DEFOGGER** **OR HEATED MIRROR** **OPERATION** **(C67 AND C68)**

REFER TO PAGES 1C-64 AND 1C-65.

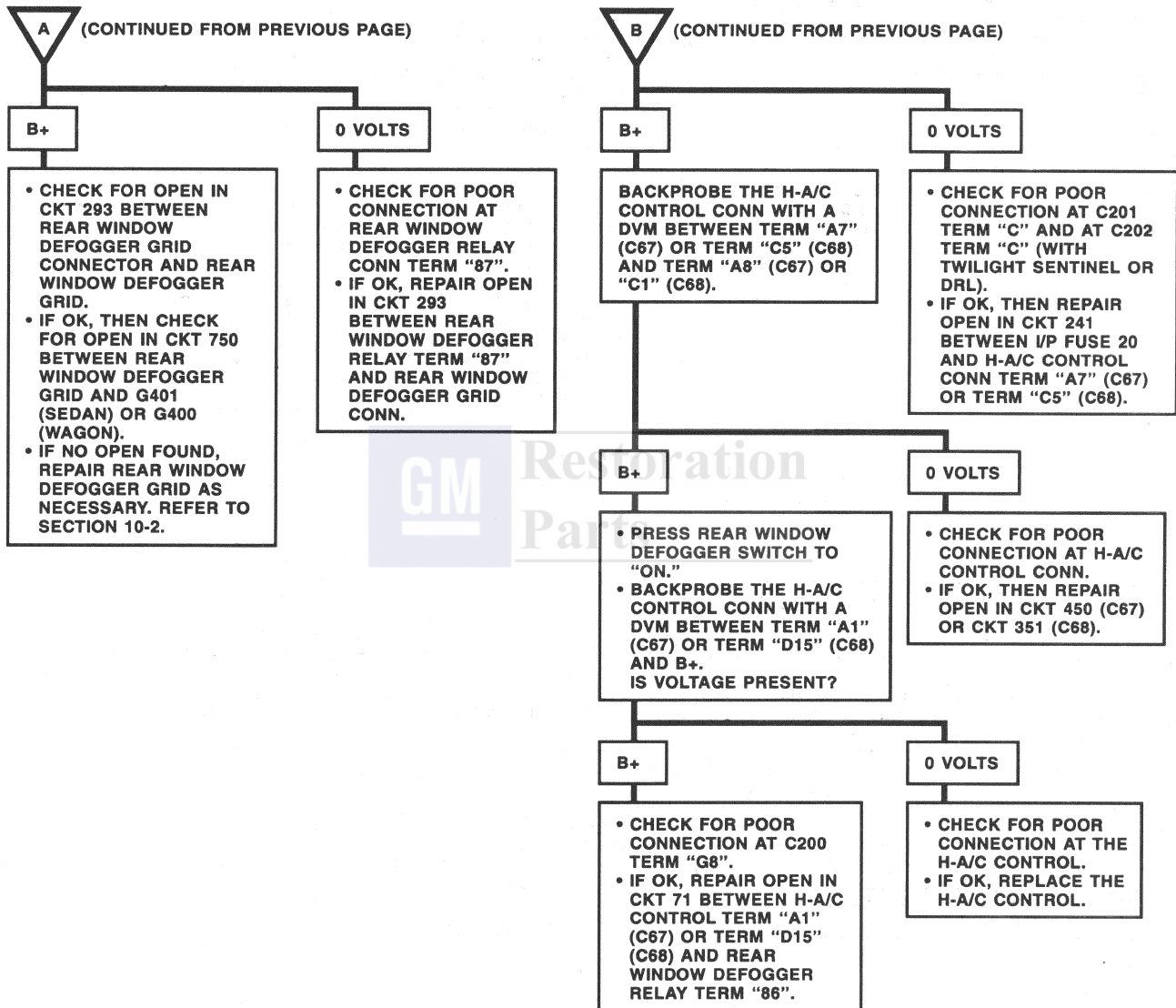


CHART 1C-7

(Page 3 of 3)
IMPROPER DEFOGGER
OR HEATED MIRROR
OPERATION
(C67 AND C68)

REFER TO PAGES 1C-64 AND 1C-65.

CONTINUED FROM
PAGE 1C-66

BOTH MIRROR DEFOGGER
INOPERATIVE WITH REAR
WINDOW DEFOGGER
OPERATING NORMALLY.

- TURN IGNITION SWITCH TO "RUN."
- REAR WINDOW DEFOGGER SWITCH "ON."
- WITH A TEST LIGHT TO GROUND, BACKPROBE C230 TERM "K". IS TEST LIGHT "ON"?

YES

CHECK FOR OPEN
IN CKT 676
BETWEEN C230
AND S244 OR
OPEN IN CKT 550
BETWEEN S258
AND G201.

NO

CHECK FOR OPEN IN
CKT 293 BETWEEN
S282 AND FUSE
BLOCK OR OPEN IN
CKT 676 BETWEEN
FUSE BLOCK AND
C230.

CONTINUED FROM
PAGE 1C-66

REAR WINDOW
DEFOGGER
INOPERATIVE
WITH MIRROR
DEFOGGER
OPERATING
NORMALLY.

- TURN IGNITION SWITCH TO "ON."
- REAR WINDOW DEFOGGER SWITCH "ON."
- WITH A TEST LIGHT TO GROUND, BACKPROBE REAR WINDOW DEFOGGER GRID CONN (CKT 293 SIDE). IS TEST LIGHT "ON"?

YES

- CHECK FOR OPEN IN CKT 750 BETWEEN REAR WINDOW DEFOGGER GRID AND G401 (SEDAN) OR G400 (WAGON).
- CHECK FOR OPEN IN CKT 293 BETWEEN REAR WINDOW DEFOGGER GRID CONN (C411 FOR WAGON) AND REAR WINDOW DEFOGGER GRID.
- IF NO OPEN IS FOUND, REPAIR REAR WINDOW DEFOGGER GRID AS NECESSARY. REFER TO SECTION 10-2.

NO

REPAIR OPEN IN CKT
293 BETWEEN S282
AND REAR WINDOW
DEFOGGER GRID
CONN.

CONTINUED FROM
PAGE 1C-66

ONE MIRROR DEFOGGER INOPERATIVE WITH THE
OTHER MIRROR DEFOGGER OPERATING NORMALLY.

- TURN IGNITION SWITCH TO "RUN."
- REAR WINDOW DEFOGGER SWITCH "ON."
- WITH A TEST LIGHT TO GROUND, BACKPROBE C500 TERM "F" (LH INOPERATIVE) OR C600 TERM "F" (RH INOPERATIVE). IS TEST LIGHT "ON"?

YES

- DISCONNECT INOPERATIVE MIRROR CONN.
- PLACE A TEST LIGHT ACROSS TERMINALS "E" AND "F" OF HARNESS SIDE CONN. IS TEST LIGHT "ON"?

NO

- CHECK FOR POOR CONNECTION AT MIRROR CONN TERM "F".
- IF OK, REPAIR OPEN IN CKT 676 BETWEEN TERM "F" AND S244.

YES

- CHECK FOR OPEN IN THE PIGTAIL WIRING TO THE MIRROR.
- IF NO OPEN FOUND, CHECK FOR A POOR CONNECTION AT MIRROR CONN.
- IF OK, REPLACE THE HEATER WITHIN THE MIRROR. REFER TO SECTION 10-6.

NO

REPAIR OPEN IN CKT 550 BETWEEN S258
AND TERM "E" OF APPROPRIATE CONN.

REFER TO PAGES 1C-64 AND 1C-65.

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**Restoration
Parts**

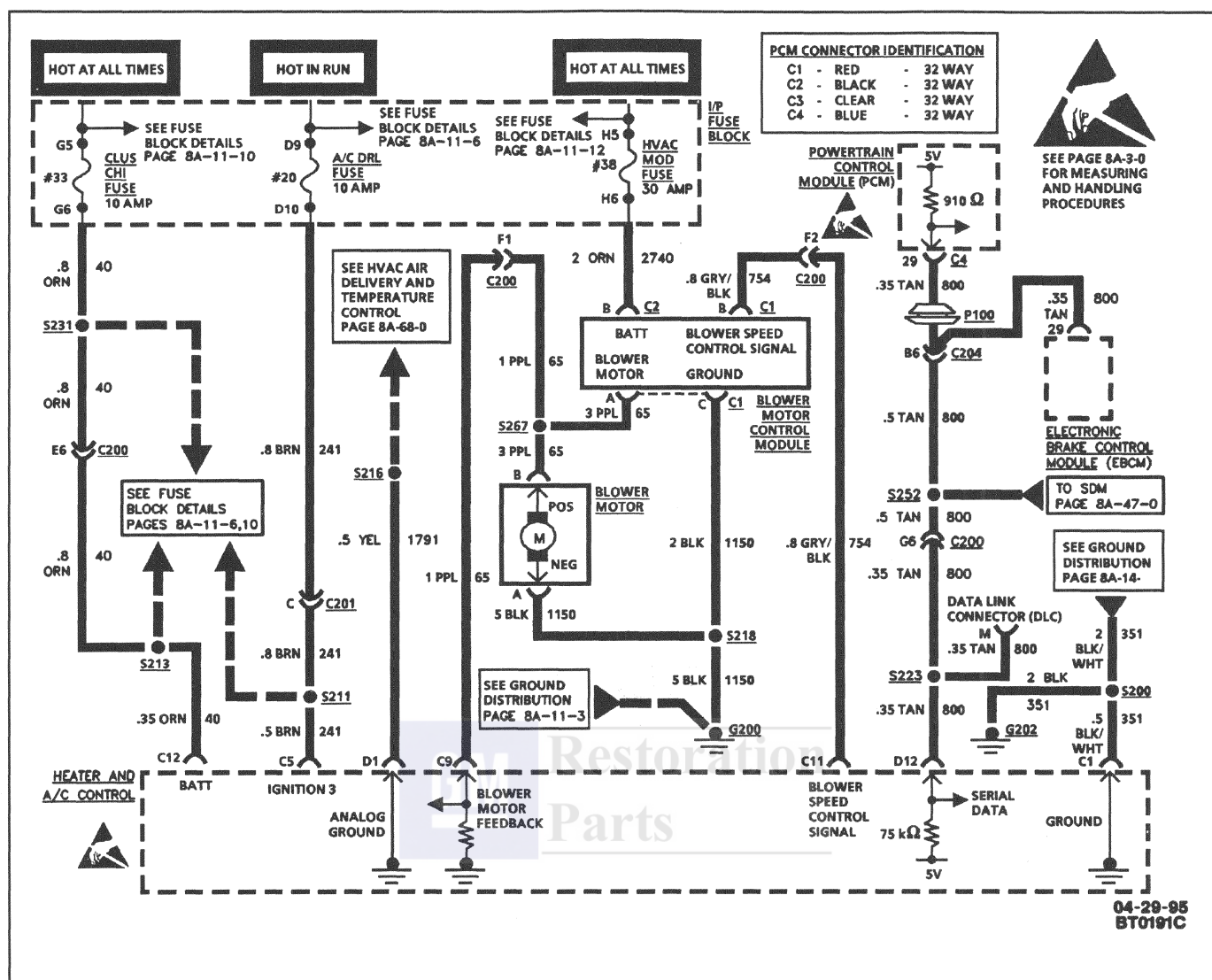


CHART 1C-8

INOPERATIVE H-A/C CONTROL (C68)

Circuit Description:

The H-A/C control receives battery voltage at all times through CKT 40. This input is used to retain the volatile memory or the H-A/C control. CKT 241 is an ignition input used to "wake up" the H-A/C control. CKT 351 supplies ground to the H-A/C control.

Diagnostic Aids:

- Check I/P fuse numbers 20 and 33 for open circuits. If open circuit is found, check for short to ground.

CHART 1C-8 INOPERATIVE H-A/C CONTROL (C68)

**IMPORTANT:**

- SYSTEM RESPONSE CHART MUST BE CHECKED FIRST.

• USING A DVM, BACKPROBE THE HVAC CONTROL ASSEMBLY CONNECTOR BETWEEN TERM "C12" AND TERM "C1". IS B+ INDICATED?

YES

• IGNITION SWITCH TO "RUN."
• USING A DVM, BACKPROBE H-A/C CONTROL CONNECTOR BETWEEN TERM "C5" AND TERM "C1". IS B+ INDICATED?

YES

REPLACE THE H-A/C CONTROL.

NO

• CHECK FOR AN OPEN OR SHORT TO B+ IN GROUND CKT 351 BETWEEN G202 AND H-A/C CONTROL.
• IF OK, CHECK FOR AN OPEN OR SHORT TO GROUND IN CKT 40.
• IF OK, REPAIR POOR MATING CONNECTION BETWEEN THE H-A/C CONTROL CONNECTOR AND THE H-A/C CONTROL.

NO

REPAIR OPEN OR SHORT TO GROUND IN CKT 241.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10323

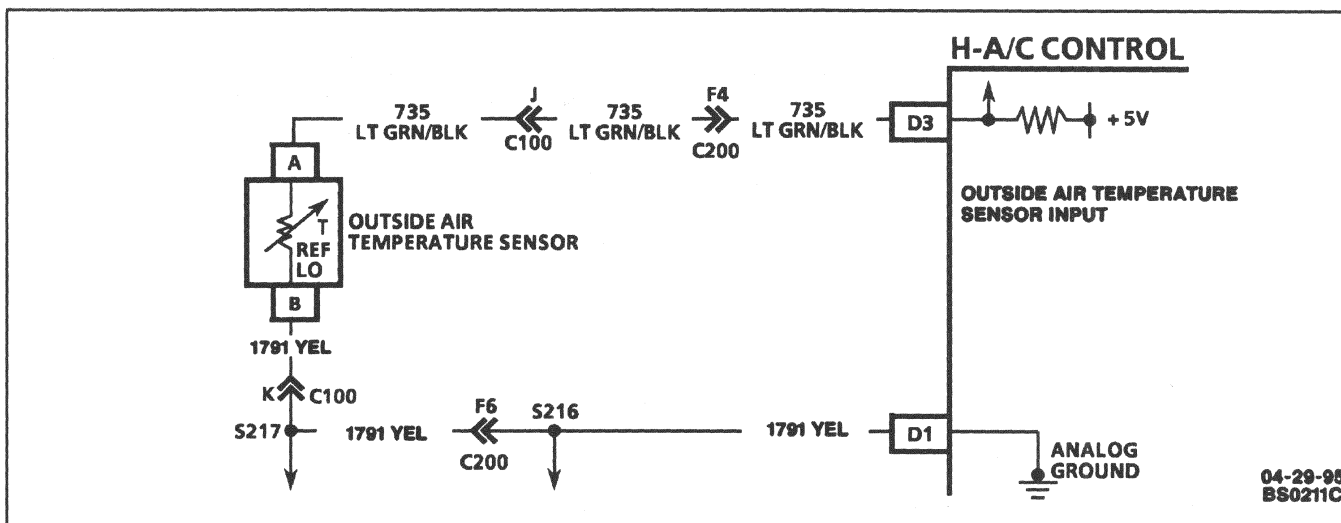


CHART 1C-9

INCORRECT OUTSIDE AIR TEMPERATURE DISPLAY (C68)

System Operation:

The outside air temperature sensor is a thermistor which changes its resistance as outside air temperature changes. As outside air temperature increases, the sensor resistance decreases. The amount of current allowed to pass through the sensor determines the outside air temperature input as monitored on CKT 735.

Outside Air Temperature Display Update

To prevent incorrect outside air temperature display due to engine heat, the H-A/C control will allow the outside air temperature display to increase only after one of the following conditions are met:

When Vehicle is First Started

- Ignition system is turned off for over three hours. The actual outside air temperature will be displayed when the ignition system is turned on.
- Ignition system turned off for less than three hours and engine coolant temperature is less than 10°C (50°F) higher than the outside air temperature reading.

If the above conditions are not met, the outside air temperature display from the previous ignition cycle will be displayed.

When Vehicle is Moving

- Vehicle speed is between 32 and 72 km/h (20 to 45 mph) for three minutes. If the vehicle speed drops below 32 km/h (20 mph), the timer will reset.
- Vehicle speed is above 32 km/h (20 mph) for one minute after reaching 72 km/h (45 mph). If the vehicle speed drops below 32 km/h (20 mph), the timer will reset.

The temperature display will be allowed to decrease at any time.

Diagnostic Aids:

Check for history DTC 101 or 102. While these codes are current, the H-A/C control will use a default value of 9°C (49°F) or 128 A/D counts. There will be no indication that this fault had occurred other than an incorrect outside air temperature display.

Enter diagnostic display mode and display DTCs (if any). Tap on the outside air temperature sensor and wiggle the sensor wiring and electrical connector. If DTC 01 or 02 sets, replace the outside air temperature sensor or repair the electrical connector.

CHART 1C-9 INCORRECT OUTSIDE AIR TEMPERATURE DISPLAY



IMPORTANT:

- ACAC SYSTEM CHECK MUST BE PERFORMED FIRST.

- ENTER DIAGNOSTICS.
 - SELECT POINTER NUMBER "-31" (OUTSIDE AIR TEMPERATURE SENSOR ASSEMBLY INPUT). DISPLAY AND RECORD VALUE.
 - COMPARE RESISTANCE VALUE AND OUTSIDE AIR TEMPERATURE. REFER TO TEMPERATURE VS. OHMS CHART ABOVE.
- IS RESISTANCE VALUE WITHIN SPECIFICATIONS?

NO

- EXIT DIAGNOSTICS.
 - DISCONNECT OUTSIDE AIR TEMPERATURE SENSOR CONNECTOR AND MEASURE RESISTANCE ACROSS SENSOR ASSEMBLY TERMINAL.
 - COMPARE RESISTANCE VALUE AND OUTSIDE AIR TEMPERATURE. REFER TO TEMPERATURE VS. OHMS CHART ABOVE.
- IS VALUE WITHIN SPECIFICATION?

NO

REPLACE
SENSOR.

YES

- REMOVE H-A/C CONTROL.
- CHECK FOR POOR CONNECTIONS AND/OR EXCESSIVE RESISTANCE IN CKTS 735 AND 1791.
- IF OK, REPLACE H-A/C CONTROL.

YES

- ALLOW SUFFICIENT TIME FOR SYSTEM TO UPDATE. REFER TO "SYSTEM OPERATION" ON FACING PAGE.
 - COMPARE RESISTANCE VALUE AND OUTSIDE AIR TEMPERATURE. REFER TO TEMPERATURE VS. OHMS CHART ABOVE.
- IS VALUE WITHIN SPECIFICATIONS?

NO

REPLACE H-A/C
CONTROL.

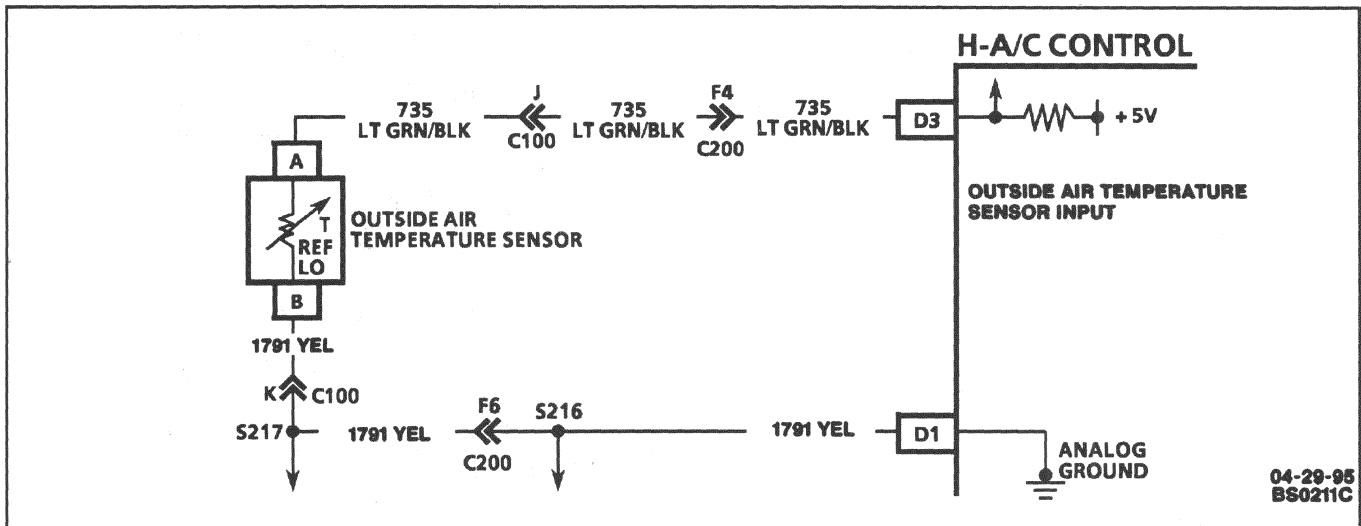
YES

- INFORM CUSTOMER OF TIME REQUIRED BEFORE SYSTEM WILL UPDATE.
- IF PROBLEM IS INTERMITTENT, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

INSIDE AIR TEMPERATURE SENSOR
TEMPERATURE VS. OHMS CHART

INSIDE AIR TEMPERATURE*	OHMS	INSIDE AIR TEMPERATURE INPUT (POINTER NUMBER "-31")
-5°C (23°F)	12,282	174
0°C (32°F)	9,407	158
5°C (41°F)	7,273	143
10°C (50°F)	5,666	127
15°C (59°F)	4,447	112
20°C (68°F)	3,514	98
25°C (77°F)	2,795	85
30°C (86°F)	2,237	73
35°C (95°F)	1,802	63
40°C (104°F)	1,459	54

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$



DTC 01

OUTSIDE AIR TEMPERATURE SENSOR CIRCUIT (C68)

(CIRCUIT OPEN)

Circuit Description:

The outside air temperature sensor is a thermistor used to control the signal voltage at the H-A/C control. The H-A/C control supplies a reference voltage (about 5 volts) on CKT 735 to the sensor. When the outside (ambient) air temperature is cold, the thermistor resistance is high; therefore, the H-A/C control will receive a high signal voltage input. If the outside (ambient) air temperature is hot, the thermistor resistance is low; therefore, the H-A/C control will receive a low signal voltage input. A DTC 01 will be set if the resistance is low; therefore, the H-A/C control will receive a low signal voltage input. A DTC 01 will be set if the resistance seen between CKT 735 and CKT 1791 is above 100.7 k Ω .

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKT 735 stays at 4.5 volts or higher.

Action Taken:

DTC 01 will set in the H-A/C control. The ACAC system will use a default value of 49°F until the fault is cleared. This can be seen by displaying pointer -31 for the outside air temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The system will return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks resistance of outside air temperature sensor.
3. This test checks for normal to above voltage on CKT 735.
4. This test checks for an open in CKT 1791.

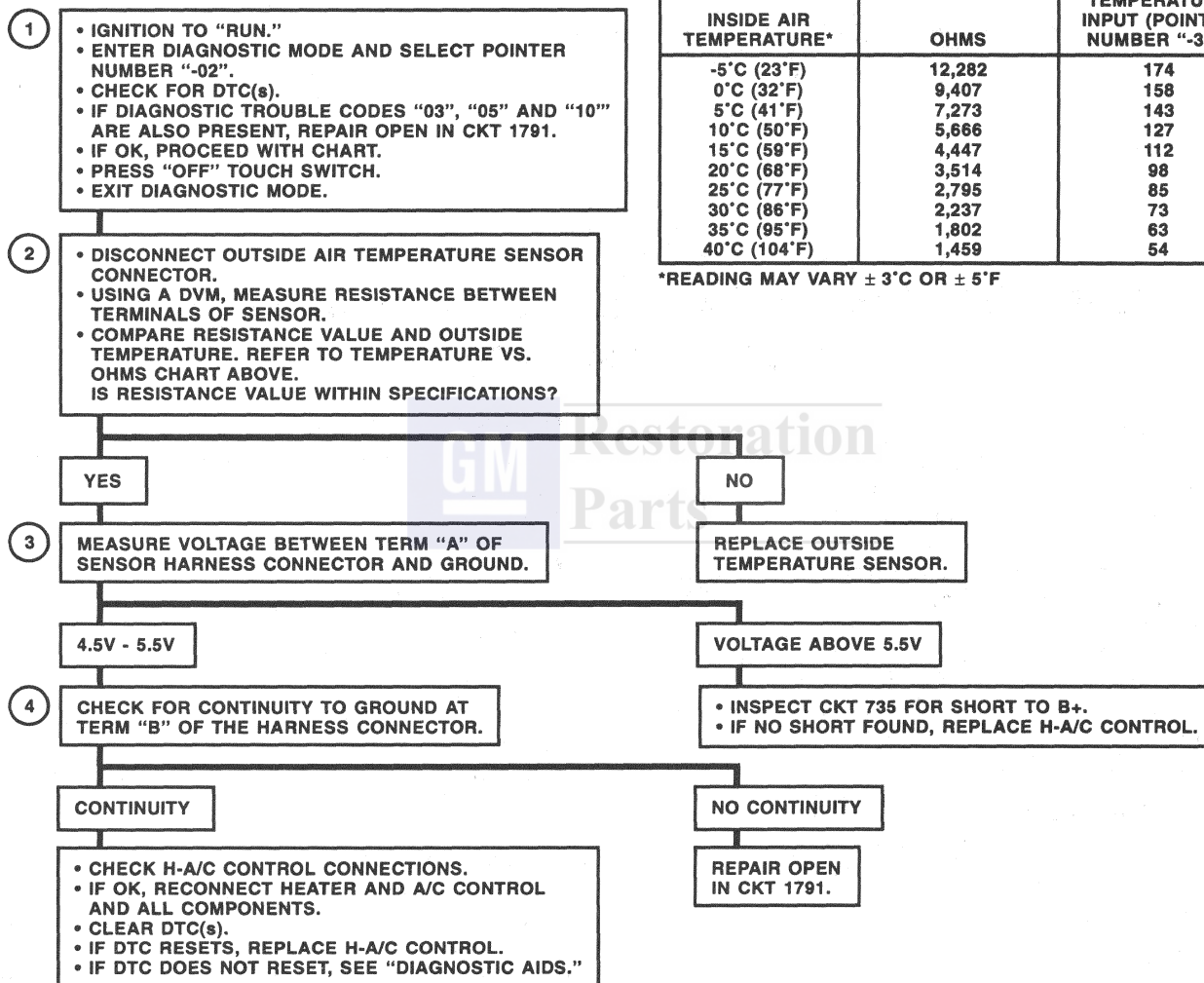
Diagnostic Aids:

Visually inspect sensor connector and harness for damage, corrosion or water intrusion. The resistance value of the sensor must be between 282 Ω and 100.7 k Ω [underhood temperature below 82°C (180°F) and above -34°C (-30°F)]. If resistance is not within specifications, replace sensor. Refer to "Outside Air Temperature Sensor" under "Sensors" in this section.

DTC 01 OUTSIDE AIR TEMPERATURE SENSOR CIRCUIT (CIRCUIT OPEN)

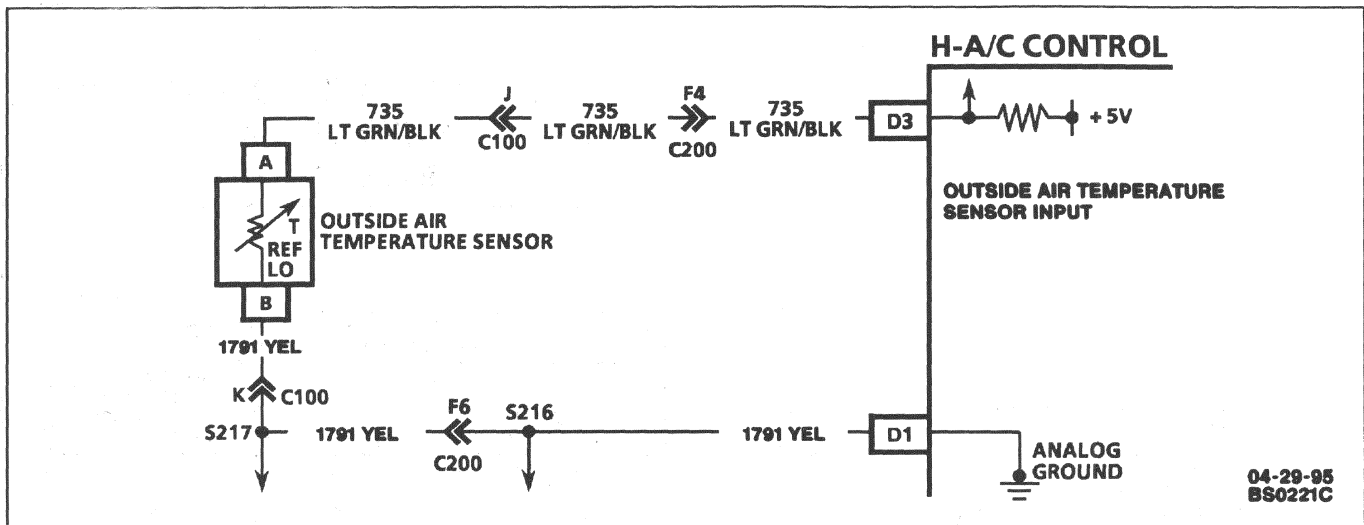
INSIDE AIR TEMPERATURE SENSOR TEMPERATURE VS. OHMS CHART		
INSIDE AIR TEMPERATURE*	OHMS	INSIDE AIR TEMPERATURE INPUT (POINTER NUMBER "-31")
-5°C (23°F)	12,282	174
0°C (32°F)	9,407	158
5°C (41°F)	7,273	143
10°C (50°F)	5,666	127
15°C (59°F)	4,447	112
20°C (68°F)	3,514	98
25°C (77°F)	2,795	85
30°C (86°F)	2,237	73
35°C (95°F)	1,802	63
40°C (104°F)	1,459	54

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C8774



DTC 02

OUTSIDE AIR TEMPERATURE SENSOR CIRCUIT (C68) (CIRCUIT SHORTED)

Circuit Description:

The outside air temperature sensor is a thermistor used to control the signal voltage at the H-A/C control. The H-A/C control supplies a reference voltage (about 5 volts) on CKT 735 to the sensor. When the outside (ambient) air temperature is cold, the thermistor resistance is high; therefore, the H-A/C control will receive a high signal voltage input. If the outside (ambient) air temperature is hot, the thermistor resistance is low; therefore, the H-A/C control will receive a low signal voltage input. A DTC 01 will be set if the resistance seen between CKT 735 and CKT 1791 is above 100.7k ohms.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKT 735 is at or near zero voltage.

Action Taken:

DTC 02 will set in the H-A/C control. The ACAC system will use a default value of 49°F (or 128 A/D counts) until the fault is cleared. This can be seen by displaying pointer -31 for the outside air temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired, and the system will return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks resistance of outside air temperature sensor.
3. This test checks for a short to ground in CKT 735.

Diagnostic Aids:

Visually inspect sensor connector and harness for damage, corrosion or water intrusion. The resistance value of the sensor must be between 282 Ω and 100.7 k Ω [underhood temperature below 82°C (180°F) and above -34°C (-30°F).] If resistance is not within specifications, replace sensor. Refer to "Outside Air Temperature Sensor" under "Sensors" in this section.

DTC 02 OUTSIDE AIR TEMPERATURE SENSOR CIRCUIT (CIRCUIT SHORTED)

INSIDE AIR TEMPERATURE SENSOR TEMPERATURE VS. OHMS CHART		
INSIDE AIR TEMPERATURE*	OHMS	INSIDE AIR TEMPERATURE INPUT (PINTER NUMBER "-31")
-5°C (23°F)	12,282	174
0°C (32°F)	9,407	158
5°C (41°F)	7,273	143
10°C (50°F)	5,666	127
15°C (59°F)	4,447	112
20°C (68°F)	3,514	98
25°C (77°F)	2,795	85
30°C (86°F)	2,237	73
35°C (95°F)	1,802	63
40°C (104°F)	1,459	54

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$

- 1
- IGNITION TO "RUN."
 - ENTER DIAGNOSTIC MODE AND SELECT PINTER NUMBER "-02".
 - CHECK FOR DTC(s).
 - PRESS "OFF" TOUCH SWITCH.
 - EXIT DIAGNOSTIC MODE.

- 2
- DISCONNECT OUTSIDE AIR TEMPERATURE SENSOR CONNECTOR.
 - USING A DVM, MEASURE RESISTANCE BETWEEN TERMINALS OF SENSOR.
 - COMPARE RESISTANCE VALUE AND OUTSIDE TEMPERATURE. REFER TO TEMPERATURE VS. OHMS CHART ABOVE.
 - IS RESISTANCE VALUE WITHIN SPECIFICATIONS?

YES

NO

- 3
- DISCONNECT H-A/C CONTROL CONNECTOR.
 - USING A DVM TO GROUND, CHECK FOR A SHORT TO GROUND AT TERM "D3" OF THE H-A/C CONTROL CONNECTOR.
 - IS CONTINUITY INDICATED?

REPLACE OUTSIDE AIR TEMPERATURE SENSOR.

YES

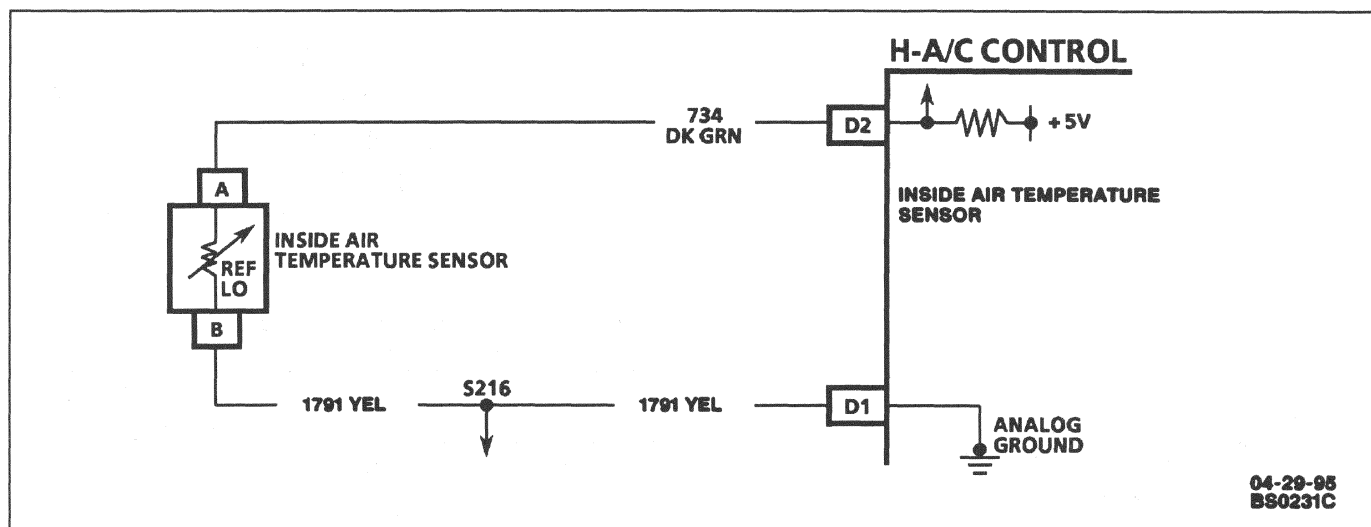
NO

REPAIR SHORT TO GROUND IN CKT 735.

- CHECK CKT 735 FOR AN INTERMITTENT SHORT TO GROUND.
- IF OK, CLEAR DTC(s).
- IF DTC RESETS, REPLACE HEATER AND A/C CONTROL.
- IF DTC DOES NOT RESET, SEE "DIAGNOSTIC AIDS."

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C8775



DTC 03

INSIDE (IN-CAR) AIR TEMPERATURE SENSOR CIRCUIT (C68) (CIRCUIT OPEN)

Circuit Description:

The inside air temperature sensor is a thermistor used to control the signal voltage at the H-A/C control. The H-A/C control supplies a reference voltage (about 5 volts) on CKT 734 to the sensor. When the inside air temperature is cold, the thermistor resistance is high; therefore, the H-A/C control will receive a high signal voltage input. If the inside air temperature is hot, the thermistor resistance is low; therefore the H-A/C control will receive a low signal voltage input.

DTC Will Set When:

With ignition in "RUN," a DTC 03 will be set if the resistance seen between CKT 734 and CKT 1791 is above 100.7 k Ω .

Action Taken:

DTC 03 will set in the H-A/C control. With DTC 03 present, the H-A/C control will use a default value of 128 or 24°C (75°F). This can be seen by displaying parameter "-28" for the inside air temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The system will then return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks resistance of inside air temperature sensor.
3. This test checks for normal to above voltage on CKT 734.
4. This test checks for an open in CKT 1791.

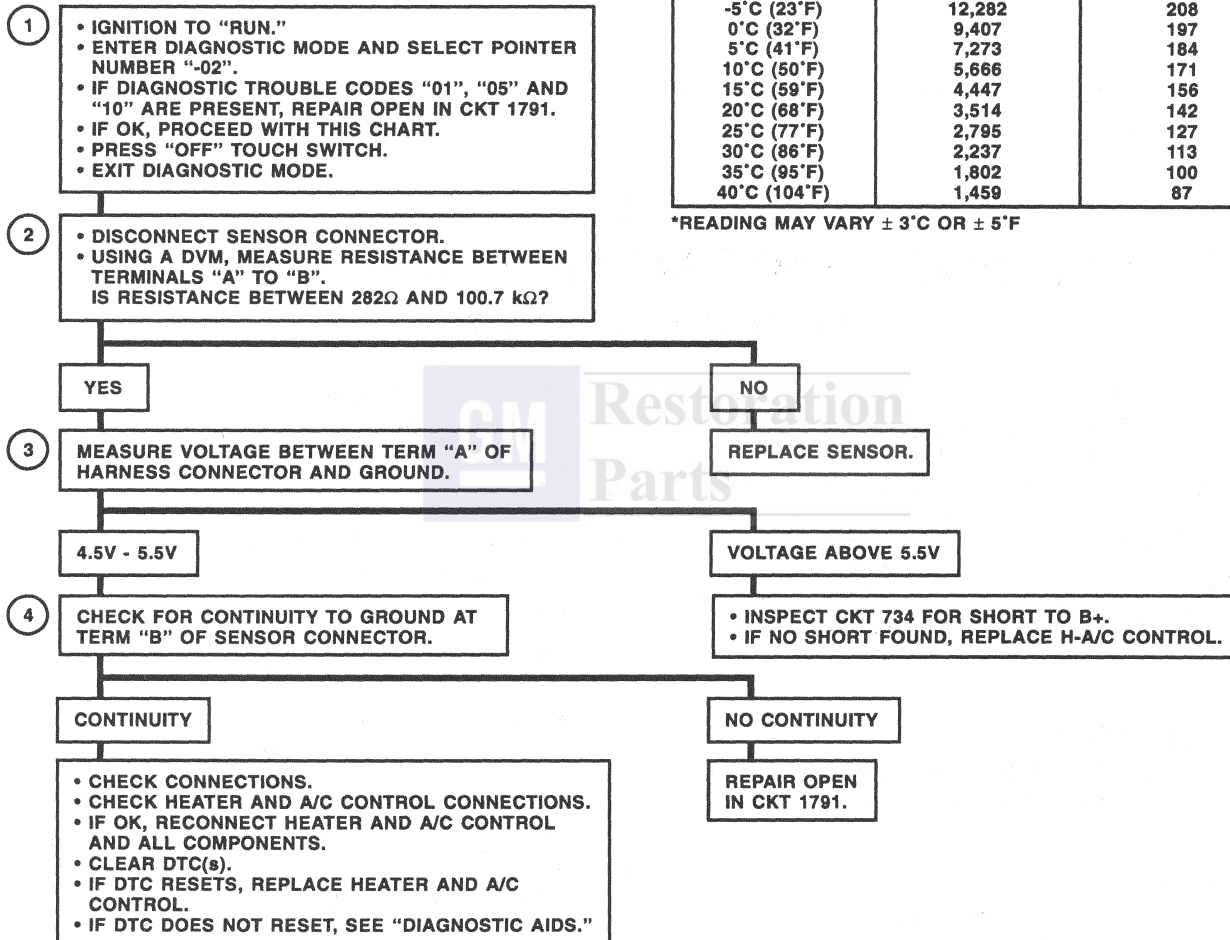
Diagnostic Aids:

Visually inspect sensor thermistor element for broken wires or contamination by removing right-hand instrument panel molding.

DTC 03 IN-CAR AIR TEMPERATURE SENSOR CIRCUIT (CIRCUIT OPEN)

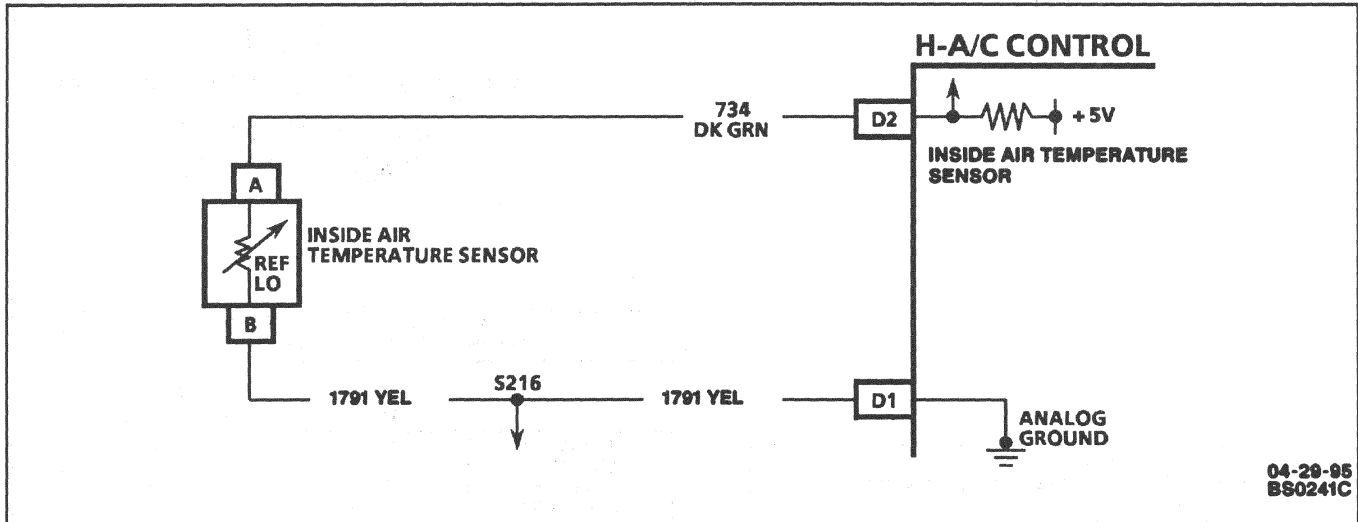
INSIDE AIR TEMPERATURE SENSOR TEMPERATURE VS. OHMS CHART		
	OHMS	POINTER "-28" SIDE AIR TEMPERATURE*
-5°C (23°F)	12,282	208
0°C (32°F)	9,407	197
5°C (41°F)	7,273	184
10°C (50°F)	5,666	171
15°C (59°F)	4,447	156
20°C (68°F)	3,514	142
25°C (77°F)	2,795	127
30°C (86°F)	2,237	113
35°C (95°F)	1,802	100
40°C (104°F)	1,459	87

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10324



DTC 04

INSIDE (IN-CAR) AIR TEMPERATURE SENSOR CIRCUIT (C68) (CIRCUIT SHORTED)

Circuit Description

The inside air temperature sensor is a thermistor used to control the signal voltage at the H-A/C control. The H-A/C control supplies a reference voltage (about 5 volts) on CKT 734 to the sensor. When the inside air temperature is cold, the thermistor resistance is high; therefore, the H-A/C control will receive a high signal voltage input. If the inside air temperature is hot, the thermistor resistance is low; therefore the H-A/C control will receive a low signal voltage input.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKT 734 stays at or near 0 volts.

Action Taken:

DTC 04 will set in the H-A/C control. With DTC 03 present, the H-A/C control will use a default value of 128 or 24°C (75°F). This can be seen by displaying parameter "-28" for the inside air temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The system will then return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks resistance of inside air temperature sensor.
3. This test checks for a ground in CKT 734.

Diagnostic Aid:

Visually inspect sensor thermistor element for broken wires or contamination by removing right-hand instrument panel molding.

DTC 04 IN-CAR AIR TEMPERATURE SENSOR CIRCUIT (CIRCUIT SHORTED)

**INSIDE AIR TEMPERATURE SENSOR
TEMPERATURE VS. OHMS CHART**

	OHMS	POINTER "-28" SIDE AIR TEMPERATURE*
-5°C (23°F)	12,282	208
0°C (32°F)	9,407	197
5°C (41°F)	7,273	184
10°C (50°F)	5,666	171
15°C (59°F)	4,447	156
20°C (68°F)	3,514	142
25°C (77°F)	2,795	127
30°C (86°F)	2,237	113
35°C (95°F)	1,802	100
40°C (104°F)	1,459	87

*READING MAY VARY $\pm 3^{\circ}\text{C}$ OR $\pm 5^{\circ}\text{F}$

- 1
- IGNITION TO "RUN."
 - ENTER DIAGNOSTIC MODE AND SELECT POINTER NUMBER "-02".
 - CHECK FOR DTC(s).
 - PRESS "OFF" TOUCH SWITCH.
 - EXIT DIAGNOSTIC MODE.

- 2
- DISCONNECT SENSOR CONNECTOR.
 - MEASURE RESISTANCE BETWEEN TERMINALS "A" TO "B".
 - IS RESISTANCE BETWEEN 282Ω AND 100.7 kΩ?

YES

NO

- 3
- DISCONNECT H-A/C CONTROL CONNECTOR.
 - USING A DVM TO GROUND, CHECK FOR A SHORT TO GROUND AT TERM "D2" OF THE H-A/C CONTROL CONNECTOR.
 - IS CONTINUITY INDICATED?

REPLACE SENSOR.

YES

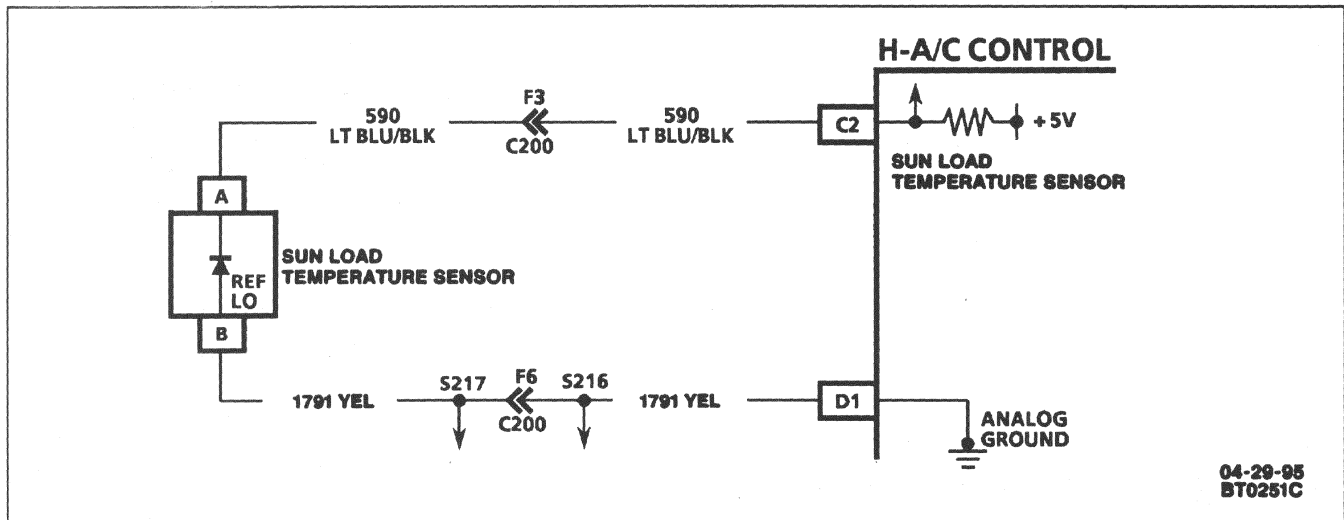
NO

REPAIR SHORT TO GROUND IN CKT 734.

- CHECK CKT 734 FOR AN INTERMITTENT SHORT TO GROUND.
- IF OK, CLEAR DTC(s).
- IF DTC RESETS, REPLACE H-A/C CONTROL.
- IF DTC DOES NOT RESET, SEE "DIAGNOSTIC AIDS."

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C8777



DTC 05

SUN LOAD TEMPERATURE SENSOR CIRCUIT (C68)

(CIRCUIT OPEN)

Circuit Description:

The sun load sensor is a reverse bias photo diode which measures sun load on the vehicle. In "AUTO" mode, the sensor is an input to the H-A/C control to control air delivery. In bright sunlight, the influence of the sensor is comparable to lowering the guide temperature setting by as much as three degrees. A current DTC 05 will be set if an open exists in the circuit.

DTC Will Set When:

With ignition in "RUN", the H-A/C control will detect this fault anytime that CKT 590 stays at or near 5V or higher.

Action Taken:

DTC 05 will set in the H-A/C control. While the DTC is present, the H-A/C control will use a default value of 240 (readout shows "-140") which is equivalent to no sun load. This can be seen by displaying pointer "-18" for the sun load temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The system will return to normal operation.

DTC Chart Test Description:

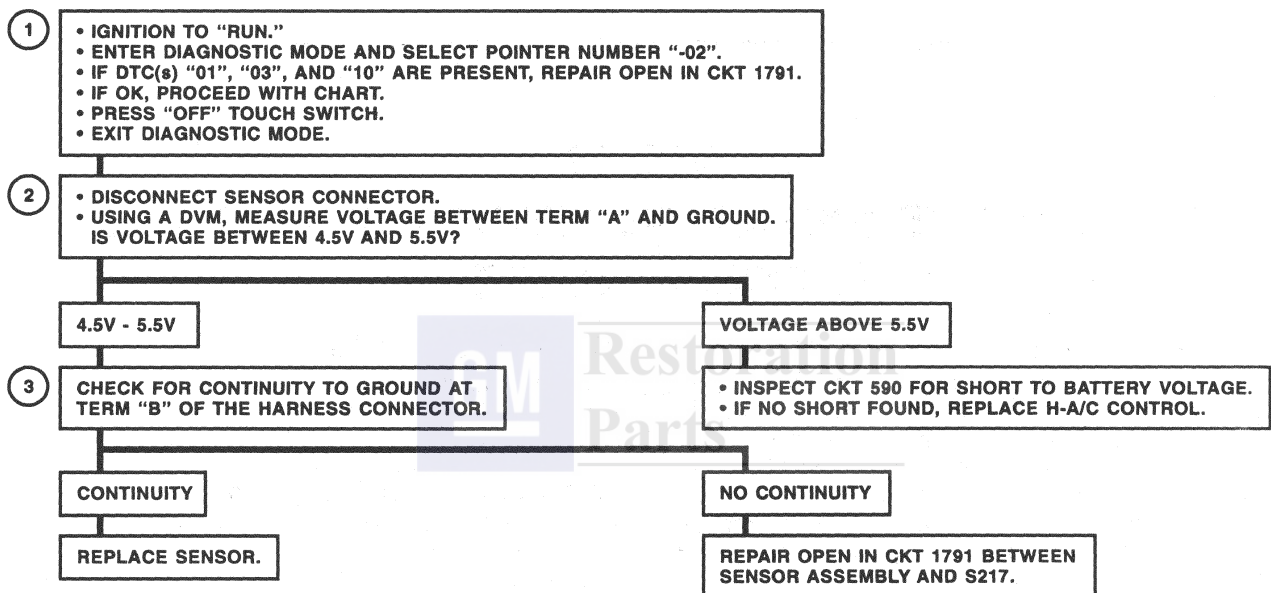
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks for normal to above voltage on CKT 590.
3. This test checks for an open in CKT 1791.

Diagnostic Aids:

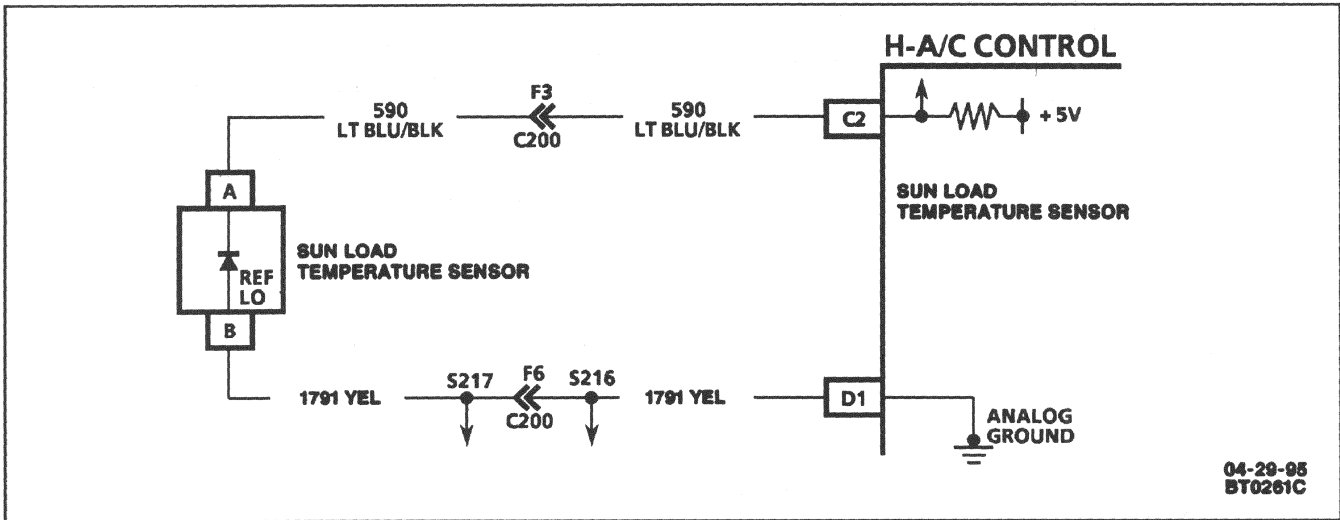
Visually inspect sensor and connector damage by removing grille.

DTC 05 SUN LOAD TEMPERATURE SENSOR CIRCUIT (CIRCUIT OPEN)



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10325



DTC 06 SUN LOAD TEMPERATURE SENSOR CIRCUIT (C68) (CIRCUIT SHORTED)

Circuit Description:

The sun load sensor is a reverse bias photo diode which measures sun load on the vehicle. In "AUTO" mode, the sensor is an input to the H-A/C control to control air delivery. In bright sunlight, the influence of the sensor is comparable to lowering the guide temperature setting by as much as three degrees. A current DTC 06 will be set if a ground exists in the circuit.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKT 590 is at or near zero voltage.

Action Taken:

DTC 06 will set in the H-A/C control. While the DTC is present, the H-A/C control will use a default value of 240 (readout shows "-140") which is equivalent to no sun load. This can be seen by displaying pointer "-18" for the sun load temperature sensor.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired, and the system will return to normal operation.

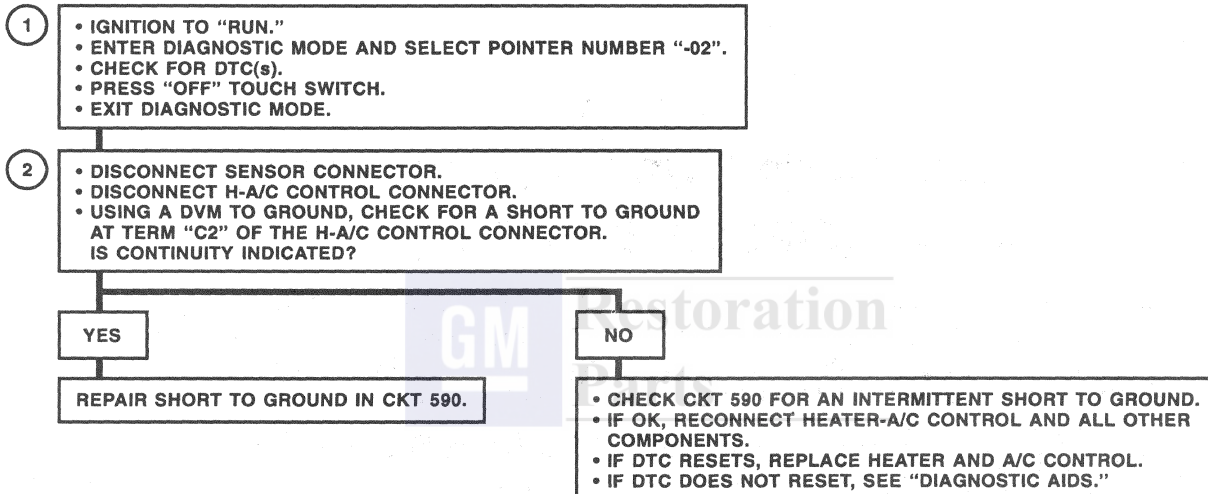
DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks for a short to ground in CKT 590.

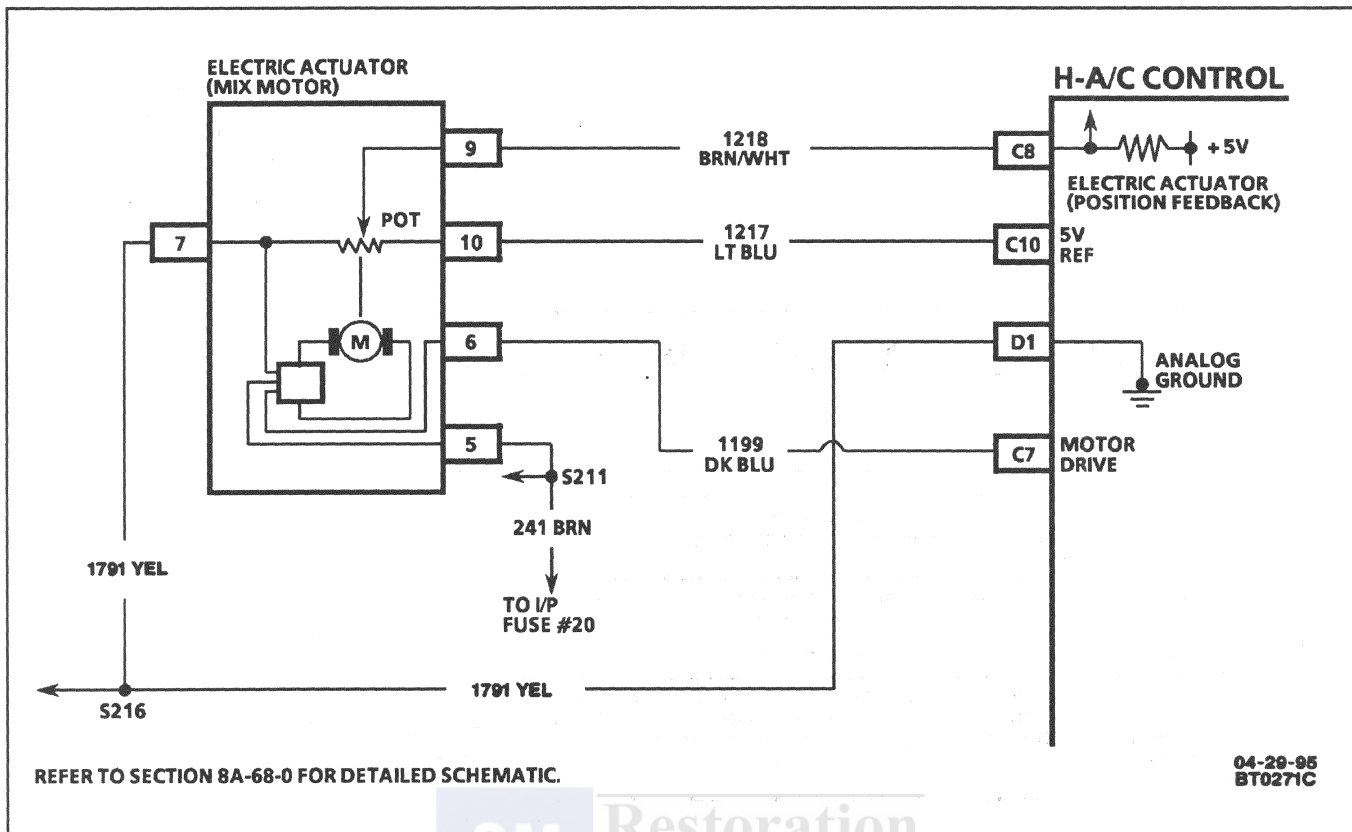
Diagnostic Aids:

Visually inspect sensor and connector damage by removing grille.

**DTC 06
SUN LOAD TEMPERATURE
SENSOR CIRCUIT
(CIRCUIT SHORTED)**

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10326



DTC 10

AIR MIX MOTOR CIRCUIT (C68) (CIRCUIT OPEN)

Circuit Description:

The electric actuator is driven by the H-A/C control to operate the temperature valve. The position of the temperature valve is adjusted to maintain the set temperature. A feedback potentiometer is used in the electric actuator so that the H-A/C control will know the position of the temperature valve. The feedback potentiometer is part of a flat-pack design motor which is mounted on the rear-facing surface of the heater and air conditioning evaporator module. A low voltage at CKT 1218 (about 1.0 volt) represents a hot air valve position and a high voltage at CKT 1218 (about 4.0 volts) a cold air valve position. The H-A/C control drives the electric actuator motor through CKT 1199 by applying 0-2.5-5 volts through the circuit. Applying 0.0V on CKT 1199 to the logic CKT 1199 will cause the temperature valve to move to the full cold position. Applying 2.5 volts causes the electric actuator to stop moving.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKTs 1217 and 1218 see voltage greater than 4.5 volts.

Action Taken:

DTC 10 will set in the H-A/C control. The ACAC system will use a default value of 128 until the fault is cleared.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The ACAC system will then return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for HVAC DTC(s) and should clear any intermittent DTC(s).
2. This test checks for voltage on CKTs 1217 and 1218.
3. This test checks for an open on CKT 1791.
4. This test checks for feedback voltage at terminal "C8" of the H-A/C control.

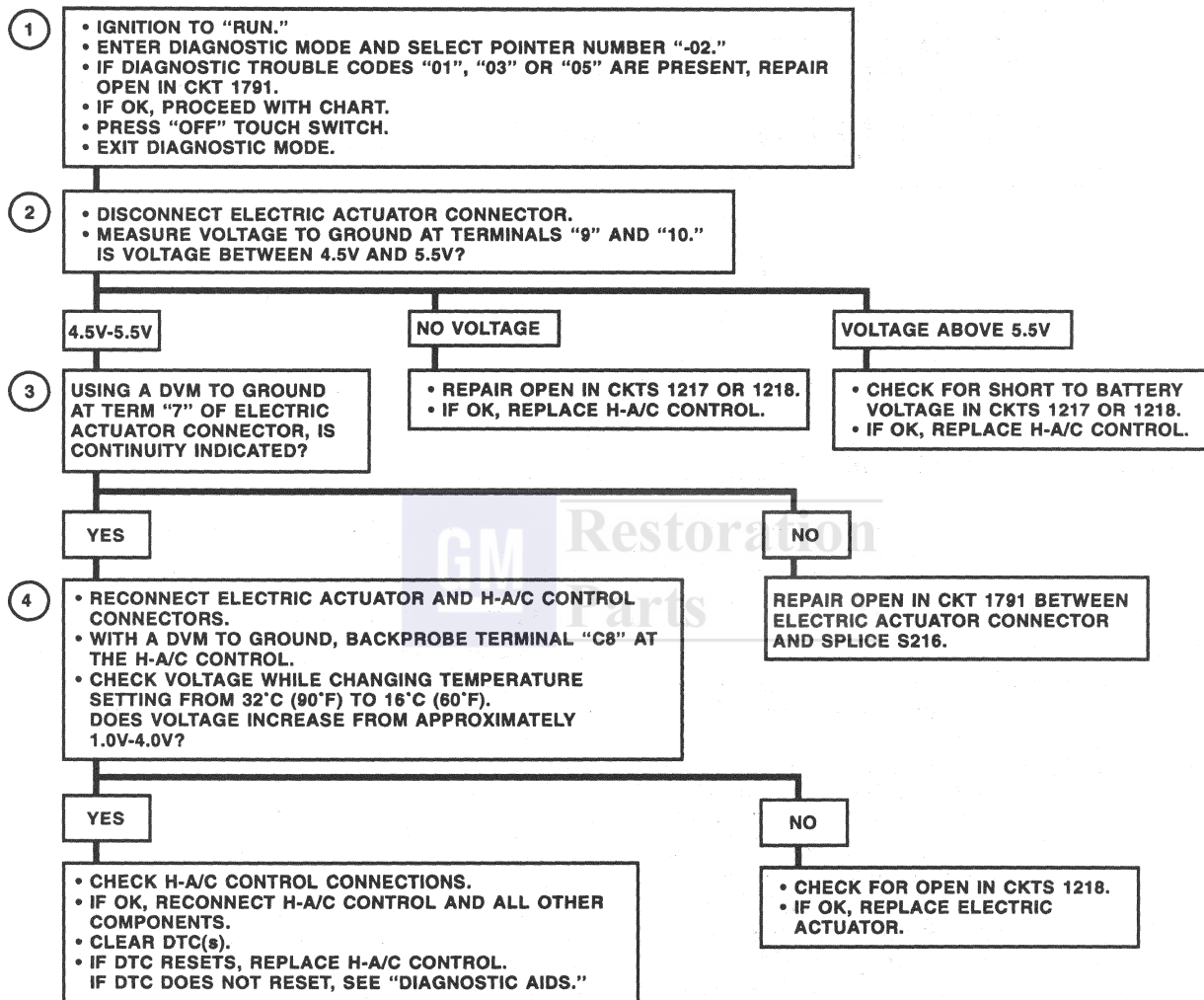
Diagnostic Aids:

Check for a binding temperature valve while removing or replacing the actuator. Check for loose connection or bent pins at the electric actuator connector. Operation of the electric actuator may be observed by opening the instrument panel compartment and then changing the H-A/C control temperature setting from full hot to full cold.

If the H-A/C control voltage supply was disconnected, a new actuator was installed or the temperature valve was disturbed, the H-A/C control will have to be re-calibrated. This will prevent a DTC from being set because of a detected difference between the former and present temperature valve positions. To recalibrate the H-A/C control, remove I/P fuse 33, install fuse 33, and turn ignition switch to the "RUN" position.

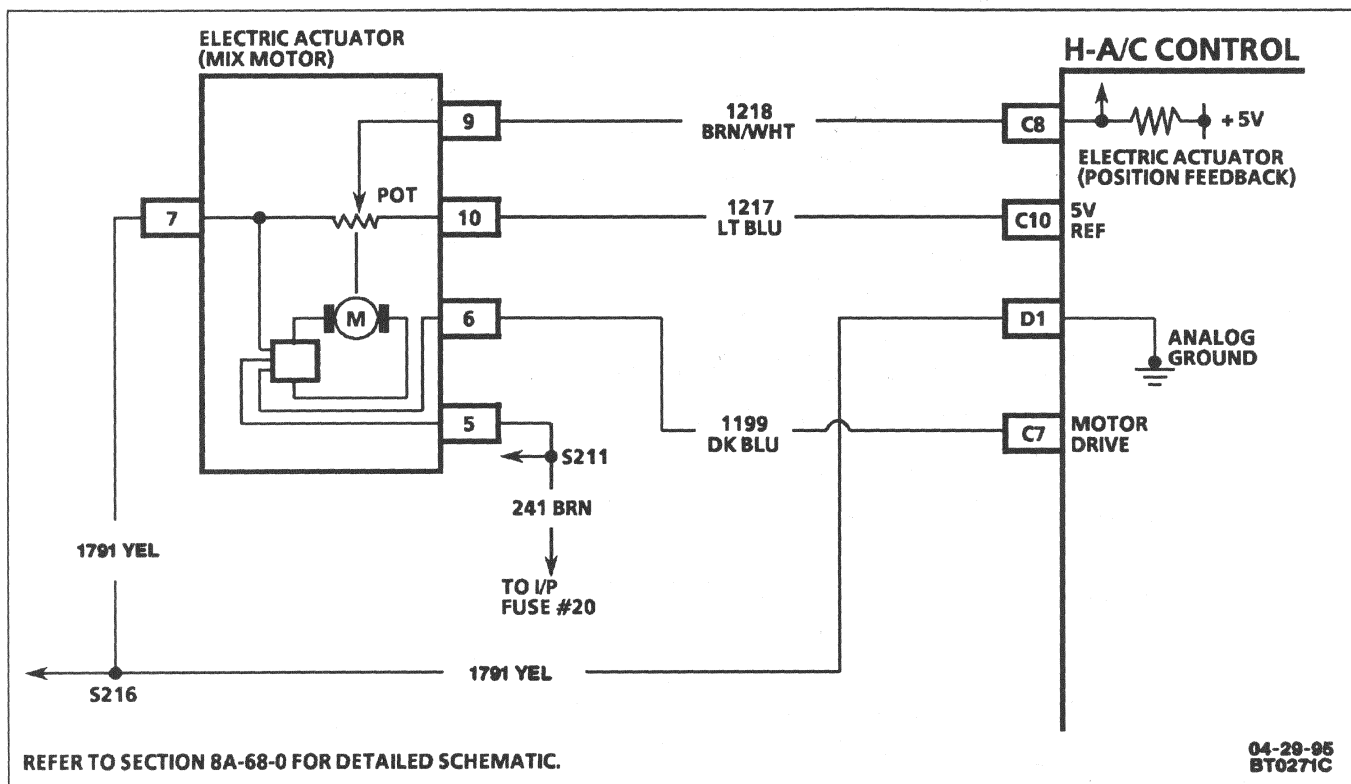
DTC 10

AIR MIX MOTOR CIRCUIT (CIRCUIT OPEN)



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10327



DTC 11 AIR MIX MOTOR CIRCUIT (C68) (CIRCUIT SHORTED)

Circuit Description:

The electric actuator is driven by the H-A/C control to operate the temperature valve. The position of the temperature valve is adjusted to maintain the set temperature. A feedback potentiometer is used in the electric actuator so that the H-A/C control will know the position of the temperature valve. The feedback potentiometer is part of a flat-pack design motor which is mounted on the rear-facing surface of the heater and air conditioning evaporator module. A low voltage at CKT 1218 (about 1.0 volt) represents a hot air valve position and a high voltage CKT 1218 (about 4.0 volts) a cold air valve position. The H-A/C control drives the electric actuator motor through CKT 1199 by applying 0-2.5-5 volts through the circuit. Applying 0.0V on CKT 1199 to the logic portion causes the temperature valve to move to the full heat position. Applying 5.0V on CKT 1199 will cause the temperature valve to move to the full cold position. Applying 2.5 volts causes the electric actuator to stop moving.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime that CKTs 1217 and 1218 see voltage near or at 0.0V.

Action Taken:

DTC 11 will set in the H-A/C control. The ACAC system will use a default value of 128 until the fault is cleared.

DTC Will Clear When:

This fault will clear as soon as the fault has been repaired. The ACAC system will then return to normal operation.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

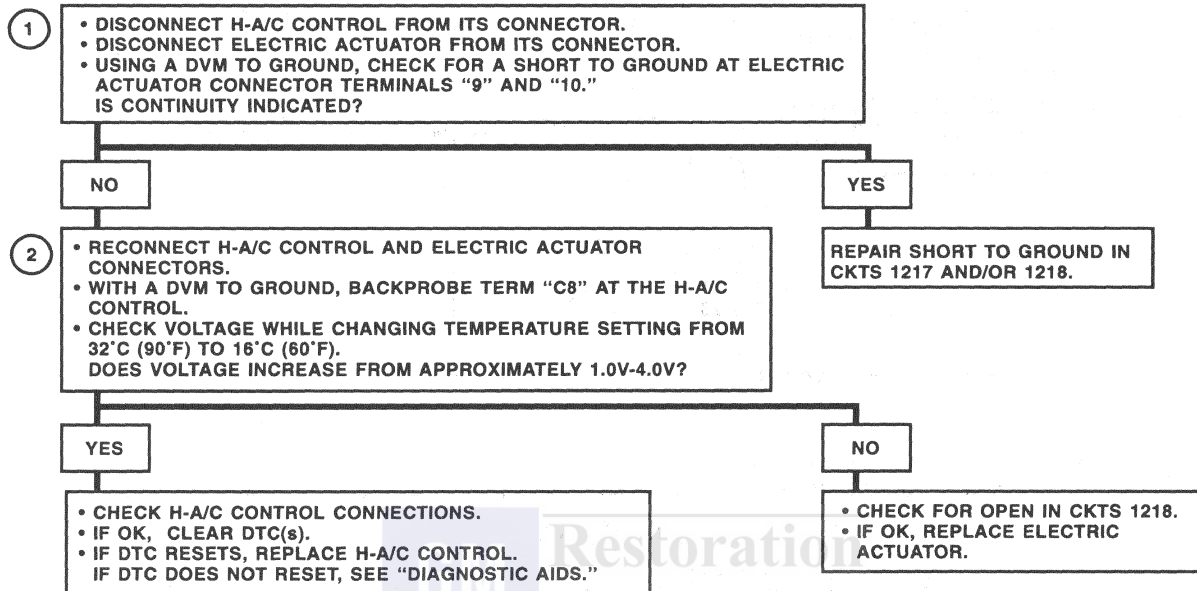
1. This test checks for a short to ground in CKTs 1217 and 1218.
2. This test checks for feedback voltage at terminal "C8" of the H-A/C control.

Diagnostic Aids:

Check for a binding temperature valve while replacing the actuator. Check for loose connection or bent pins at the electric actuator connector. Operation of the electric actuator may be observed by opening the instrument panel compartment and then changing the H-A/C control temperature setting from full hot to full cold.

If the H-A/C control voltage supply was disconnected, a new actuator was installed or the temperature valve was disturbed. The H-A/C control will have to be re-calibrated. This will prevent a DTC from being set because of a detected difference between the former and present temperature valve positions. To recalibrate the H-A/C control, remove I/P fuse 33, install fuse 33, and turn ignition switch to the "RUN" position.

DTC 11 AIR MIX MOTOR CIRCUIT (CIRCUIT SHORTED)



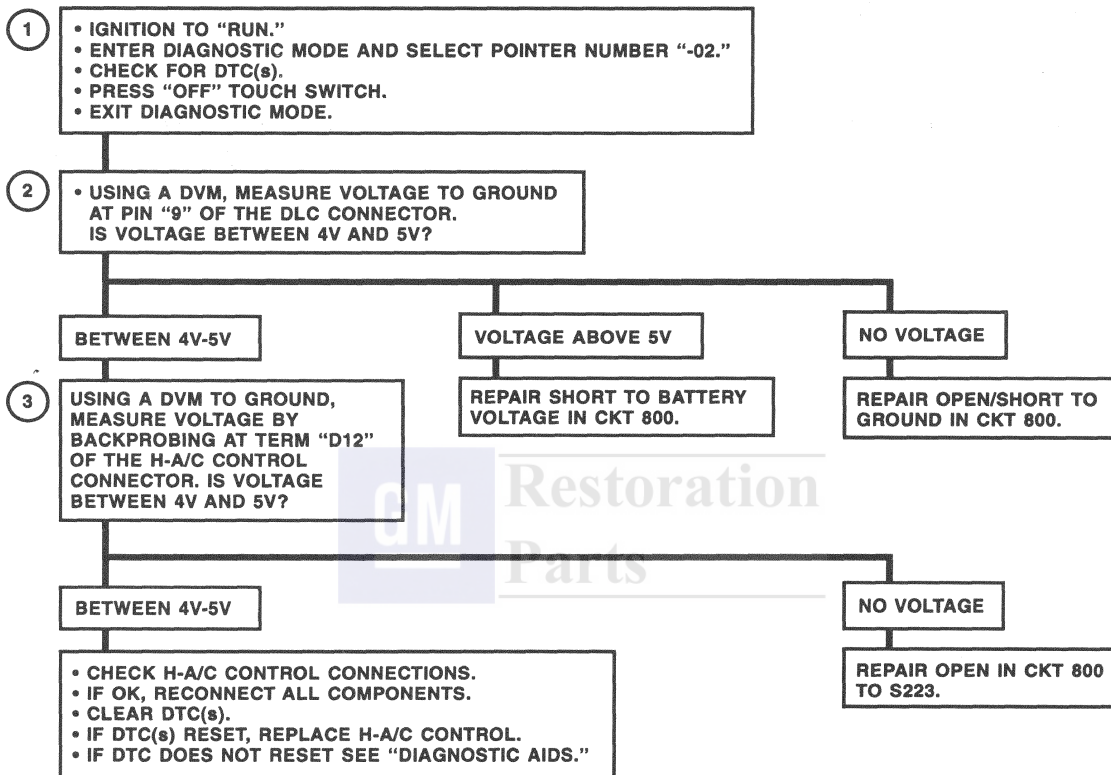
WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

(CIRCUIT SHORTED TO GROUND, SHORTED TO B+, OPEN)

Looking at the systems on CKT 800 (with a scan tool) and returning to the “HVAC” selection can cause a HVAC DTC 26 to set in the H-A/C control. When diagnosing a HVAC DTC 26, clear the DTC and check for HVAC DTCs again.

DTC 26

SERIAL DATA COMMUNICATION (CIRCUIT SHORTED TO GROUND, SHORTED TO B+, OPEN)



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

C10328

DTC 27

INVALID EEPROM DETECTED (C68)

Circuit Description:

The H-A/C control EEPROM contains the necessary software to run the heating and air conditioning program.

DTC Will Set When:

With ignition in "RUN," the H-A/C control will detect this fault anytime the EEPROM experiences an internal fault.

Action Taken:

DTC 27 will set. The ACAC system can operate in an erratic manner.

DTC Will Clear When:

This fault will clear as soon as the EEPROM internal fault goes away.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

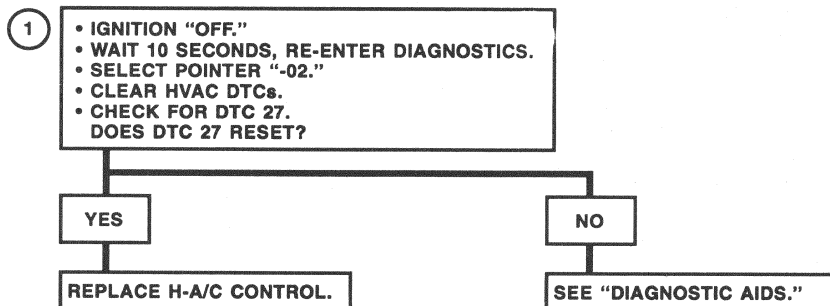
- This test has you clear DTC(s) and recheck for DTC 27.

Diagnostic Aids:

Check connections at H-A/C control connector. Check B+, ignition and ground to the H-A/C control.



DTC 27 INVALID EEPROM DETECTED



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

ON-VEHICLE SERVICE (C67 and C68)

! Important

- If a service procedure for a specific component or system is not mentioned in this section, refer to SECTION 1B.

ADJUSTMENTS (C68)

Temperature Valve Adjustment

If a new temperature valve has been installed or voltage to the H-A/C control has been disconnected, the H-A/C control must be re-calibrated to assure proper functioning of the valve.

To recalibrate the H-A/C control, remove I/P fuse 33, reinstall fuse 33 and turn ignition switch to the "RUN" position. For fuse location, refer to ELECTRICAL DIAGNOSIS 8A-11. The system will automatically recalibrate.

If the outside temperature is at least 10°C (50°F) and the engine is warmed up to its normal operating temperature, a quick check of overall system performance can be made after the H-A/C control is done re-calibrating. After waiting for 30 seconds with the system in "AUTO" and the temperature set for maximum heating, feel for a strong (high blower motor speed) flow of warm air from the floor outlet before changing the temperature setting.

When the temperature setting is changed to maximum cooling, blower motor speed should diminish momentarily, then increase to high speed again as the shift is completed. During the shift, air should begin to flow from the instrument panel outlets as blower speed decreases. As the blower motor returns again to high speed, the airflow from the floor outlet should stop. If time is available, allow one minute (as opposed to 30 seconds) of operation in the maximum cooling mode. By that time, discharge air temperature at the instrument panel center outlet should be at least 11°C (20°F) lower than outside air temperature.

Before turning off the engine, change the temperature setting to any intermediate number higher than the inside air temperature. The air inlet valve should close as the system shifts out of maximum cooling. Two sounds normally occur to indicate the closing of the air inlet valve; the sound of the valve closing and an apparent reduction in air noise.

If any discrepancies are noted, refer to "Diagnosis" in this section.

REPLACEMENT PROCEDURE (C68)

Sensors (C68)

! Important

- After replacing any sensor, any HVAC Diagnostic Trouble Code (DTC) being displayed by the H-A/C control should be cleared by first pressing the "OFF" switch of the control panel, while displaying DTC(s) in pointer number "-02."

Inside Air Temperature Sensor (C68)

Figure 1C-16

1. Instrument panel trim plate. Refer to SECTION 8C.
2. Open I/P compartment (glove box) past stops.
3. Duct from sensor (17).
4. Bolts/screws (18).
5. Connector from harness connector.
6. Sensor (17).

↔ Install or Connect

1. Sensor (17).
2. Pigtail connector to harness connector.
3. Bolts/screws (18)

⌚ Tighten

- Bolts/screws (18) to 1.5 N.m (13 lb. in.)
4. Duct to sensor (17).
 5. Close I/P compartment (glove box).
 6. Instrument panel trim panel plate. Refer to SECTION 8C.

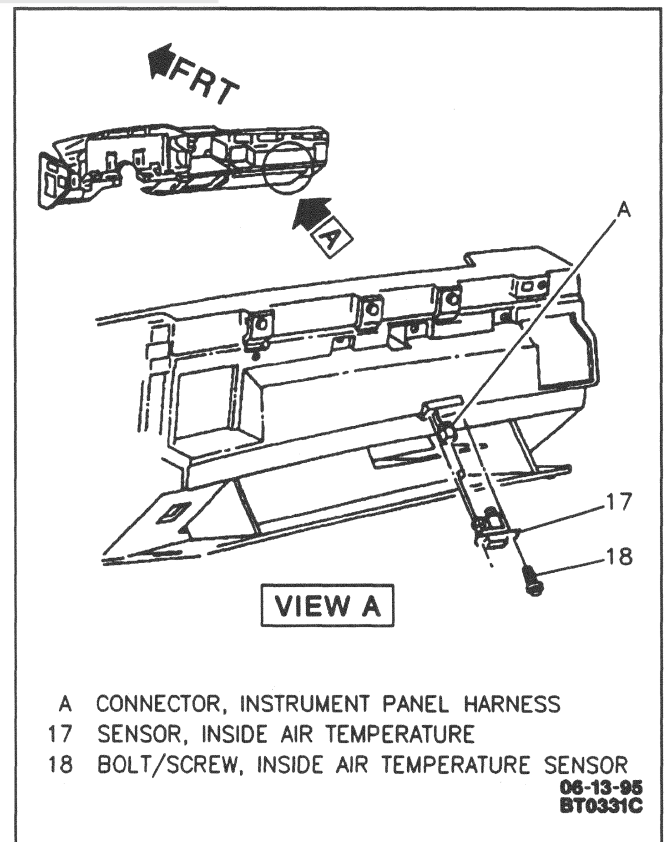


Figure 1C-16 - Inside Air Temperature Sensor (C68)

Inside Air Temperature Sensor Duct (C68)

Figure 1C-17

Remove or Disconnect

1. Instrument panel upper trim pad. Refer to SECTION 8C.
2. Passenger inflator module. Refer to SECTION 9J.
3. Open I/P compartment (glove box) past stops.
4. Duct from sensor (17).
5. Duct (4) from aspirator on evaporator module (1).
6. Retainers (2) by pulling straight out.
7. Ducts (3 and 4).

Install or Connect

1. Ducts (3 and 4) into position.
2. Retainer (2) by pushing straight in.
3. Duct (4) to aspirator on module (1).
4. Duct (3) to sensor (17).
5. Passenger inflator module. Refer to SECTION 9J.
6. Instrument panel upper trim pad. Refer to SECTION 8C.

Outside Air Temperature Sensor (C68)

Figure 1C-18

Remove or Disconnect

1. Sensor lead connector from harness (100) near sensor (96).
2. Sensor (96) from support (112).
 - A. Remove bolt/screw (98).
 - B. Remove nut (97) and sensor (96).

Install or Connect

NOTICE: Refer to "Notice" on page 1C-1 of this section.

1. Nut (97) to sensor (96).
2. Sensor (96) to support (112).
 - Fit sensor locator tab to hole in support (112) and hold sensor (96) in position.
3. Bolt/screw (98).

Tighten

- Bolt/screw (98) to 10 N.m (89 lb. in.).
4. Sensor lead connector to harness (100).

Sun Load Temperature Sensor (C68)

Figure 1C-19

Remove or Disconnect

1. Grill (29) from pad (24).
 - Gently unsnap.
2. Sensor (19) from grill (29).
 - Twist counterclockwise.

3. Pigtail connector from harness connector, making sure harness connector does not fall under pad (24).

Install or Connect

1. Pigtail connector to harness connector.
2. Sensor (19) into grill (29).
 - Twist clockwise.
3. Grill (29) to pad (24).
 - Snap into place.

Heater and Air Conditioning Control Typical (C67 and C68)

Figure 1C-20

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Instrument panel trim plate. Refer to SECTION 8C.
3. Bolts/screws (34).
 - Pull control (16) out of panel (25) far enough to reach the electrical connector at the back of control (16).
4. Electrical connector from control (16).
5. Control (16).

Install or Connect

NOTICE: Refer to "Notice" on page 1C-1 of this section.

1. Electrical connector to control (16).
2. Control (16).
3. Bolts/screws (34).

Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).

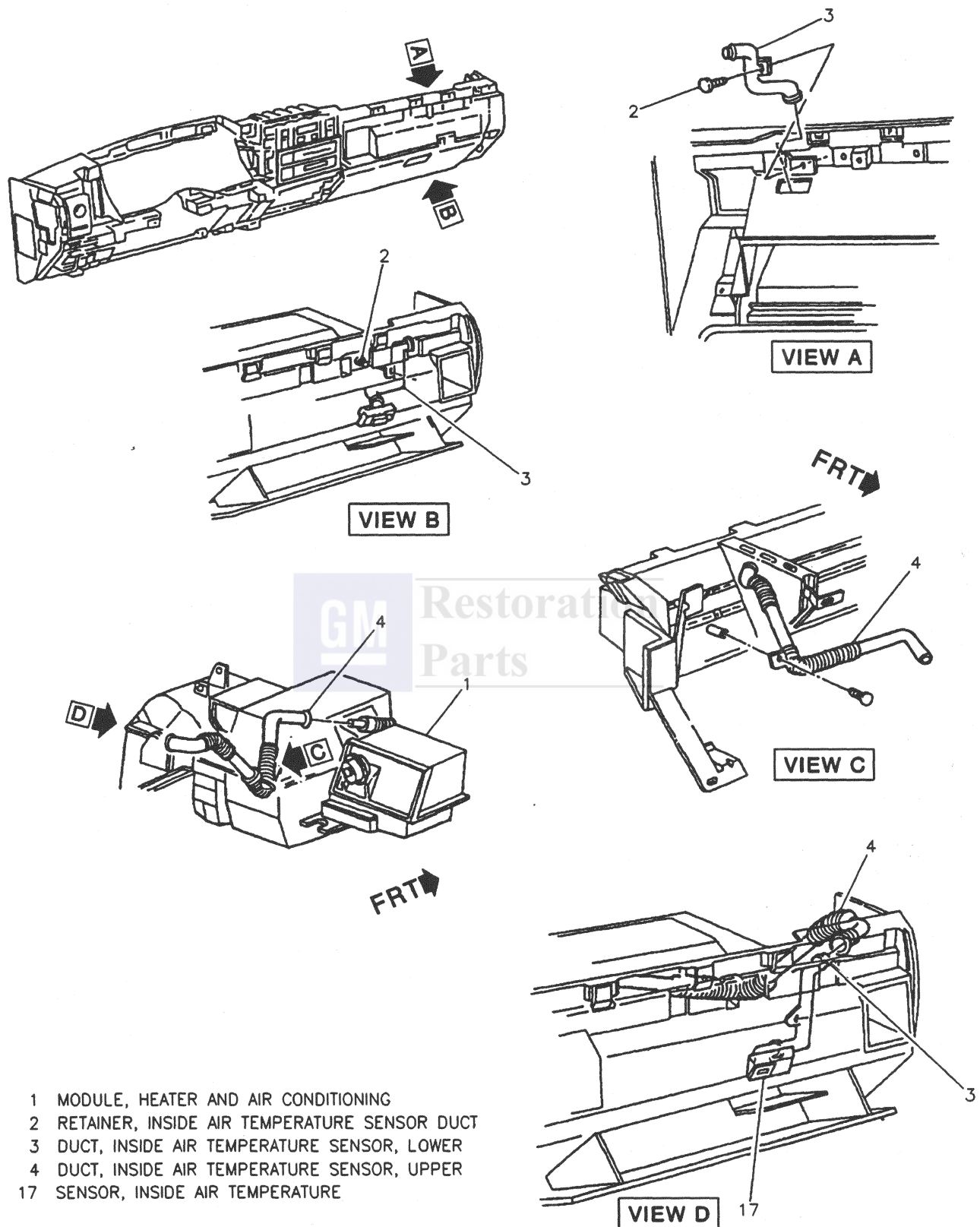
Blower Motor Control Module (C68)

Figures 1C-21 and 1C-22

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the battery negative cable" in SECTION 0A.

1. Battery negative cable.
2. Right hand instrument panel sound insulator. Refer to SECTION 8C.
3. Electrical connectors from module (20).



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Figure 1C-17 - Inside Air Temperature Sensor Ducts(C68)

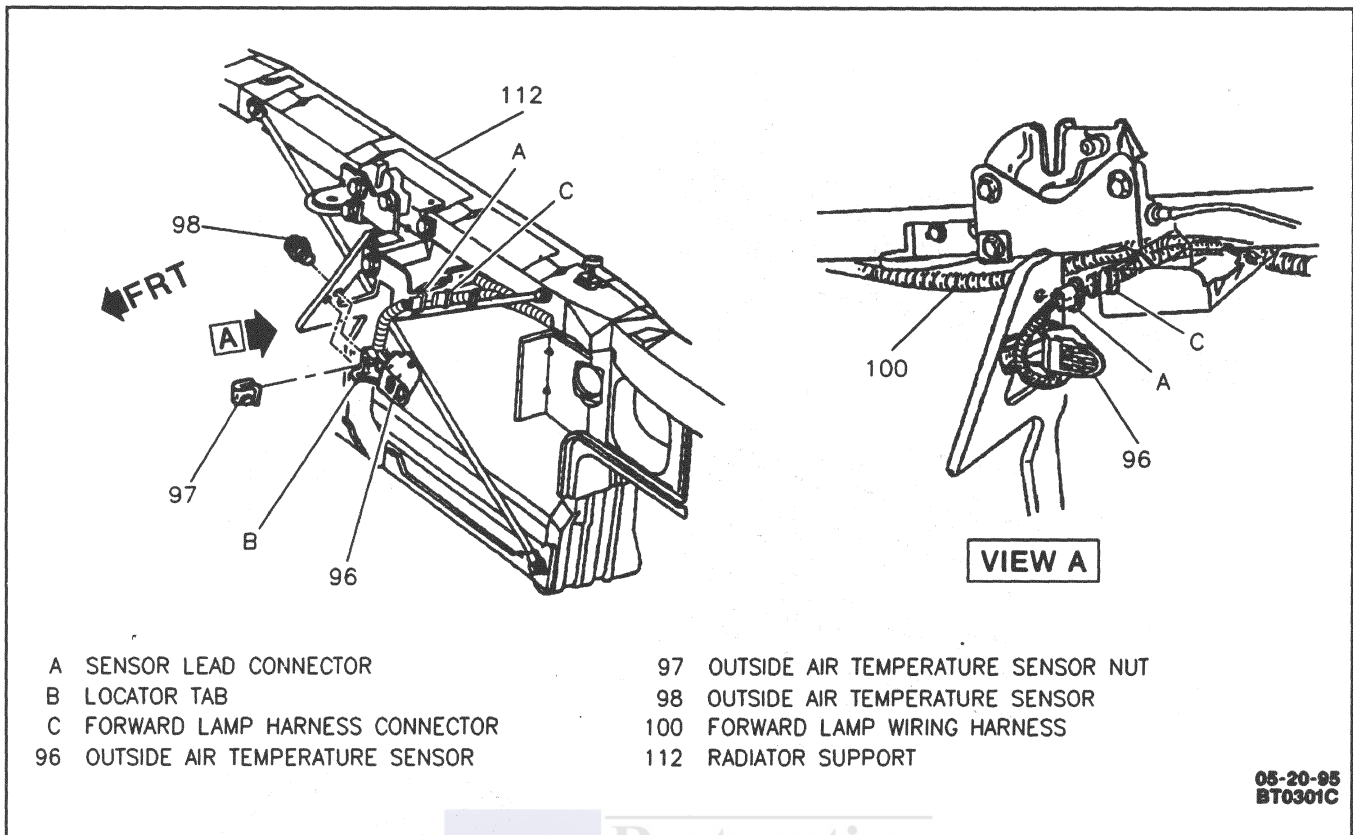


Figure 1C-18 - Outside Air Temperature Sensor (C68)

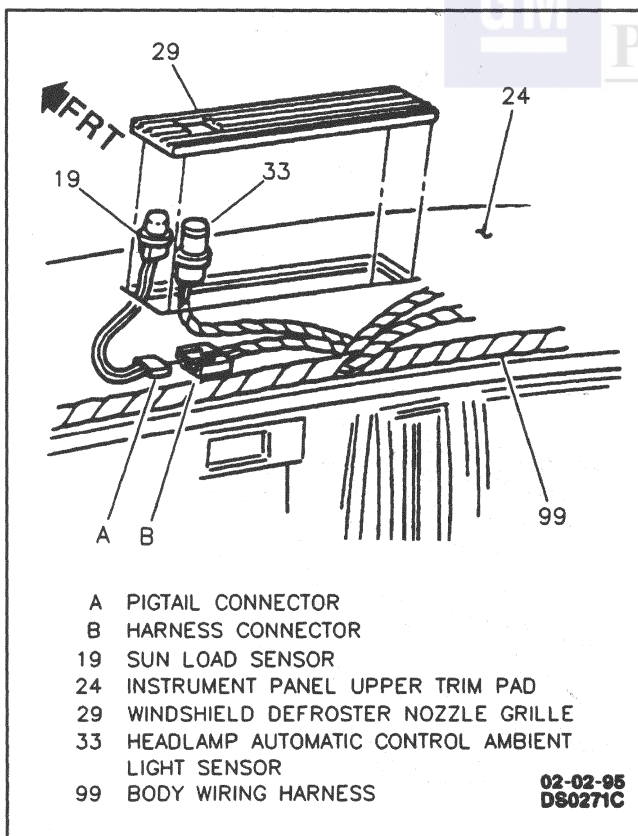


Figure 1C-19 - Sun Load Temperature Sensor

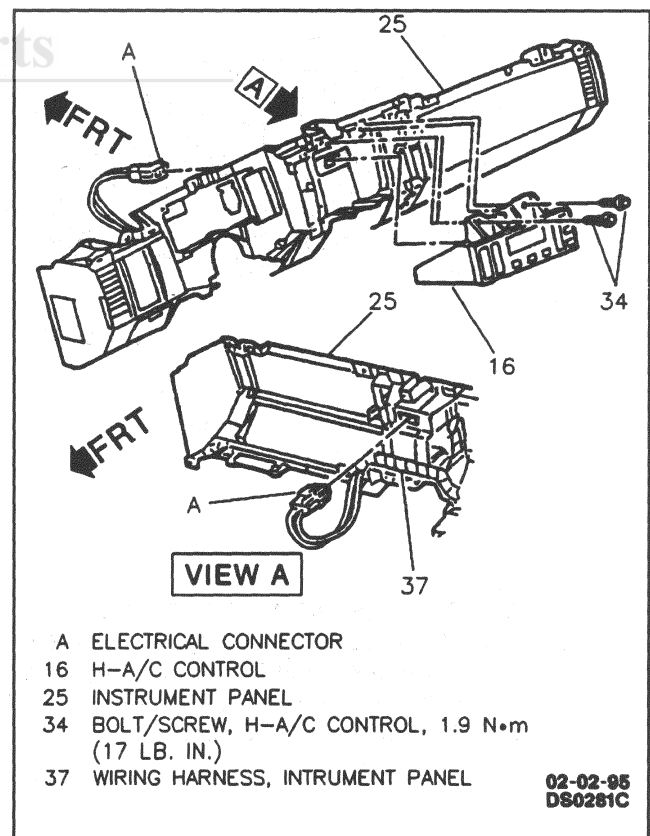


Figure 1C-20 - Heater and Air Conditioning Control Typical (C67 and C68)

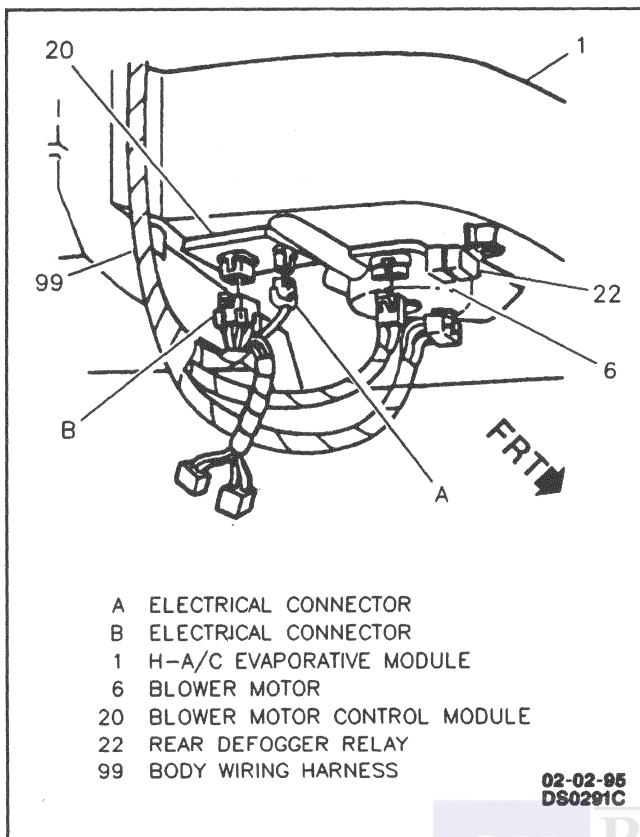


Figure 1C-21 - Blower Motor Control Module

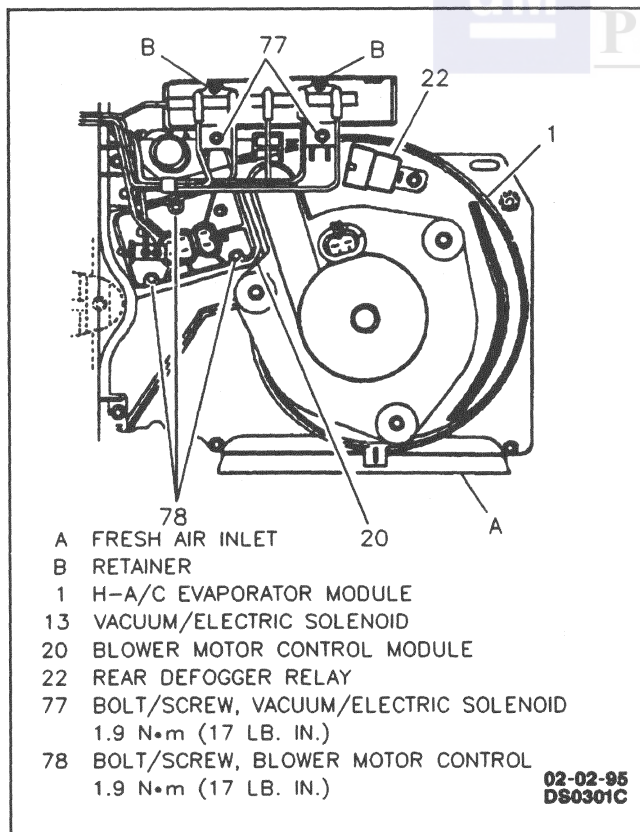


Figure 1C-22 - Module Area From Below

4. Three bolts/screws (78) holding module (20) to bottom of evaporator module (1).
5. Module (20).

Install or Connect

NOTICE: Refer to "Notice" on page 1C-1 of this section.

1. Module (20).
2. Bolts/screws (78).

Tighten

- Bolts/screws (78) to 1.9 N•m (17 lb. in.).
3. Electrical connectors to module (20).
 4. Right hand instrument panel sound insulator. Refer to SECTION 8C.
 5. Battery negative cable.

Tighten

- Battery negative cable to 17 N•m (13 lb. ft.).

Electric Actuator

Figure 1C-23

Remove or Disconnect

Important

- After replacing actuator (12), any HVAC Diagnostic Trouble Code (DTC) displayed by the H-A/C control should be cleared by first pressing the "OFF" switch of the H-A/C control panel, while displaying DTC(s) in pointer number "-02."

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

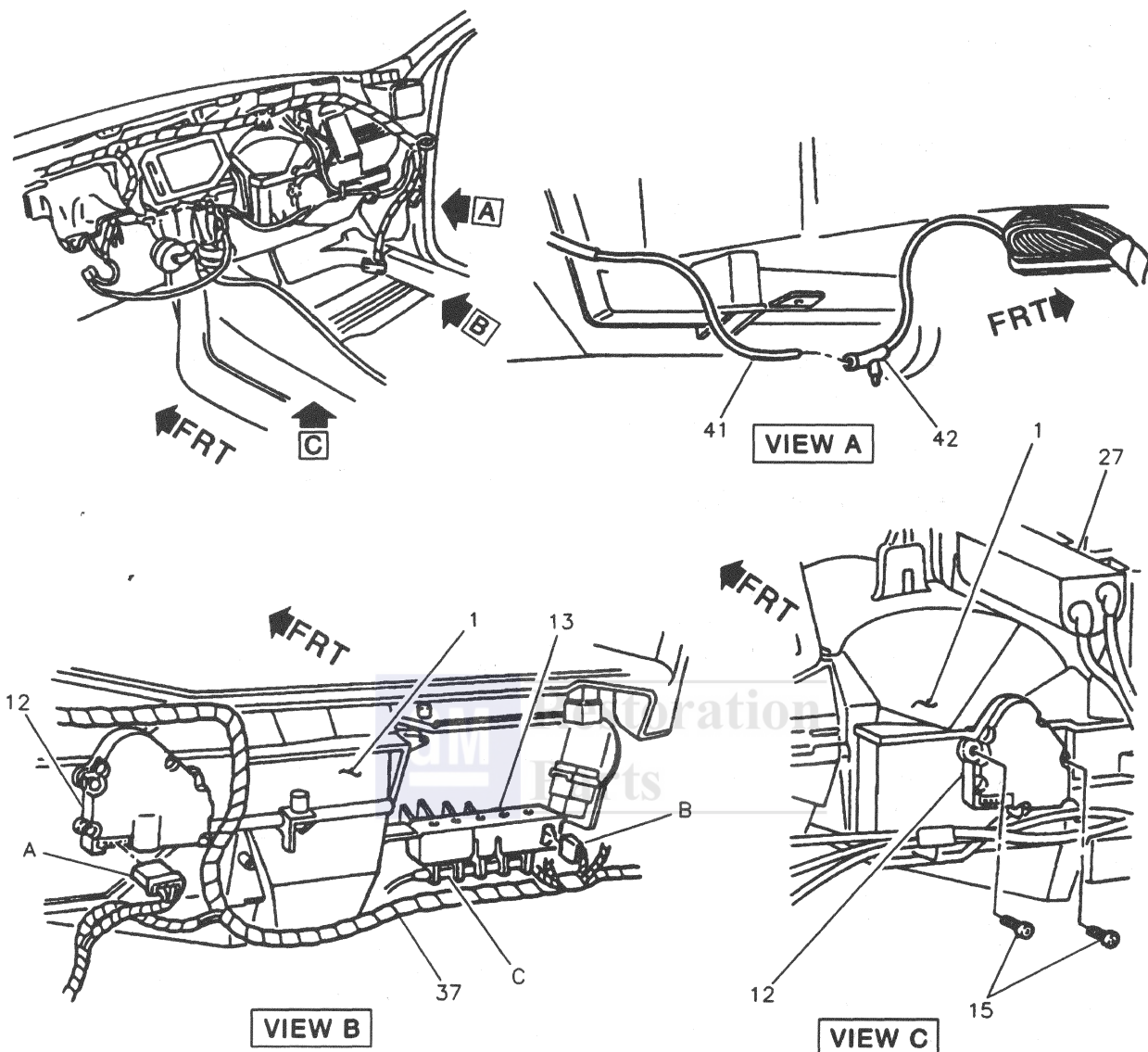
1. Battery negative cable.
2. Instrument panel compartment. Refer to SECTION 8C.
3. Electrical connector from actuator (12).
4. Actuator (12).

- A. Remove two attaching bolts/screws (15).
- B. Pull actuator (12) straight rearward and off temperature valve shaft.

Install or Connect

NOTICE: Refer to "Notice" on page 1C-1 of this section.

NOTICE: Do not operate actuator unless it is installed or damage to actuator may result.



- A ELECTRICAL CONNECTOR
- B ELECTRICAL CONNECTOR
- C MANIFOLD
- 1 H-A/C EVAPORATIVE MODULE
- 12 ELECTRIC ACTUATOR
- 13 VACUUM/ELECTRIC SOLENOID
- 15 BOLT/SCREW, ELECTRIC ACTUATOR, 1.9 N•m (17 LB. IN.)
- 27 VACUUM TANK
- 37 INSTRUMENT PANEL WIRING HARNESS
- 41 AIR CONDITIONING VACUUM HOSE
- 42 ENGINE VACUUM HARNESS CONNECTOR

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Figure 1C-23 - Vacuum Harness and Electric Actuator

1C-98 AUTOMATIC CONTROL AIR CONDITIONING

1. Actuator (12).
 - A. Align metal drive sleeve of actuator (12) with flats on temperature valve shaft and press actuator (12) straight forward into position.
 - B. Install two attaching bolts/screws (15).



Tighten

- Bolts/screws (15) to 1.9 N.m (17 lb. in.).
2. Electrical connector to actuator (12).
 3. Instrument panel compartment. Refer to SECTION 8C.
 4. Battery negative cable.



Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).
5. Recalibrate H-A/C control by turning ignition switch to the "RUN" position. The system will automatically recalibrate.

Vacuum Hose Harness (C67 and C68)

Figures 1C-7 and 1C-23

It is not necessary to replace the entire harness in case of a localized leakage or hose collapse. A repair can be made by cutting the hose and inserting a plastic connector.



Remove or Disconnect

1. Disable SIR system. Refer to SECTION 9J.
2. Passenger inflatable restraint module, if access to hose connection at vacuum tank (27) is necessary. Refer to SECTION 9J.
3. Vacuum hose manifold from solenoid (13).
 - Remove manifold by releasing retainers holding it to solenoid (13).
4. Connector (42).
 - Disconnect connector (42) from hose (41).
5. Vacuum hose and connectors at vacuum actuators and tank (27).
 - Disconnect hose end connectors from vacuum tubes of actuators and vacuum tank barbed tubes of sliding plastic retainer tab past bend of L-shaped tube or connector. Then slide connector off tube while continuing to hold tab back against body of the connector.
6. Vacuum hose harness.
 - Remove vacuum hose harness, noting positions and routing of all hoses for reference during installation.



Inspect

- Vacuum hoses for cracks, leaks and collapsed sections. Repair hose or replace harness as required.



Install or Connect

1. Vacuum hose harness.

- Place vacuum hose harness in position as noted during removal. Individual hoses are routed as follows:
 - Black hose to lower fitting of tank (27).
 - Violet hose to upper fitting of tank (27).
 - Orange hose to actuator (9).
 - Blue hose to actuator (11).
 - Gray hose to actuator (11).
 - Red hose to upper fitting of actuator (10).
 - Tan hose to lower fitting of actuator (10).

2. Vacuum hose end connectors.

- Connect hose end connectors by bending retaining tab of plastic connector back flush against end of connector and holding it there while slipping tab and connector onto vacuum tube. When connector is fully seated, pull retaining tab over tube to hold connector in place.

3. Connector (42).

- Connect connector (42) to hose (41).

4. Vacuum hose manifold to solenoid (13).

- Snap manifold into place on bottom of solenoid (13).

5. Passenger inflatable restraint module. Refer to SECTION 9J.

6. Enable SIR system. Refer to SECTION 9J.

Vacuum/Electric Solenoid (C67 and C68)

Figures 1C-22 and 1C-23



Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Right hand instrument panel sound insulator. Refer to SECTION 8C.
3. Electrical connector from solenoid (13).
4. Two attaching bolts/screws (77) holding solenoid (13) to evaporator module (1).
5. Solenoid (13) with vacuum hose manifold attached.
6. Vacuum hose manifold from solenoid.
 - Remove manifold by releasing retainers holding it to solenoid (13).



Install or Connect

NOTICE: Refer to "Notice" on page 1C-1 of this section.

1. Vacuum hose manifold to solenoid (13).
 - Snap manifold into place on bottom of solenoid (13).
2. Solenoid (13) and two attaching bolts/screws (77) to evaporator module (1).



Tighten

- Bolts/screws (77) to 1.9 N.m (17 lb. in.).
- 3. Electrical connector to solenoid (13).
- 4. Right hand instrument panel sound insulator.
Refer to SECTION 8C.
- 5. Battery negative cable.



Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).

SPECIFICATIONS (C67 and C68)

FASTENER TIGHTENING SPECIFICATIONS

Battery Negative Cable	17 N.m (13 lb. ft.)
Blower Motor Control Module Bolt/screw	1.9 N.m (17 lb. in.)
Electric Actuator Bolt/screw	1.9 N.m (17 lb. in.)
Heater and Air Conditioning Control Bolt/screw	1.9 N.m (17 lb. in.)
Outside Air Temperature Sensor Bolt/screw	10 N.m (89 lb. in.)
Vacuum/Electric Solenoid Bolt/screw	1.9 N.m (17 lb. in.)



1C-100 AUTOMATIC CONTROL AIR CONDITIONING



SECTION 1D2

HD6/HT6 AIR CONDITIONING COMPRESSOR SERVICE OR UNIT REPAIR R-134a

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under ON-VEHICLE SERVICE and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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General Description	1D2-1	Major Compressor	
Metric Thread Size Information	1D2-3	Repair Procedures	1D2-8
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Minor Compressor		Seal Leak Detection	1D2-8
Repair Procedures	1D2-3	Compressor Pressure Relief Valve	1D2-10
Compressor Clutch Plate and		Control Switches	1D2-11
Hub Assembly	1D2-3	Compressor Leak Testing	1D2-11
Compressor Clutch Rotor and/or Bearing	1D2-4	Bench-Check Procedures	1D2-11
Compressor Clutch Coil	1D2-7	Special Tools	1D2-12

GENERAL DESCRIPTION

The HD6/HT6 Automotive Conditioning Compressor and Clutch Assembly is a lightweight, six cylinder axial design consisting of three double ended pistons and weighs 5.8 kg (12.7 lbs.).

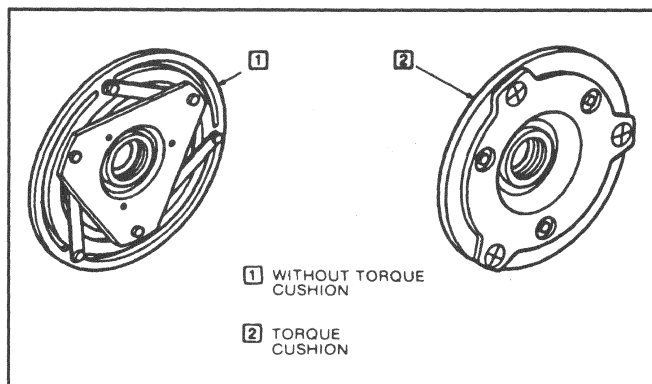


Fig. 1 Clutch Driver Designs

Although this compressor is the same for all vehicle applications, there are differences in installations, mounting brackets, pulleys, torque cushions and switches, none of which will affect the following overhaul procedures.

There are two clutch driver designs for these compressors. The clutch driver without a torque cushion and the clutch driver having a thin torque cushion (Fig. 1).

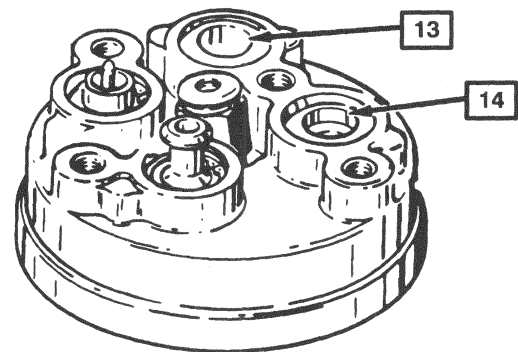
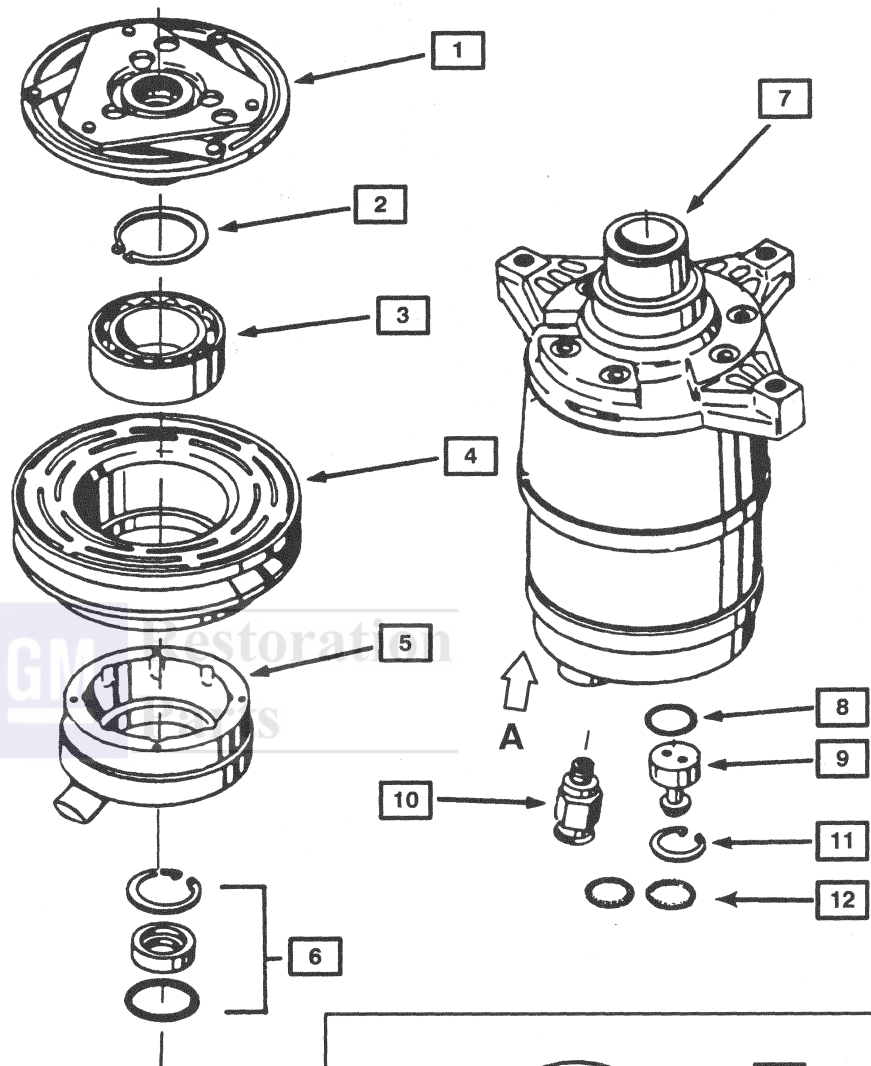
Service compressors are supplied with either the control switches assembled in the rear head or a plug may be found where a control switch is required. If the service compressor requires control switches, the plug may be removed from the appropriate rear head switch cavity of the replaced compressor and assembled as prescribed in this manual.

When servicing the compressor, keep dirt or foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any "on vehicle" repairs, or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent and dried with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

The operations described below are based on bench overhaul with the compressor removed from the vehicle, except as noted. They have been prepared in order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of PAG lubricant remaining in the compressor should be drained,

1D2-2 HD6/HT6 AIR CONDITIONING COMPRESSOR

- 1 — CLUTCH DRIVER
- 2 — ROTOR BEARING RETAINER
- 3 — PULLEY BEARING
- 4 — PULLEY
- 5 — CLUTCH COIL ASSEMBLY
- 6 — SHAFT SEAL PARTS
- 7 — PUMP ASSEMBLY
- 8 — SWITCH O-RING
- 9 — SYSTEM CONTROL SWITCH
- 10 — HIGH PRESSURE RELIEF VALVE
- 11 — RETAINER RING SWITCH
- 12 — SUCTION/DISCHARGE PORT SEALING WASHERS
- 13 — SPECIAL 134a SUCTION PORT
- 14 — SPECIAL 134a DISCHARGE PORT



Compressor — Rear Head
As Viewed in Direction of Arrow "A"

Fig. 2 Compressor Components — Disassembly

measured and recorded. This PAG lubricant should then be discarded and an equal amount of new PAG lubricant added to the compressor.

The service compressor is shipped with 240 ml (8 oz.) of PAG lubricant. This lubricant should be drained and retained for use as replacement lubricant when service procedures require addition of new lubricant to compressor. **NOTE:** Replace only with GM approved PAG oil P/N 12345923.

Most minor repair procedures may be done on the vehicle without discharging the system. Major repair procedures require that the system be discharged of refrigerant.

UNIT REPAIR

MINOR COMPRESSOR REPAIR PROCEDURES

THE FOLLOWING OPERATIONS TO THE COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST RECOVERING REFRIGERANT FROM THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The Compressor Shaft Seal assembly, control switches, and Pressure Relief Valve may also be serviced **WITHOUT REMOVING THE** compressor from the vehicle but these operations are covered later in this section as **MAJOR REPAIR PROCEDURES** because the system must be reclaimed, evacuated and recharged to complete service.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the parts that preliminary diagnosis shows are in need of service. Refer to Figures 2 and 5 for information relative to part names and location.

Removal and installation of external compressor parts, and disassembly and assembly of internal parts, must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

Remove or Disconnect

1. Clamp the holding fixture J 33026 in a vise and attach compressor to holding fixture with thumb screws J 33026-1 (Fig. 3).
2. With center screw forcing tip in place to thrust against the end of the shaft, thread the Clutch Plate and Hub Assembly Installer-Remover J 33013-B into the hub. Hold the body of the remover with a wrench and turn the

METRIC THREAD SIZE INFORMATION

1. Compressor to mounting bracket bolts.
Front M10 x 1.5 – 6H
Rear M8 x 1.25 – 6H
2. Suction-discharge port screw.
M10 x 1.5 – 6H
3. Compressor shaft.
M9 x 1.25 – 6H
4. Internal hub-clutch drive assembly.
M22 x 1.5 – 6H

center screw into the remover body to remove the clutch plate and hub assembly (Fig. 3).

NOTICE: Do not drive or pound on the clutch hub or shaft. Internal damage to compressor may result. The forcing tip on J 33013-B remover-installer center screw must be flat or the end of the shaft/axial plate assembly will be damaged.

3. Remove the shaft key and retain for reassembly.

Install or Connect

1. Install the shaft key into the hub key groove (Fig. 4). Allow the key to project approximately 3.2mm (1/8") out of the keyway. The shaft key is curved slightly to provide an interference fit in the hub key groove.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the clutch plate and hub assembly.
3. Align the shaft key with the shaft keyway and place the clutch plate and the hub assembly onto the compressor shaft.

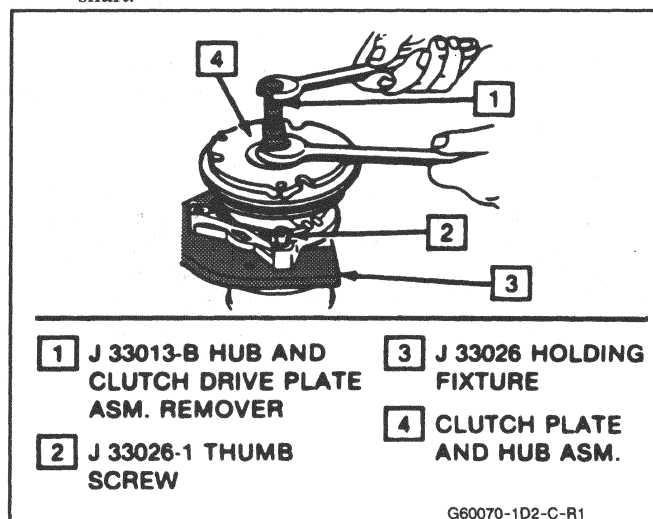


Fig. 3 Clutch Plate and Hub Assembly Removal

1D2-4 HD6/HT6 AIR CONDITIONING COMPRESSOR

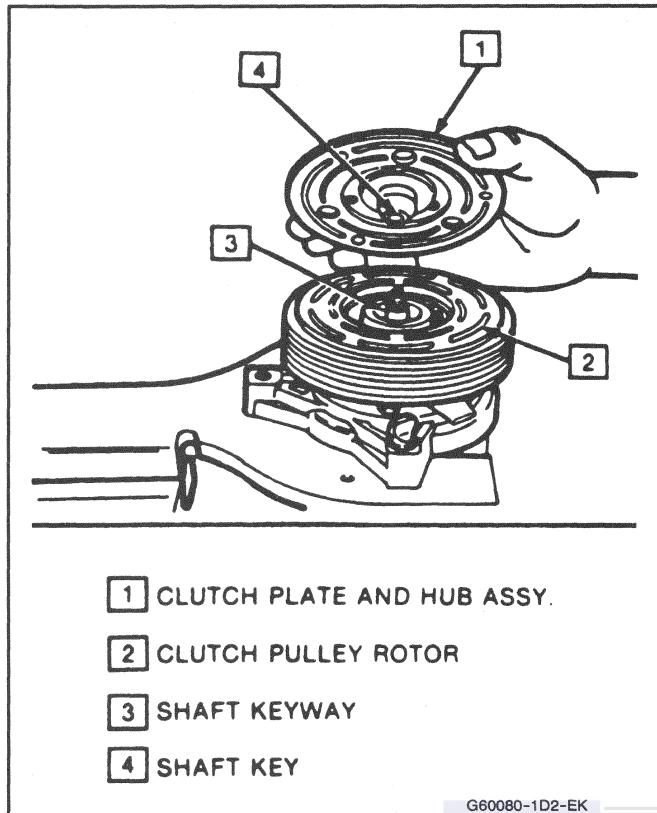


Fig. 4 Shaft Key, Clutch Plate/Hub Installation

4. Remove the forcing tip on J 33013-B clutch plate and hub assembly installer-remover center screw and reverse the body direction on the center screw, as shown in Figure 5.

5. Install the clutch plate and hub installer-remover J 33013-B with bearing as shown in Figure 8.

The body of the J 33013-B installer-remover should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft.

6. Hold the center screw with a wrench. Tighten the hex portion of the installer-remover J 33013-B body to press the hub onto the shaft. Tighten the body several turns, remove the installer and **check to see that the shaft key is still in place in the keyway before installing the clutch plate and hub assembly to its final position.** The air gap between frictional surfaces of the clutch plate and clutch rotor should be 0.50-0.76mm (.020-.030").

NOTICE: If the center screw is threaded **fully** onto the end of the compressor shaft, or if the body of the installer is held and the center screw is rotated, the key will wedge and will break the clutch hub.

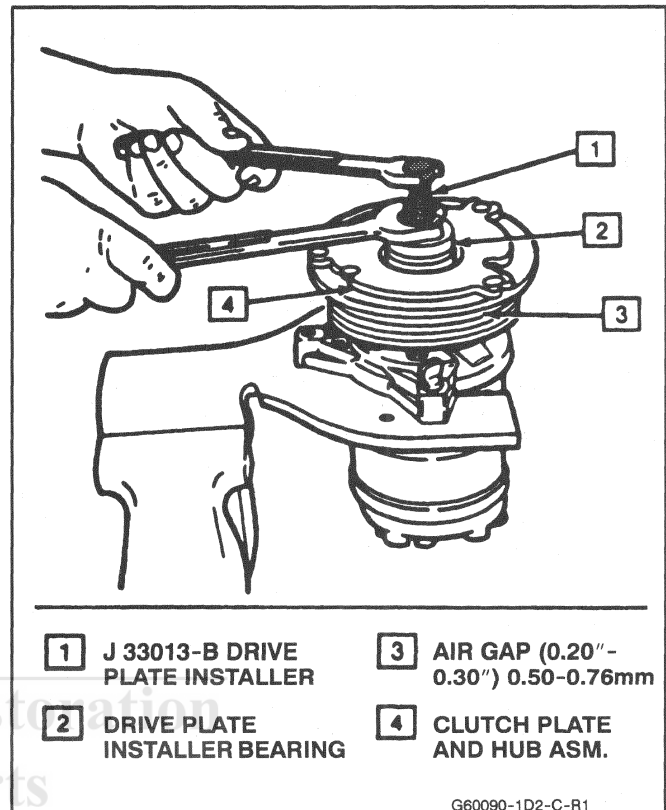


Fig. 5 Installing Clutch Plate & Hub Assembly

7. Remove installer J 33013-B, check for proper positioning of the shaft key (even or slightly above the clutch hub).
8. Spin the pulley rotor by hand to see that the rotor is not rubbing the clutch drive plate.

COMPRESSOR CLUTCH ROTOR AND/OR BEARING

Remove or Disconnect

1. Remove the clutch plate and hub assembly as described previously.
2. Remove rotor and bearing assembly retaining ring, using snap ring pliers J 6083 (Fig. 6).

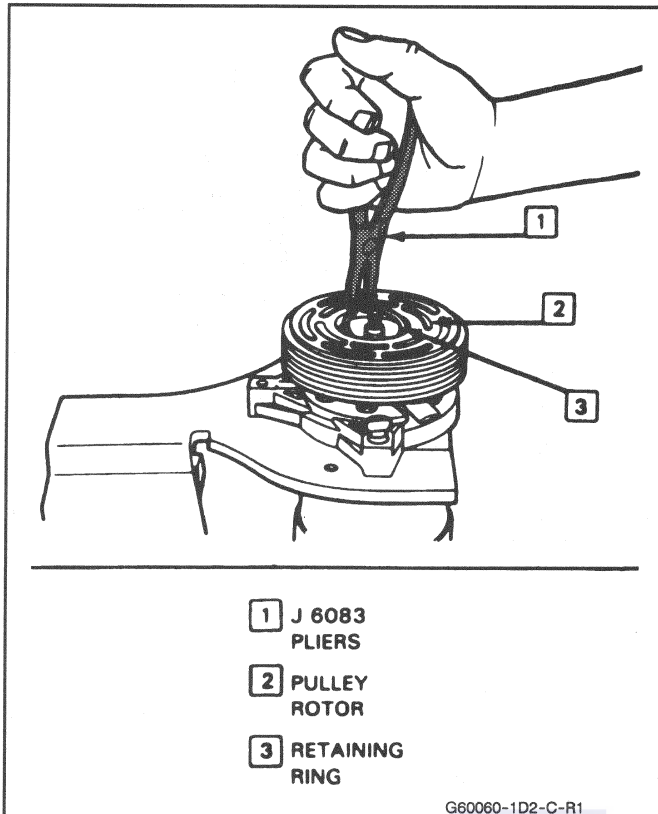


Fig. 6 Installing-Removing Pulley Rotor & Bearing Assembly Retaining Ring

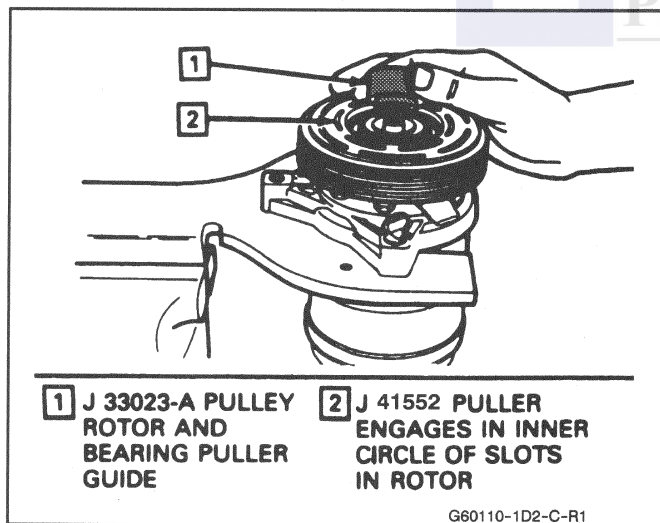


Fig. 7 Installing Pulley Rotor/Bearing Puller Guide

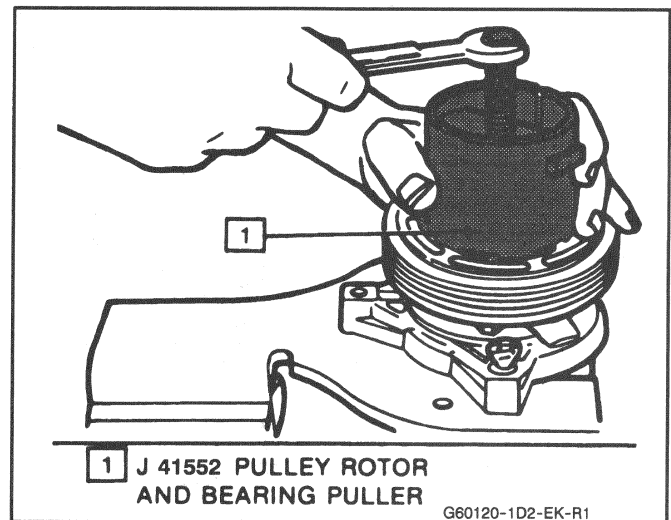


Fig. 8 Removing Pulley Rotor and Bearing Assembly

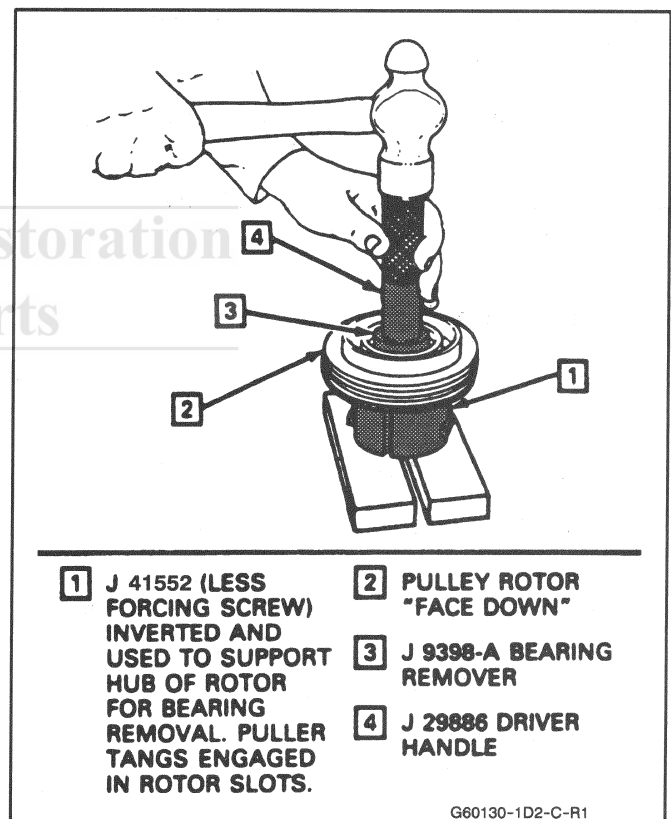


Fig. 9 Pulley Rotor Bearing Removal

3. Install pulley rotor and bearing puller guide J 33023-A to the front head (Fig. 7) and install J 41552 pulley rotor and bearing puller down into the inner circle of slots in the rotor. Turn the J 41552 puller clockwise in the slots in the rotor (Fig. 8).
4. Hold the J 41552 puller in place and tighten the puller screw against the puller guide to remove the pulley rotor and bearing assembly.
5. To prevent damage to the pulley rotor during bearing removal the rotor hub must be properly supported.

Remove the forcing screw from J 41552 puller and, with the puller tangs still engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks as shown in Figure 9.

6. Drive the bearing out of the rotor hub with rotor bearing remover J 9398-A and J 29886 universal handle (Fig. 9).

NOTICE: It is not necessary to remove the staking in front of the bearing to remove the bearing, however, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore or the bearing may be damaged.

1D2-6 HD6/HT6 AIR CONDITIONING COMPRESSOR

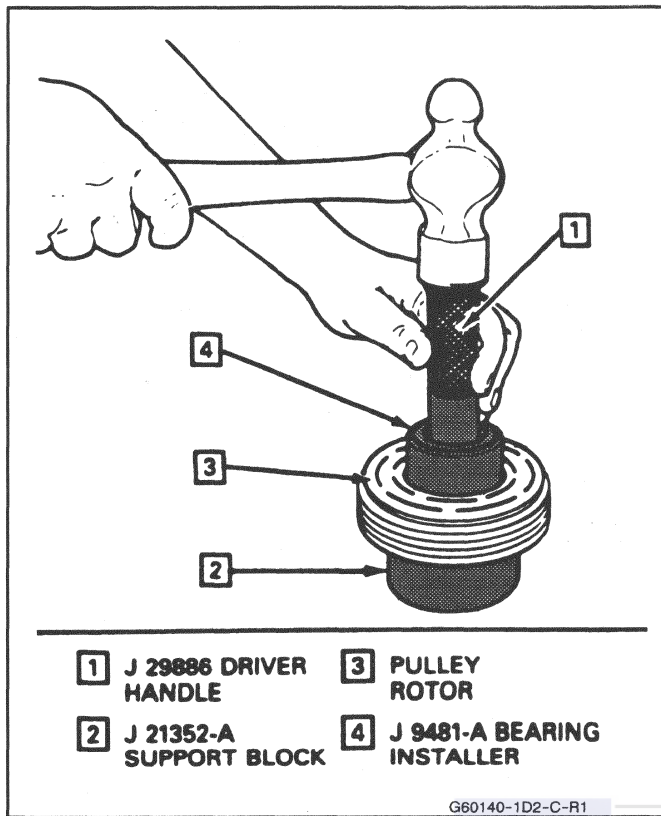


Fig. 10 Installing Pulley Rotor Bearing

Install or Connect

1. Place the pulley rotor on the J 21352-A support block to fully support the rotor hub during bearing installation (Fig. 10).

NOTICE: DO NOT support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent.

2. Align the new bearing squarely with the hub bore and using puller and bearing installer J 9481-A with universal handle J 29886, drive the bearing fully into the hub (Fig. 10). The installer will apply force to the outer race of the bearing, if used as shown.
3. Place bearing staking guide J 33019-1 and bearing staking pin J 33019-2 in the hub bore as shown in Figure 11. Shift the rotor and bearing assembly on the J 21352-A support block to give full support of the hub under the staking pin location. A heavy-duty rubber band may be used to hold the stake pin in the guide (Fig. 11), and the stake pin should be properly positioned in the guide after each impact on the pin.
4. Using care to prevent personal injury, strike the staking pin with a hammer until a metal stake, similar to the original, is formed **down to** but **not touching** the bearing.

Noisy bearing operation and reduced bearing life may result if outer bearing race is deformed while staking. The stake metal should not contact the outer race of the bearing. Stake three places 120 degrees apart as shown in Figure 12.

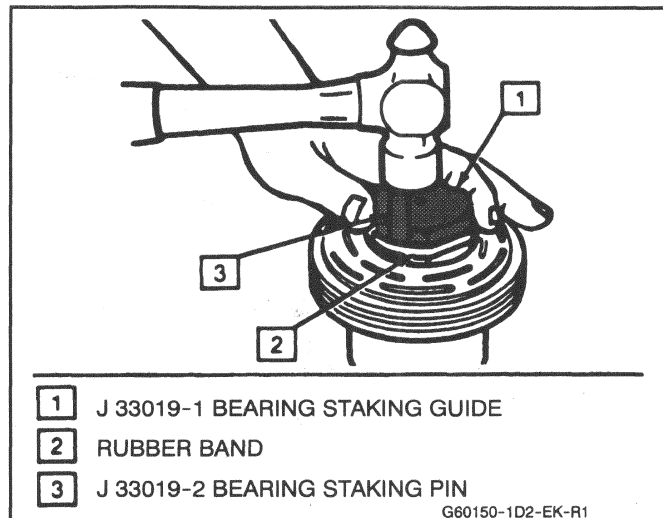


Fig. 11 Staking Bearing In Rotor Hub Bore

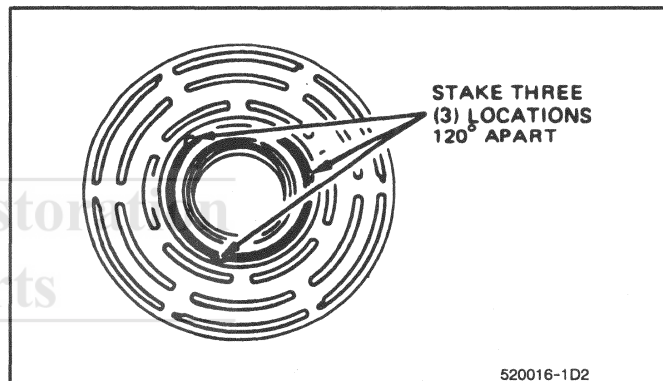


Fig. 12 Bearing Staked in Place

5. With the compressor mounted to the J 33026 holding fixture, position the rotor and bearing assembly on the front head (Fig. 13).
6. Position the J 33017 pulley, rotor and bearing installer and J 33023-A puller pilot directly over the inner race of the bearing (Fig. 13).
7. Position puller crossbar J 8433-1 on the puller pilot J 33023-A and assemble the two J 33026-2 through bolts and washers through the puller bar slots and thread them into the J 33026 holding fixture (Fig. 13). The thread of the through bolts should engage the full thickness of the holding fixture.
8. Tighten the center screw in the J 8433-1 puller crossbar to force the pulley rotor and bearing assembly onto the compressor front head (Fig. 13). Should the J 33017 pulley rotor and bearing installer slip off direct in-line contact with the inner race of the bearing, loosen the J 8433-1 center forcing screw and realign the installer and pilot so that the J 33017 installer will properly clear the front head.
9. Install rotor and bearing assembly retainer ring, using snap ring pliers J 6083 (Fig. 6).
10. Reinstall clutch plate and hub assembly as described previously.

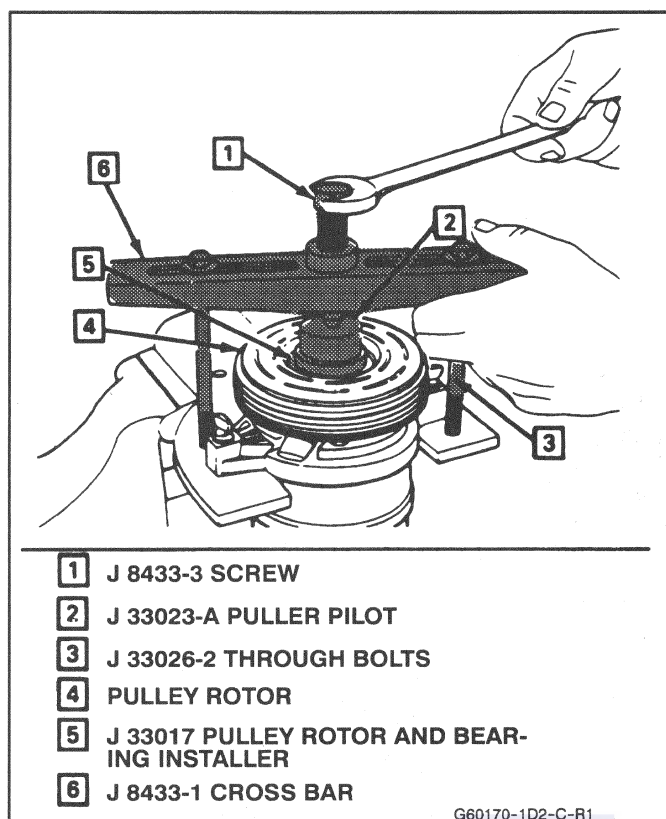


Fig. 13 Installing Pulley Rotor and Bearing Assembly

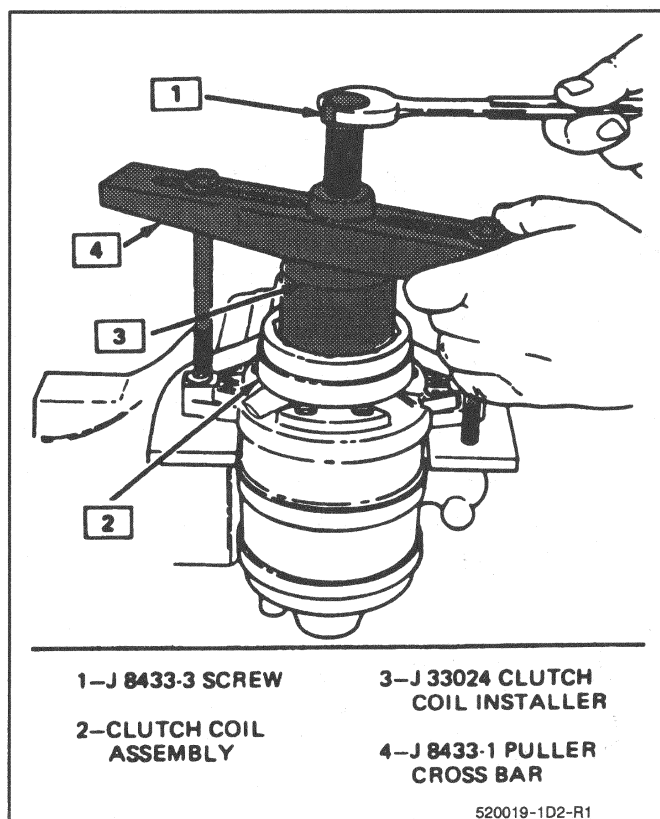


Fig. 15 Installing Clutch Coil Assembly

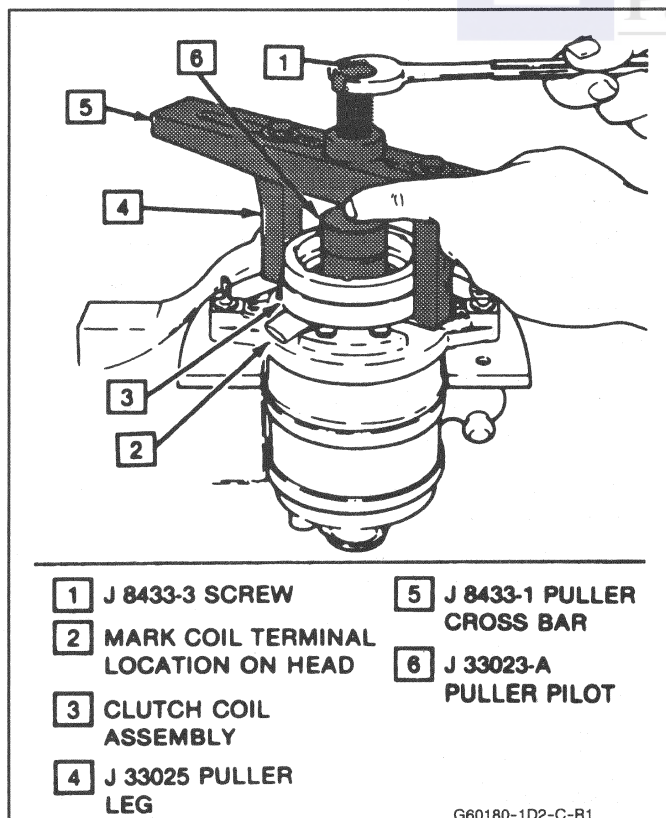


Fig. 14 Clutch Coil Assembly Removal

COMPRESSOR CLUTCH COIL

Remove or Disconnect

1. Perform Steps 1 through 4 of "Clutch Rotor and/or Bearings" removal procedure. **Mark clutch coil terminal location on compressor front head.**
2. Install J 33023-A puller pilot on front head of compressor (Fig. 14). Also install J 8433-1 puller crossbar with J 33025 puller legs as shown in Figure 14.
3. Tighten J 8433-3 forcing screw against the puller pilot to remove the clutch coil.

Install or Connect

1. Place the clutch coil assembly on the front head with the terminals positioned at the "marked" location.
2. Place the J 33024 clutch coil installer over the internal opening of the clutch coil housing and align installer with the compressor front head.
3. Center the J 8433-1 puller crossbar in the counter-sunk center hole of the J 33024 clutch coil installer. Install the J 33026-2 through bolts and washers through the crossbar slots and thread them into the holding fixture J 33026 to full fixture thickness (Fig. 15).
4. Turn the center forcing screw of the J 8433-1 puller crossbar to force the clutch coil onto the front head. Be sure clutch coil and J 33024 installer stay "in-line" during installation.

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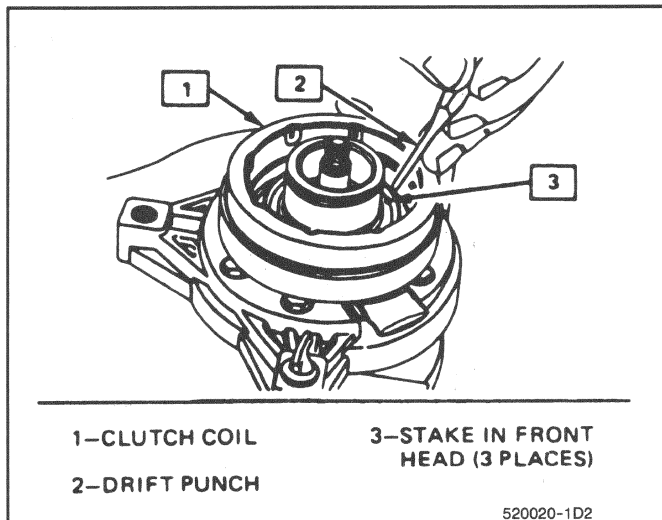


Fig. 16 Staking Clutch Coil to Front Head

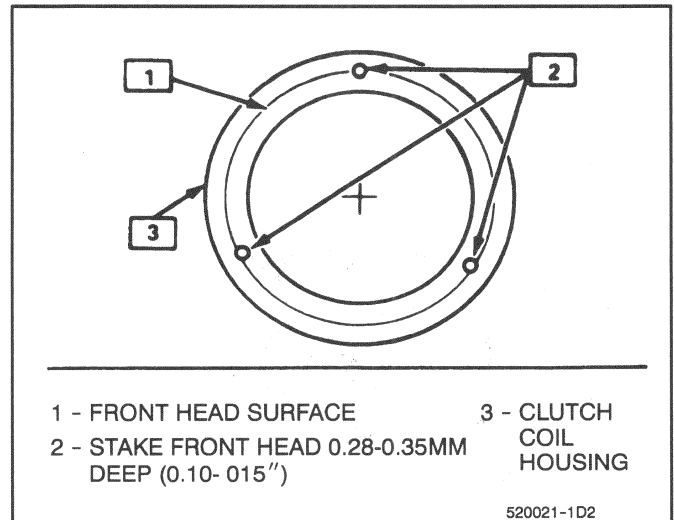


Fig. 17 Details of Stakes in Front Head for Clutch Coil

5. When coil is fully seated on the front head, use a 1/8" diameter drift punch and stake the front head at three places 120 degrees apart (Fig. 16), to ensure clutch coil remains in position.
 - Stake size should be only one-half the area of the punch tip and be only approximately 0.28-0.35mm (.010-.015") deep (Fig. 17).
6. Install rotor and bearing assembly and the clutch plate and hub assembly as described previously.

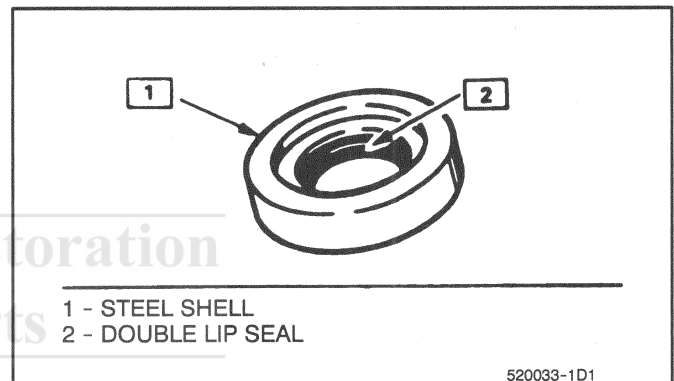


Fig. 18 Compressor Shaft Seal

MAJOR COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly (Fig. 18), pressure relief valve or control switches (Fig. 19), it will be necessary to recover the refrigerant. Other than clutch repair procedures, the same holds true for any disassembly of the compressor.

A clean workbench covered with a sheet of clean paper, and a place (clean trays, etc.) for all parts being removed and replaced is important, as is the use of proper clean service tools.

NOTICE: Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservative process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package. **Seals and protective packaging should be left intact until just prior to installation.**

If the compressor rear head, front head or cylinder and shaft assembly is to be serviced or replaced, the oil in the compressor must be drained, measured, recorded and replaced.

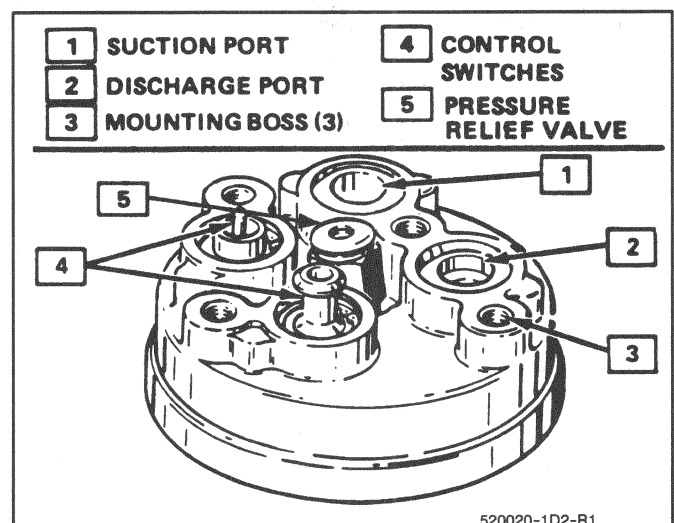


Fig. 19 Compressor — Rear Head

COMPRESSOR SHAFT SEAL REPLACEMENT

Seal Leak Detection

A shaft seal should not be changed because of small amounts of oil found on an adjacent surface but only after actual refrigerant leakage is found using an approved leak detector, J 39400 or equivalent.

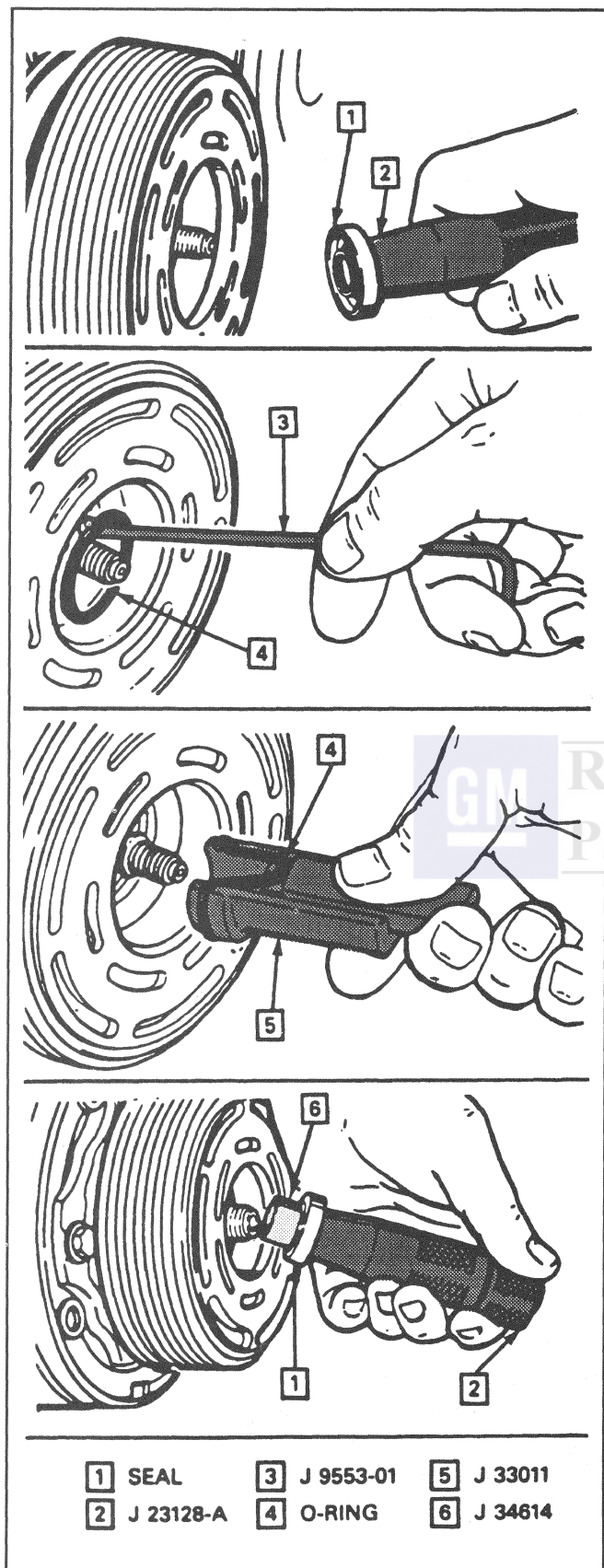


Fig. 20 Removing and Installing Shaft Seal and O-Ring

Remove or Disconnect

1. Recover the refrigerant using J 39500-GM.
2. Loosen and reposition compressor in mounting brackets, if necessary.
3. Remove clutch plate and hub assembly from compressor as described in minor repairs.
4. Remove the shaft seal retainer ring, using snap ring pliers J 5403 (Fig. 21).
5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal, the retainer ring groove and the shaft itself. Any dirt or foreign material getting into compressor may cause damage.
6. Fully engage the knurled tangs of Seal Remover-Installer J 23128-A into the recessed portion of the Seal by turning the handle clockwise. Remove the Seal from the compressor with a rotary-pulling motion (Fig. 22). Discard the seal. The handle must be hand-tightened securely. Do not use a wrench or pliers.
7. Remove and discard the seal seat O-ring from the compressor neck using O-ring remover J 9553-01, Figure 20.
8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Clean

- Thoroughly clean O-ring seal groove in front head.

NOTICE: Seals should not be re-used. Always use a new specification service seal on rebuild (Fig. 18). Be sure that the seal to be installed is not scratched or damaged in anyway. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

Install or Connect

1. Dip the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-ring installer J 33011, Figure 20.
2. Insert the O-ring installer J 33011 into the compressor neck until the installer "bottoms". Lower the moveable slide of the O-ring installer to release the O-ring into the seal O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate the installer to seat the O-ring and remove the installer.
3. Dip the new seal in clean 525 viscosity refrigerant oil and assemble seal to Seal Installer J 23128-A, by turning handle clockwise. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so that flared-out side of lip seal is facing and installed towards the compressor. Install seal protector J 34614, in the seal lip and place over the compressor shaft, Figure 22, and push the seal in place with a rotary motion or place the seal protector J 34014 over end of compressor shaft, Figure 22, and slide the new

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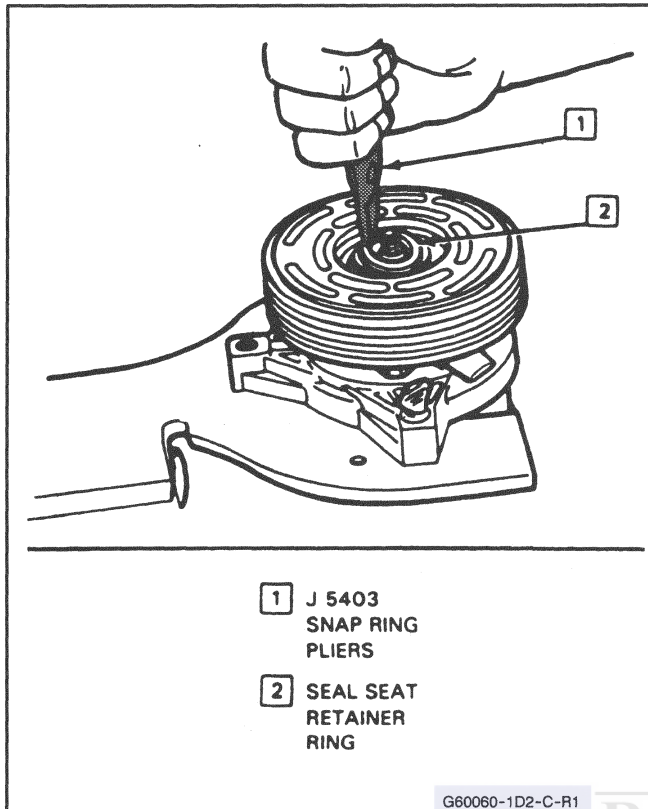


Fig. 21 Removing or Installing Shaft Seal Retaining Ring

seal onto the shaft with a rotary motion until it stops. Take care not to dislodge the O-ring. Be sure the seal makes good contact with the O-ring. Disengage the installer from the seal and remove the installer J 23128-A and the seal protector J 34614.

NOTICE: Handling and care of seal protector is important. If seal protector is nicked or the bottom flared, the new seal may be damaged during installation.

4. Install the new seal retainer ring with its flat side against the Seal, using Snap-Ring Pliers J 5403. See Figure 21. Use the sleeve from O-ring installer J 33011 to press in on the seal retainer ring so that it snaps into its groove.
5. To leak test, install compressor leak test fixture J 39893 on rear head of compressor and connect gage charging lines and J 39500-GM Refrigerant Recovery System. Pressurize suction and high-side of compressor with R-134a Refrigerant. Temporarily install (M9 x 1.25 thread on shaft) nut and, with the compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several turns by hand. Leak test the seal area and correct and leak found. Recover the refrigerant. Remove shaft nut.
6. Remove any excess oil resulting from installing the new seal parts from the shaft and inside the compressor neck.
7. Install the clutch plate and hub assembly as described in minor repair procedures.
8. Reinstall compressor belt and tighten bracket.
9. Evacuate and charge the refrigerant system.

COMPRESSOR PRESSURE RELIEF VALVE

↔ Remove or Disconnect

1. Recover the refrigerant using J 39500-GM.
2. Remove old pressure relief valve (Fig. 19).

→ Install or Connect

1. Clean valve seat area on rear head.
2. Lubricate O-ring of new pressure relief valve and O-ring assembly with new 525 viscosity refrigerant oil. Install new valve and torque in place, 9.0 N•m (6.1 lbs.-ft.)
3. Evacuate and recharge the system.
4. Leak test system.

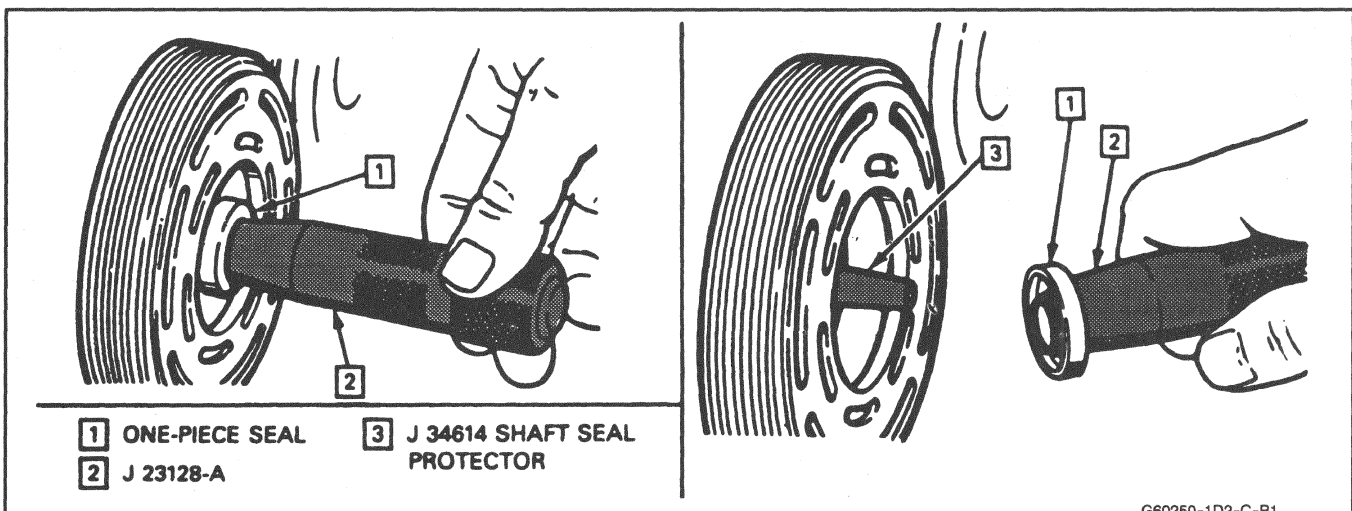


Fig. 22 Removing or Installing Shaft Seal

CONTROL SWITCHES

Figure 20

Remove or Disconnect

1. Recover the refrigerant.
2. Disconnect the electrical connector from the switch in the rear head of compressor.
3. Remove the switch retaining ring using J 5403 internal snap ring pliers.
4. Remove the switch from the compressor.
5. Remove old O-ring seal from the switch cavity using J 9553-01 O-ring removal tool.

If existing control switch is reinstalled in the compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used. A new switch kit has the O-ring and retainer ring included.

Install or Connect

1. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install a new O-ring coated with clean refrigerant oil into groove in switch cavity.
2. Lubricate the control switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J 9533-1 snap ring pliers install switch retaining ring with high point of curved sides adjacent to switch housing. Be sure retaining ring is properly seated in switch cavity retaining groove. Leak test according to bench test procedure.

COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

1. Install test plate J 39893 on rear head of compressor.
2. Using J 39500-GM Refrigerant Recovery System, attach center hose of manifold gage set on charging station to a refrigerant drum standing in an upright drum.
3. Connect charging station high and low pressure lines to corresponding fittings on test plate J 39893. Suction port (low-side) of compressor has large internal opening. Discharge port (high-side) has smaller internal opening into compressor and deeper recess.
4. Open low pressure control, high pressure control and refrigerant control on charging station to allow refrigerant vapor to flow into compressor.
5. Using a leak detector, check for leaks at pressure relief valve, rear head switch location, compressor front and rear head seals, center cylinder seal, through bolt head gaskets and compressor shaft seal. After checking, shut off low pressure control and high-pressure control on charging station.

6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Recover the refrigerant.
8. Disconnect both hoses from the test plate J 39893.
9. Add 90 ml (3 oz.) new PAG lubricant to the compressor assembly. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a M9 x 1.25 threaded nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to insure piston assembly to cylinder wall lubrication.
12. Using J 39500-GM Refrigerant Recovery System, connect J 9893 the charging station high-pressure line to the test plate high-side connector.
13. Using J 39500-GM Refrigerant Recovery System, connect the charging station low-pressure line to the low pressure port of the test plate J 39893. Oil will drain out of the compressor suction port if the compressor is positioned with the suction port downward.
14. Attach the compressor to the J 33026 holding fixture and mount the compressor in a vise so that the compressor will be in a horizontal position and the shaft can be turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten complete revolutions at a speed of approximately one-revolution per second. Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on high-pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 690 kPa (100 psi) or above. A pressure reading of less than 620 kPa (90 psi) would indicate one or more suction and/or discharge valves leaking an internal leak, or an inoperative valve, and the refrigerant must be recovered and the compressor disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.
17. When the pressure pump-up test is completed, recover the refrigerant from the high-side and remove the test plate J 39893.
18. Tilt the compressor so that the compressor suction and discharge ports are down. Drain the PAG lubricant from the compressor.
19. Allow the compressor to drain for 10 minutes, then refill with the proper amount of PAG lubricant, per oil balance procedure in section 1B of the service manual. The PAG lubricant may be poured into the suction port. If further assembly or processing is required, a shipping plate or test plate J 39893 should be installed to keep out air, dirt and moisture until the compressor is installed.

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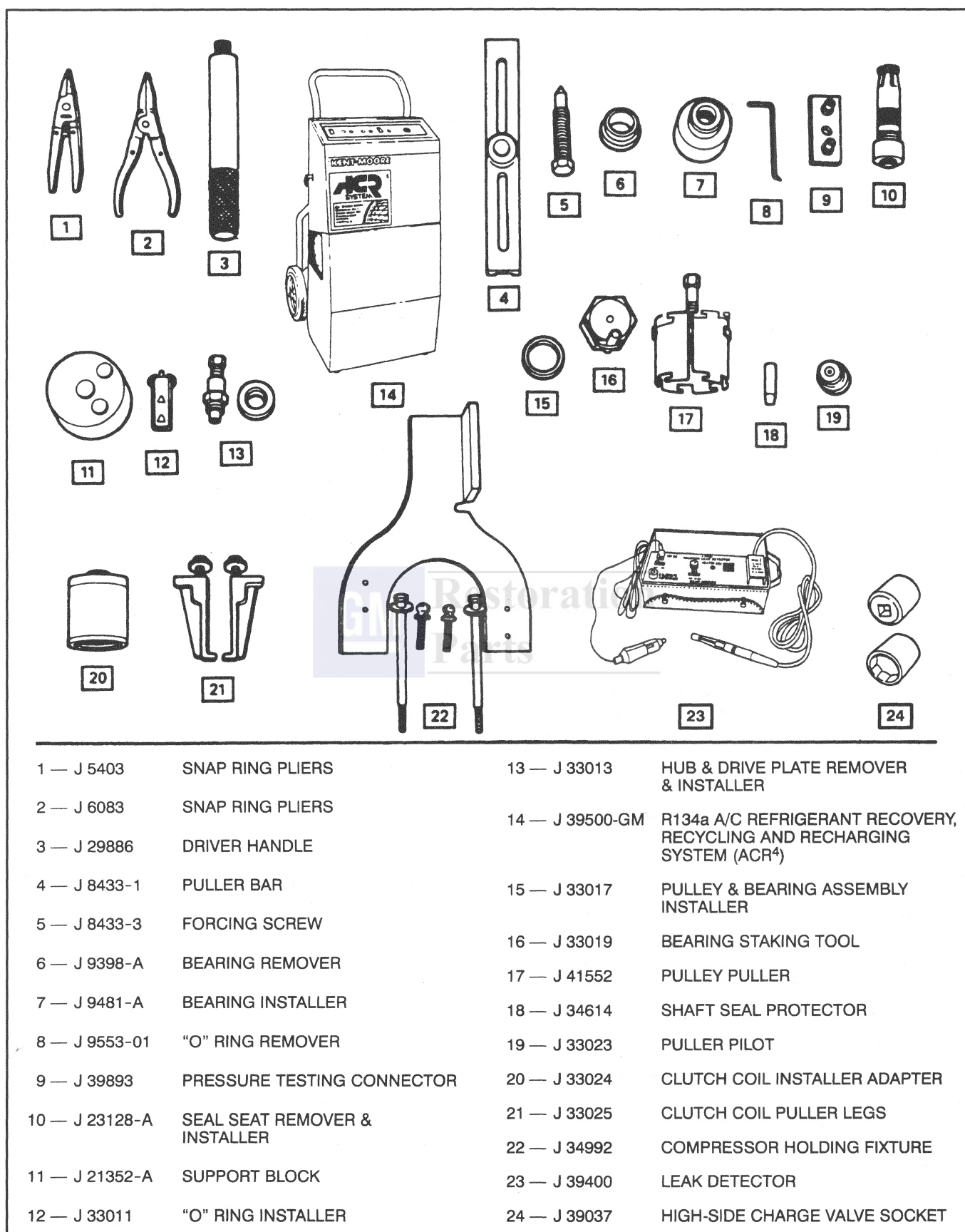


Fig. 23 Compressor Overhaul — Special Tools

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS

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Steering, Suspension, Tires and Wheels Diagnosis.....	Section 3	Front Suspension.....	Section 3C
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Power Steering Gear and Pump On-Vehicle Service	Section 3B	Electronic Level Control System	Section 3D1
Power Steering Gear Unit Repair	Section 3B1A	Tires and Wheels	Section 3E
Power Steering Pump Unit Repair.....	Section 3B1B	Steering Wheel and Column On-Vehicle Service	Section 3F
Steering Linkage	Section 3B3	Supplemental Inflatable Restraint (SIR) Tilt Steering Column	
Variable Effort Steering	Section 3B5	Unit Repair	Section 3F5A or 3F5B

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS DIAGNOSIS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

Since the problems in steering, suspension, tires and wheels involve several systems, they must all be considered when diagnosing a complaint. To avoid using the wrong symptom, always road test the vehicle first. Proceed with the following preliminary checks and correct any substandard conditions which are found.



Inspect

- Wrong pressure and uneven wear on tires.
- Loose connections or wear on joints from the steering column to the steering gear.

- Loose or damaged parts on the front and rear suspension, steering gear, or steering linkage.
- Out-of-round or out-of-balance tires, damaged wheels.
- Loose and/or rough wheel bearings.
- Power steering fluid level.

The following symptom diagnosis tables may help you find the cause of a problem. The tables list a number of symptoms, along with associated possible causes. More information on any particular listing can be found in the sections referenced in the "Refer To" column.

GENERAL DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Vehicle Pulls or Leads	Misaligned Front Wheels	3A
	Mismatched or Uneven Tires	3E
	Broken or Sagging Spring	3C, 3D
	Radial Tire Lead/Pull	3E
	Unbalanced Steering Gear Spool Valve	3B1A
	Dragging Front Brake	5
Shimmy, Shake or Vibration	Bent Wheel/Excessive Runout	3E
	Out of Balance Wheel	3E
	Excessive Wheel Bolt Runout	3
	Excessive Brake Drum/Rotor Imbalance	5
	Worn Steering Linkage Components	3B3
	Worn Upper or Lower Ball Studs	3C
	Excessive Loaded Radial Runout	3E
	Worn Control Arm Bushings	3C
	Out of Balance Propeller Shaft	4A
Abnormal; Noise at Front End	Improper Drive Line Angle	4A
	Lack of Steering Linkage/Suspension Lubrication	0B
	Damaged Suspension Components	3C
	Front Springs Contacting Frame Pockets	3C
	Broken Stabilizer Shaft Links	3C
	Loose Suspension Nuts or Bolts/Screws	3C, 3D
	Misadjusted Steering Gear	3B1A
	Worn Shock Absorbers	3C, 3D

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
	Scuffed or Cupped Tires	3E
Low or Uneven Trim Height	Broken, Incorrect or Sagging Springs	3C, 3D
	Inoperative ALC System, if equipped	3D1
Body Leans or Sways in Corners	Broken Stabilizer Shaft Links	3C
	Worn Shock Absorbers	3C, 3D
	Broken or Sagging Springs	3C, 3D
Suspension Bottoms	Worn Shock Absorbers	3C, 3D
	Incorrect, Sagging or Broken Springs	3C, 3D
	Inoperative ALC System, if Equipped	3D1
	Missing or Damaged Lower Control Arm Bumper	3C
"Dog Tracking"	Damaged Lower Control Arm	3D
	Bent Rear Axle	4B
	Bent Frame	10-3

TIRES AND WHEELS DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Excessive Tire Wear	Misalignment	3A
	Hard Driving	-
	Overloaded Vehicle	-
	Tires Not Rotated	3E
	Low or Excessive Tire Pressure	0B
Wheel Tramp (Bounce)	Out of Balance Wheel	3E
	Worn Shock Absorbers	3C
	Bump or Broken Belt on Tire	3E
Cupped Tires	Wheel Alignment	3A
	Worn Shock Absorbers	3C
	Loose Wheel Bearings	3C
	Worn Control Arm Ball Studs	3C

STEERING DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Poor Returnability	Incorrect Caster Setting	3A
	Lack of Lubrication	0B
	Bind in Steering Column	3F5A or 3F5B
	Misadjusted Steering Gear	3B1A
	Binding Steering/Suspension Components	3B3, 3C
Hard Steering	Hydraulic System Failure	Perform "Steering System Test Procedure" in this section.
	Misadjusted Steering Gear	3B1A
	Excessive Caster	3A
	Variable Effort Steering System	3B5
Too Much Play in Steering	Worn relay Rod or Idler Arm	3B3
	Misadjusted Steering Gear	3B1A
	Loose Stering Gear Mounting	3B
Wander or Poor Stability	Wheel Alignment	3A
	Lack of Steering/Suspension Lubrication	0B
	Worn Shock Absorbers	3C
	Broken or Sagging Spring	3, 3C
Erratic Steering When Braking	Warped Brake Rotor	5B1
	Worn or Loose Wheel Bearings	3C
	Sticking Brake Caliper Piston	5B1
	Worn Steering/Suspension Components	3B3, 3C
Steering Wheel Kick Back	Worn Steering Dampener (if Equipped)	3B3
	Loose Column-to-Gear Connections	3F
	Air in Power Steering System	3B
	Worn Tie Rod Ends	3B3
	Loose Steering Gear Mounting	3B
Steering Wheel Surges or Jerks	Broken Belt in Tire	3E
	Sluggish Steering Gear Spool Valve	3B1A
	Loose or Oil Soaked Drive Belt	6A4A
	Variable Effort Steering System Malfunction	3B5
	Air in Power Steering System	3B

RIDE DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Ride Too Soft(Vehicles With FE1 Suspension are Designed to Ride Soft)	Incorrect Shock Absorbers	3C
	Incorrect Springs	3C, 3D
Ride Too Harsh	Overinflated Tires	0B
	Malfunctioning ALC System	3D1
	Incorrect Springs	3C
	Incorrect Shock Absorbers	3C

POWER STEERING GEAR DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Hissing Noise	Some Noise May Be Heard While Manouvering When the Vehicle is not Moving. This is Normal	Refer to "Power Steering Pump Diagnosis" for More Information
Rattle or Chucking Noise	Outlet (Pressure) Hose (Metal Portion) Contacting Frame	3B
	Loose Tie Rod End	3B3
	Loose Steering Gear Attachment	3B
	Loose Pitman Shaft	3B
Momentary High Effort When Turning Wheel Quickly	Internal Pressure Leak	3
	Sticking or Damaged Steering Gear Spool Valve	3B1A
	Insufficient Pump Pressure	3
	Low Fluid Level	3B
	Refer to "Steering Diagnosis" for More Information	

POWER STEERING PUMP DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Foamy, Milky Fluid	System not Bled After Service	3B
	Air Injested Due to Low Fluid	3B
	Internal Pump Leakage	3B1B
Low Pressure Due To Pump	Stuck or Inoperative Flow Control Valve	3B
	Vanes Sticking in Rotor	3B1B

3-6 STEERING, SUSPENSION, TIRES AND WHEELS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Growling Noise From Pump	Cracked/Broken Thrust or Pressure Plate	3B1B
	Variable Effort Steering Actuator Sticking	3B5
	Restricted Inlet (Pressure) Hose	3B
	Scored Thrust Plate, Pressure Plate or Rotor	3B1B
	Loose Pump Mounting	3B
	Damaged Pump Shaft Bearing	3B1B

STEERING COLUMN DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Steering Column Will Not Unlock	Damaged Lock Cylinder	3F, 3F5A, 3F5B
	Damaged Lock Bolt	3F, 3F5A, 3F5B
	Damaged Rack or Sector	3F, 3F5A, 3F5B
	Damaged/Incorrect Key	3F, 3F5A, 3F5B
Steering Column Will Not Lock	Broken Lock Bolt Spring	3F5A, 3F5B
	Damaged Rack or Sector	3F5A, 3F5B
	Damaged Lock Cylinder	3F, 3F5A, 3F5B
	Improper Shift Linkage Adjustment	7A
	Park/Lock Cable Misadjusted (Floor Shift)	7A
	Stuck Ignition Switch	3F
	Incorrectly Installed Sector	3F5A, 3F5B
Sticks In "START"	Deformed Actuator Rod	3F5A, 3F5B
	Distorted Rack	3F5A, 3F5B
Key Can Not Be Removed In "LOCK"	Misadjusted Ignition Switch	3F
	Damaged Lock Cylinder	3F5A, 3F5B
	Misadjusted Shift Linkage	7A
	Misadjusted Park Lock Cable	7A
High Lock Effort	Damaged Lock Cylinder	3F5A, 3F5B
	Damaged Ignition Switch	3F
	Broken/Deformed Rack Preload Spring	3F5A, 3F5B
	Burrs on Sector, Rack, Housing or Support	3F5A, 3F5B
	Bent Sector Shaft	3F5A, 3F5B
	Bent Actuator Rod	3F5A, 3F5B
	Bent Ignition Switch Mounting Bracket	3F5A, 3F5B
	Improper Shift Linkage Adjustment	7A

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Noise In Steering Column	Loose Steering Column-to-Gear Connections	3F
	Lack of Lubrication on Bearings	3F5A, 3F5B
	Worn/Damaged Steering Shaft Lower Bearing	3F5A, 3F5B
	Unseated Lock Plate Retainer Ring	3F5A, 3F5B
	Unlubricated Spherical Joint	3F5A, 3F5B
High Steering Shaft Rotating Effort	Misaligned Steering Column	3F
	Damaged Upper or Lower Bearing	3F5A, 3F5B
	Tight Intermediate Shaft Coupling	3F
High Shift Effort	Improper Bolts/Screws Used on Ignition Switch	3F
	Damaged/Restricted Shift Tube (Column Shift)	3F5A
	Incorrectly Assembled Lower Bearing	3F5A
Lash in Steering Column	Loose Housing Support Bolts/Screws	3F5A, 3F5B
	Broken Weld Nuts on Jacket	3F5A, 3F5B
	Loose Tilt Shoes/Broken Tilt Spring	3F5A, 3F5B
	Loose Pivot Pin(s)	3F5A, 3F5B
	Loose Housing Support Bolts/Screws	3F
Housing Scraping Bowl	Bent Bowl or Bowl Not Concentric	3F5A, 3F5B
	Improperly Installed Shroud	3F5A, 3F5B
Loose Steering Wheel	Loose Pivot Pin(s)	3F5A, 3F5B
	Upper Bearing Not Seated/Missing Spring	3F5A, 3F5B
	Loose Housing Support Bolts/Screws	3F5A, 3F5B
Loose Steering Wheel (Every Other Tilt Position)	Loose Fit Between Tilt Shoes and Pivot Pins	3F5A, 3F5B
Steering Column Will Not Lock in Any Tilt Position	Broken Tilt Shoe Spring	3F5A, 3F5B
	Tilt Shoe Seized on Pivot	3F5A, 3F5B
	Dirt/Debris in Tilt Shoe Grooves	3F5A, 3F5B
Steering Column Fails To Return To Top Tilt Position	Seized Pivot Pins	3F5A, 3F5B
	Broken/Weak Tilt Spring	3F5A, 3F5B
	Binding Turn Signal Switch Wires	3F5A, 3F5B
Noise When Tilting Steering Column	Worn Upper Tilt Bumper	3F5A, 3F5B

3-8 STEERING, SUSPENSION, TIRES AND WHEELS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
	Shoe Lock Spring Rubbing in Housing	3F5A, 3F5B
Turn Signal Will Not Stay in Turn Position	Foreign Material in Switch	3F5A, 3F5B
	Broken/Missing Detent Spring	3F5A, 3F5B
	None of Above	Replace Switch
Turn Signal Will Not Cancel	Loose Switch Mounting Screws	3F5A, 3F5B
	Broken Switch/Anchor Bosses	3F5A, 3F5B
	Worn Cancelling Cam	3F5A, 3F5B
Turn Signal Difficult To Operate	Loose Turn Signal Switch Arm	3F5A, 3F5B
	Foreign Parts/Material in Switch	3F5A, 3F5B
	Loose Switch Mounting Screws	3F5A, 3F5B
	None of Above	Replace Switch
Hazard Switch Can Not Be Turned "OFF"	Foreign Material Lodged in Switch	3F5A, 3F5B
Hazard Switch Will Not Stay "ON"	Loose Switch	3F5A, 3F5B
	None of Above	Replace Switch
Ignition Switch Will Not Turn "ON"	Damaged Actuator Rod	3F5A, 3F5B
	Damaged Lock Cylinder	3F5A, 3F5B
Ignition Switch Can Not Be Adjusted Properly	Deformed Actuator Rod	3F5A, 3F5B
	Sector/Rack Engaged In Wrong Tooth	3F5A, 3F5B

POWER STEERING GEAR AND PUMP LEAK DIAGNOSIS

Preliminary Inspection



Inspect

- Fluid level and condition.
 - If fluid reservoir is empty, avoid running vehicle. Prolong useage without fluid will damage pump.
 - Fluid other than what is recommended (refer to SECTION 0B) can damage seals, i.e. transmission fluid, brake fluid, engine oil. If this has happened, a complete disassembly, cleaning and inspection of both the pump and gear may be required.
- Hoses and lines for cuts, loose clamps, loose fittings at pump or gear.



Clean

- If leak is not obivous, clean all suspected areas throughly before inspecting.
 - Point from which fluid is dripping is not necessarily point where system is leaking. It is important to identify exact point of leakage.
- Identify exact point of leakage. Refer to "External Leakage Check" in this section.

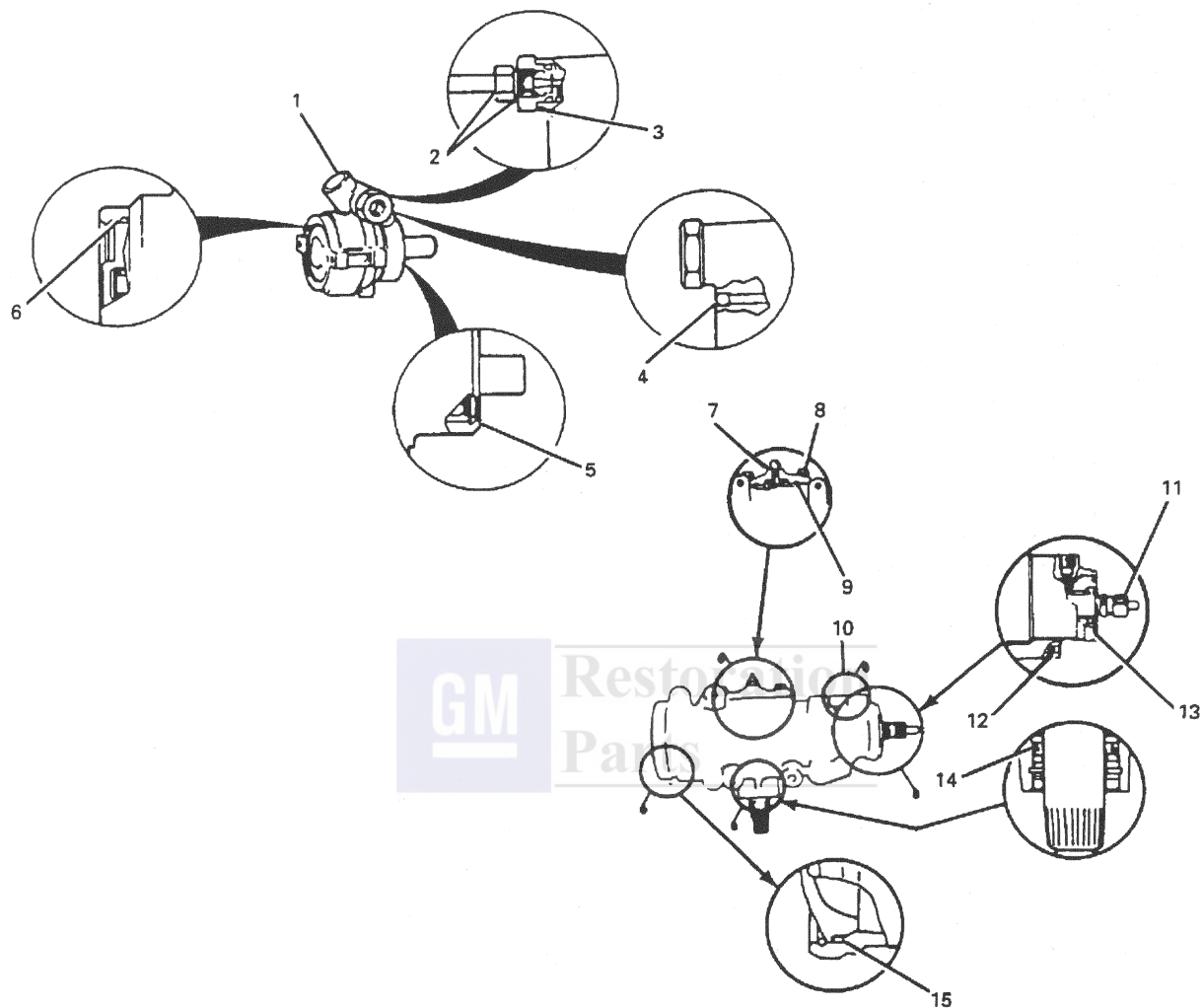
EXTERNAL LEAKAGE CHECK

Figure 1

This procedure will help identify exact location of leak. Some leaks can easily be located, but seepage type leaks may be more difficult. To locate seepage leaks, use the following method:

NOTICE: Refer to "Notice" on page 3-1 of this section.

POWER STEERING GEAR AND PUMP ASSEMBLIES LEAK DIAGNOSIS



- 1 REPLACE O-RING SEAL, AND CHECK RESERVOIR FOR DAMAGE.
- 2 TORQUE INLET HOSE FITTING TO 27 N·m (20 LB. FT.). IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
- 3 TORQUE UNION FITTING TO 75 N·m (55 LB. FT.). IF LEAKAGE CONTINUES, REPLACE O-RING SEAL.
- 4 SEAT BALL IN HOUSING WITH BLUNT PUNCH. FOLLOW MANUFACTURER'S DIRECTION AND APPLY LOCTITE 75559 SOLVENT AND LOCTITE 290 ADHESIVE, OR EQUIVALENT TO AREA. (THIS ALSO APPLIES TO THE OTHER BALL, LOCATED NEAR THE OPPOSITE END OF THE VALVE ASSEMBLY HOUSING).
- 5 REPLACE DRIVESHAFT SEAL. BE SURE DRIVESHAFT SEAL IS CLEAN AND FREE OF PITTING IN SEAL AREA.
- 6 REPLACE O-RING SEAL.
- 7 TORQUE STEERING GEAR PITMAN SHAFT ADJUST NUT TO 49 N·m (36 LB. FT.). REPLACE STEERING GEAR PITMAN SHAFT ADJUST NUT IF LEAKAGE PERSISTS.
- 8 TORQUE STEERING GEAR HOUSING COVER BOLT/SCREW TO 60 N·m (44 LB. FT.). REPLACE STEERING GEAR HOUSING COVER GASKET IF LEAKAGE PERSISTS.
- 9 REPLACE STEERING GEAR HOUSING COVER (O-RING) SEAL.
- 10 TORQUE POWER STEERING GEAR PIPE FITTING SEAT TO 28 N·m (21 LB. FT.). IF LEAKAGE PERSISTS, REPLACE POWER STEERING GEAR PIPE FITTING (O-RING) SEAL.
- 11 REPLACE STEERING GEAR VALVE BODY.
- 12 SEAT STEERING GEAR BALL FLUSH WITH PUNCH AND RESTAKE. IF SEEPAGE PERSISTS, REPLACE STEERING GEAR HOUSING.
- 13 REPLACE STEERING GEAR STUB SHAFT ADJUST (O-RING) SEALS.
- 14 REPLACE STEERING GEAR PITMAN SHAFT SEALS.
- 15 REPLACE STEERING GEAR HOUSING PLUG (O-RING) SEAL.

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Figure 1 - Power Steering Gear and Pump Leak Diagnosis

3-10 STEERING, SUSPENSION, TIRES AND WHEELS

1. With engine off, wipe dry complete power steering system.
2. Check fluid level in reservoir and adjust as necessary. If reservoir is empty, system will have to be bled. Refer to SECTION 3B for procedure.
3. Start engine, then turn steering wheel from stop to stop several times.
 - Do not hold it at a stop for any length of time as this can damage pump.
 - It is easier for someone else to operate steering wheel while you search for seepage.
4. Find exact location of leak and repair.

SEAL REPLACEMENT RECOMMENDATIONS

Lip seals, which seal rotating shafts, require special treatment. Lip seals are used on the steering gear and on the pump drive shaft. When a leak is in one of these areas, always replace the seal(s) after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by first smoothing with crocus cloth.

POWER STEERING SYSTEM TEST PROCEDURE

Figure 2

Tools Required:

- J 5176-E Power Steering Pressure Tester 0-2000 PSI and
- J 5176-92 18 mm Power Steering Pressure Tester Adapter

If a hydraulic or mechanical malfunction of the pump or power steering gear is suspected, perform the following procedure to determine the cause.

NOTICE: Refer to "Notice" on page 3-1 of this section.

1. Remove brake pressure modulator valve bracket bolts/screws and nut and support unit to provide access to steering gear hose attachment.
 - Do not disconnect any brake lines.
2. Disconnect steering gear inlet (pressure) hose at gear. Use a small container to catch any fluid which might leak.
3. Connect pressure gage J 5176-E to gear inlet (pressure) hose and use adapter J 5176-92 to connect pressure gage to steering gear.
 - The power steering system may be tested using J 5176-E as described here. It can also be tested with available tool J 25325 power steering analyzer which will also measure flow rate.
4. Open valve on J 5176-E.

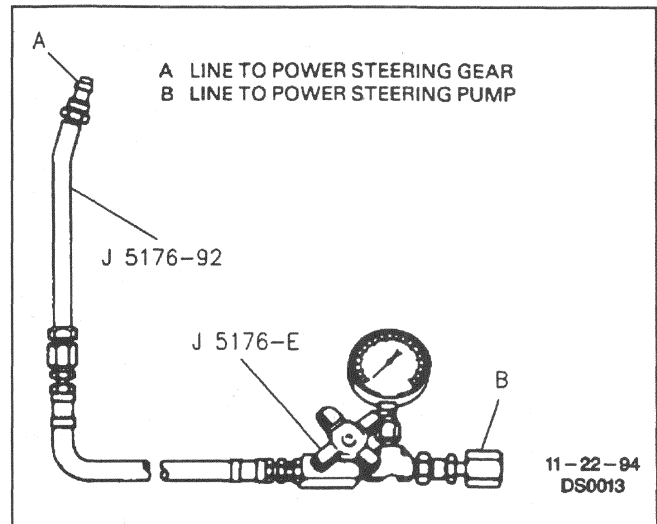


Figure 2 - Power Steering Pressure Gage

CAUTION: After connecting J 5176-E, ensure hoses do not contact serpentine belt or any pulleys. Personal injury may result.

5. Bleed power steering system. Refer to SECTION 3B.
6. Start engine and allow engine to reach normal operating temperature.
7. With engine at idle and valve open on J 5176-E, pressure should be no more than 1 034 kPa (150 psi).
 - If pressure is more than 1 034 kPa (150 psi), check the hoses and pipes for restrictions or kinks, and check valve on steering gear inlet hose fitting for proper operation and/or restriction. If O.K., steering gear is restricted internally. Refer to SECTION 3B1A for unit repair information.

NOTICE: Do not leave the valve fully closed for more than 5 seconds as the pump could be damaged.

8. Close valve on J 5176-E three times and record pressure reading each time. Each reading should show at least 6 895 kPa (1,000 psi). The three readings should be within 345 kPa (50 psi) of each other.
 - If pressure readings are high enough and are within 345 kPa (50 psi) of each other, pump is functioning properly.
 - If pressure readings are high enough but are not within 345 kPa (50 psi) of each other, control valve in pump is sticking.
 - A. Remove valve, clean it and remove any burrs using crocus cloth or fine hone.
 - B. If system contains some contamination, flush it.
 - If pressure readings are less than 6 895 kPa (1,000 psi), replace flow control valve and recheck.
 - If pressures are still low, repair or replace power steering pump.

9. If pump checks to specification, leave valve open and turn steering wheel (or have someone else turn it) to both stops.
 - Record highest pressures and compare with highest pump pressure recorded earlier.
 - If pressure at both stops is not same as maximum pressure, steering gear is leaking internally and must be repaired.
10. Turn off engine.
11. Remove J 5176-E and J 5176-92.
12. Connect steering gear inlet (pressure) hose to steering gear.

**Tighten**

- Steering gear inlet hose fitting nut to 28 N.m (21 lb. ft.).
13. Position brake pressure modulator valve and install bolts/screws and nut.

**Tighten**

- Brake pressure modulator valve bolts/screws and nut to 24 N.m (18 lb. ft.).
14. Bleed power steering system. Refer to SECTION 3B.

SHOCK ABSORBERS**ON-VEHICLE CHECKS****Weak**

1. Check and adjust tire pressures to pressures shown on tire placard.
2. Note load conditions under which vehicle is normally driven. If vehicle is normally overloaded, shock absorbers will wear out much sooner than normal.
3. Road test vehicle to verify problem.
4. Test each shock absorber in turn by quickly pushing down, then lifting up corner of the bumper nearest the shock absorber being checked.
 - A. Use same amount of effort on each test and note resistance on compression and rebound.
 - B. If possible compare this with a similar vehicle having acceptable ride quality. Both vehicles should provide the same feeling of resistance.
 - C. Shock absorbers should have most of the resistance on rebound, if bumper is jounced then released, bumper should not rebound more than once.
 - If there is much difference between the shock absorbers of the two vehicles, or rebounds more than once, replace the shock absorbers in pairs (front or rear)

Noisy

1. Check all mountings for proper tightening.
2. If all mountings are intact, jounce vehicle as in step 4 in "Weak" above to isolate suspected unit.
3. Replace shock absorber if detected noise is any sound other than hissing.

Leaks

1. Fully extend shock absorbers (wheels unsupported) to fully expose shock absorber for inspection.
2. Look for signs of leaks in seal cover area for front shocks and around base of boot for rear shock.
 - Slight trace of fluid is not cause for replacement. The seal permits some seepage to lubricate the piston rod and there is a built-in fluid reserve to allow for seepage.
 - A leaking shock absorber can easily be found because there will be fluid around seal cover and an excessive amount of fluid on shock absorber.
3. A leaking shock absorber must be replaced.

TIRES**Irregular or Premature Wear****Figures 3 and 4**

Irregular or premature tire wear has many causes. Some of them are: incorrect inflation pressures, lack of regular rotation, driving habits, or improper wheel alignment. If wheel alignment is reset due to a tire wear condition, always reset toe to zero degrees.

**Inspect**

1. Front and rear tire wear. Rotate tires if:
 - Uneven wear exists across tread of any tire.
 - Left and right front tire wear is unequal.
 - Left and right rear tire wear is unequal.
 - Scheduled maintenance interval. Refer to SECTION 0B.
2. Wheel alignment if following conditions are noted:
 - Left and right front tire wear is unequal.
 - Wear is uneven across tread of any front tire.

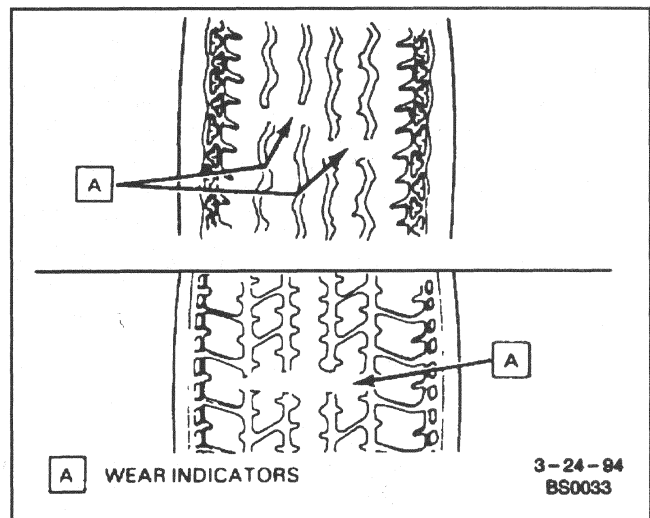


Figure 3 - Tread Wear Indicators

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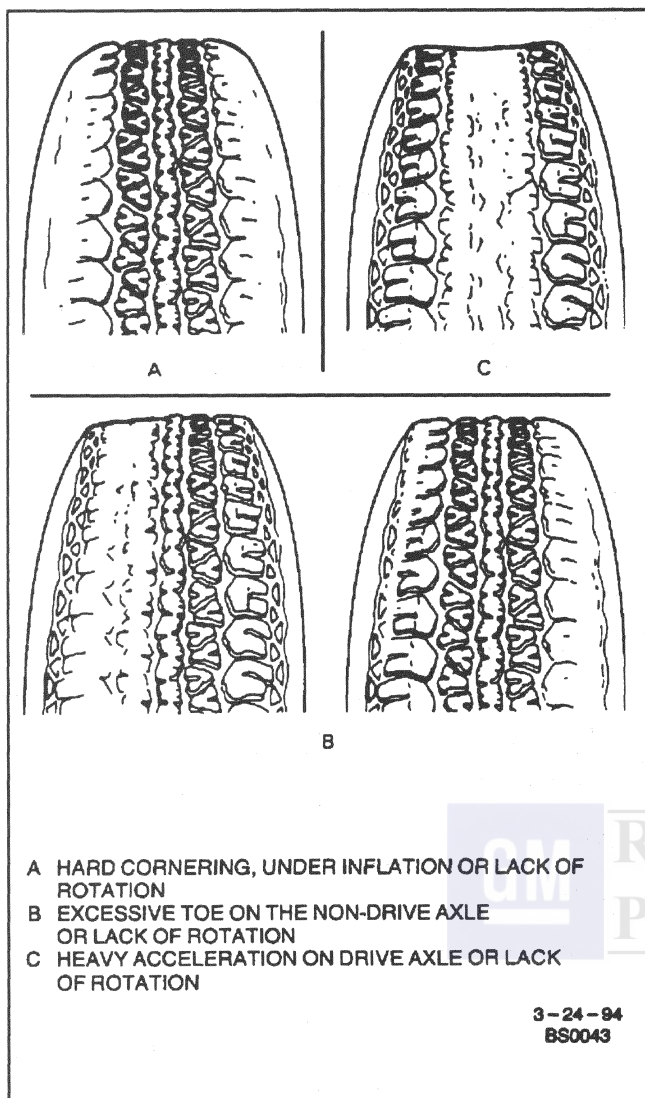


Figure 4 - Tire Wear Diagnosis

- Front tire treads have a scuffed appearance with “feather” edges on one side of tread ribs or blocks.

Tread Wear Indicators

Figure 3

The original equipment tires have built-in tread wear indicators to show when the tires should be replaced. These indicators will appear as 12.7 mm (1/2 inch) wide bands when the tire tread depth becomes 1.6 mm (1/16 inch). When the indicators appear in 2 or more grooves at 3 locations, replace the tire.

Tire Waddle Complaint

Figure 5

Tire waddle is side-to-side movement at the front and/or rear of the vehicle. It can be caused by the steel belt not being straight within the tire (broken belt); or by excessive lateral runout of the tire or

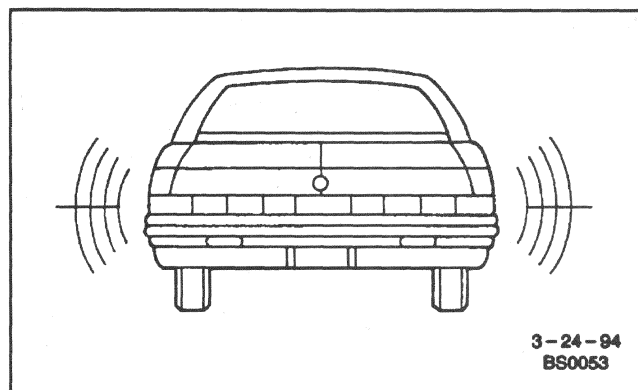


Figure 5 - Tire Waddle

wheel. It is most noticeable at low speed, about 8 to 48 km/h (5 to 30 mph). It may also appear as a ride roughness at 80 to 113 km/h (50 to 70 mph).

Inspect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Perform a preliminary inspection by rotating each tire and wheel by hand.
 - A broken or shifted belt will appear as a twist or bump in the tread.
3. If the problem has not been identified, perform a runout check. Refer to “Runout Check” in this section.
4. If problem has not been identified, a tire substitution may be used to identify the faulty tire and wheel.
 - Use the spare tire to replace each tire, one at a time, while test driving the vehicle. The problem will be eliminated when the faulty tire is removed from the vehicle.

Radial Tire Lead/Pull

Lead/pull is the deviation of the vehicle from a straight path, on a level road with no pressure on the steering wheel. Lead/pull is usually caused by:

- Poor tire construction.
- Improper wheel alignment.
- Brake caliper not fully releasing.

The way in which a tire is built can produce lead in a vehicle. An example of this is placement of the belt. Off-center belts on radial tires can cause the tire to develop a side force while rolling straight down the road and the tire will tend to roll like a cone.

Refer to the lead/pull correction chart to determine cause of lead/pull.

Vibration

Figure 7

A vibration is considered a shake or shimmy at higher speeds than a tire waddle. If problem is noticed at low speeds (8 to 48 km/h (5 to 30 mph)), refer to “Tire Waddle Complaint” in this section.

Before performing diagnosis, perform the following preliminary inspections:



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Inspect

- Tire inflation pressure.
- Damaged rims from chuckhole or curb impact.
- Tires for tread distortions, separations, bulges, or mixed sizes.
 - Slight sidewall indentations are normal and will not affect ride.
 - Sidewall bulges are not normal and indicate impact damage.
- Mud or tar build-up on tire or wheel.
- Loose or missing balance weights or wheel nuts.
- Irregular or excessive tire wear.
- Bent drive shaft or worn universal joints.

Refer to vibration diagnosis chart to determine cause of vibration.

Tire and Wheel Balance

Before removing the tire and wheel from the vehicle, mark the wheel bolt nearest the valve stem for future reference. Also mark the vehicle position (left front, etc.) on each tire. Balance is the easiest procedure to perform and should be done first if the vibration occurs at highway speeds. An off-vehicle, two-plane dynamic balance should be performed first. This will correct any imbalance in the tire and wheel.

An on-vehicle finish balance may also be required. This may offset brake drum and rotor imbalance. If balance does not correct the highway speed vibration, or if the vibration occurs at low speeds, tire or wheel runout may be the probable cause. Refer to "Runout Check" in this section.

Runout Check

This procedure may be stopped at whatever point the acceptable level of runout is reached.



Measure

1. Free runout of tire and wheel on vehicle using a dial indicator with a roller wheel.
 - Lateral runout (side to side) should be measured on tire's sidewall as close to tread shoulder as possible.
 - Radial runout (up and down) should be measured on center tread rib.

— Some tread designs may require wrapping a piece of tape tightly around center tread circumference for better dial indicator contact.

- Disregard any instantaneous indicator needle jumps due to sidewall depressions, tread blocks, etc.

2. Record total indicator reading, and location of high point of runout.
3. If radial or lateral runout exceeds 1.27 mm (0.050 inch), mount tire and wheel on a dynamic balance machine and remeasure runout.
 - Make sure wheel is centered on machine by wheel center pilot hole.
4. Record total indicator reading, and location of the high point of runout.
5. If radial or lateral runout exceeds 1.27 mm (0.050 inch), break down and rotate tire on rim 180 degrees.

- In many cases, rotating tire on wheel will bring runout to an acceptable range.
- Whenever a tire is rotated on the wheel, in this way, the must be rebalanced.

6. Reinflate, mount on dynamic balance machine and remeasure runout.
7. Record total indicator reading and location of high point of runout.
8. If radial or lateral runout still exceeds 1.27 mm (0.050 inch) and high point has moved approximately 180 degrees, following tire around rim, tire is faulty and should be replaced.
9. If second high point still exceeds 1.27 mm (0.050 inch) and is close to original high point, relative to the rim, runout of the wheel should be checked.

- Replace wheel if radial or lateral runout of wheel exceeds:
 - Aluminum wheel - 0.76 mm (0.030 inch).
 - Steel Wheel - 1.14 mm (0.045 inch).

10. If runout of tire and wheel is within limits when measured off the vehicle, yet exceeds the limits when measured on the vehicle, the attachment of tire and wheel to hub is probable cause.

- A. Clean mounting surface and check for any debris, rust or corrosion on mounting surface.
- B. If problem can not be corrected by cleaning mounting surface, replace rotor or axle shaft.

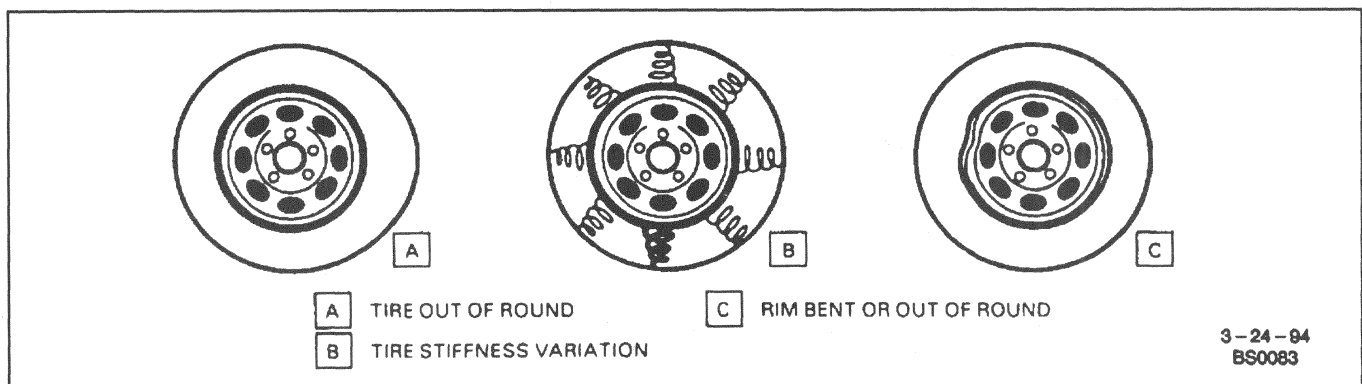
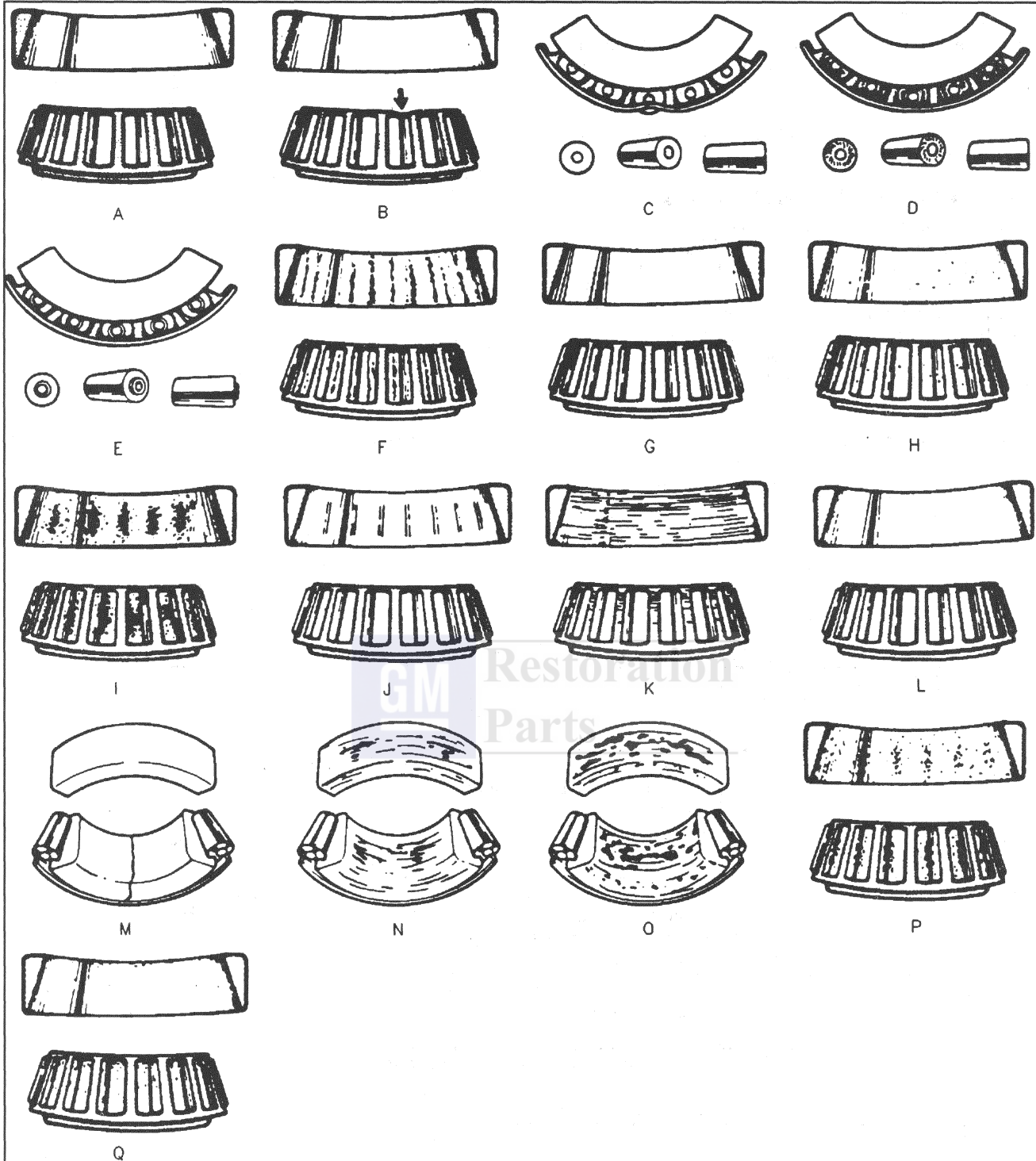


Figure 6 - Runout Conditions Which Can Cause Vibration



A GOOD BEARING
B BENT CAGE
C BENT CAGE
D GALLING
E ABRASIVE STEPWEAR

F ETCHING
G MISALIGNMENT
H INDENTATIONS
I FATIGUE SPALLING
J BRINELLING

K CAGE WEAR
L ABRASIVE ROLLER WEAR
M CRACKED INNER RACE
N SMEARS
O FRETAGE

P HEAT DISCOLORATION
Q STAIN DISCOLORATION

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Figure 7 - Tapered Roller Bearing Diagnosis

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Substitution method

Install a known good set of tires and wheels. If these correct the vibration, the original tires and wheels should be reinstalled one at a time until the vibration returns. This can also be done using the spare tire, substituting one tire at a time until the problem is eliminated.

TAPERED ROLLER BEARING DIAGNOSIS

Bearing noises are normally a grinding or rumbling noise heard at all speeds. The noise may become louder or quieter when the steering wheel is turned slightly to either side (this transfers some of the load from one bearing to the other (inner bearing-to-outer bearing, or outer bearing-to-inner bearing). Tapered roller bearings are used only on the front wheels, if noise is coming from the rear axle, refer to SECTION 4B.

Remove or Disconnect

1. Front brake rotor. Refer to SECTION 3C.
2. Inner wheel bearing and seal from front brake rotor.
 - Pry out seal from rotor, then remove inner bearing.

Inspect

- Grease surrounding inner and outer bearings. If any metal chips are noticed, both inner and outer bearings and races must be replaced. Refer to SECTION 3C for procedure.

Clean

- All grease from the front brake rotor, and spindle, and thoroughly clean out any grease in the inner and outer bearings. Use clean solvent. Use a small brush with no loose bristles to clean out all old grease.

NOTICE: Do not spin the inner and outer bearings with compressed air while drying or the bearings may be damaged.

Inspect

- Bearings and races for condition and color. Compare with the following charts.
- Spindle for roughness or damage on the bearing mating surfaces. Bearings must "creep" on spindle surface. If surface is damaged, the spindle must be replaced.

TAPERED ROLLER BEARING DIAGNOSIS

CONDITION	CAUSE	REPAIR PROCEDURE
Bent Cage	Damage due to improper handling or tool usage.	Replace bearing.
Galling	Metal smears on roller ends due to overheating. Lubricant failure or overload.	Replace bearing. Check inner bearing seal.
Abrasive Step Wear	Pattern on roller ends caused by fine abrasives.	Clean all parts. Replace bearings and seal.
Etching	Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.	Replace bearings. Check inner bearing seal for damage. Replace seal if necessary.
Misalignment	Outer race misalignment due to a foreign object	Clean related parts and replace bearing. Make sure races are properly seated.
Indentations	Surface depressions on race and rollers caused by hard particles of foreign material.	Clean all parts and housing. Check inner bearing seal and replace bearings.
Fatigue Spalling	Flaking of surface metal resulting from fatigue.	Replace bearings. Clean all related parts.
Brinelling	Surface indentations in raceway caused by rollers either under impact loading or vibration while bearing is not rotating.	Replace bearing.
Cage Wear	Wear around outside diameter of cage and roller pockets caused by abrasive material and insufficient lubrication.	Replace bearings. Check inner bearing seal.

TAPERED ROLLER BEARING DIAGNOSIS (cont'd)

CONDITION	CAUSE	REPAIR PROCEDURE
Abrasive Roller Wear	Pattern on races and rollers caused by fine abrasives.	Clean all parts and housings. Check inner bearing seals and bearings. Replace if leaking, rough, or noisy.
Cracked Inner Race	Race cracked due to improper fit, cocking, or poor bearing seats.	Replace inner race.
Smears	Smearing of metal due to excessive slippage. Excessive slippage can be caused by poor fits, poor lubrication, overheating, overloads, or handling damage.	Replace bearings. Clean related parts and check for proper fit on spindle. Replace spindle if damaged.
Fretting	Corrosion set up by small relative movement of parts with no lubrication.	Replace bearings. Clean related parts. Check inner bearing seal.
Heat Discoloration	Discoloration can range from faint yellow to dark blue and can result from overload or incorrect lubricant, and overheating. Excessive heat can cause softening of the races on rollers	Replace bearings and inner seal if overheating damage is indicated.
Stain Discoloration	Discoloration can range from light brown to black and can be caused by incorrect lubricant or moisture.	Reuse bearings if stains can be removed by cleaning and if there is no evidence of overheating. Check inner bearing seal.

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TRIM HEIGHT

Figures 8 and 9

Incorrect trim heights can cause bottoming out over bumps, possible damage to suspension components and symptoms similar to those produced when there is a problem with the wheel alignment. Trim heights should be checked when diagnosing suspension complaints and before checking wheel alignment.

Before measuring trim heights perform the following:

1. Set tire pressures to pressure shown on tire placard (located on rear of drivers door).
2. Check fuel level, add additional weight, if necessary to simulate a "full tank".
3. Place front seats in the full back position, second seat in upward position, and third seat down.
4. Make sure the rear compartment is empty except for spare tire and jack and simulated fuel load
5. Make sure vehicle is on a level surface (such as an alignment rack).
6. All doors, hood and rear compartment lid or tailgate are closed.

All dimensions shown on Figures 8 and 9 are measured vertical to the ground. Trim heights should be within 10 mm (0.4 inch) to be considered correct.

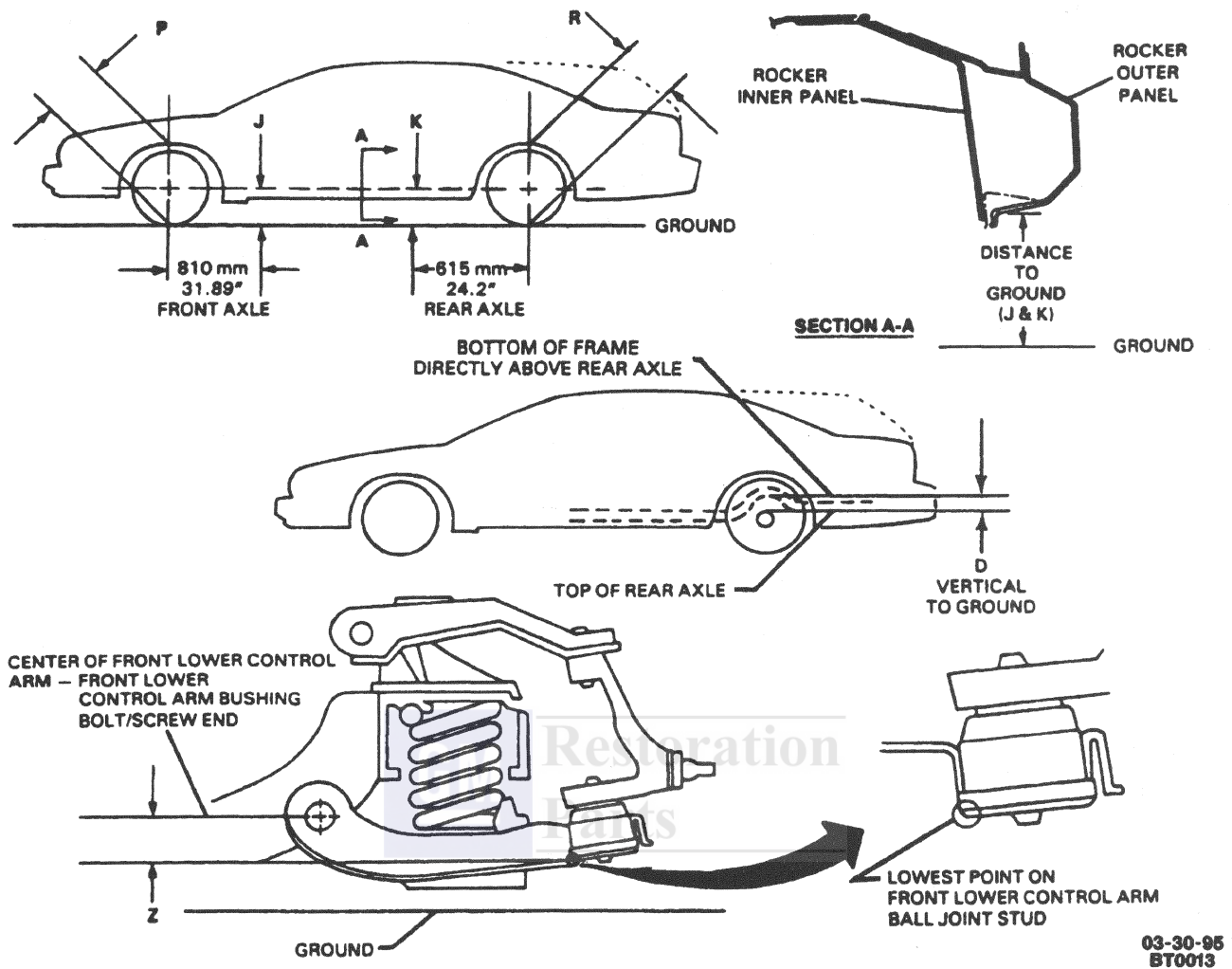
Measuring "Z," "J" and "P" Dimensions

1. Lift front bumper of vehicle up approximately 38 mm (1 1/2 inches). Gently remove hands and let vehicle settle.
2. Push front bumper down approximately 38 mm (1 1/2 inches). Gently remove hands and let vehicle rise on its own.
3. Measure "Z," "J" and "P" dimensions and calculate trim heights.
 - Trim heights are average of high and low measurements.
4. Verify trim heights with Figures 8 or 9.
5. To correct front trim heights, the front springs must be replaced.

Measuring "D," "K" and "R" Dimensions

Repeat procedure as described for "Measuring "Z," "J" and "P" Dimensions" using the rear bumper and measuring "D," "K" and "R" at the appropriate times. Automatic level control system must be operative while taking measurements. Trim height adjustments can be made by adjusting the automatic level control height sensor, if equipped or replacing springs.

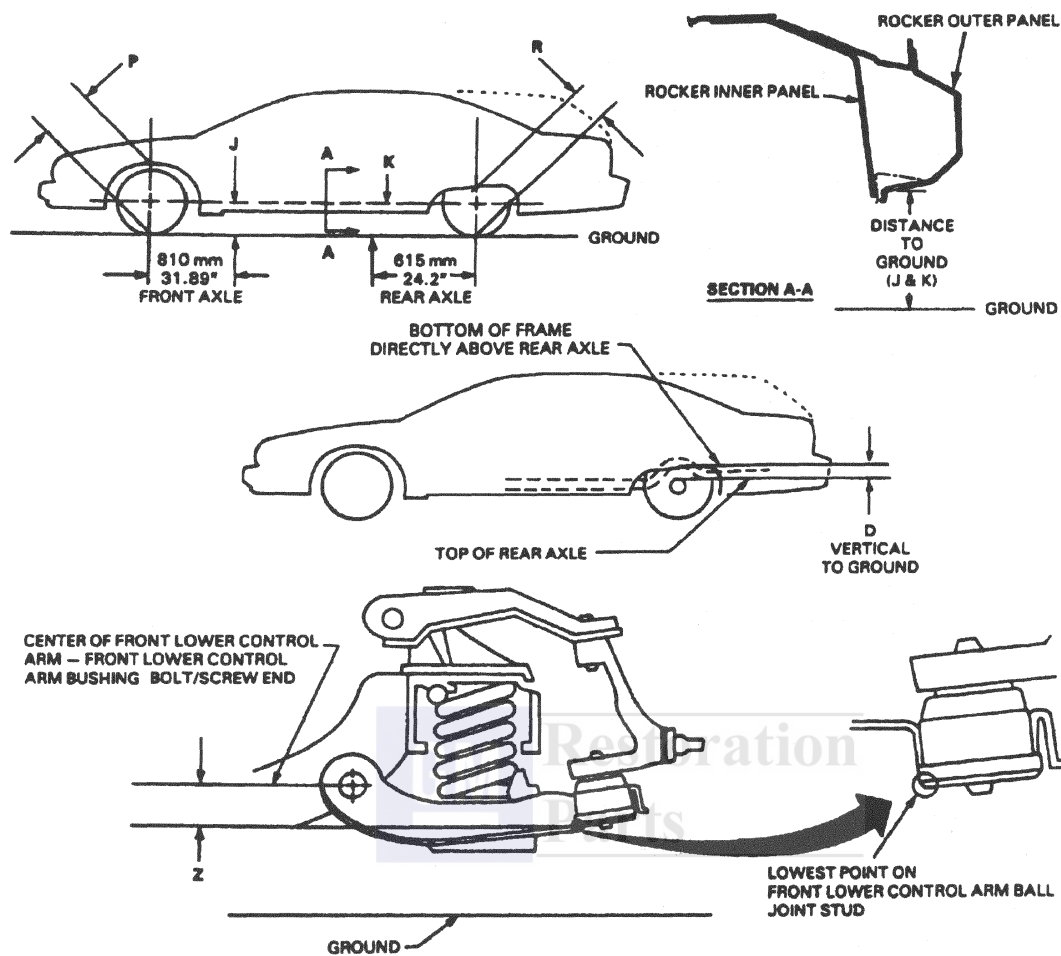
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MODEL	SUSPENSION	TIRE	J		K		P		R		D		Z	
			mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH
CHEVROLET SEDAN	FE1	215-75	257	10.1	259	10.2	736	29.0	723	28.5	142	5.6	71	2.8
		225-70 (SEO ONLY)	252	9.9	264	10.4	726	28.6	732	28.8	152	6.0	61	2.4
	FE2/F41	225-70 (EXC SEO)	252	9.9	254	10.0	731	28.8	718	28.3	138	5.4	69	2.7
		225-70 (SEO)	252	9.9	264	10.4	726	28.6	732	28.8	151	5.9	62	2.4
	FE3	235-70	252	9.9	254	10.0	731	28.8	718	28.3	133	5.2	62	2.4
	7B3 (SEO ONLY)	215-75	252	9.9	264	10.4	726	28.6	732	28.8	149	5.9	60	2.4
		225-70	252	9.9	264	10.4	726	28.6	732	28.8	153	6.0	64	2.5
		235-70	252	9.9	264	10.4	726	28.6	732	28.8	145	5.7	54	2.1
	FE4 (IMPALA SS)	255-50	227	8.9	229	9.0	706	27.8	693	27.3	114	4.5	40	1.6
CHEVROLET WAGON	F40	225-75	252	9.9	264	10.4	742	29.2	551	21.7	123	4.8	51	2.0
		225-70 (SEO)	252	9.9	264	10.4	742	29.2	551	21.7	134	5.3	62	2.4

Figure 8 - Trim Height Diagnosis (Chevrolet)


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MODEL	SUSPENSION	TIRE	J		K		P		R		D		Z	
			mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH
BUICK SEDAN	FEI	235-70	252	9.9	264	10.4	737	29.0	546	21.5	146	5.7	55	2.1
	FE2/F41	225-70	252	9.9	264	10.4	737	29.0	546	21.5	153	6.0	63	2.5
	FE3	235-70	252	9.9	254	10.4	737	29.0	546	21.5	147	5.8	57	2.3
BUICK WAGON	F40	225-75	252	9.9	264	10.4	748	29.4	557	21.9	123	4.8	52	2.0

NOTE: Trim height should be within +/- 10 mm (0.4 inch).

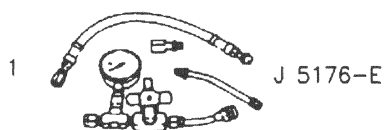
Figure 9 - Trim Height Diagnosis (Buick)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Brake Pressure Modulator Valve Bracket Bolt/Screw or Nut.....	24 N·m (18 lb. ft.)
Power Steering Gear Inlet Hose Fitting (pressure).....	28 N·m (21 lb. ft.)

SPECIAL TOOLS



- 1 POWER STEERING PRESSURE TESTER 0-2000 PSI
- 2 POWER STEERING PRESSURE TESTER ADAPTER

11-22-94
DS0043



SECTION 3A

WHEEL ALIGNMENT

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR Components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

Wheel alignment refers to the angular relationship between the wheels, the suspension attaching parts, and the ground.

CASTER

Caster is the tilting of the front steering axis (at the top) either forward or backward from the vertical. A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences directional control of the steering but does not affect tire wear and is adjustable only at the front wheels. Caster is affected by vehicle height, therefore it is important to keep the body at its designed height. Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster. For trim height information, refer to SECTION 3.

CAMBER

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is

positive (+). When the wheels tilt inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Camber setting influences directional control and tire wear.

TOE

Toe is a measurement of how much the front wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel. Toe also serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward. In other words, even when the wheels are set to toe in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. Toe affects tire wear.

THRUST ANGLE

The wheels aim or steer the vehicle, but the rear wheels control tracking. This tracking action is relative to thrust angle. Thrust angle is defined as the path that the rear wheels will take. Ideally, the thrust angle is geometrically aligned with the body centerline.

3A-2 WHEEL ALIGNMENT

PRELIMINARY INSPECTIONS

Steering and vibration complaints are not always the result of improper alignment. Another possibility is tire "lead" due to worn or improperly manufactured tires. "Lead" is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. Refer to SECTION 3 for the procedure to determine if the vehicle has a tire lead problem. Before making any adjustment affecting wheel alignment, make the following inspections to ensure correct alignment readings and alignment adjustments.



Inspect

- All tires for proper inflation pressures. Also check that all tires have about the same tread wear.
- Wheel bearings for proper adjustment and correct if necessary.
- Control arm ball studs, relay rod and tie rod ends. If they are loose, correct them before adjusting wheel alignment. Refer to SECTION 3B3 and 3C.
- Runout of wheels. Refer to SECTION 3.
- Vehicle trim height. If out of limits and a correction is to be made, do so before adjusting wheel alignment. Refer to SECTION 3 for trim height chart.
- Steering gear loose at frame.
- Control arms for loose bushings.
- Stabilizer shafts for loose or missing parts.
- Leaking or worn out shock absorbers.
- Remaining suspension and steering components for damage. All worn parts **must** be replaced prior to adjusting wheel alignment.
- Vehicle for stability. The fuel tank should be full, or the vehicle should have compensating ballast.
- Jounce front and rear of vehicle lightly three times.

Consideration must be given to excess loads, such as tool boxes, sample cases, etc. If these items are normally carried in the vehicle, they should remain in the vehicle during alignment adjustments. Consideration should also be given to the condition of the equipment being used to adjust alignment. Be sure to follow the equipment manufacturer's instructions. Regardless of the equipment used to adjust alignment, the vehicle must be on a level surface, both front-to-rear and side-to-side.

ON-VEHICLE SERVICE

MEASURING FRONT ALIGNMENT ANGLES

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, should the settings vary beyond the specifications shown at the end of this section, the alignment angles should be corrected. Perform preliminary inspections prior to measuring alignment angles or inaccurate reading may result.



Measure

- Front alignment angles.
 - a. Install alignment equipment according to the manufacturer's instructions.
 - b. Jounce the front and rear bumpers lightly three times to normalize suspension prior to measuring angles.
 - c. Measure alignment angles and record the readings. If adjustments are required, make them in the following order: caster, camber, and toe.

FRONT CASTER AND CAMBER ADJUSTMENT

Figures 1 and 3

Caster and camber adjustments are made by inserting shims between the control arm pivot shaft and the frame. Shims may be added, subtracted or transferred to change the readings as follows:

1. Caster - Transfer shims, front-to-rear or rear-to-front.
 - Example: The transfer of one shim from the control arm pivot shaft rear bolt/screw to the control arm pivot shaft front bolt/screw will decrease positive caster.
2. Camber - Add or subtract shims at both the front and rear of the control arm pivot shaft.
 - Example: Adding an equal number of shims at both the front and rear of the control arm pivot shaft will decrease positive camber.

Caster and camber can be adjusted in one operation. Toe must be checked after changing camber or caster.



Adjust

- Front caster and camber.
1. Jounce the front bumper three times before making any adjustment in the caster to allow the vehicle to return to its normal height.
 2. Loosen the control arm pivot shaft nuts (4).
 3. Add, subtract, or transfer shims as required per the alignment correction chart (Figure 3).

NOTICE: Refer to "Notice" on page 3A-1 of this section.

4. Tighten the control arm pivot shaft nuts (4).
 - Always tighten control arm pivot shaft nut (4) on the thinner shim pack first. This improves control arm pivot shaft-to-frame clamping force.



Tighten

- Control arm pivot shaft nuts (4) to 95 N·m (70 lb. ft.).

A normal shim pack will leave at least two threads of the control arm pivot shaft bolt/screw exposed beyond the control arm pivot shaft nut. The

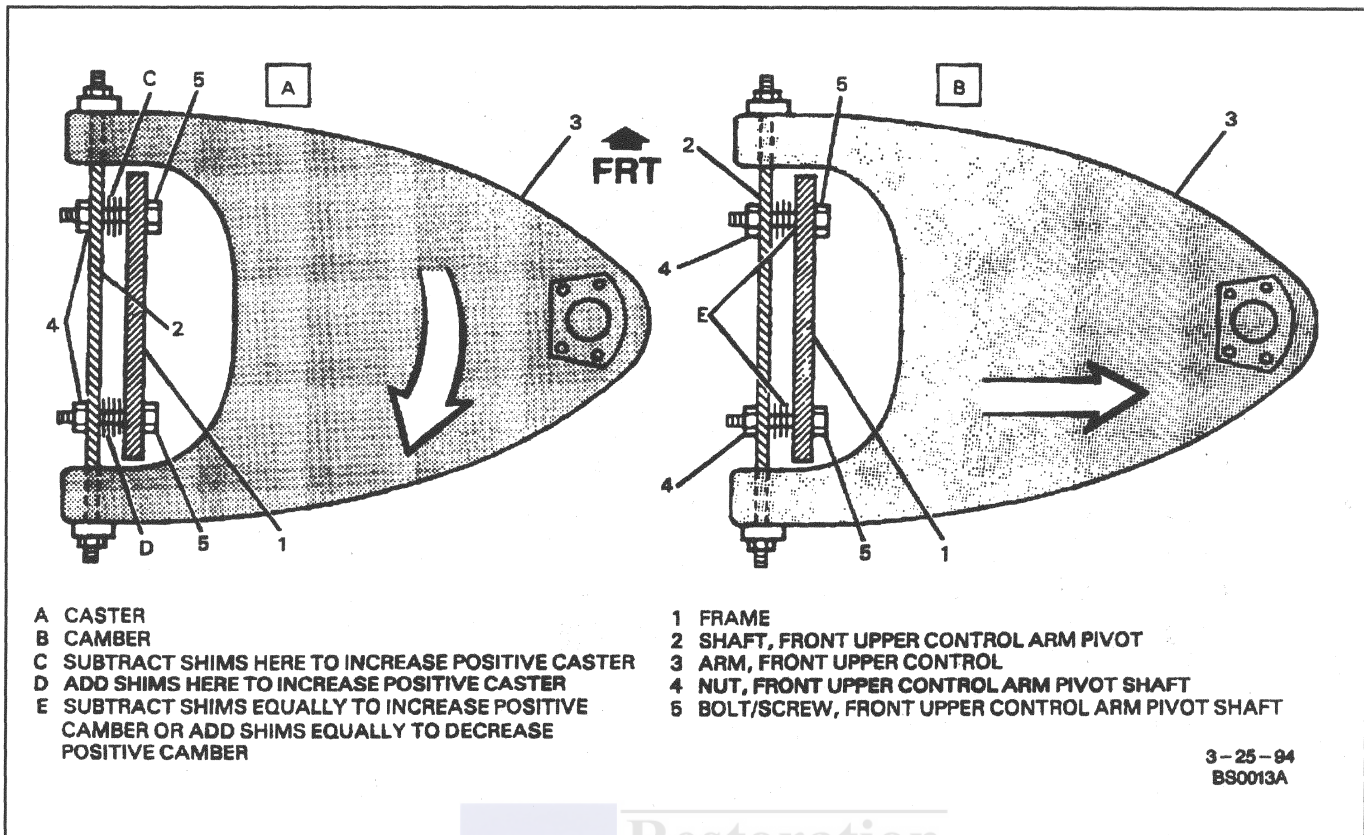


Figure 1 - Front Caster and Camber Adjustment

difference between front and rear shim packs should not exceed 10.16 mm (0.400 inch). If these requirements cannot be met in order to reach specifications, check for damaged suspension and/or steering components and replace parts as necessary.

TOE ADJUSTMENT

Figure 2

! Important

- Tie rod adjuster parts can become rusted in service. In such cases, it is recommended that if the torque required to remove the tie rod adjust clamp nut from the tie rod adjust clamp bolt/screw after breakaway exceeds 9 N.m (80 lb. in.), discard the tie rod adjust clamp nuts and tie rod adjust clamp bolts/screws. Apply penetrating oil between the tie rod adjust clamp and tie rod adjuster and rotate the tie rod adjust clamps until they move freely. Install new tie rod adjust clamp bolts/screws and tie rod adjust clamp nuts having the same part number to assure proper clamping at the specified torque.

Toe-in can be increased or decreased by changing the length of the tie rods. A threaded adjusting sleeve is provided for this purpose.

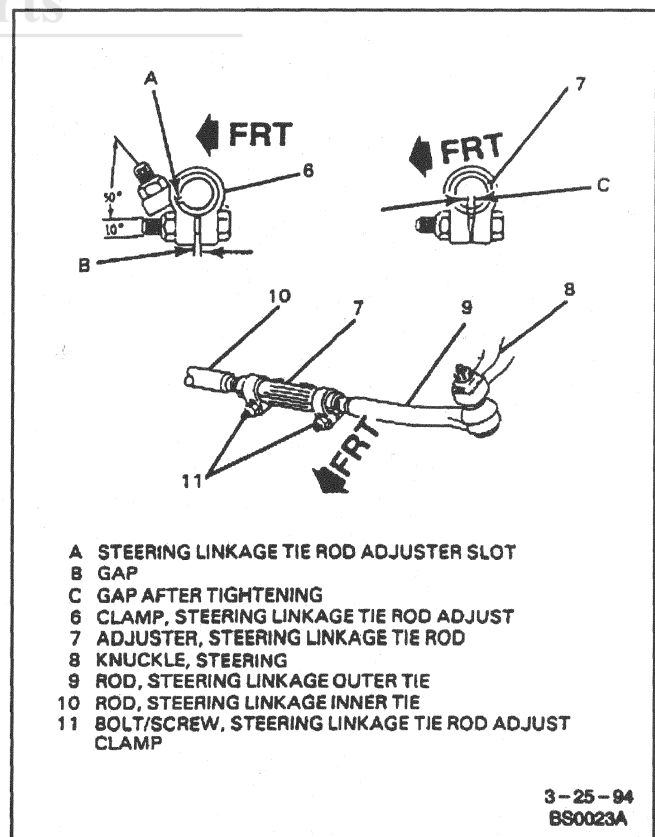


Figure 2 - Positioning Tie Rod Adjuster and Tie Rod Adjust Clamps

FRONT SUSPENSION ALIGNMENT CHART

		DEGREES CASTER															
		LEFT	+4.65°	+4.45°	+4.25°	+4.05°	+3.85°	+3.65°	+3.45°	+3.25°	+3.05°	+2.85°	+2.65°	+2.45°	+2.25°	+2.05°	+1.85°
		RIGHT	+5.15°	+4.95°	+4.75°	+4.55°	+4.35°	+4.15°	+3.95°	+3.75°	+3.55°	+3.35°	+3.15°	+3.95°	+3.75°	+3.55°	+2.35°
DEGREES CAMBER		FRONT UPPER CON- TROL ARM PIVOT SHAFT BOLT/SCREW															
	+1.4°	FRONT	+300	+211	+211	+210	+210	+201	+201	+201	+200	+200	+111	+111	+110	+110	+110
		REAR	+101	+101	+110	+110	+111	+200	+200	+201	+210	+210	+211	+211	+300	+301	+301
	+1.2°	FRONT	+210	+210	+210	+201	+201	+200	+200	+111	+111	+110	+110	+110	+101	+101	+100
		REAR	+011	+100	+101	+101	+110	+110	+111	+200	+200	+201	+210	+210	+211	+300	+300
	+1.0°	FRONT	+201	+201	+200	+200	+111	+111	+110	+110	+110	+101	+101	+100	+100	+100	+011
		REAR	+010	+011	+011	+100	+101	+101	+110	+110	+111	+200	+200	+201	+210	+210	+211
	+0.8°	FRONT	+200	+200	+111	+111	+110	+110	+101	+101	+100	+100	+100	+011	+011	+010	+010
		REAR	+001	+001	+010	+011	+011	+100	+100	+101	+110	+110	+111	+200	+200	+201	+210
	+0.6°	FRONT	+111	+110	+110	+101	+101	+100	+100	+100	+011	+011	+010	+010	+010	+001	+001
		REAR	-000	+000	+001	+001	+010	+011	+011	+100	+100	+101	+110	+110	+111	+200	+200
	+0.4°	FRONT	+110	+101	+101	+100	+100	+011	+011	+010	+010	+010	+010	+001	+001	+000	-000
		REAR	-010	-001	-000	+000	+001	+001	+010	+011	+011	+100	+101	+101	+110	+111	+111
	+0.2°	FRONT	+100	+100	+011	+011	+010	+010	+010	+001	+001	+000	-000	-000	-001	-001	-010
		REAR	-011	-010	-010	-001	-000	+000	+001	+001	+010	+011	+011	+100	+101	+101	+110
	0.0°	FRONT	+011	+011	+010	+010	+001	+001	+000	-000	-000	-001	-001	-010	-010	-010	-011
		REAR	-100	-100	-011	-010	-010	-001	-001	+000	+001	+001	+010	+011	+011	+100	+101
	-0.2°	FRONT	+010	+001	+001	+001	+000	-000	-001	-001	-010	-010	-010	-011	-011	-100	-100
		REAR	-101	-101	-100	-100	-011	-010	-010	-001	-001	+000	+001	+001	+010	+011	+011
	-0.4°	FRONT	+001	+000	-000	-001	-001	-010	-010	-010	-011	-011	-100	-100	-100	-101	-101
		REAR	-111	-110	-101	-101	-100	-100	-011	-010	-010	-001	-000	+000	+001	+010	+010
	-0.6°	FRONT	-001	-001	-001	-010	-010	-011	-011	-100	-100	-101	-101	-101	-110	-110	-110
		REAR	-200	-111	-111	-110	-101	-101	-100	-100	-011	-010	-010	-001	-000	+000	+001
	-0.8°	FRONT	-010	-010	-011	-011	-100	-100	-100	-101	-101	-110	-110	-111	-111	-111	-200
		REAR	-201	-201	-200	-111	-111	-110	-101	-101	-100	-100	-011	-010	-010	-001	-000
	-1.0°	FRONT	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-111	-200	-200	-201	-201
		REAR	-210	-210	-201	-201	-200	-111	-111	-110	-101	-101	-100	-100	-011	-010	-010
-1.2°	FRONT	-100	-101	-101	-110	-110	-110	-111	-111	-200	-200	-201	-201	-201	-210	-210	
	REAR	-300	-211	-210	-210	-201	-201	-200	-111	-111	-110	-101	-101	-100	-011	-011	

INSTRUCTIONS FOR USING ALIGNMENT CHART

1. Determine vehicle's current caster and camber measurements.
2. Using the caster reading, read down the appropriate column to the lines corresponding to the current camber reading.
3. Correction values will be given for the front upper control arm pivot shaft front and rear bolts/screws.
EXAMPLE: Current reading +2.25° left caster - 0.4° camber. By reading down the chart from +2.25° left - 0.4° camber you will find that the front upper control arm pivot shaft front bolt/screw requires an adjustment of -100 and the front upper control arm pivot shaft rear an adjustment of +001.

+ = Shim Addition
- = Shim Removal

Correction Value Example:

(as shown)
on current figure

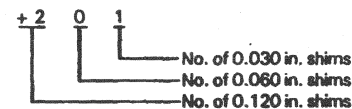


Figure 3 - Alignment Correction Chart

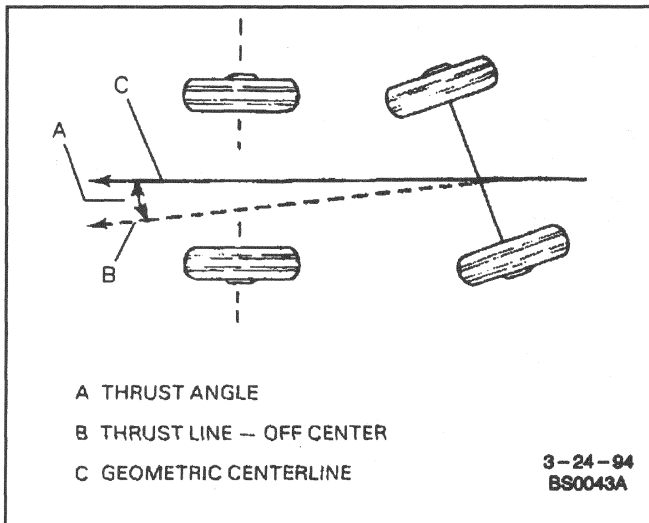


Figure 4 - Thrust Angle

Adjust

NOTICE: Refer to "Notice" on page 3A-1 of this section.

1. Make sure steering wheel is set in a straight-ahead position within 2.5 degrees.
2. Toe adjustments are made separately at each individual tire and wheel.

3. Loosen the tie rod adjust clamp bolts/screws (11) at each end of the tie rod adjuster (7).
 - Rotate the inner and outer tie rod sockets to the limit of the control arm ball stud travel.
4. With the steering wheel set in straight-ahead position, turn the tie rod adjuster (7) to obtain the proper toe adjustment. Refer to "Specifications" at the end of this section.
5. Position tie rod adjust clamps (6) within the angles shown in Figure 2.
 - Slot in tie rod adjuster (7) must not be within the gap area of the tie rod adjust clamping jaws.
 - Tie rod adjust clamps must be between and clear of dimples before tightening tie rod adjust clamp nut.

Tighten

- Tie rod adjust clamp bolts/screws (11) to 19 N.m (14 lb. ft.). Tie rod adjust clamp ends may touch when tie rod adjust clamp nuts are tightened to specification but a gap must be visible adjacent to the tie rod adjuster (7).
6. When adjustment has been completed, check to see that the number of threads showing on each end of the tie rod adjuster (7) are equal and that the outer tie rod ends are at right angles to the steering knuckle.

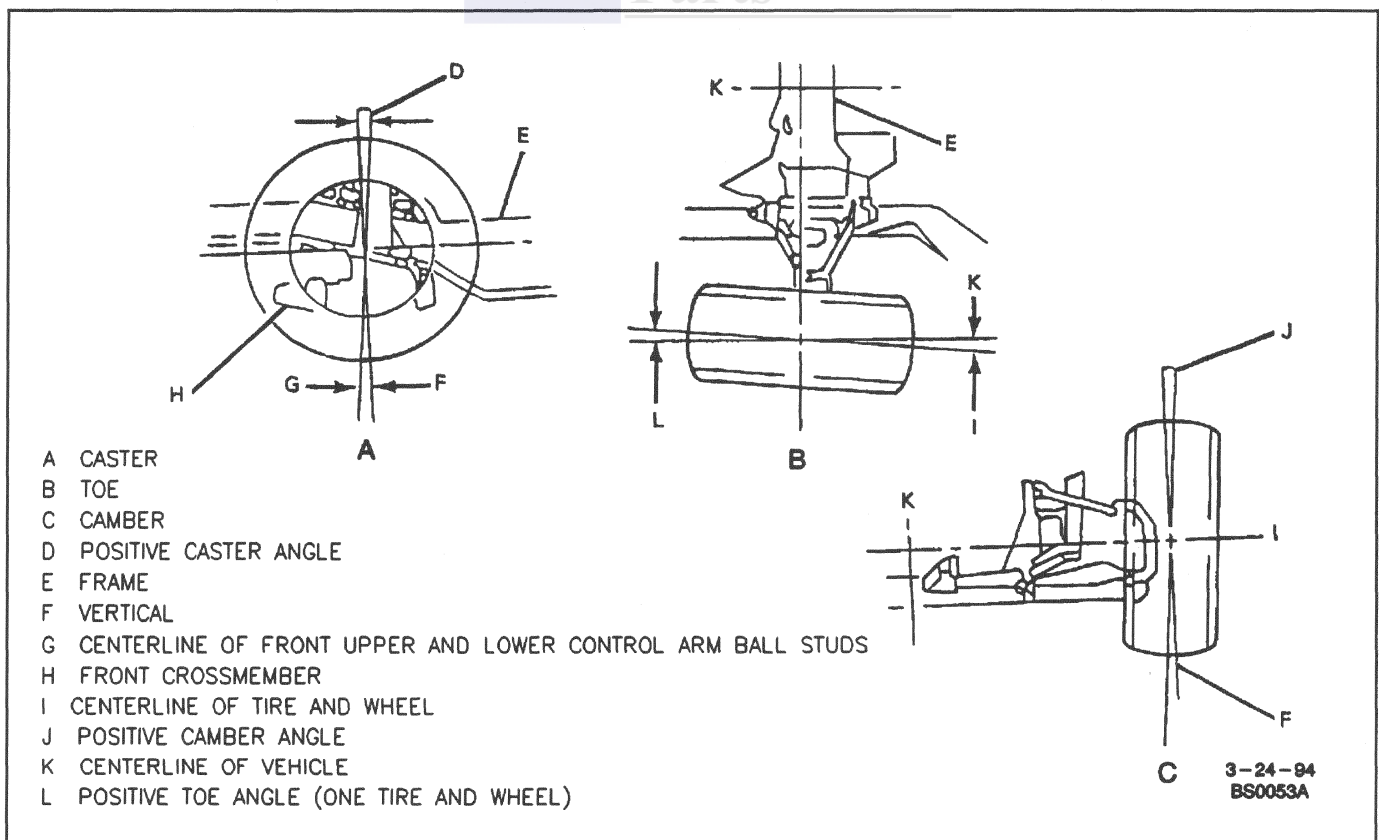


Figure 5 - Caster, Camber and Toe

3A-6 WHEEL ALIGNMENT

MEASURING REAR ALIGNMENT ANGLES

After front tire and wheel alignment has been completed, the rear alignment angles should be checked if there is excessive rear tire wear or wheels do not track properly. Rear wheels should be parallel to and the same distance from the vehicle's centerline.

If tires do not track correctly after a front tire and wheel alignment, no amount of adjustment will correct the problem. Poor tracking or excessive rear

tire wear after a front tire and wheel alignment usually indicates that the axle housing, frame, or suspension arms have been bent.

REAR THRUST ANGLE ADJUSTMENT

If the thrust angle is not within specification, inspect the rear axle upper and lower control arms for damage. If the control arms are ok, then check the frame dimensions. Refer to SECTION 10-3.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Upper Control Arm Pivot Shaft-to-Frame Nut	95 N.m (70 lb. ft.)
Steering Linkage Tie Rod Adjust Clamp Bolt/Screw	19 N.m (14 lb. ft.)

WHEEL ALIGNMENT SPECIFICATIONS

FRONT

Caster

Left	3.25° +/- 1.0°
Right	3.75° +/- 1.0°
Right-to-Left Difference	0.5° +/- 0.7°

Camber

Left or Right	0.0° +/- 1.5°
Right-to-Left Difference	0.0° +/- 1.5°

Toe

Individual Toe	0.08° +/- 0.1°
Total Toe	0.16° +/- 0.2°

Steering Wheel Angle	0.0° +/- 2.5°
----------------------------	---------------

REAR

Thrust Angle	0.0° +/- 0.15°
--------------------	----------------

SECTION 3B

POWER STEERING GEAR AND PUMP
ON-VEHICLE SERVICE

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, cap or plug all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

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GENERAL DESCRIPTION

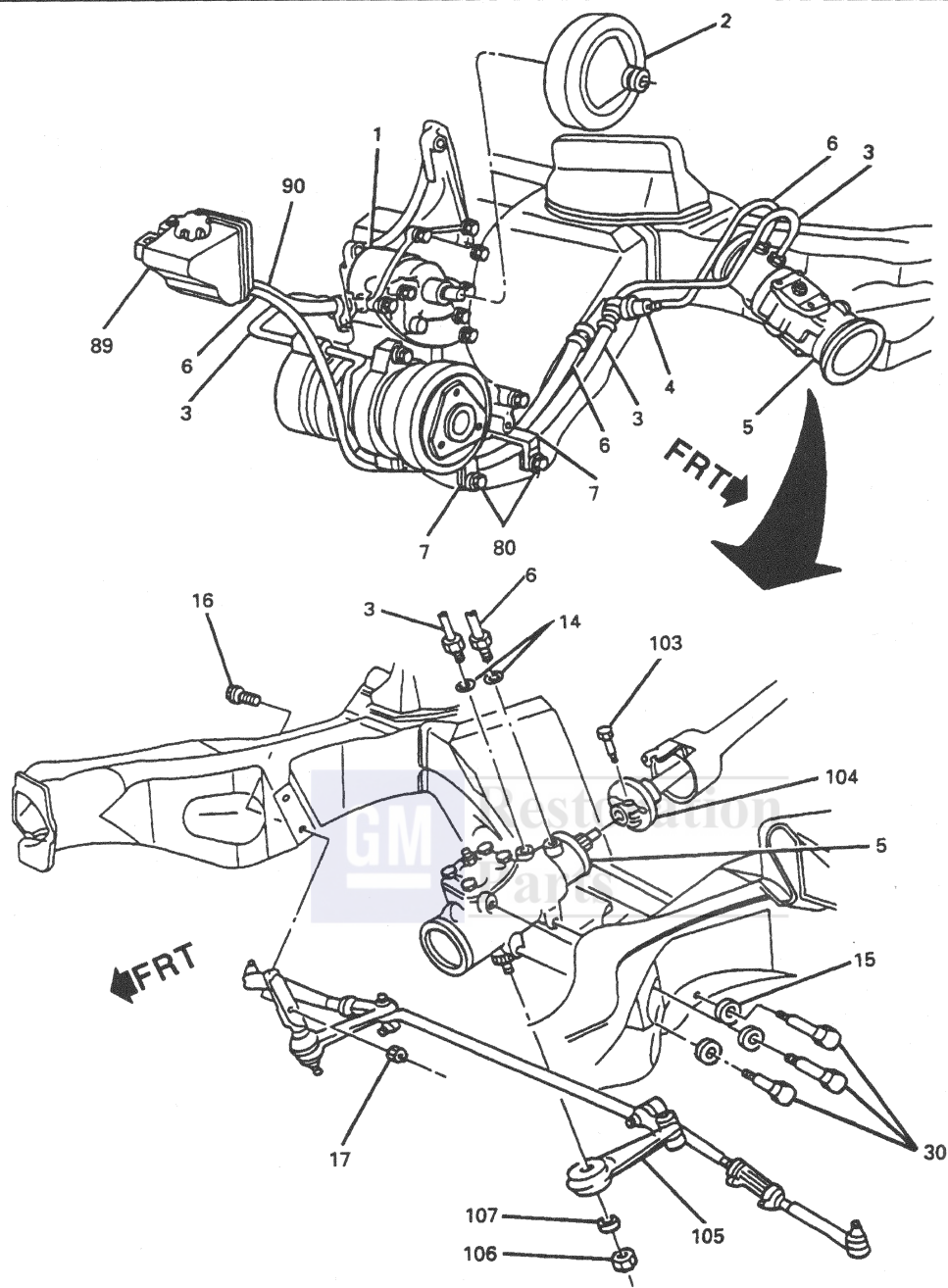
POWER STEERING GEAR

Figure 1

The steering gear is mounted on the left frame side rail and is secured by three bolts/screws. The steering gear is joined to the intermediate shaft by a coupling that helps isolate noise and road shock from the interior (Figure 1). The major internal components of the steering gear are the valve, worm gear, rack, and the pitman shaft. The movement of these parts, while turning or parked, is aided by hydraulic pressure supplied by the pump. Manual steering is always available at times when the engine is not running or in the event of pump or belt failure. Steering effort is increased under such conditions.

The stub shaft, valve, worm gear and rack are all “in line.” The steering gear has a recirculating ball system which acts as a rolling thread between the worm gear and the rack. The worm gear is supported by a worm gear thrust bearing preload and two conical worm gear thrust bearing races at the lower end, and stub shaft bearing in the stub shaft adjuster at the upper end. When the worm gear is turned right, the rack moves up in gear. Turning the worm gear left moves the rack down in gear. The rack teeth mesh with the sector, which is part of the pitman shaft. Turning the worm gear turns the pitman shaft, which turns the wheels through the linkage. The control valve in the steering gear directs the fluid to either side of the rack. The rack converts the hydraulic pressure into a mechanical force. If the power steering system becomes damaged and loses hydraulic pressure, the vehicle can be controlled manually. Refer to SECTION 3B1A for more information.

3B-2 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE



- | | |
|--|--|
| 1 PUMP, POWER STEERING | 30 BOLT/SCREW, STEERING GEAR |
| 2 PULLEY, POWER STEERING PUMP | 80 BOLT/SCREW, POWER STEERING RESERVOIR HOSE CLAMP |
| 3 HOSE, POWER STEERING GEAR INLET | 89 RESERVOIR, POWER STEERING FLUID |
| 4 SWITCH, IDLE SPEED CONTROL POWER STEERING PRESSURE | 90 HOSE, POWER STEERING FLUID RESERVOIR |
| 5 GEAR, POWER STEERING | 103 BOLT/SCREW, INTERMEDIATE STEERING SHAFT |
| 6 HOSE, POWER STEERING GEAR OUTLET | 104 COUPLING, STEERING GEAR |
| 7 CLAMP, POWER STEERING FLUID RESERVOIR HOSE | 105 ARM, PITMAN |
| 14 SEAL, POWER STEERING GEAR PIPE FITTING | 106 NUT, PITMAN ARM |
| 15 WASHER, STEERING GEAR | 107 WASHER, PITMAN ARM |
| 16 BOLT/SCREW, STEERING LINKAGE IDLER ARM | |
| 17 NUT, STEERING LINKAGE IDLER ARM | |

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Figure 1 - Power Steering System

POWER STEERING PUMP

A constant displacement vane type pump provides hydraulic pressure for the power steering system. The pump is located on the engine and is belt driven by the engine vibration dampener.

The major components of the pump are the shaft, housing, ring, pressure plate, thrust plate, flow control valve, rotor, and vane. The reservoir cap has a fluid level indicator attached to show the fluid level in the fluid reservoir. There are two bore openings at the rear of the housing. The larger opening contains the ring, pressure plate, thrust plate, rotor, vane and end plate. The smaller opening contains the flow control valve seal (O-ring), valve and spring. The flow control orifice is used to calibrate the amount of fluid flow for specific applications. The pressure relief valve inside the flow control valve limits the pressure.

SEAL REPLACEMENT

Steering Gear Pitman Shaft Seal

Pitman shaft seals, which seal the pitman shaft of the gear, require special treatment. When leakage occurs in this area, always replace the pitman shaft seals, after inspecting and thoroughly cleaning the sealing surfaces. Replace the pitman shaft if pitting is found. If corrosion in the pitman shaft seal contact zone is slight, clean the surface of the pitman shaft with crocus cloth. Replace the pitman shaft only if leakage cannot be stopped by smoothing with crocus cloth first.

O-Ring Seals

Whenever a part which forms a sealing surface for an O-ring seal is removed, the O-ring seal should also be removed and replaced with a new O-ring seal. Lubricate all new O-ring seals with fluid to ease assembly.

ON-VEHICLE SERVICE

CHECKING AND ADDING POWER STEERING FLUID

Figure 2

Fluid level is indicated by marks on a fluid level indicator on the fluid reservoir cap (12).

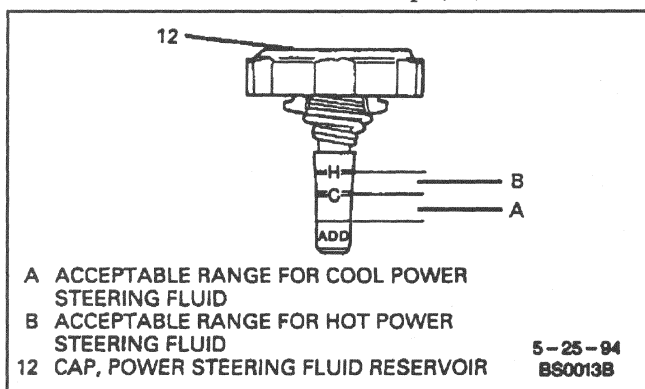


Figure 2 - Checking Power Steering Fluid Level

NOTICE: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to "Power Steering Fluid Recommendations" in this section.

If the fluid is warmed up, about 77° C (170° F) -hot to the touch, the fluid level should be between the "H" mark and the "C" mark. If the fluid is cool, about 21° C (70° F), the fluid level should be between the "C" mark and the line just below the "C" mark.

POWER STEERING FLUID REPLACEMENT

The fluid replacement procedure is a two-stage process: first, flushing the old fluid from the system with new fluid; and second, bleeding the system to remove trapped air. The following two sequences outline the steps in each procedure.

FLUSHING THE POWER STEERING SYSTEM

NOTICE: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to "Power Steering Fluid Recommendations" in this section.

1. Raise and suitably support front of vehicle off ground until wheels are free to turn. Refer to SECTION 0A.
2. Siphon fluid from reservoir, disconnect power steering gear outlet hose from the reservoir and plug the reservoir.
 - Position power steering gear outlet hose toward large container to catch draining fluid.
3. While an assistant is filling fluid reservoir with either standard fluid or optional cold climate fluid, start and run engine at idle.

NOTICE: Do not hold the steering wheel against stops while flushing the system. Holding steering wheel against stops will cause high power steering system pressure, overheating, and damage to the power steering pump and/or power steering gear.

4. Turn steering wheel from stop to stop.
5. Continue draining until all of old fluid is cleared from power steering system. Addition of approximately 0.94 liters (1 quart) of new fluid will be required to flush system.



Inspect

- Draining fluid while refilling fluid reservoir.



Important

- Do not reuse any drained fluid.

3B-4 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE

6. Remove plug from the reservoir and connect power steering gear outlet hose.
7. Turn engine off and fill fluid reservoir to "C" mark. Continue with following procedure "Bleeding the Power Steering System."

BLEEDING AIR FROM POWER STEERING SYSTEM

Figure 3

Refer to Figure 3 for recommended steering system bleed procedure.

NOTICE: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to "Power Steering Fluid Recommendations" in this section.

NOTICE: If the system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

POWER STEERING DRIVE BELT

The pump is driven by a drive belt. No adjustment of the drive belt is required. To remove or install the drive belt, refer to "Serpentine Drive Belt and Tensioner" in SECTION 6A4A.

POWER STEERING PUMP PULLEY

Figure 4

Tools Required:

- J 25034-B Power Steering Pump Pulley Remover
- J 25033-B Power Steering Pump Pulley Installer

Remove or Disconnect

1. Fan blade and clutch, if equipped with mechanical fan. Refer to SECTION 6B.
2. Radiator outlet hose, if equipped with mechanical fan. Refer to SECTION 6B.
3. Serpentine drive belt from power steering pump pulley. Refer to SECTION 6A4A.
4. Pulley (2) from pump using J 25034-B.

Install or Connect

1. Pulley (2) to pump using J 25033-B.
 - Face of pulley hub must be flush with end of pulley shaft.
2. Serpentine drive belt to power steering pump pulley. Refer to SECTION 6A4A.
3. Radiator outlet hose, if removed. Refer to SECTION 6B.
4. Fan blade and clutch, if removed. Refer to SECTION 6B.

IDLE SPEED CONTROL POWER STEERING PRESSURE SWITCH

Figure 1

Remove or Disconnect

1. Electrical connection from pressure switch (4).
2. Place drain pan under gear (5).
3. Pressure switch (4) from inlet hose (3).

Install or Connect

NOTICE: Refer to "Notice" on page 3B-1 of this section.

1. Use power steering fluid to lightly coat threads of pressure switch (4) past O-ring seal.
2. Pressure switch (4) to inlet hose (3).

Tighten

- Pressure switch (4) to 13 N.m (115 lb. in.).
3. Electrical connection to pressure switch (4).
 4. Fill Power Steering Fluid Reservoir.
 5. Bleed power steering system. Refer to "Bleeding the Power Steering System" in this section.

HYDRAULIC PUMP FLOW CONTROL VALVE

Figure 5

Remove or Disconnect

1. Power steering pump. Refer to "Power Steering Pump" in this section.
2. Fitting (8) and O-Ring seal (9), on vehicles without variable effort steering.
3. Solenoid actuator and discharge fitting on vehicles with variable effort steering. Refer to SECTION 3B5.
4. Flow control valve (10) and spring (11) from pump (1), using magnet.

NOTICE: Do not disassemble the flow control valve.

Inspect

- Flow control valve (10) for free movement within housing bore.
 - A. If sticking occurs, check for burrs and clean as necessary.
 - B. If necessary, replace flow control valve (10).

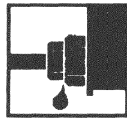
Bleeding Air from Power Steering Systems

Before bleeding: Inspect steering system. Check, and correct as needed:



Hoses must not touch any other part of vehicle.

- Steering system noise could be caused by hose touching frame, body, or engine



All hose connections must be tight.

- Loose connections might not leak but could allow air into system

When to bleed:

After any component replacement
After disconnecting fluid line
In case of steering system noise

Why bleed?

To prevent pump damage
To ensure proper system operation
To stop steering system noise

Power Steering Fluid

Use only clean, new power steering fluid. Fluid must be

Conventional Climate

GM #1052884 - 16 ounce

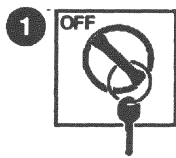
#1050017 - 32 ounce

Cold Climate

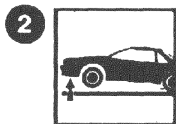
GM #12345866 - 16 ounce

#12345867 - 32 ounce

How to bleed:



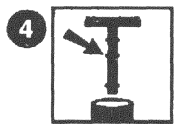
Switch ignition off.



Raise front wheels off ground.



Turn steering wheel full left.



Fill fluid reservoir to "FULL COLD" level. Leave cap off.



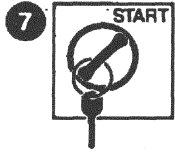
With assistant checking fluid level and condition, turn steering wheel lock-to-lock at least 20 times. Engine remains off.

- On systems with long return lines or fluid coolers, turn steering wheel lock-to-lock at least 40 times
- Trapped air may cause fluid to overflow. Thoroughly clean any spilled fluid to allow for leak check
- Keep fluid level at "FULL COLD"

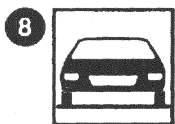


While turning wheel, check fluid constantly.

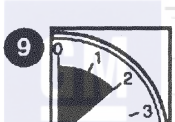
- No bubbles are allowed
- For any sign of bubbles, recheck connections. Repeat step 5.



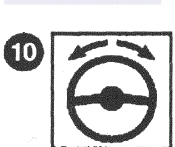
Start engine. With engine idling, maintain fluid level. Reinstall cap.



Return wheels to center. Lower front wheels to ground.



Keep engine running for two minutes.



Turn steering wheel in both directions.

Verify

- ☒ Smooth power assist
- ☒ Noiseless operation
- ☒ Proper fluid level
- ☒ No system leaks
- ☒ Proper fluid condition
- No bubbles, no foam, no discoloration

11 If all proper conditions apply, procedure is complete.

12 If any problem remains, see "Special Conditions"

Special Conditions:

Fluid



- Foam or bubbles in fluid
Fluid must be completely free of bubbles. In step 5, be alert to periodic bubbles that could indicate a loose connection or leak. O-ring seal in either the return hose or pressure hose.
- Discolored fluid (milky, opaque, or light tan color)

Switch ignition off. Wait two minutes. Recheck hose connections. Repeat steps 7-10. If condition still exists, replace and check a possible cause.

- ☒ Return hose clamps
- ☒ Return hose O-ring
- ☒ Pressure hose O-rings
- ☒ Gear cylinder line O-rings

Fill system and repeat bleed procedure for each possible cause. Repeat steps 7-10 to verify whether noise has been eliminated.

Noise



- Pump whine or groan
With engine running, recheck hoses for possible contact with frame body or engine. If no contact is found, follow either method below to cool down fluid and repressurize system.

Method 1: Normal Cool Down

Switch engine off.
Wait for system to cool.
Install reservoir cap.

Method 2: Partial Fluid Replacement

Switch engine off.
Use a suction device to remove fluid from reservoir.
Refill with cool, clean fluid.
Install reservoir cap.

After either method of cooling, start engine and allow engine to come up to operating temperature. If noise persists, remove and replace power steering pump. Repeat bleed procedure following pump replacement.

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Figure 3 - Bleeding Air from Power Steering System

3B-6 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE

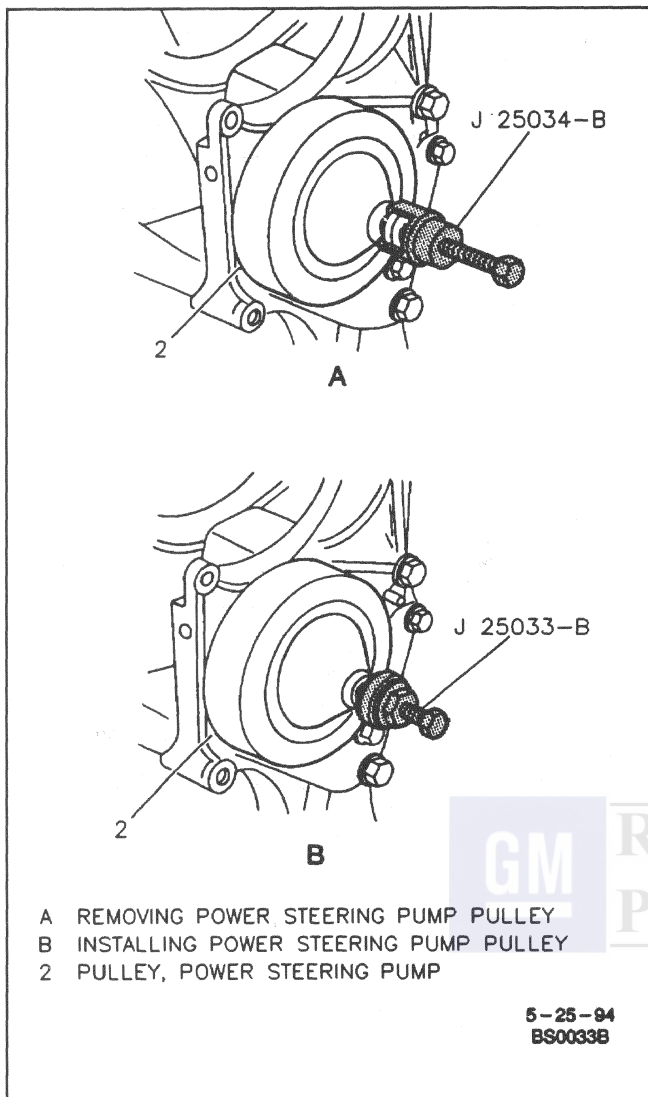


Figure 4 - Removing and Installing Power Steering Pump Pulley

Install or Connect

NOTICE: Refer to “Notice” on page 3B-1 of this section.

1. Flow control valve spring (11) and flow control valve (10) to pump (1).
2. New O-ring seal (9) to fitting (8) on vehicles without variable effort steering
 - Lubricate O-Ring seal (9) with power steering fluid.
3. Fitting (8) and O-Ring seal (9), if equipped, to pump (1)

Tighten

- Fitting (8) to 75 N·m (55 lb. ft.).
4. Solenoid actuator and discharge fitting on vehicles equipped with variable effort steering. Refer to SECTION 3B5.

5. Power steering pump. Refer to “Power Steering Pump” in this section.
6. Fill fluid reservoir with fluid.
7. Bleed system. Refer to “Bleeding Air from Power Steering System” in this section.

POWER STEERING GEAR INLET AND OUTLET HOSES

Figures 5, 6, 7 and 8

Remove or Disconnect

1. Power steering fluid.
 - Siphon power steering fluid from reservoir (89) to prevent excessive spillage.
2. Power steering gear outlet hose (6) from reservoir (89).
 - A. Squeeze clamp (8) and slide downward.
 - B. Rotate and slide hose (6) from reservoir (89).
3. Power steering gear inlet hose (3) from power steering pump (1).
4. Secondary air injection reaction pump. Refer to SECTION 6E3.
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Electrical connector from switch (4).
7. Power steering gear inlet and outlet hoses (3 and 6) from gear (5).
 - Slide steering gear shield rearward, away from outlet hose (6) to provide access to inlet and outlet hose (3 and 6) fittings.
8. Hose clamp bolts/screws (9).
9. Power steering gear inlet and outlet hose (3 and 6) with hose clamps (13) attached, from vehicle.
10. Hose clamps (13) from power steering gear inlet and outlet hoses (3 and 6).

Install or Connect

NOTICE: Refer to “Notice” on page 3B-1 of this section.

Important

- Always replace O-ring seals whenever hoses (3 and 6) are disconnected from gear (5) or pump (1).
1. Hose clamps (13) to power steering gear inlet and outlet hoses (3 and 6).
 2. Power steering gear inlet and outlet hoses (3 and 6) with hose clamps (13) attached, to vehicle.
 3. Hose clamp bolts/screws (9).

Tighten

- Bolts/screws (9) to 5 N·m (44 lb. in.).
4. Power steering gear inlet and outlet hoses (3 and 6) to gear (5) with new O-ring seals on the fittings.

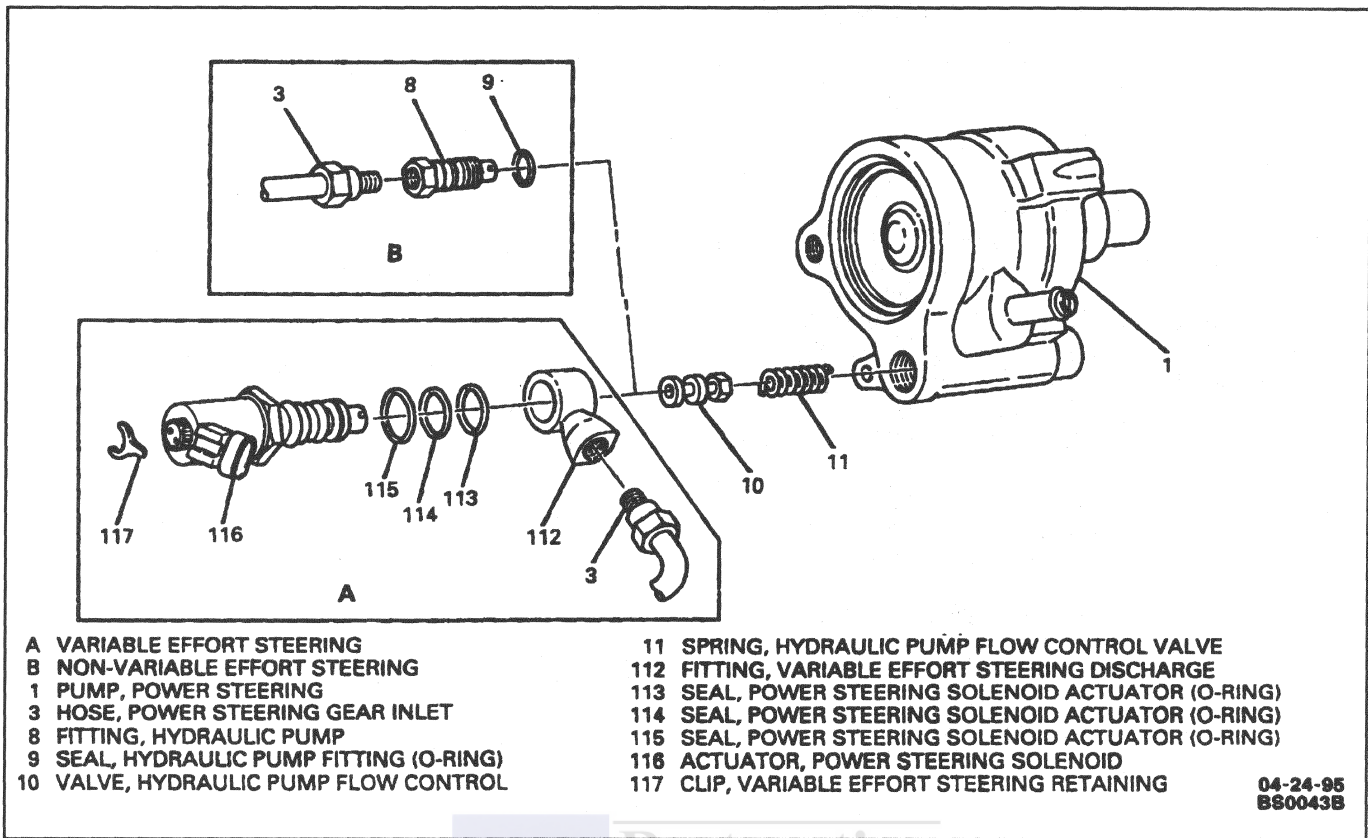


Figure 5 - Hydraulic Pump Flow Control Valve



Tighten

- Power steering gear inlet and outlet hose fittings to 28 N·m (21 lb. ft.).
- Slide steering gear shield forward, onto outlet hose (6), after fittings are tightened.

5. Electrical connector to switch (4).



Tighten

- Idle speed control power steering pressure switch fitting to 13 N·m (115 lb. in.).

6. Lower vehicle.

7. Secondary air injection reaction pump. Refer to SECTION 6E3.

8. Power steering gear inlet hose (3) to power steering pump (1).

- Make sure power steering gear inlet hose insulator is just resting on air conditioning compressor as fitting is tightened.



Tighten

- Power steering gear inlet hose fitting to 28 N·m (21 lb. ft.).

9. Power steering gear outlet hose (6) to reservoir (89).

- A. Rotate and slide hose (6) onto reservoir (89).
- B. Squeeze clamp (8) and slide upward into position.

10. Fill reservoir (89) with power steering fluid.

11. Bleed power steering system. Refer to "Bleeding Air from Power Steering System" in this section.

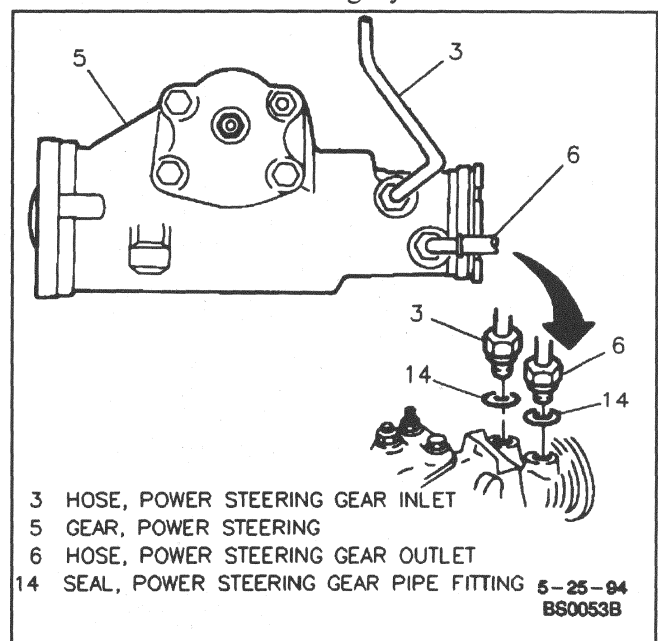


Figure 6 - Power Steering Gear Connections

3B-8 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE

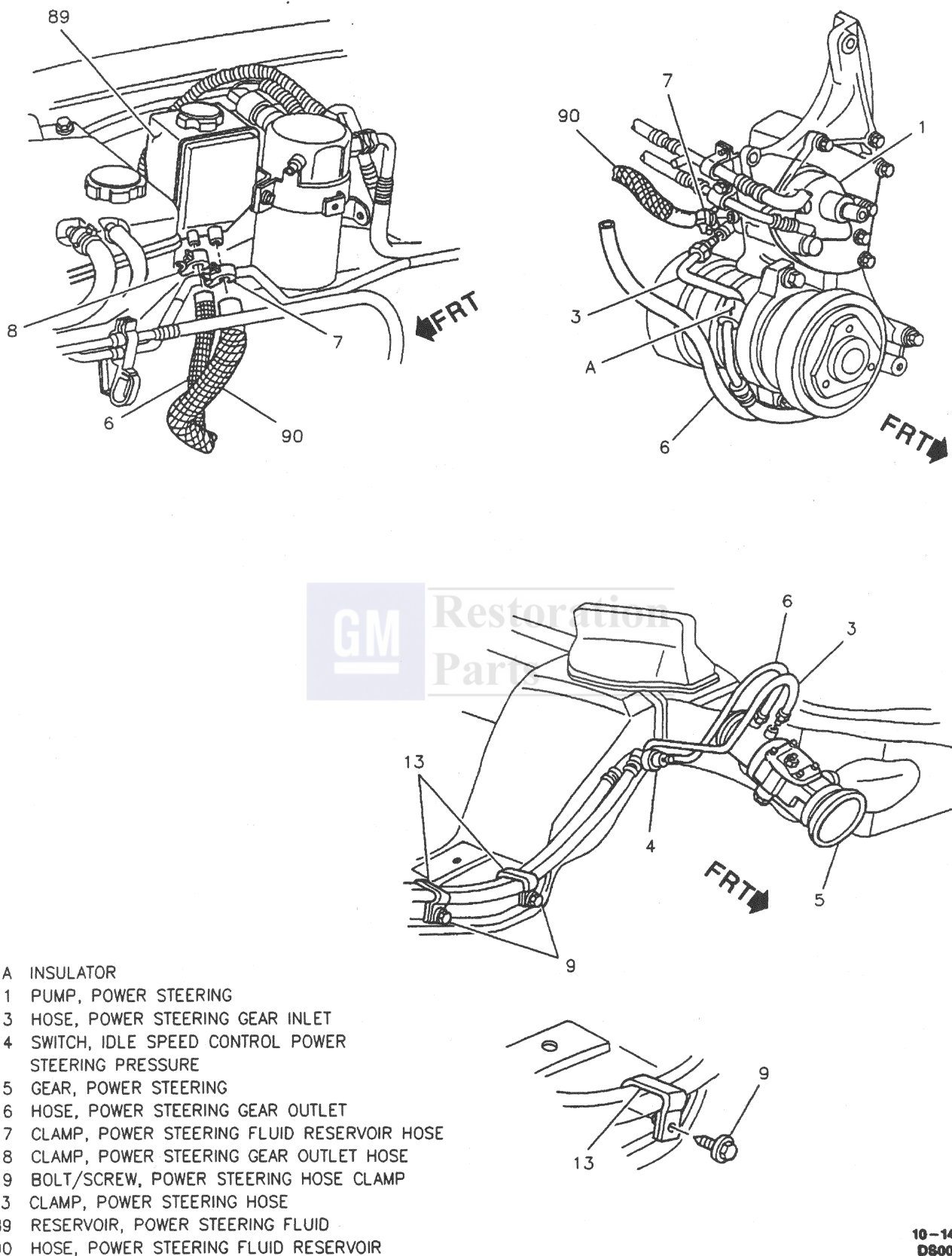


Figure 7 - Power Steering Gear Inlet and Outlet Hoses

POWER STEERING FLUID RESERVOIR

Figure 8

Remove or Disconnect

1. Power steering fluid.
 - A. Place drain pan under reservoir (89).
 - B. Siphon fluid from reservoir (89) to prevent excessive spillage.
2. Clamps (83 and 95).
3. Both hose ends from reservoir ports.
4. Rock and pull reservoir (89) from air conditioner accumulator bracket tang.

Install or Connect

1. Reservoir (89).
 - A. Place reservoir (89) to air conditioning accumulator bracket tang.
 - B. Push down on reservoir (89) to fully engage tangs.
2. Both hose ends to reservoir ports.
3. Clamps (83 and 95).
4. Remove drain pan.
5. Fill fluid reservoir (89) with fluid.
6. Bleed system. Refer to "Bleeding Air from Power Steering System" in this section.

POWER STEERING FLUID COOLER REPLACEMENT

POLICE VEHICLES ONLY

Figure 9

Remove or Disconnect

1. Power steering fluid.
 - A. Place a drain pan under reservoir (89) and gear (5).
 - B. Siphon fluid from reservoir (89) to prevent excessive spillage.
2. End of fluid cooler (87) from hose (6).
3. Fluid cooler fitting from gear (5).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Bolts/screws (84).
6. Clips (88).
7. Fluid cooler (87).
8. Nuts (97), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 3B-1 of this section.

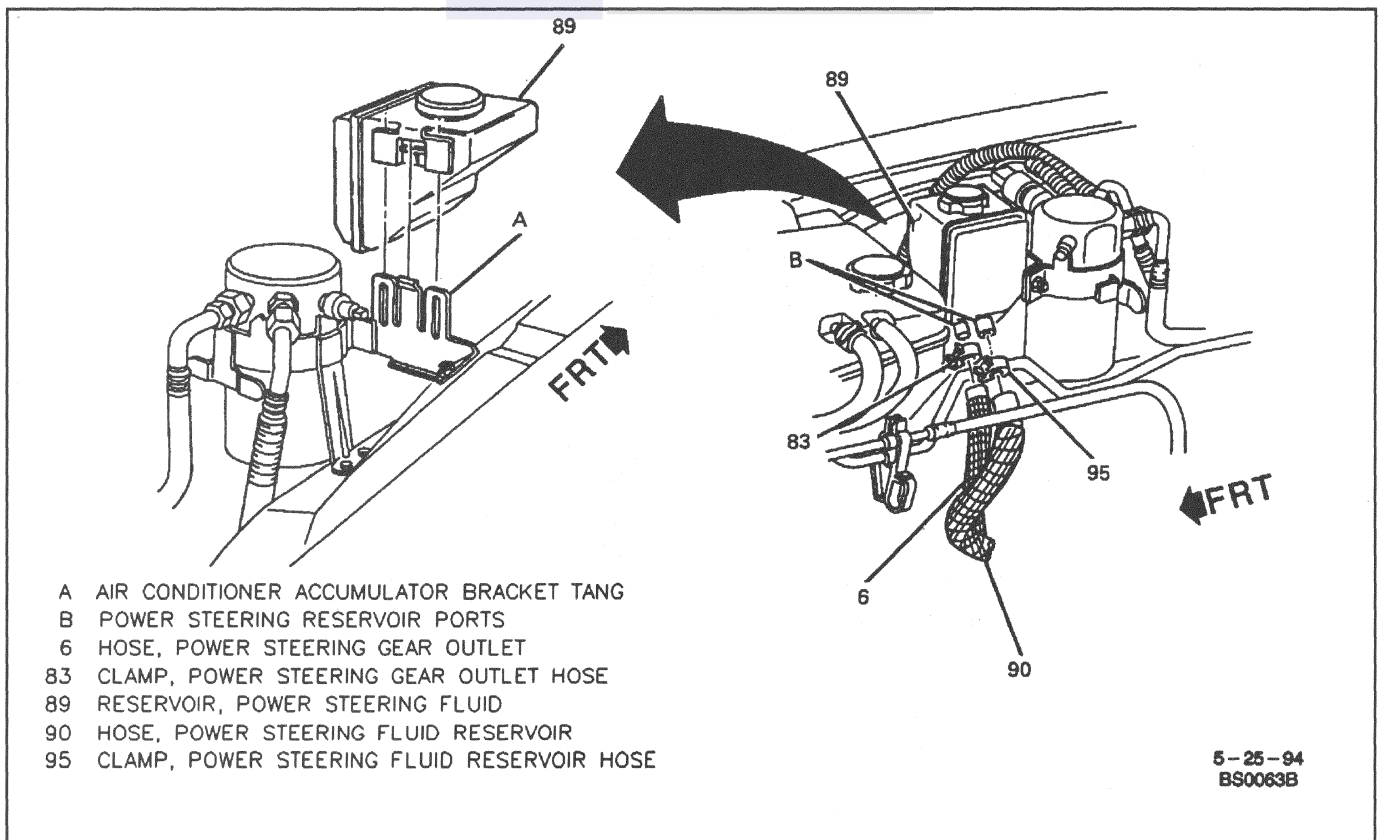


Figure 8 - Power Steering Fluid Reservoir

3B-10 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE

Install or Connect

1. Nuts (97), if removed.
2. Fluid cooler (87).
3. Clips (88).
4. Bolts/screws (84).

Tighten

- Bolts/screws (84) to 10 N.m (89 lb. in.).
5. Lower vehicle.
 6. Fluid cooler fitting to gear (5).

Tighten

- Fluid cooler fitting to 28 N.m (21 lb. ft.).
7. End of fluid cooler (87) to hose (6).
 8. Fill power steering fluid reservoir (89).
 9. Bleed system. refer to "Bleeding the Power Steering System" in this section.

POWER STEERING PUMP

Figures 7 and 10

Remove or Disconnect

1. Power steering fluid.
 - Siphon power steering fluid from reservoir (89) to prevent excessive spillage.
2. Drain engine cooling system. Refer to SECTION 6B.

3. Engine cooling fan pulley bracket, if vehicle is equipped with mechanical fan. Refer to SECTION 6B.
4. Heater inlet and outlet hoses from water pump.
5. Heater inlet and outlet hose clip bolt/screw from generator and power steering pump bracket (94).
 - Position heater inlet and outlet hoses up and out of the way to prevent coolant spillage.
6. Drive belt from power steering pump pulley. Refer to SECTION 6A4A.
7. Power steering gear inlet hose (3) from power steering pump (1).
8. Power steering fluid reservoir hose (90) from power steering pump (1).
 - A. Squeeze clamp (7) and slide away from power steering pump (1).
 - B. Rotate and slide hose (90) away from power steering pump (1).
9. Pump bracket bolts/screws (24) and generator bracket bolt/screw (25).
10. Power steering pump (1) with pump pulley (2).
11. Pump pulley from power steering pump. Refer to "Power Steering Pump Pulley" in this section.
12. Power steering pump bolts/screws (96) and bracket (93), if necessary.

Important

- To service power steering solenoid actuator, discharge, fitting and flow control valve, refer to SECTION 3B5.

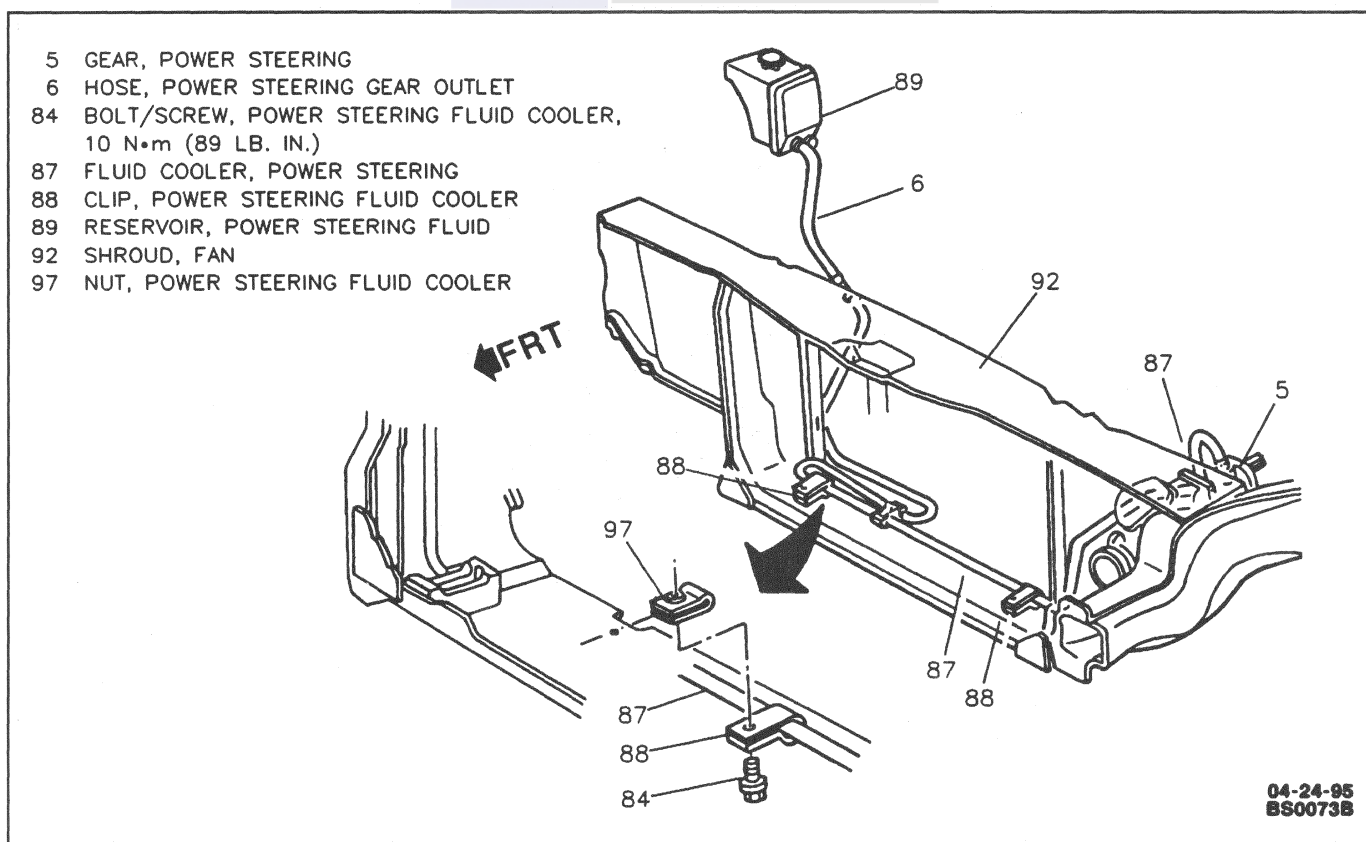


Figure 9 - Power Steering Fluid Cooler (Police Vehicles Only)

Install or Connect

NOTICE: Refer to "Notice" on page 3B-1 of this section.

1. Power steering pump bracket (93) and bolts/screws (96), if removed.

Tighten

- Power steering pump bolts/screws (96) to 50 N.m (37 lb. ft.).
2. Pump pulley to power steering pump. Refer to "Power Steering Pump Pulley" in this section.
 3. Power steering pump (1) with pump pulley (2).
 4. Generator bracket bolt/screw (25) and pump bracket bolts/screws (24).

Tighten

- Pump bracket bolts/screws (24) to 41 N.m (30 lb. ft.).
 - Generator bracket bolt/screw (25) to 50 N.m (37 lb. ft.).
5. Power steering fluid reservoir hose (90) to power steering pump (1).
 - A. Rotate and slide hose (90) onto power steering pump (1).
 - B. Squeeze clamp (7) and slide toward power steering pump (1).

6. Power steering gear inlet hose (3) to power steering pump (1) with new O-ring seal on fitting.

Tighten

- Power steering gear inlet hose fitting to 28 N.m (21 lb. ft.).
7. Drive belt to power steering pump pulley. Refer to SECTION 6A4A.
 8. Heater inlet and outlet hose clip bolt/screw to generator and power steering pump bracket (94).

Tighten

- Heater inlet and outlet hose clip bolt/screw to 1.9 N.m (17 lb. in.).
9. Heater inlet and outlet hoses to water pump.
 10. Engine cooling fan pulley bracket, if vehicle is equipped with mechanical fan. Refer to SECTION 6B.

Important

- Do not start engine until after power steering system has been bled.
11. Refill power steering fluid reservoir (89).
 12. Refill engine cooling system. Refer to SECTION 6B.
 13. Bleed power steering system. Refer to "Bleeding Air from Power Steering System" in this section.
 14. Bleed engine cooling system. Refer to SECTION 6B.

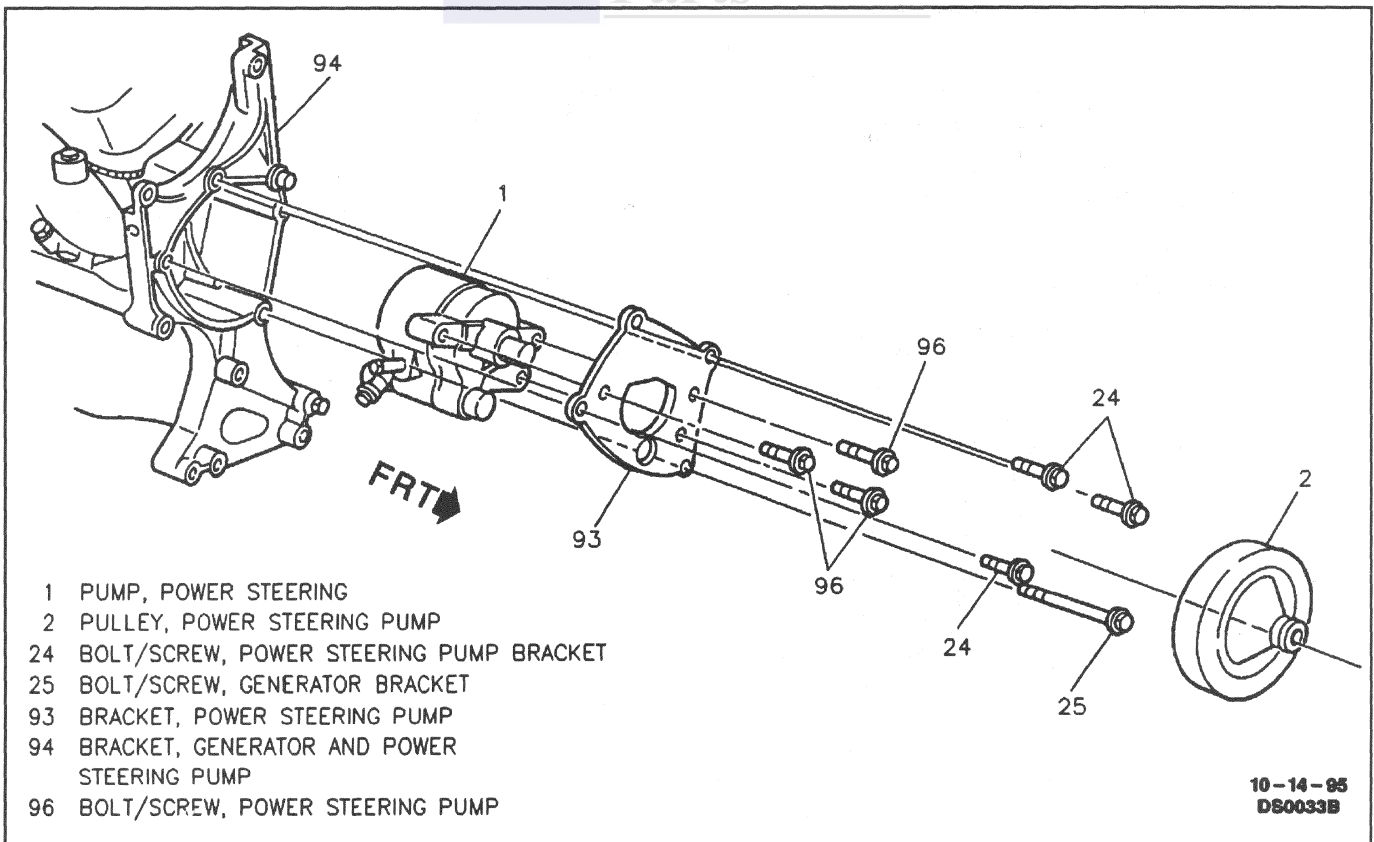


Figure 10 - Power Steering Pump

POWER STEERING GEAR

Figure 11

Remove or Disconnect

1. Power steering fluid.
 - A. Place drain pan under gear (5).
 - B. Siphon fluid from reservoir to prevent excessive spillage.
2. Intermediate shaft from power steering gear. Refer to SECTION 3F.
3. Brake modulator valve bracket nut from gear (5).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Pitman arm from power steering gear. Refer to SECTION 3B3.
6. Inlet and outlet hoses from gear (5).
 - Raise hoses to prevent fluid drainage.
7. Bolts/screws (30), washers (29) and gear (5).

Install or Connect

NOTICE: Refer to "Notice" on page 3B-1 of this section.

1. Position gear (5) to frame.
2. Washers (29) and bolts/screws (30) loosely.

Adjust

- Gear (5) so that it aligns as straight as possible with intermediate shaft.

Tighten

- Bolts/screws (30) to 85 N.m (63 lb. ft.).
3. Inlet and outlet hoses to gear (5).

Tighten

- Hose fittings to 28 N.m (21 lb. ft.).

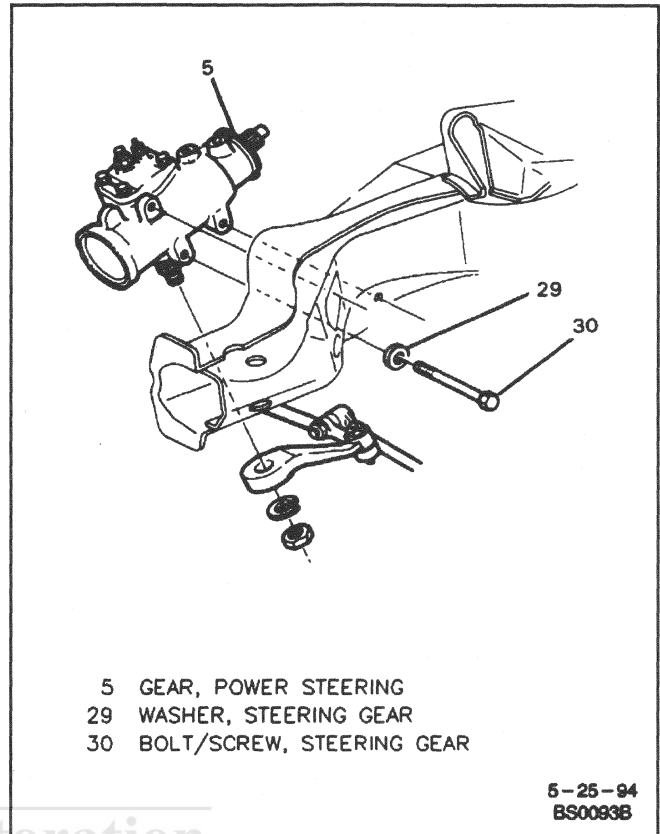


Figure 11 - Mounting Power Steering Gear

4. Pitman arm to power steering gear. Refer to SECTION 3B3.
5. Lower vehicle.
6. Brake modulator valve bracket nut to gear (5).

Tighten

- Valve bracket nut to 24 N.m (18 lb. ft.).
7. Intermediate shaft to power steering gear (5). Refer to SECTION 3F.
 8. Remove drain pan.
 9. Fill power steering fluid reservoir.
 10. Bleed system. Refer to "Bleeding Air from Power Steering System" in this section.

STEERING GEAR PITMAN SHAFT SEALS**Figures 12 and 13**

Tools Required:

J 4245 Internal Snap Ring Pliers

J 6219 Pitman Shaft Oil Seal Installer

**Remove or Disconnect**

1. Pitman arm from power steering gear. Refer to SECTION 3B3.

**Clean**

- Exposed end of shaft (53) and housing (54).
2. Retainer ring (35) using J 4245.
 3. Place drain pan under shaft (53).
 4. Washer (34) and seal (33).
 5. Start engine and turn wheels fully to left to force out pitman shaft seals and pitman shaft washers.
 6. Turn engine off.
 7. Washer (32) and seal (31).

**Inspect**

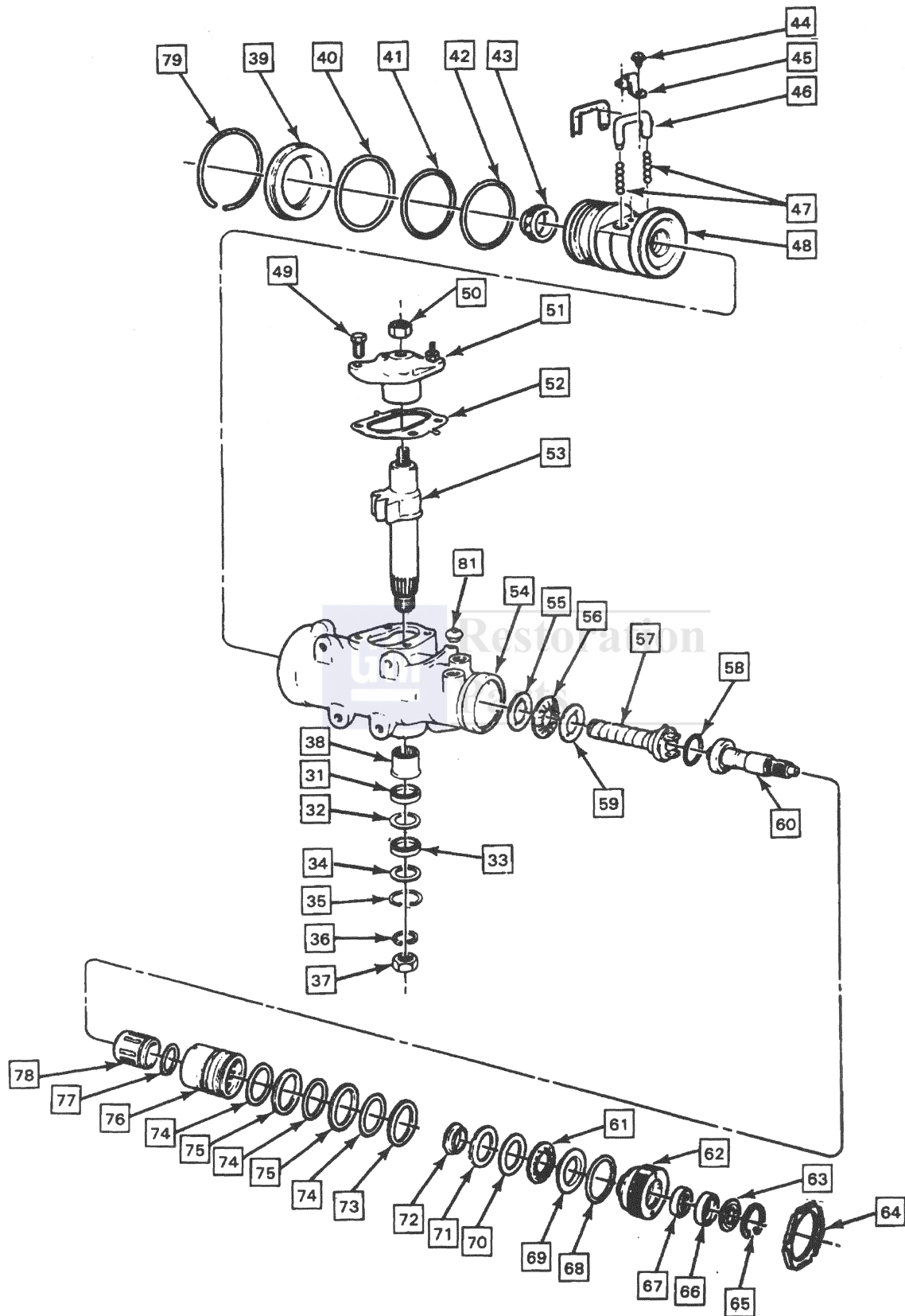
- Pitman shaft seal surfaces for roughness or pitting. If pitted, replace power steering gear.
- Housing (54) for burrs. Remove burrs before installing new pitman shaft seals.

**Install or Connect**

1. Seal (31) and washer (32).
2. Coat seal (33) and washer (34) with grease.
3. Seal (33) using J 6219.
4. Washer (34).
5. Retainer ring (35) using J 4245.
6. Pitman arm to power steering gear. Refer to SECTION 3B3.
7. Remove drain pan.
8. Fill power steering fluid reservoir.
9. Bleed system. Refer to "Bleeding Air from Power Steering System" in this section.



3B-14 POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE



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Figure 12 - Power Steering Gear

- | | |
|--|---|
| 31 SEAL, STEERING GEAR PITMAN SHAFT | 56 BEARING, STEERING GEAR WORM GEAR THRUST |
| 32 WASHER, STEERING GEAR PITMAN SHAFT | 57 GEAR, STEERING GEAR WORM |
| 33 SEAL, STEERING GEAR PITMAN SHAFT | 58 SEAL, STEERING GEAR STUB SHAFT (O-RING) |
| 34 WASHER, STEERING GEAR PITMAN SHAFT | 59 RACE, STEERING GEAR WORM GEAR THRUST BEARING |
| 35 RING, STEERING GEAR PITMAN SHAFT SEAL RETAINER | 60 SHAFT, STEERING GEAR STUB |
| 36 WASHER, PITMAN ARM | 61 BEARING, STEERING GEAR VALVE THRUST |
| 37 NUT, PITMAN ARM | 62 ADJUSTER, STEERING GEAR STUB SHAFT |
| 38 BEARING, STEERING GEAR PITMAN SHAFT | 63 SEAL, STEERING GEAR STUB SHAFT ADJUST (O-RING) |
| 39 PLUG, STEERING GEAR HOUSING | 64 NUT, STEERING GEAR STUB SHAFT ADJUST |
| 40 SEAL, STEERING GEAR HOUSING PLUG (O-RING) | 65 RING, STEERING GEAR STUB SHAFT SEAL RETAINER |
| 41 RING, STEERING GEAR RACK | 66 SEAL, STEERING GEAR STUB SHAFT |
| 42 SEAL, STEERING GEAR RACK (O-RING) | 67 BEARING, STEERING GEAR STUB SHAFT |
| 43 PLUG, STEERING GEAR RACK | 68 SEAL, STEERING GEAR STUB SHAFT ADJUST (O-RING) |
| 44 BOLT/SCREW, STEERING GEAR BALL RETURN GUIDE CLAMP | 69 RACE, STEERING GEAR VALVE THRUST BEARING |
| 45 CLAMP, STEERING GEAR BALL RETURN GUIDE | 70 RACE, STEERING GEAR VALVE THRUST BEARING |
| 46 GUIDE, STEERING GEAR BALL RETURN | 71 SPACER, STEERING GEAR VALVE THRUST BEARING |
| 47 BALL, STEERING GEAR | 72 RETAINER, STEERING GEAR STUB SHAFT ADJUST |
| 48 RACK, STEERING GEAR | 73 SEAL, STEERING GEAR VALVE BODY (O-RING) |
| 49 BOLT/SCREW, STEERING GEAR HOUSING COVER | 74 RING, STEERING GEAR VALVE BODY |
| 50 NUT, STEERING GEAR PITMAN SHAFT ADJUST | 75 SEAL, STEERING GEAR VALVE BODY (O-RING) |
| 51 COVER, STEERING GEAR HOUSING | 76 BODY, STEERING GEAR VALVE |
| 52 GASKET, STEERING GEAR HOUSING COVER | 77 SEAL, STEERING GEAR VALVE SPOOL (O-RING) |
| 53 SHAFT, STEERING GEAR PITMAN (WITH GEAR) | 78 SPOOL, STEERING GEAR VALVE |
| 54 HOUSING, STEERING GEAR | 79 RING, RETAINING |
| 55 RACE, STEERING GEAR WORM GEAR THRUST BEARING | 81 VALVE, CHECK |

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Figure 13 - Power Steering Gear - Legend



SPECIFICATIONS

POWER STEERING FLUID RECOMMENDATIONS

Warm Climate

Power Steering Fluid Requirement GM Power Steering Fluid P/N 1050017 or 1052884, or equivalent meeting GM Specification 9985010

Cold Climate

Power Steering Fluid Requirement GM Power Steering Fluid P/N 12345867 or 12345866 (System should be drained and refilled prior to using this fluid.)

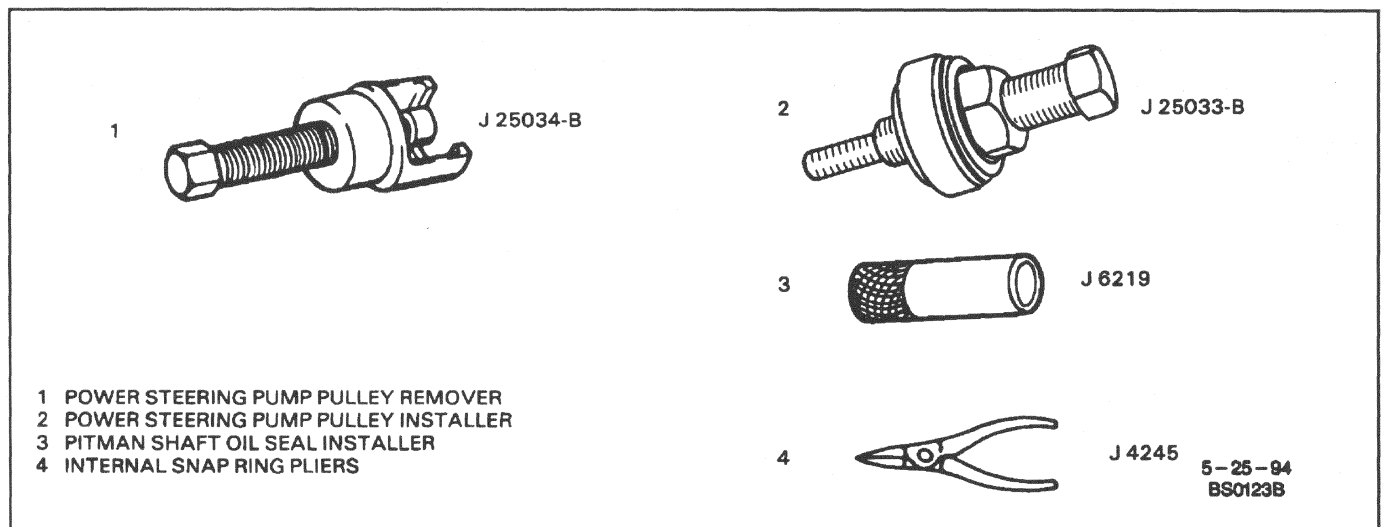
FITTING TIGHTENING SPECIFICATIONS

Hydraulic Pump Fitting-to-Power Steering Pump.....	75 N.m (55 lb. ft.)
Idle Speed Control Power Steering Pressure Switch.....	13 N.m (115 lb. in.)
Power Steering Gear Inlet Hose Fitting-to-Power Steering Gear	28 N.m (21 lb. ft.)
Power Steering Gear Inlet Hose Fitting-to-Power Steering Pump.....	28 N.m (21 lb. ft.)
Power Steering Gear Inlet Hose-to-Variable Effort Steering Discharge Fitting	28 N.m (21 lb. ft.)
Power Steering Gear Outlet Hose Fitting-to-Power Steering Gear.....	28 N.m (21 lb. ft.)
Power Steering Pump Discharge Fitting.....	75 N.m (55 lb. ft.)
Variable Effort Steering Discharge Fitting	75 N.m (55 lb. ft.)

FASTENER TIGHTENING SPECIFICATIONS

Brake Pressure Modulator Valve Bracket Nut	24 N.m (18 lb. ft.)
Generator Bracket Bolt/Screw	50 N.m (37 lb. ft.)
Heater Inlet and Outlet Hose Clip Bolt/Screw	1.9 N.m (17 lb. in.)
Hose Clamp Bolts/Screws	5 N.m (44 lb. in.)
Power Steering Fluid Cooler Bolt/Screw	10 N.m (89 lb. in.)
Power Steering Hose Clamp Bolt/Screw	5 N.m (44 lb. in.)
Power Steering Pump Bolt/Screw	50 N.m (37 lb. ft.)
Power Steering Pump Bracket Bolt/Screw	41 N.m (30 lb. ft.)
Steering Gear Bolt/Screw	85 N.m (63 lb. ft.)

SPECIAL TOOLS



SECTION 3B1A

POWER STEERING GEAR UNIT REPAIR

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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3B1A-2 POWER STEERING GEAR UNIT REPAIR

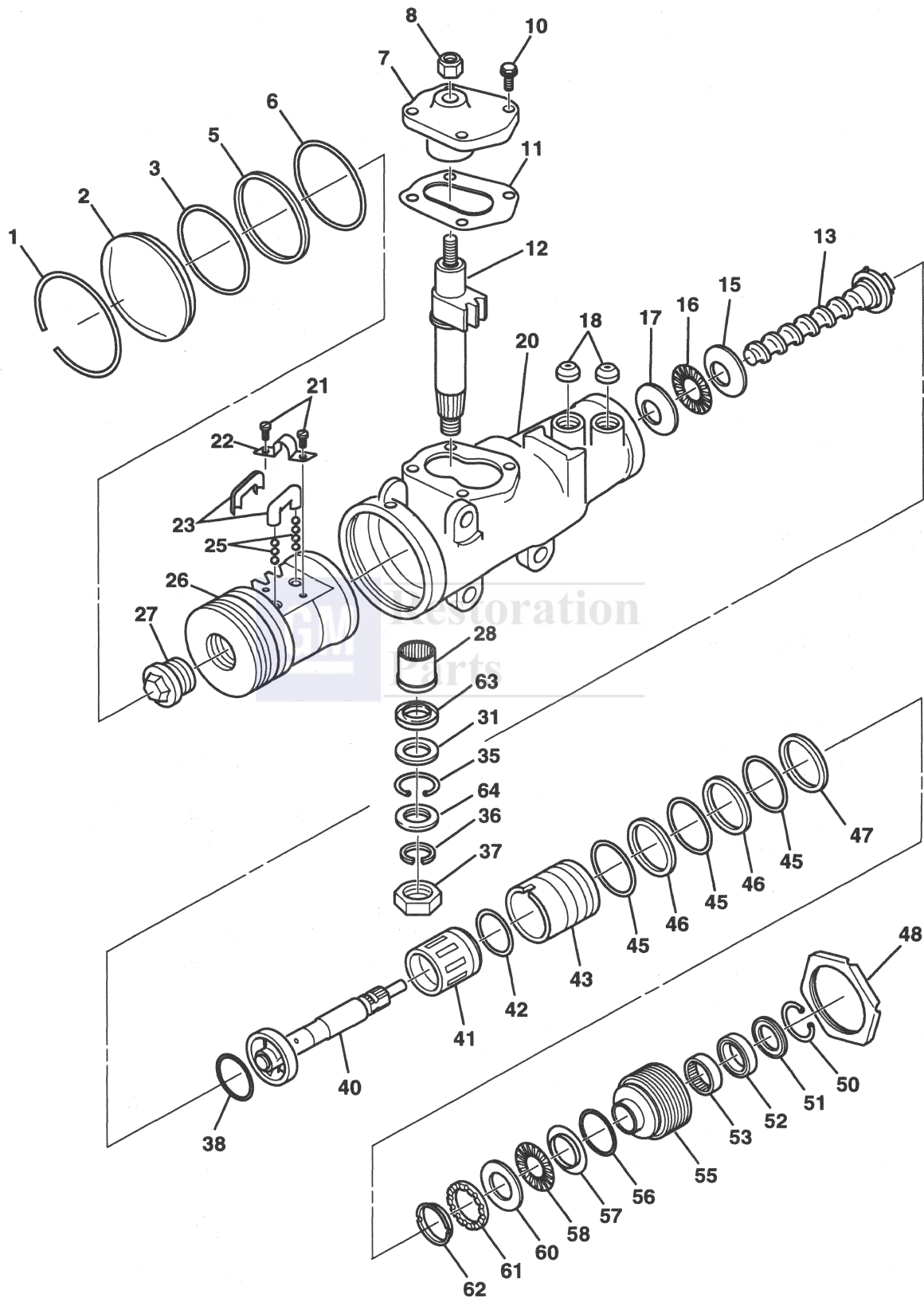


Figure 1 Power Steering Gear

Key No. Part Name

- 1 - RING, RETAINING
- 2 - PLUG
- 3 - SEAL, O-RING
- 5 - RING, TEFLON
- 6 - SEAL, O-RING
- 7 - COVER, SIDE
- 8 - NUT, ADJUSTER LOCK
- 10 - BOLT
- 11 - GASKET
- 12 - SHAFT, PITMAN
- 13 - SHAFT, WORM
- 15 - RACE
- 16 - BEARING
- 17 - RACE
- 18 - VALVE, CHECK
- 20 - HOUSING
- 21 - SCREW
- 22 - CLAMP
- 23 - GUIDE, BALL
- 25 - BALLS
- 26 - PISTON, RACK
- 27 - PLUG
- 28 - BEARING
- 35 - RING, RETAINING
- 36 - WASHER, LOCK

Key No. Part Name

- 37 - NUT
- 38 - SEAL
- 40 - SHAFT, STUB
- 41 - SPOOL, VALVE
- 42 - SEAL
- 43 - BODY, VALVE
- 45 - SEAL
- 46 - RING
- 47 - SPACER
- 48 - NUT, ADJUSTER PLUG LOCK
- 50 - RING, RETAINING
- 51 - SEAL
- 52 - SEAL
- 53 - BEARING, NEEDLE
- 55 - PLUG, ADJUSTER
- 56 - SEAL
- 57 - RACE
- 58 - BEARING
- 60 - RACE
- 61 - SPACER
- 62 - RETAINER, BEARING
- 63 - SEAL, PITMAN SHAFT
- 64 - SEAL, DUST

Figure 2 Power Steering Gear – Legend

STEERING GEAR ADJUSTMENTS

Important

- Before any adjustments are made on the steering gear, refer to “Steering, Suspension, Tires and Wheels Diagnosis” (Section 3) for reviewing the possible steering system problems. Any steering gear adjustment is made only as a correction and not as a periodic adjustment.

For proper adjustment, remove the steering gear from the vehicle. Drain the power steering fluid from the gear. Mount the gear in a vise and make the following adjustments.

The steering gear requires two adjustments:

- The worm thrust bearing preload
- The pitman shaft over-center preload adjustment

The worm thrust bearing preload is controlled by the amount of compression force exerted by the adjuster plug on the conical worm bearing thrust races.

The pitman shaft over-center preload is controlled by the pitman shaft adjuster screw, which determines the clearance between the rack piston and the pitman shaft sector teeth.

Important

- Adjust the worm thrust bearing preload first, then adjust the pitman shaft over-center preload.

WORM THRUST BEARING PRELOAD ADJUSTMENT

Figures 1 thru 6

Tool Required:

J 7624 Spanner Wrench

1. Remove steering gear from vehicle. Refer to “Power Steering Gear Replacement” in section 3B.
2. Rotate stub shaft (40) back and forth to drain power steering fluid.
3. Remove adjuster plug lock nut (48) from housing (20).

Notice: See “Notice” on page 3B1A-1 of this section.

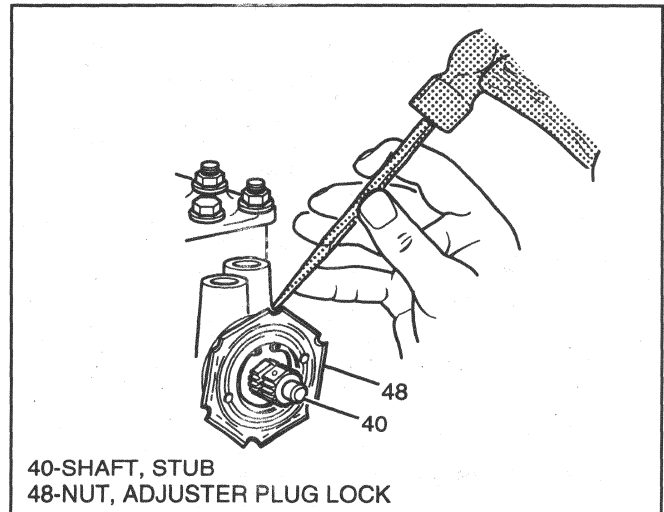


Figure 3 Loosening Adjuster Plug Nut

3B1A-4 POWER STEERING GEAR UNIT REPAIR

- Turn adjuster plug (55) in (clockwise) using J 7624 until adjuster plug (55) and thrust bearing (58) are firmly bottomed in housing (20).



Tighten

- Adjuster plug (55) to 30 N•m (22 lb. ft.).
- Place an index mark on housing (20) even with one of the holes in the adjuster plug (55).
 - Measure back counterclockwise 13 mm (1/2 inch) and place a second mark on housing (20), (see Figure 5).
 - Turn adjuster plug (55) counterclockwise until hole in adjuster plug (55) is aligned with the second mark on the housing (20) (see Figure 6).
 - Install adjuster plug lock nut (48).



Tighten

- Adjuster plug lock nut (48) to 109 N•m (80 lb. ft.) using a drift in a notch.
 - Hold adjuster plug (55) to maintain alignment of the marks.
- Install steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

PITMAN SHAFT OVER-CENTER PRELOAD ADJUSTMENT

Figures 7 thru 9

- Remove steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.
- Rotate stub shaft back and forth to drain power steering fluid.
- Loosen the adjuster lock nut (8).
- Turn the pitman shaft adjuster screw counterclockwise until fully extended, then turn clockwise 1 full turn.
- Rotate the stub shaft (40) from stop to stop, using a 12-point socket, and count the number of turns.

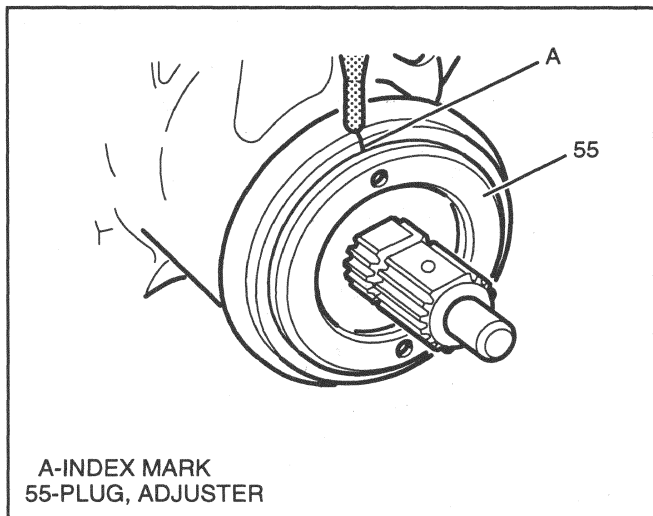


Figure 4 Marking Housing Even with Adjuster Plug

- Starting at either stop, turn the stub shaft (40) back 1/2 the total number of turns. This is the "center" of the gear.

- When the gear is centered, the flat on the stub shaft (40) should face upward and be parallel with the side cover (7) and the master spline on the pitman shaft should be in line with the adjuster screw (see Figure 8).

- Place a torque wrench on the stub shaft (40) with the handle in the vertical position. Rotate the stub shaft (40) 45 degrees each side of the center (see Figure 9).

- Stub shaft must rotate smoothly and must not stick or bind.
- Record the worm bearing preload measured on or near the center.
- Recorded bearing preload to be 0.7-1.7 N•m (6-15 lb. in.), with worm and ballnut installed. If the torque is outside this range, the gear assembly should be readjusted or repaired as required.

Notice: See "Notice" on page 3B1A-1 of this section.



Adjust

- Over-center torque by turning the pitman shaft adjuster screw clockwise until the correct preload torque is obtained.
- Add 0.7-1.1 N•m (6-10 lb. in.) torque to the previously measured worm bearing preload torque.



Tighten

- Adjuster lock nut (8) to 49 N•m (36 lb. ft.).
 - Prevent adjuster screw from turning while tightening adjuster lock nut (8).
- Install steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

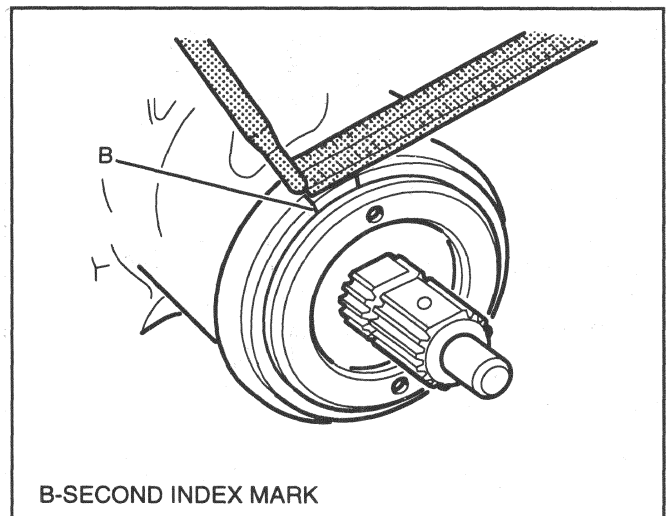


Figure 5 Remarking the Housing

STEERING GEAR SERVICE

PITMAN SHAFT AND SIDE COVER REPLACEMENT

Figures 1 and 2

Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.
- Pitman arm from steering gear. Refer to "Steering Linkage" in section 3B3.
- Rotate stub shaft back and forth to drain power steering fluid.



Clean

- Exposed end of pitman shaft and housing.
- Use a wire brush to clean pitman shaft spline.



Disassemble

1. Adjuster lock nut (8).
2. Bolts (10).
 - Rotate stub shaft (40), using a 12-point socket, to center gear.
3. Side cover (7), gasket (11), and pitman shaft (12) as an assembly.
4. Pitman shaft (12) from the side cover (7).



Assemble

Notice: See "Notice" on page 3B1A-1 of this section.

1. Pitman shaft (12) to side cover (7) by screwing pitman shaft (12) in until it fully seats to side cover (7).
2. Adjuster lock nut (8).
 - Do not tighten adjuster lock nut (8) until after pitman shaft adjustment has been made.

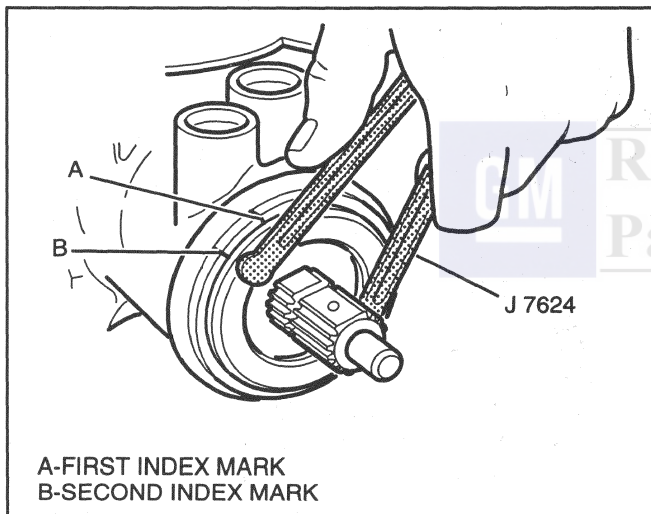


Figure 6 Aligning the Adjuster Plug to the Second Mark

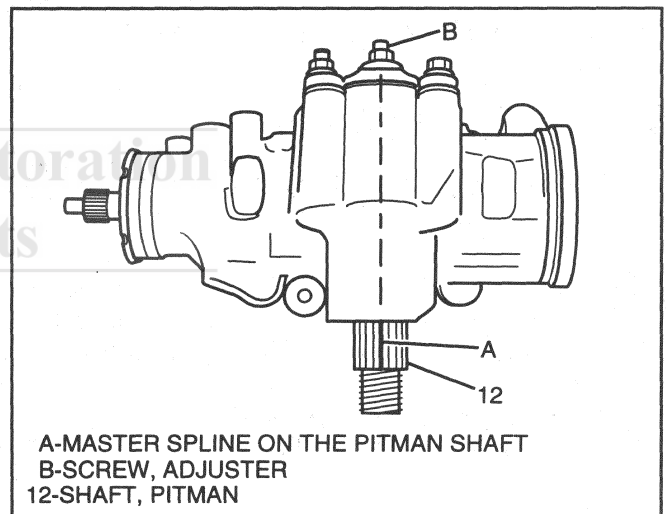


Figure 8 Aligning Pitman Shaft Master Spline

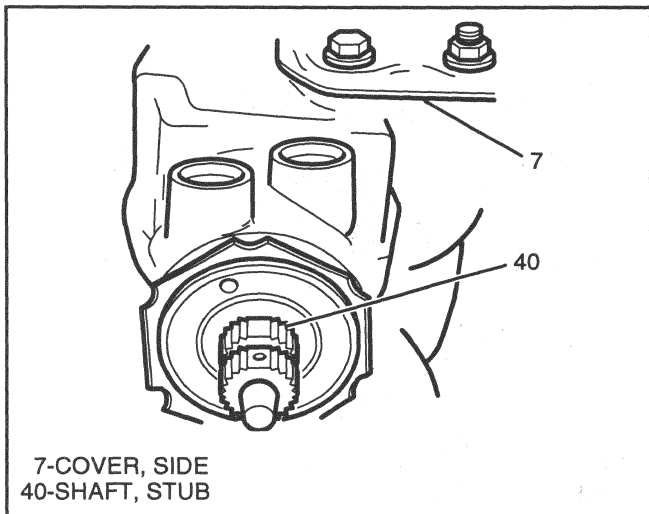


Figure 7 Aligning the Stub Shaft

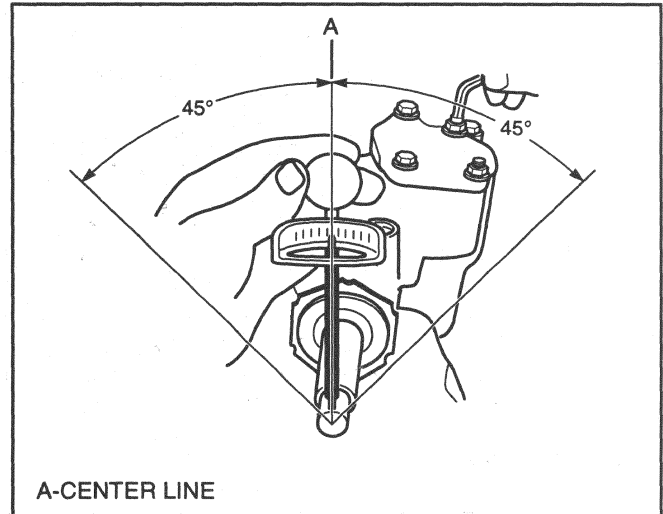


Figure 9 Checking Over-Center Rotational Torque

3B1A-6 POWER STEERING GEAR UNIT REPAIR

3. Gasket (11) to side cover (7) and bend tabs around edges of side cover (7).
4. Pitman shaft assembly and side cover (7) to housing (20).
5. Bolts (10).



Tighten

- Bolts (10) to 60 N•m (44 lb. ft.).



Adjust

- Pitman shaft. Refer to "Pitman Shaft Over-Center Sector Adjustment" in this section.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

HOUSING END PLUG REPLACEMENT

Figure 10



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

- Rotate stub shaft back and forth to drain fluid.
1. Retaining ring (1) by using a punch inserted into the housing access hole to unseat it.
 2. Plug (2).
 3. O-ring seal (3).

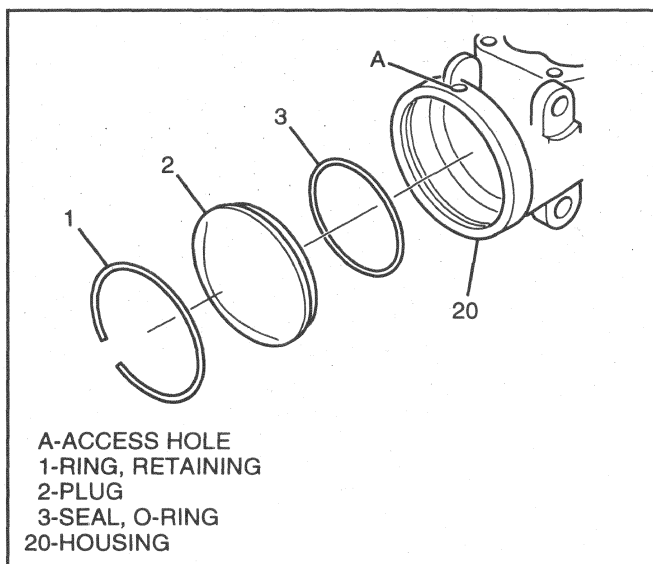


Figure 10 Housing End Plug



Assemble

- Lubricate O-ring seal with power steering fluid.
1. O-ring seal (3) into housing (20).
 2. Plug (2).
 3. Retaining Ring (1).
 - Install retaining ring (1) so that open end is approximately 25 mm (1 inch) from access hole in housing (20).



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

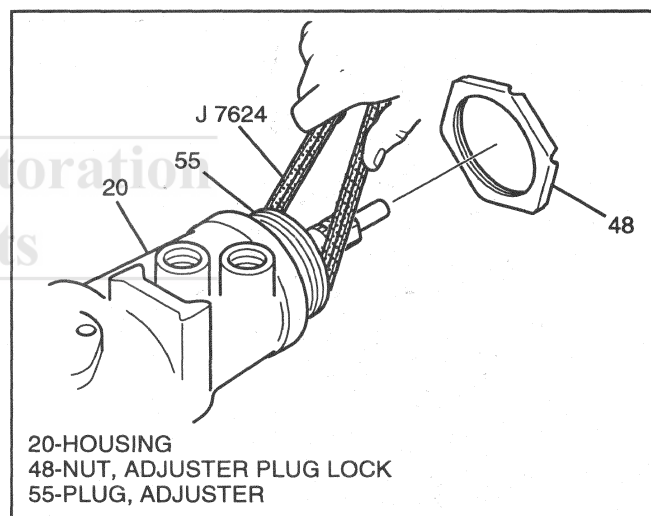


Figure 11 Removing Adjuster Plug

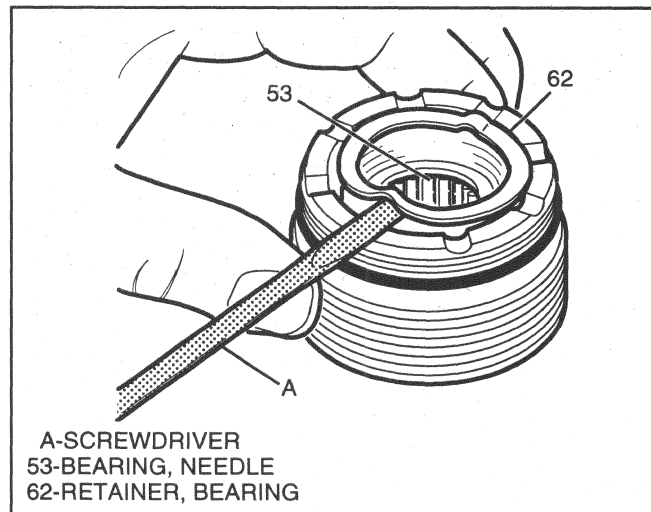


Figure 12 Removing Bearing Retainer

ADJUSTER PLUG ASSEMBLY REPLACEMENT

Figures 1, 2, 11 thru 14

Tools Required:

J 7624 Spanner Wrench

J 6221 Adjuster Plug Bearing Remover and Installer



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

- Adjuster plug lock nut (48) from housing (20).
- Adjuster plug (55) from housing (20) using J 7624.
- Thrust washer bearing retainer (62) from adjuster plug (55) by using a screwdriver to pry at raised area of bearing retainer (62).
- Bearing spacer (61), races (57 and 60) and thrust bearing (58).
- O-ring seal (56).
- Retaining ring (50).
 - Position adjuster plug (55) face down on a suitable support (see Figure 13).
- Needle bearing (53), dust seal (51) and lip seal (52) using J 6221 to drive them from adjuster plug (55).



Assemble

- Position adjuster plug (55) face up on a suitable support.

Notice: Needle bearing must be installed with identification on bearing facing tool to prevent damage to bearing.

- Needle bearing (53) to adjuster plug (55) using J 6221.

- Lip seal (52) to adjuster plug (55) using J 6221.
- Dust seal (51) to adjuster plug (55) using J 6221.
- Retaining ring (50).
- O-ring seal (56) to adjuster plug (55).
- Large bearing race (57), thrust bearing (58), small bearing race (60) and bearing spacer (61) to adjuster plug (55).
- Thrust washer bearing retainer (62) to adjuster plug (55).
 - Lubricate O-ring seal (56) and rubber lip of seals (51 and 52).

Notice: When installing adjuster plug, care should be taken not to cut the seals.

- Adjuster plug (55) to housing (20) using J 7624.



Adjust

- Thrust bearing preload. Refer to "Worm Bearing Preload Adjustment" in this section.
- Install adjuster plug lock nut (48), and using a drift in a notch, tighten securely.
 - Hold adjuster plug (55) to maintain alignment of the marks.



Adjust

- Pitman shaft over-center sector. Refer to "Pitman Shaft Over-Center Sector Adjustment" in this section.



Install or Connect

- Power steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

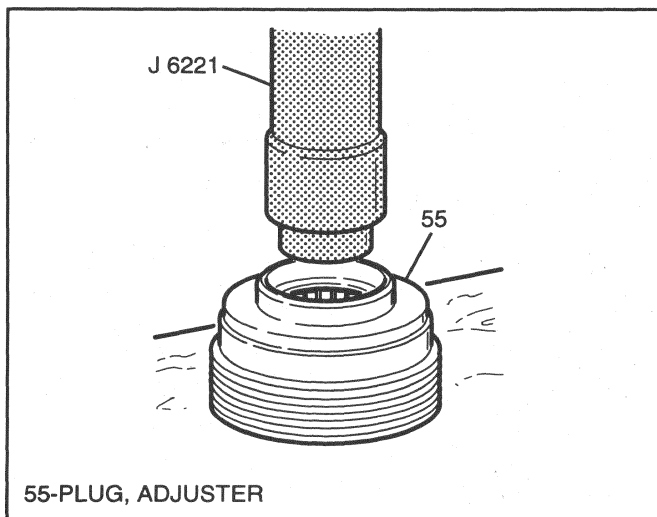


Figure 13 Removing Bearing and Seals

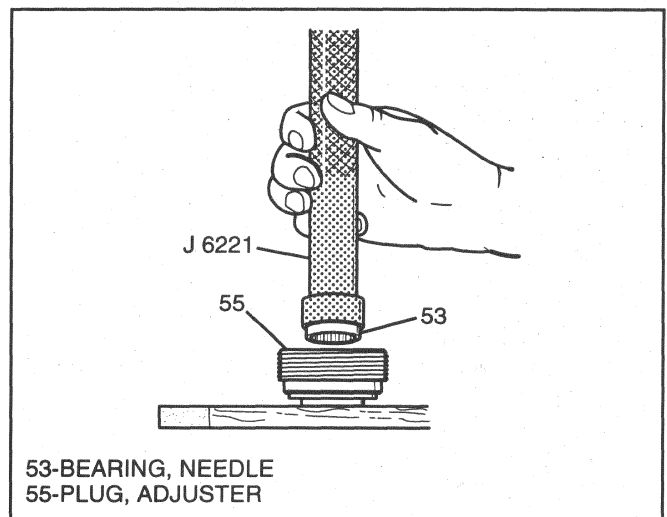


Figure 14 Installing Bearing and Seals

VALVE REPLACEMENT

Figures 1, 2, 15 thru 18



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

- Adjuster plug (55). Refer to "Adjuster Plug Assembly Replacement" in this section.
- Stub shaft (40) and valve assembly.
- Stub shaft (40) from valve assembly, if necessary.
 - Tap stub shaft (40) lightly on a wood block to loosen shaft cap.
 - Pull cap and valve spool (41) out from valve body (43) 6 mm (1/4 inch) and disengage stub shaft pin from hole in valve spool (41).
- Valve assembly, if necessary.
 - Remove valve spool (41) by pulling and rotating from valve body (43).
 - Remove valve spool O-ring seal (42).
 - Remove valve body teflon rings (46) and O-ring seals (45).



Assemble

- Valve assembly, if necessary.
 - Install valve spool O-ring seal (42) to valve spool (41).
 - Lubricate valve spool (41) and O-ring seal (42) with power steering fluid.

- Install valve spool (41) to valve body (43) by pushing and rotating until hole in valve spool (41) for stub shaft pin is accessible from opposite end of valve body (43).
- Stub shaft (40) to valve spool, if necessary and insert pin.
 - Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.
 - Install O-ring seals (45) and teflon rings (46) to valve body (43).
 - Lubricate O-ring seals (45) and teflon rings (46) with power steering fluid.
 - Stub shaft (40) and valve assembly to worm shaft (13), fitting pin on worm shaft (13) to slot in the valve assembly.
 - Adjuster plug. Refer to "Adjuster Plug Assembly Replacement" in this section.

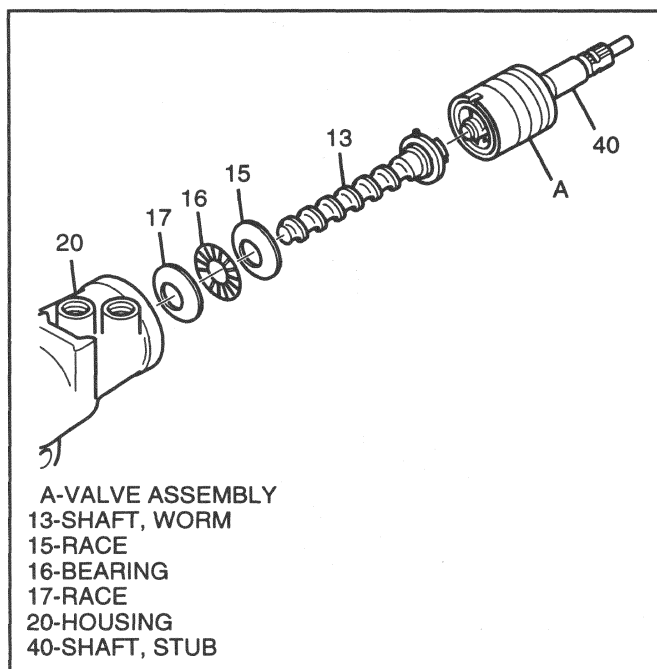


Figure 15 Bearing, Worm and Valve Assembly

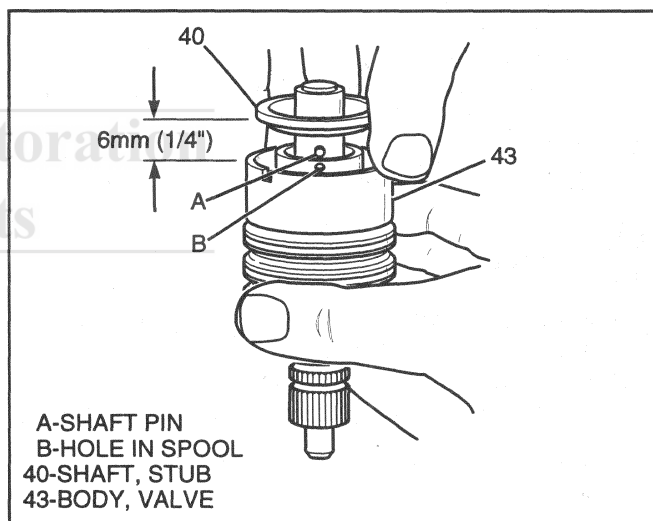


Figure 16 Remove and Install Stub Shaft

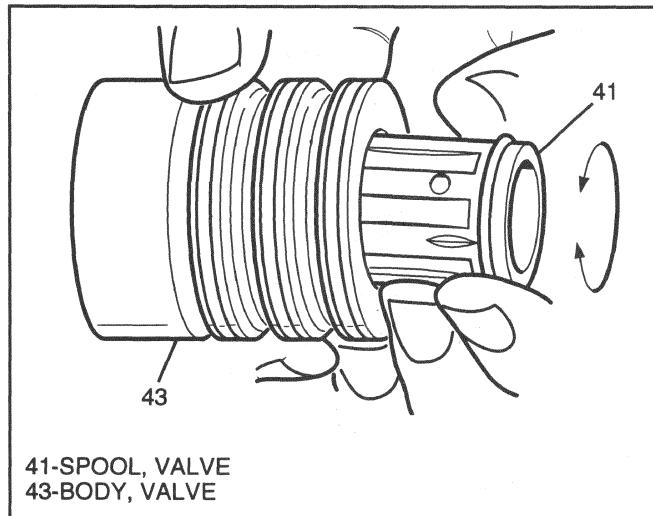


Figure 17 Remove and Install Spool



Adjust

- Thrust bearing preload and pitman shaft over-center sector. Refer to "Steering Gear Adjustments" in this section.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

RACK PISTON AND WORM SHAFT REPLACEMENT

Figures 1, 2, 19, 20, 21 and 22



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.

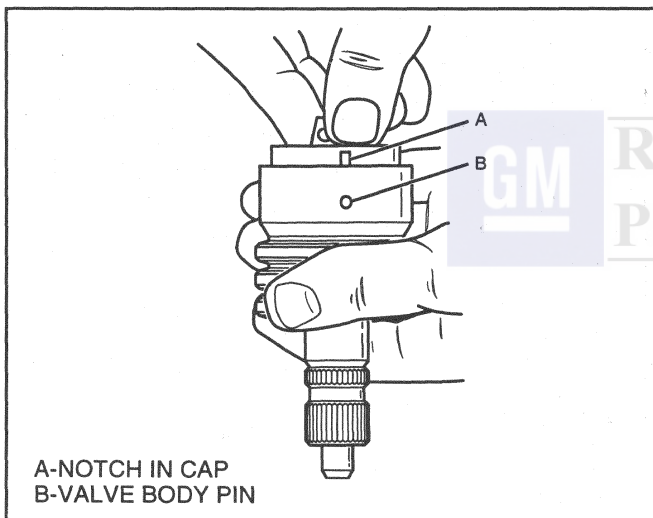


Figure 18 Engage Stub Shaft

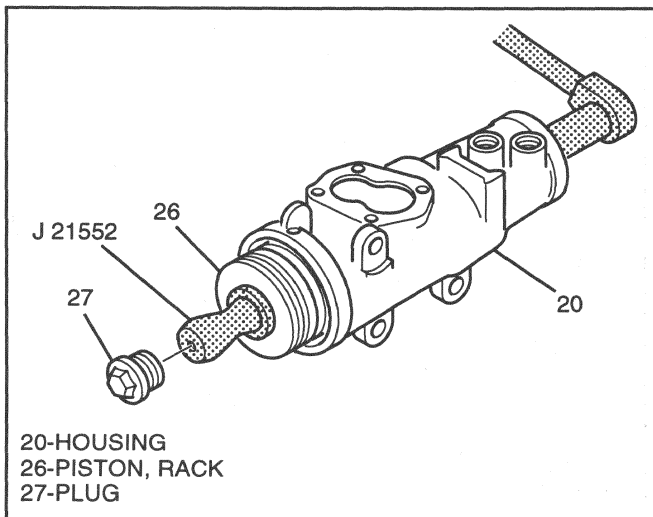


Figure 19 Rack Piston



Disassemble

Tool Required:

J 21552 Rack Piston Arbor

1. Pitman shaft and side cover. Refer to "Pitman Shaft and Side Cover Replacement" in this section.
2. Housing end plug. Refer to "Housing End Plug Replacement" in this section.
 - Turn stub shaft counterclockwise until the rack piston (26) begins to come out of the housing (20).
3. Rack piston plug (27).
 - Insert J 21552 into bore of rack piston (26). Hold J 21552 tightly against worm shaft while turning the stub shaft counterclockwise.
 - The rack piston (26) will be forced onto J 21552 and hold the rack piston balls (25) in place.
4. Rack piston (26), rack piston balls (25), and J 21552 together from housing (20).
5. Valve. Refer to "Valve Replacement" in this section.
6. Worm shaft (13).
7. Thrust bearing (16) and races (15 and 17).
8. J 21552 from rack piston (26).
9. Rack piston balls (25).
10. Screws (21), clamp (22) and ball guide (23).
11. Teflon ring (5).
12. O-ring seal (6).



Clean

- All disassembled parts.



Inspect

- All disassembled parts for wear. Replace if necessary.



Assemble

Tools Required:

J 8947 Rack Piston Teflon Ring Compressor

J 21332 Rack Piston Arbor

1. O-ring seal (6) and teflon ring (5) and lubricate with power steering fluid.
2. Worm shaft (13) to rack piston (26) outside of housing (20).
 - Fully seat worm shaft (13) to rack piston (26) and align worm shaft spiral groove with rack piston ball return guide hole (see Figure 20).



Important

- Make sure that all rack piston balls (25) are reinstalled in the rack piston. Improper rack piston ball installation may result in personal injury.

3B1A-10 POWER STEERING GEAR UNIT REPAIR

Notice: The black rack piston balls are smaller than the silver balls. The black and silver balls must be installed alternately into the rack piston and ball guide to maintain rack piston to worm shaft preload.

- Lubricate rack piston balls (25) with power steering fluid.
- 3. Rack piston balls (25) to rack piston (26) by inserting through ball return guide hole while turning worm shaft (13) counterclockwise.
- 4. Remaining rack piston balls (25) to ball guide (23) using grease at each end to retain balls (25) (see Figure 21).
- 5. Ball guide (23) to rack piston (26).

Notice: See "Notice" on page 3B1A-1 of this section.

- 6. Ball guide clamp (22) and screws (21).



Tighten

- Screws (21) to 58 N•m (43 lb. in.).
 - Insert J 21552 into bore of rack piston (26) while turning worm shaft (13) counterclockwise. The rack piston (26) will be forced onto J 21552 and will hold the rack piston balls (25) in place.
- 7. Races (15 and 17) and thrust bearing (16) to worm shaft (13) (see Figure 22).
 - 8. Worm shaft (13) to housing (20).
 - 9. Valve. Refer to "Valve Replacement" in this section.
 - 10. Rack piston (26) to worm shaft (13) from J 21552, using J 8947 to compress seals.
 - Hold J 21552 tightly against worm shaft and turn stub shaft clockwise until rack piston (26) is seated on worm shaft (13).

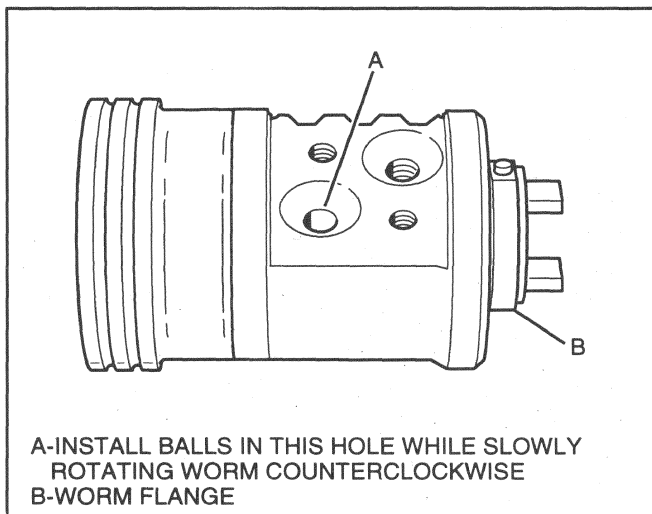


Figure 20 Installing the Balls in the Rack Piston



Important

- Make sure that all rack piston balls (25) are reinstalled in the rack piston. Improper rack piston ball installation may result in personal injury.

- 11. Rack piston plug (27).



Tighten

- Rack piston plug (27) to 150 N•m (111 lb. ft.)
- 12. Housing end plug. Refer to "Housing End Plug Replacement" in this section.
- 13. Pitman shaft and side cover. Refer to "Pitman Shaft and Side Cover Replacement" in this section.



Adjust

- Steering gear. Refer to "Steering Gear Adjustments" in section 3B.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in this section.

PITMAN SHAFT SEALS AND BEARING REPLACEMENT

Figures 1 and 2

This procedure covers the seal and bearing replacement for steering gears. Seals may be replaced without removing the power steering gear. Refer to "On Vehicle Service."

Tools Required:

- J 6278 Pitman Shaft Bearing Remover and Installer
- J 6219 Pitman Shaft Oil Seal Installer
- J 4245 Internal Snap Ring Pliers

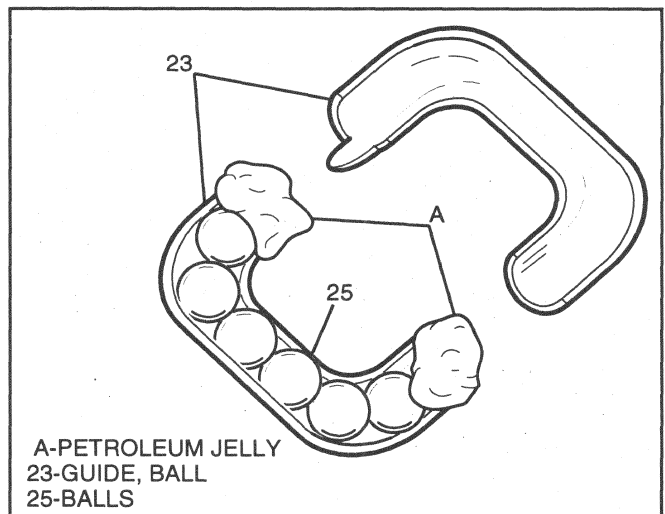


Figure 21 Placing Balls in the Ball Return Guide



Remove or Disconnect

- Pitman arm from steering gear. Refer to "Steering Linkage" in Section 3B3.



Clean

- Exposed end of pitman shaft (12) and housing (20).
- Use a wire brush to clean pitman shaft splines.



Disassemble

Notice: Use care not to score the housing bore when prying out seals and washers

1. Pitman shaft dust seal (64) using a screwdriver to pry it from the housing (20).
2. Retaining ring (35) using J 4245.
3. Backup washer (31) and pitman shaft seal (63) using a screwdriver.



Inspect

- Housing (20) for burrs and remove if necessary.
4. Needle bearing (28).
 - Insert J 6278 through the hole in the top of the housing (20) and drive out bearing (28).



Assemble

- Coat lips of pitman shaft seal (63) and dust seal (64) with white petroleum grease.
1. Needle bearing (28) to housing (20) using J 6278.
 2. Pitman shaft seal (63) (cavity facing in) using J 6219.

Notice: Seal (63) must not bottom against needle bearing (28).

3. Backup washer (31).
4. Retaining ring (35) using J 4245.
5. Pitman shaft dust seal (64) (cavity facing out) using J 6219.
 - Cover entire cavity of dust seal (64) with white petroleum grease.

Notice: Clean pitman shaft splines after packing seal cavity with grease.

Notice: Pack the small cavity between pitman shaft seal (63) and dust seal (64) with white petroleum grease before reinstalling pitman shaft (12). Packing this area will help prevent early seal leaks by eliminating moisture accumulation, and rust on the pitman shaft.

6. Pitman shaft and side cover. Refer to "Pitman Shaft and Side Cover Replacement" in this section.



Install or Connect

- Pitman arm to steering gear. Refer to "Steering Linkage" in Section 3B3.

CHECK VALVE REPLACEMENT



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

Notice: Use care not to damage threads of housing when removing check valve.

- Check valve (18) by prying from housing with a small screwdriver.



Assemble

- Check valve (18) using a 3/8-inch diameter piece of tubing 100 mm (4 inches) long to drive into housing.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

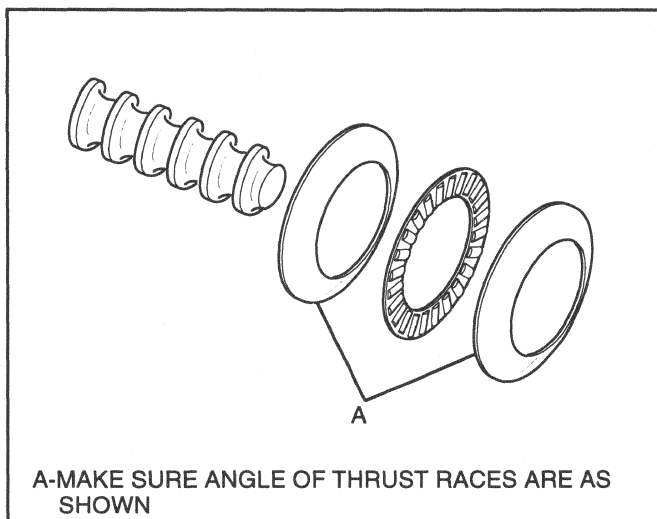


Figure 22 Worm Shaft and Bearing

3B1A-12 POWER STEERING GEAR UNIT REPAIR

SPECIFICATIONS

FLUID CAPACITIES

Power Steering Fluid Requirement GM Power Steering Fluid
Part No. 1050017 or Equivalent meeting GM Specification 9985010.

FASTENER TIGHTENING SPECIFICATIONS

(8)	Steering Gear Adjuster Lock Nut	49 N•m	(36 lb. ft.)
(21)	Rack Piston Guide Clamp Screw	58 N•m	(43 lb. in.)
(27)	Rack Piston Plug	150 N•m	(111 lb. ft.)
(48)	Adjuster Plug Lock Nut	109 N•m	(80 lb. ft.)

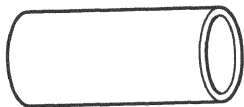
ADJUSTMENT TIGHTENING SPECIFICATIONS

(40)	Pitman Shaft Over-Center Preload*	0.7-1.1 N•m	(6-10 lb. in.)
(55)	Steering Gear Adjuster Plug	30 N•m	(22 lb. ft.)

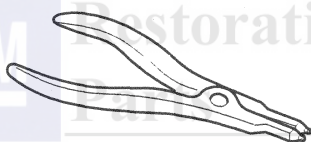
*Figure is in addition to worm shaft thrust bearing preload and valve and seal drag.

SPECIAL TOOLS

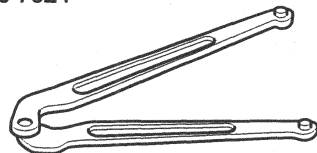
1. J 6219



2. J 4245



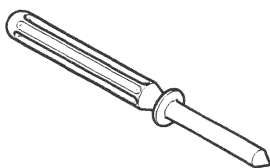
3. J 7624



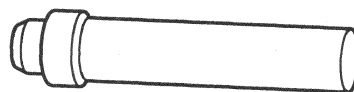
4. J 8947



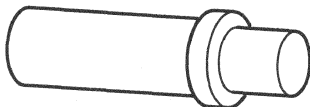
5. J 21552



6. J 6221



7. J 6278



1. PITMAN SHAFT OIL SEAL INSTALLER
2. INTERNAL SNAP RING PLIERS
3. SPANNER WRENCH
4. RACK PISTON TEFLON RING COMPRESSOR
5. RACK PISTON ARBOR
6. ADJUSTER PLUG BEARING REMOVER AND INSTALLER
7. PITMAN SHAFT BEARING REMOVER AND INSTALLER

SECTION 3B1B

POWER STEERING PUMP UNIT REPAIR

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with “live” exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the “off” or “lock” position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Power Steering Pump Assembly	3B1B-2	Specifications	3B1B-5
Variable Assist Steering Actuator		Fluid Capacities	3B1B-5
(Buick only)	3B1B-3	Fastener Tightening Specifications	3B1B-5
Drive Shaft Seal Replacement	3B1B-4	Special Tools	3B1B-5
End Plate and Rotating Group Replacement ...	3B1B-4		

3B1B-2 POWER STEERING PUMP UNIT REPAIR

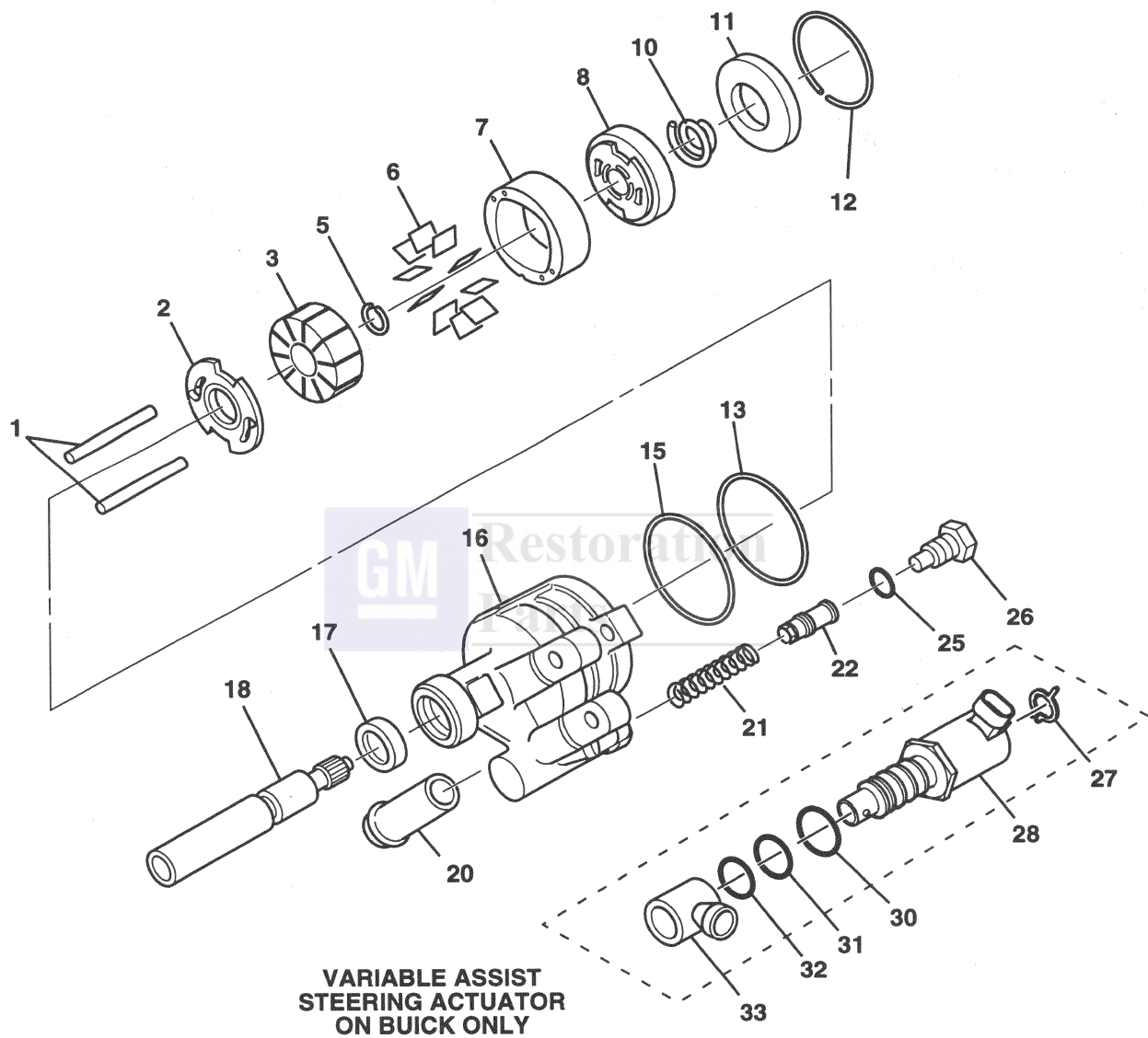


Figure 1 Power Steering Pump

KEY NO. PART NAME

- 1 - PIN, DOWEL
- 2 - PLATE, THRUST
- 3 - ROTOR, PUMP
- 5 - RING, SHAFT RETAINING
- 6 - VANE, PUMP
- 7 - RING, PUMP
- 8 - PLATE, PRESSURE
- 10 - SPRING, PRESSURE PLATE
- 11 - PLATE, END
- 12 - RING, END PLATE RETAINING
- 13 - SEAL, O-RING
- 15 - SEAL, O-RING
- 16 - HOUSING ASM, PUMP

KEY NO. PART NAME

- 17 - SEAL, DRIVE SHAFT
- 18 - SHAFT, DRIVE
- 20 - TUBE, PUMP
- 21 - SPRING, FLOW CONTROL
- 22 - VALVE ASM, CONTROL
- 25 - SEAL, O-RING
- 26 - FITTING ASM, (CONNECTOR &)
- 27 - CLIP, RETAINING
- 28 - ACTUATOR, VARIABLE ASSIST STEERING
- 30 - SEAL, O-RING
- 31 - SEAL, O-RING
- 32 - SEAL, O-RING
- 33 - FITTING, DISCHARGE

Figure 2 Power Steering Pump - Legend

VARIABLE ASSIST STEERING ACTUATOR REPLACEMENT*(Buick only)**Figures 1, 2 and 3***Remove or Disconnect**

1. Negative (-) battery cable.
2. Pump assembly from vehicle, if necessary for access.
3. Power steering pressure line.
4. Electrical connector from Variable Assist Steering actuator (28).
5. Retaining clip (27) from Variable Assist Steering actuator (28).
6. Variable Assist Steering actuator (28) and discharge fitting (33).
 - Discharge fitting from Variable Assist Steering actuator.
 - O-ring seals (30, 31 and 32) from Variable Assist Steering actuator (28).

**Install or Connect**

1. O-ring seals on Variable Assist Steering actuator.
2. Discharge fitting (33) to Variable Assist Steering actuator (28).
3. Variable Assist Steering actuator and discharge fitting (33) to pump assembly.
4. Position discharge fitting (33).

**Tighten**

- Variable Assist Steering actuator (28) to 62 N•m (46 lb. ft.).

5. Electrical connector to Variable Assist Steering actuator (28).
6. Retaining clip (27) to Variable Assist Steering actuator (28).
 - If a new actuator (28) is being installed, position electrical connector before installing retaining clip (27).
7. Power steering pressure line.
8. Pump assembly to vehicle, if removed.
9. Negative (-) battery cable.

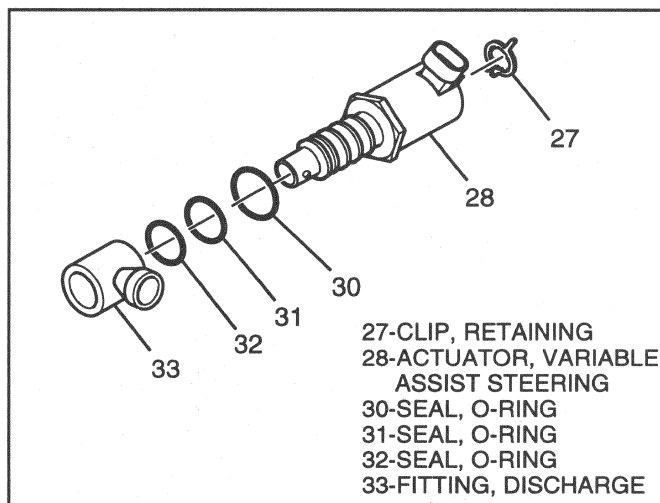


Figure 3 Variable Assist Steering Actuator Assembly

3B1B-4 POWER STEERING PUMP UNIT REPAIR

DRIVE SHAFT SEAL REPLACEMENT

Figures 1, 2 and 4



Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.



Disassemble

- Protect drive shaft (18) with shim stock.
- Seal (17) by cutting with a chisel.



Assemble

Tool Required:

J 22670 Shaft Oil Seal Installer

- Lubricate seal (17) with power steering fluid.
- Seal (17) using J 22670.



Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.



Disassemble

- Retaining ring (12).
- End plate (11) and spring (10).

Notice: Examine exposed portion of pump drive shaft. If it is corroded, clean with crocus cloth before removing. This will prevent damage to the shaft bushing which might require replacement of the entire housing.

- Pressure plate (8) by using a rubber mallet to tap lightly on the drive shaft (18).
- Pump ring (7).
- Pump vanes (6).
- Shaft, rotor and thrust plate assembly.
- Shaft retaining ring (5).
- Pump rotor (3).
- Thrust plate (2).
- Drive shaft (18).
- Dowel pins (1).
- O-ring seals (13 and 15).



Important

- Use new seals and drive shaft retaining ring when assembling pump.

END PLATE AND ROTATING GROUP REPLACEMENT

Figures 1, 2 and 5



Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.

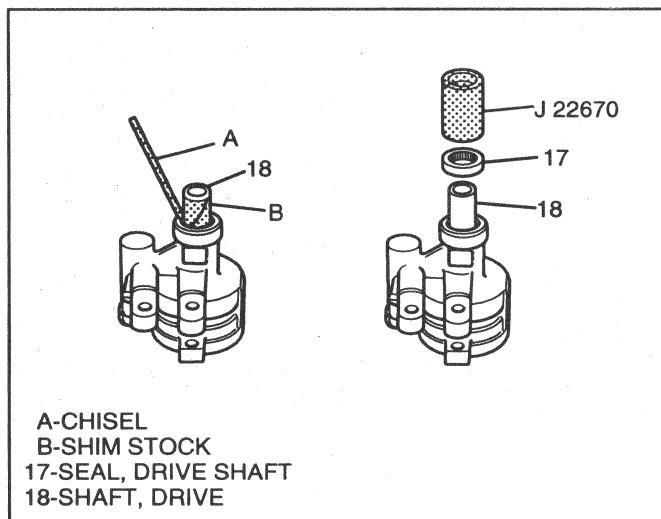


Figure 4 Drive Shaft Seal

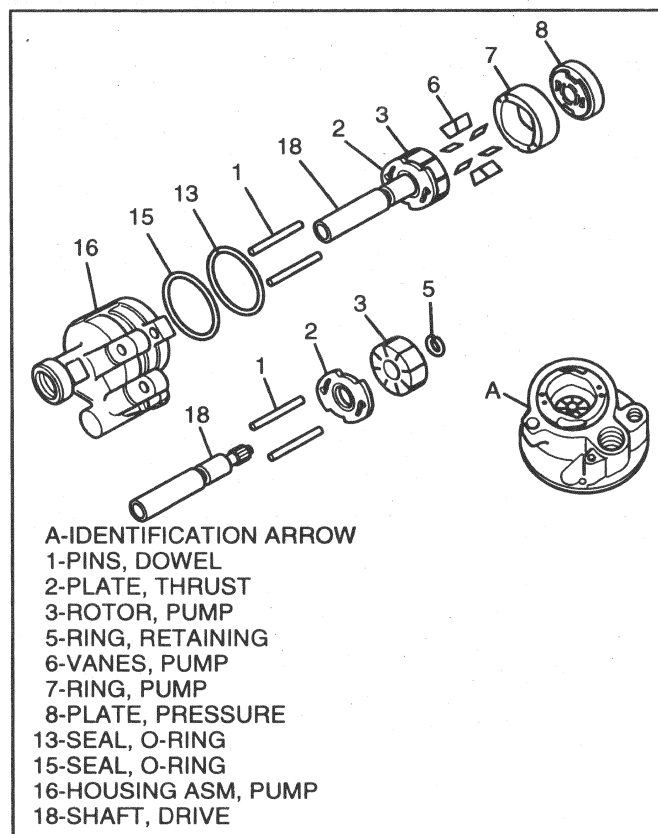


Figure 5 Rotating Group



Assemble

- Lubricate O-ring seals (13 and 15) with power steering fluid.
- 1. O-ring seals (13 and 15) to housing (16).
- 2. Dowel pins (1) to housing (16).
- 3. Thrust plate (2) and pump rotor (3) to drive shaft (18) and secure with retaining ring (5).
- 4. Shaft, rotor and thrust plate assembly to housing (16).

- 5. Pump vanes (6) to pump rotor (3).
- 6. Pump ring (7) to housing (16) with identification arrows on top edge of ring (7) facing outward.
- 7. Pressure plate (8).
- 8. Spring (10) and end plate (11).
- 9. Retaining ring (12).



Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

SPECIFICATIONS

FLUID CAPACITIES

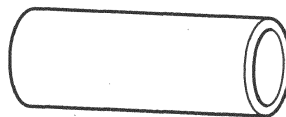
Power Steering Fluid Requirement GM Power Steering Fluid
Part No. 1050017 or Equivalent meeting GM Specification 9985010.

FASTENER TIGHTENING SPECIFICATIONS

(27) Variable Assist Steering Actuator Assembly 62 N•m (46 lb. ft.)

SPECIAL TOOLS

1. J 22670



1. SHAFT OIL SEAL INSTALLER



SECTION 3B3

STEERING LINKAGE

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Steering Linkage Tie Rods.....	3B3-2	Steering Linkage Outer Tie Rod Seal	3B3-8
Steering Linkage Inner Tie Rod.....	3B3-2	Steering Linkage Inner Tie Rod Seal.....	3B3-9
Steering Linkage Outer Tie Rod.....	3B3-2	Specifications.....	3B3-9
Steering Linkage Relay Rod.....	3B3-5	Fastener Tightening Specifications.....	3B3-9
Steering Linkage Shock Absorber.....	3B3-5	Special Tools.....	3B3-9

GENERAL DESCRIPTION

A parallelogram type steering linkage connects both wheels to the steering gear through the pitman arm. The outer tie rods are attached to the steering knuckle and hub and the inner tie rods are attached to the relay rod. The left end of the relay rod is supported by the steering gear and the right end by the idler arm which pivots on an idler arm support attached to the frame. The pitman arm and idler arm are always parallel to each other and move through symmetrical arcs. Lubricate steering linkage with EP Chassis Lubricant GM P/N 1052356 or equivalent, meeting GM-6031M specifications whenever work is done on the steering linkage, and at intervals specified in the maintenance schedule. Refer to SECTION 0B. Worn or damaged steering linkage seals should be replaced.

NOTICE: Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

ON-VEHICLE SERVICE

CHECKING STEERING LINKAGE WEAR

Figure 1

Tool Required:
J 8001 Dial Indicator Set

Important

- The front wheel bearings must be adjusted prior to performing this inspection. Refer to SECTION 3C for adjustment procedure.

Inspect

- Steering linkage for wear.
 - A. Raise the vehicle on one side at the frame directly behind the front wheel so that the wheel is approximately 25 mm (1 inch) off the floor. Refer to SECTION 0A.
 - B. Position the steering wheel in the straight ahead and locked position.
 - C. Position J 8001 at outer edge of rim.
 - D. Grasp front wheel and move the wheel back and forth.
 - E. Read indicator. Indicator reading should not exceed 2.74 mm (0.108 inch).
 - If indicator reading is not within specifications, a check should be made of all front suspension and steering linkage parts.

3B3-2 STEERING LINKAGE

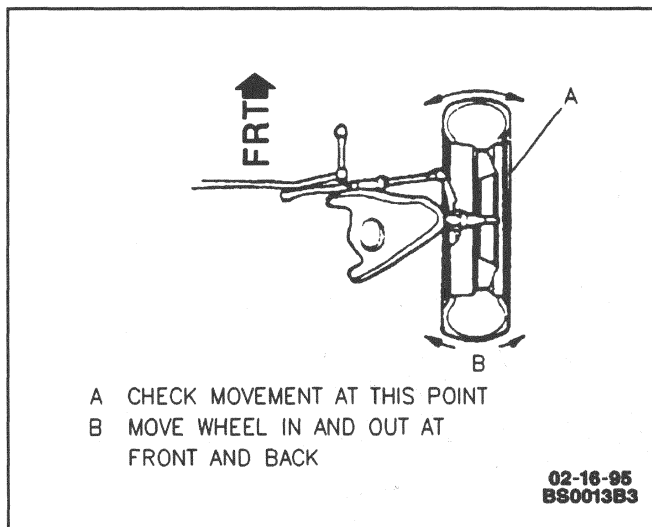


Figure 1 - Checking Steering Linkage Wear

STEERING LINKAGE TIE RODS

Figures 2, 3 and 4

! Important

- Tie rod adjuster parts often become rusted in service. In such cases, it is recommended that if the torque required to remove the tie rod clamp nut (9) from the bolt/screw (7) after breakaway exceeds 9 N.m (80 lb. in.), discard nuts (9) and bolts/screws (7). Apply penetrating oil between tie rod clamp (8) and adjuster (11) and rotate the clamps (8) until they move freely. Install new bolts/screws (7) and nuts (9) having the same part number to ensure proper clamping at specified torque.

Steering Linkage Inner Tie Rod

Tools Required:

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (22).
3. Inner tie rod ball joint from relay rod (14) using J 24319-B.
4. Loosen tie rod clamp bolt/screw (7) at the inner end of the tie rod adjuster (11).

! Important

- Count the number of turns required to remove the inner tie rod (3) from the tie rod adjuster (11).
5. Inner tie rod (3) from tie rod adjuster (11).

🔍 Inspect

- Threads on the ball stud and in the inner tie rod nut (22). If threads are not clean and smooth, the ball may turn inside the inner tie rod when attempting to tighten the nut during installation.
- Ball stud taper for nicks.
- Inner tie rod seals (31) for damage. Replace as necessary. Refer to "Steering Linkage Inner Tie Rod Seal" under "Steering Linkage Tie Rod Seal Replacement" in this section.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Lubricate the tie rod adjuster threads with EP Chassis Lube GM P/N 1052356 or equivalent.
2. Threaded end of inner tie rod (3) into the tie rod adjuster (11) using the same number of turns counted during removal.
3. Inner tie rod ball joint into the relay rod (14).
4. J 29193 to seat the tapers.

🔧 Tighten

- J 29193 to 20 N.m (15 lb. ft.).
5. Remove J 29193.
 6. Nut (22) to the ball stud.

🔧 Tighten

- Nut (22) to 47 N.m (35 lb. ft.).

! Important

- Before tightening tie rod adjust clamp bolt/screw (7) on the rod adjuster (11), make certain that the adjuster (11) and adjust clamp (8) are positioned properly. Refer to "Steering Linkage Tie Rod Adjuster" in this section for proper positioning of the adjuster (11) and adjust clamp (8).

🔧 Tighten

- Tie rod clamp bolt/screw (7) to 19 N.m (14 lb. ft.).
7. Lower vehicle.

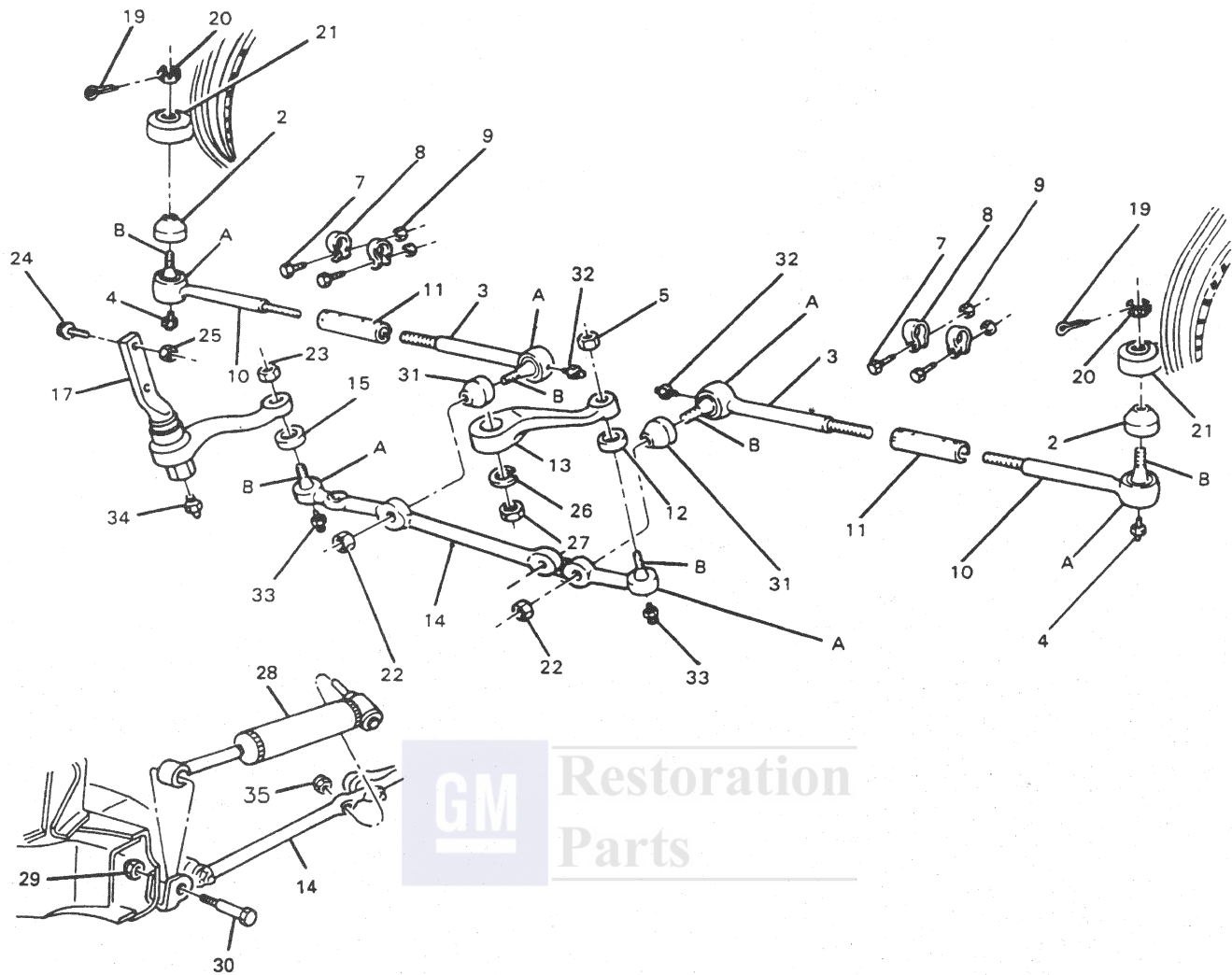
🔧 Adjust

- Toe to specification. Refer to SECTION 3A.

Steering Linkage Outer Tie Rod

Tool Required:

- J 24319-B Universal Steering Linkage Puller



BUICK WITH RPO NV7

- | | |
|---|--|
| A BALL JOINT | 19 PIN, STEERING LINKAGE OUTER TIE ROD COTTER |
| B BALL STUD | 20 NUT, STEERING LINKAGE OUTER TIE ROD |
| 2 SEAL, STEERING LINKAGE OUTER TIE ROD | 21 KNUCKLE STEERING |
| 3 ROD, STEERING LINKAGE INNER TIE | 22 NUT, STEERING LINKAGE INNER TIE ROD |
| 4 FITTING, STEERING LINKAGE OUTER TIE ROD LUBRICATION | 23 NUT, STEERING LINKAGE RELAY ROD |
| 5 NUT, STEERING LINKAGE RELAY ROD | 24 BOLT/SCREW, STEERING LINKAGE IDLER ARM |
| 7 BOLT/SCREW, STEERING LINKAGE TIE ROD ADJUST CLAMP | 25 NUT, STEERING LINKAGE IDLER ARM |
| 8 CLAMP, STEERING LINKAGE TIE ROD ADJUST | 26 WASHER, PITMAN ARM |
| 9 NUT, STEERING LINKAGE TIE ROD ADJUST CLAMP | 27 NUT, PITMAN ARM |
| 10 ROD, STEERING LINKAGE OUTER TIE | 28 ABSORBER, STEERING LINKAGE SHOCK |
| 11 ADJUSTER, STEERING LINKAGE TIE ROD | 29 NUT, STEERING LINKAGE SHOCK ABSORBER |
| 12 SEAL, STEERING LINKAGE RELAY ROD | 30 BOLT/SCREW, STEERING LINKAGE SHOCK ABSORBER |
| 13 ARM, PITMAN | 31 SEAL, STEERING LINKAGE INNER TIE ROD |
| 14 ROD, STEERING LINKAGE RELAY | 32 FITTING, STEERING LINKAGE INNER TIE ROD LUBRICATION |
| 15 SEAL, STEERING LINKAGE RELAY ROD | 33 FITTING, STEERING LINKAGE RELAY ROD LUBRICATION |
| 17 ARM, STEERING LINKAGE IDLER | 34 FITTING, STEERING LINKAGE IDLER ARM LUBRICATION |
| | 35 NUT, STEERING LINKAGE SHOCK ABSORBER |

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Figure 2 - Steering Linkage Components

3B3-4 STEERING LINKAGE

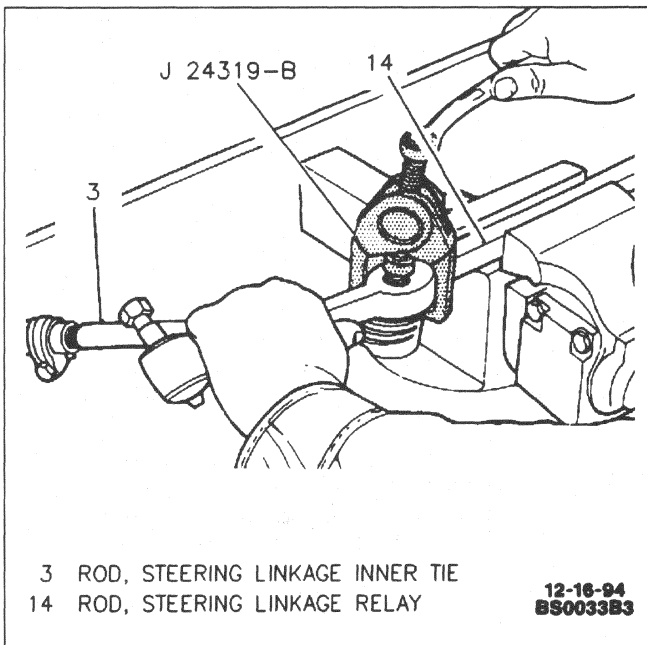


Figure 3 - Separating Steering Linkage Inner Tie Rod at Steering Linkage Relay Rod

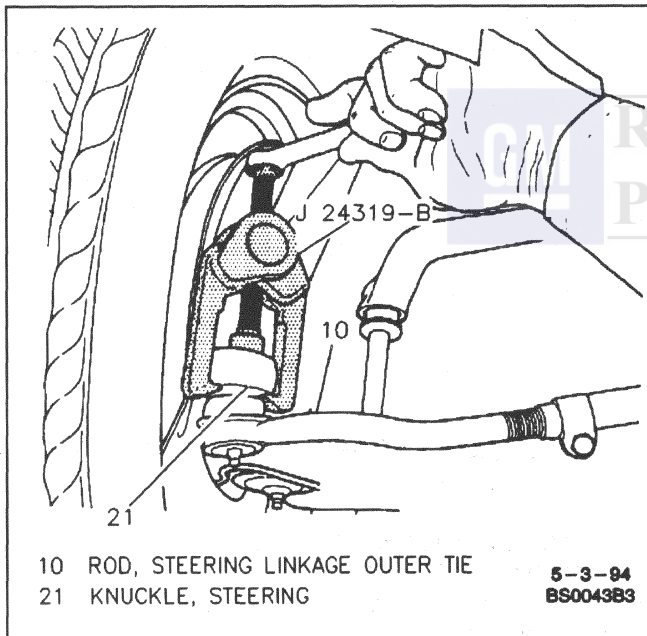


Figure 4 - Separating Steering Linkage Outer Tie Rod at Steering Knuckle and Hub

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Cotter pin (19) and nut (20) from the outer tie rod (10).
3. Outer tie rod (10) from steering knuckle and hub (21) by using J 24319-B.
4. Loosen tie rod clamp bolt/screw (7) at the outer tie rod end of the tie rod adjuster (11).

Important

- Count the number of turns required to remove the outer tie rod end from the tie rod adjuster (11).
5. Outer tie rod (10) from the tie rod adjuster (11).

Inspect

- Threads on the ball stud and in the outer tie rod nut (20). If threads are not clean and smooth the ball may turn inside the outer tie rod when attempting to tighten the outer tie rod nut (20) during installation.
- Ball stud taper for nicks.
- Outer tie rod seals (2) for damage. Replace if necessary. Refer to "Steering Linkage Outer Tie Rod Seal" under "Steering Linkage Tie Rod Seal Replacement" in this section.

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Lubricate the tie rod adjuster threads with EP Chassis Lube GM P/N 1052356 or equivalent.
2. Threaded end of the outer tie rod (10) into the tie rod adjuster (11) using the same number of turns counted during removal.
3. Outer tie rod (10) into the steering knuckle and hub (21).
4. Nut (20).

Tighten

- A. Nut (20) to 47 N.m (35 lb. ft.).
 - B. After tightening nut (20) to specification, tighten again just enough to align slot in nut (20) with hole in stud. Do not back off nut (20) to insert cotter pin (19). Turn to next hole.
5. Cotter pin (19).

Important

- Before tightening the tie rod adjust clamp bolt/screw (7) on the tie rod adjuster (11), make certain that the adjuster (11) and adjust clamp (8) are positioned properly. Refer to "Steering Linkage Tie Rod Adjuster" in this section for proper positioning of the adjuster (11) and adjust clamp (8).

Tighten

- Tie rod clamp bolt/screw (7) to 19 N.m (14 lb. ft.).
6. Lower vehicle.

**Adjust**

- Toe to specification. Refer to SECTION 3A.

STEERING LINKAGE RELAY ROD**Figures 2, 3, 5, 6 and 7****Tools Required:**

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)

**Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Inner tie rods from relay rod. Refer to "Steering Linkage Tie Rods" in this section.
3. Nut (5) from relay rod (14) at pitman arm (13).
4. Relay rod (14) with seal (12) from the pitman arm (13) by using J 24319-B.
 - Move the steering linkage as required to free pitman arm (13) from the relay rod (14).
5. Shock absorber nut (35), if equipped.
6. Shock absorber (28), if equipped, from relay rod (14).
7. Nut (23) from idler arm (17).
8. Relay rod (14) with seal (15) from idler arm (17) by using J 24319-B.

**Inspect**

- Steering linkage seals for damage. Replace as necessary.

**Install or Connect**

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Relay rod (14) with seal (15) to idler arm (17).
2. J 29193 to seat the tapers.

**Tighten**

- A. J 29193 to 20 N.m (15 lb. ft.).
 - B. Remove J 29193.
3. Nut (23) to the ball stud.

**Tighten**

- Nut (23) to 47 N.m (35 lb. ft.).
4. Shock absorber (28), if removed, to relay rod (14).
 5. Nut (35).

**Tighten**

- Nut (35) to 72 N.m (53 lb. ft.).
6. Relay rod (14) with seal (12) to pitman arm (13).
 7. J 29193 to seat tapers.

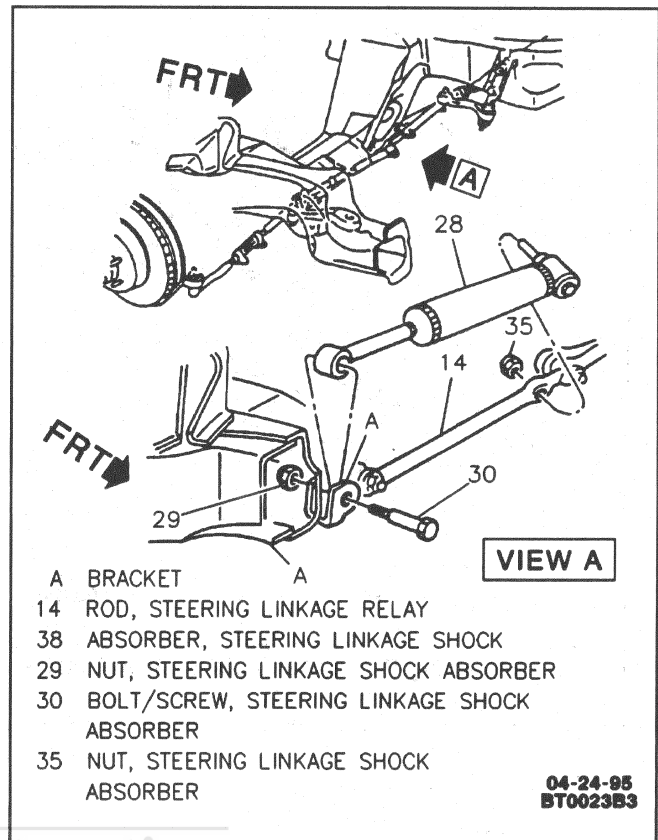


Figure 5 - Steering Linkage Shock Absorber

**Tighten**

- A. J 29193 to 20 N.m (15 lb. ft.).
 - B. Remove J 29193.
8. Nut (5) to the ball stud.

**Tighten**

- Nut (5) to 47 N.m (35 lb. ft.).
9. Inner tie rods to relay rod. Refer to "Steering Linkage Tie Rods" in this section.
 10. Lower vehicle.

**Adjust**

- Toe to specification. Refer to SECTION 3A.

STEERING LINKAGE SHOCK ABSORBER**Figure 5****Remove or Disconnect**

1. Raise and suitably support vehicle.
2. Nut (35) and shock absorber (28) from relay rod (14).
3. Nut (29) and bolt/screw (30) from frame.
4. Shock absorber (28).

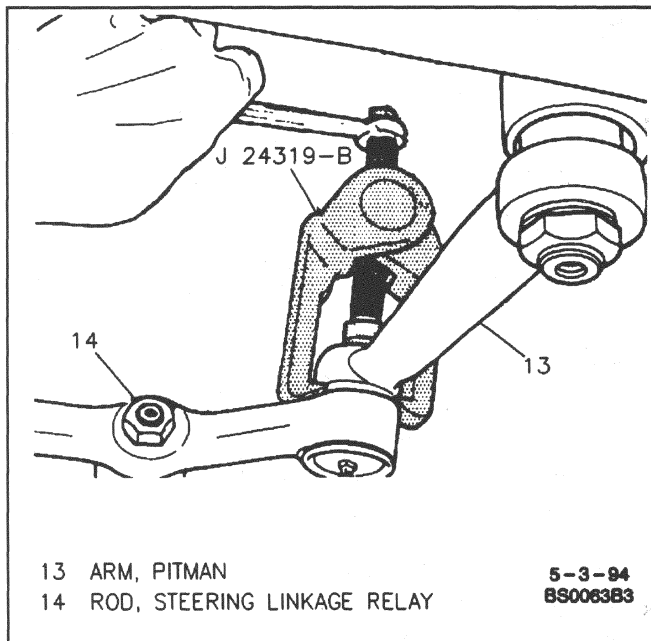


Figure 6 - Separating Pitman Arm from Steering Linkage Relay Rod

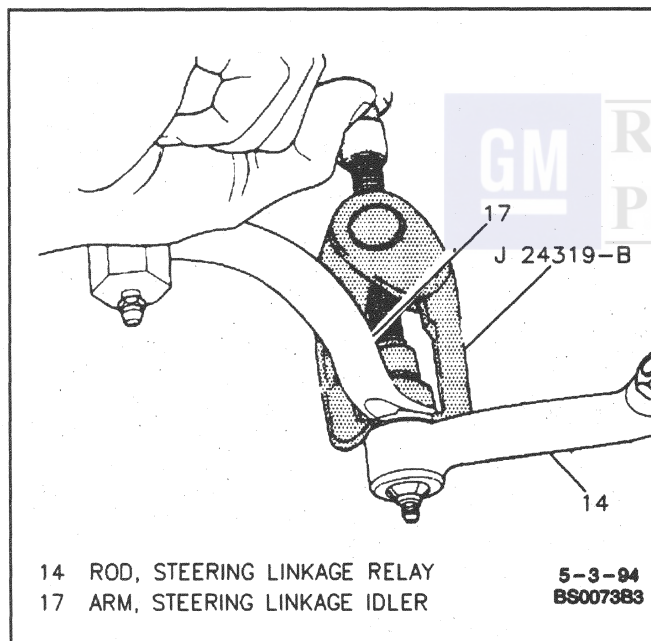


Figure 7 - Separating Steering Linkage Idler Arm from Relay Rod

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

- Shock absorber (28).
- Nut (29) and bolt/screw (30) to frame.
- Shock absorber (28) and nut (35) to relay rod (14).

Tighten

- Nut (29) to 54 N.m (40 lb. ft.).
- Nut (35) to 72 N.m (53 lb. ft.).
- Lower vehicle.

STEERING LINKAGE TIE ROD ADJUSTER

Figures 2, 3, 4 and 8

Tool Required:

J 24319-B Universal Steering Linkage Puller

Important

- Tie rod adjuster parts often become rusted in service. In such cases, it is recommended that if the torque required to remove the tie rod clamp nut (9) from the tie rod clamp bolt/screw (7) after breakaway exceeds 9 N.m (80 lb. in.), discard nuts (9) and bolts/screws (7). Apply penetrating oil between the tie rod clamp (8) and adjuster (11) and rotate the steering linkage clamps (8) until they move freely. Install new bolts/screws (7) and nuts (9) having the same part number to ensure proper clamp at specified torque.

Remove or Disconnect

- Raise and suitably support vehicle. Refer to SECTION 0A.
- Outer tie rod. Refer to "Steering Linkage Outer Tie Rod" under "Steering Linkage Tie Rods" in this section.
- Loosen tie rod clamp bolt/screw (7) at the inner tie rod end of the tie rod adjuster (11).

Important

- Count the number of turns required to remove the tie rod adjuster (11) from the inner tie rod (3).
- Tie rod adjuster (11) from the inner tie rod (3).

Inspect

- Outer tie rod seals (2) for damage. Replace as necessary.
- Threads on ball stud and outer tie rod nut (20). If threads are not clean and smooth the ball stud may turn in the outer tie rod when attempting to tighten nut (20).
- Ball stud taper for nicks.

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

- Lubricate tie rod threads with EP Chassis Lubricant GM P/N 1052356 or equivalent.

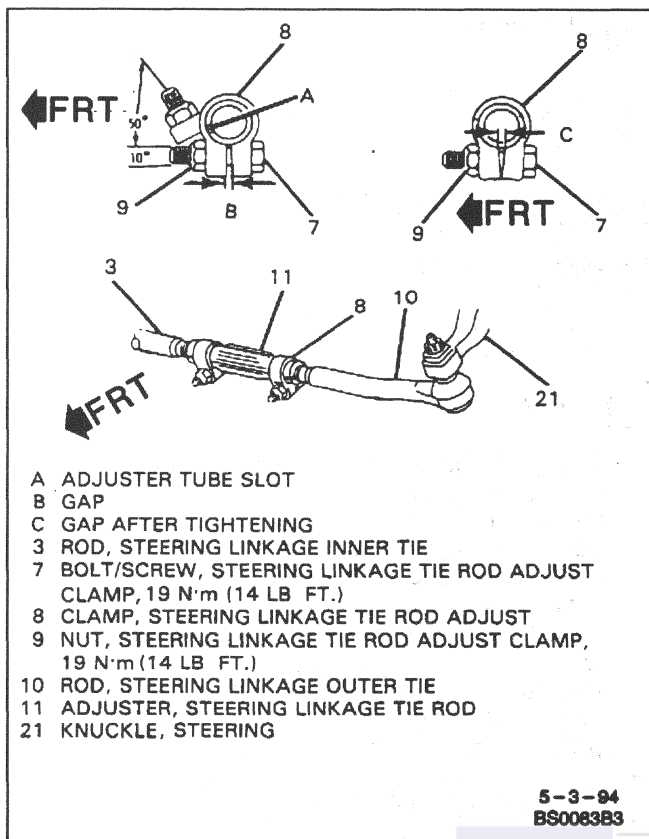


Figure 8 - Positioning Steering Linkage Tie Rod Adjuster and Adjust Clamps

2. Tie rod adjuster (11) to the inner tie rod (3) using the same number of turns as counted during removal.
3. Outer tie rod. Refer to "Steering Linkage Outer Tie Rod" under "Steering Linkage Tie Rods" in this section.

Important

- Ensure that both ends of the tie rod adjuster (11) are threaded an equal distance onto the inner and outer tie rods (3 and 10).

Adjust

- Tie rod adjust clamps (8).
 - A. Install the tie rod clamp bolts/screws (7) in the direction shown in Figure 8.
 - B. Rotate the inner and outer tie rod sockets rearward to the limit of the ball stud travel.
 - C. Position clamps (8) within the angles shown in Figure 8.
 - D. Slot in tie rod adjuster (11) must not be within the gap area of the clamping jaws.
 - E. Clamps (8) must be between and clear of the dimples before tightening nuts (9).

Tighten

- Nuts (9) to 19 N·m (14 lb. ft.).
4. Lower vehicle.

Adjust

- Toe to specification. Refer to SECTION 3A.

STEERING LINKAGE IDLER ARM

Figures 2, 7 and 9

Tools Required:

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)

Measure

- Vertical lash.
 - The idler arm should be replaced if vertical lash exceeds 3.2 mm (1/8 inch) when an up and down force of 110 newtons (25 pounds) is applied at the relay rod end of the idler arm.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (24) and nuts (25) connecting the idler arm support to the frame.
3. Nut (23) from ball stud connecting the idler arm (17) to the relay rod (14).
4. Idler arm (17) and seal (15) from relay rod (14) using J 24319-B.

Inspect

- Seal (15) for damage. Replace if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. The steering linkage assembly requires proper location of the idler arm (17) on its threaded support so that the idler arm ball socket will be level with the pitman arm ball socket. The idler arm support must be threaded into the idler arm bushing until the distance from the center of the lower mounting bolt hole is 59.44 mm +/- 1.60 mm (2.344 +/- 0.063 inches) from the top edge of the idler arm, refer to figure 9. The position of the idler arm must be adjusted before the idler arm (17) is installed in the vehicle. After adjusting, the idler arm support must be free to rotate 90 degrees in each direction.
2. Idler arm support to the frame with the attaching idler arm bolts/screws (24) and nuts (25).

Tighten

- Nuts (25) to 83 N·m (61 lb. ft.).
3. Relay rod (14) to idler arm (17) with seal (15).
 4. J 29193 to seat the tapers.

3B3-8 STEERING LINKAGE

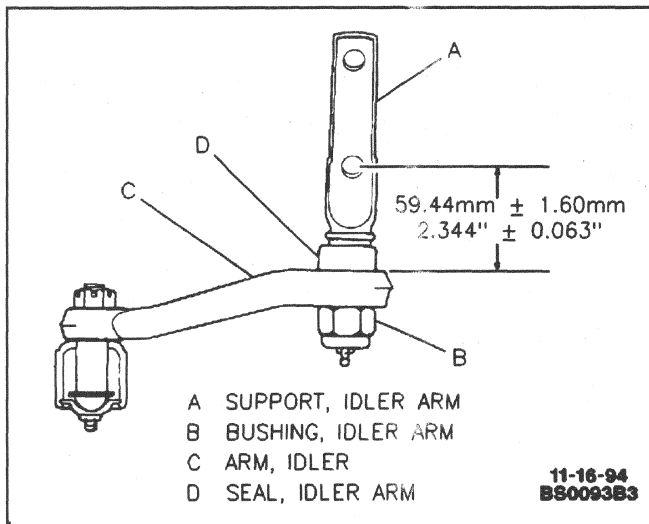


Figure 9 - Steering Linkage Idler Arm Adjustment

Tighten

- J 29193 to 20 N.m (15 lb. ft.).

5. Remove J 29193.

6. Nut (23) to the ball stud.

Tighten

- Nut (23) to 47 N.m (35 lb. ft.).

7. Lower vehicle.

Adjust

- Toe to specification. Refer to SECTION 3A.

PITMAN ARM

Figures 2 and 6

Tools Required:

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)
- J 9172 Pitman Arm Puller

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (5) from the pitman arm ball stud.
3. Relay rod (14) with seal (12) from pitman arm (13) using J 24319-B.
 - Move the steering linkage as required to free the pitman arm (13) from the relay rod (14).
4. Seal (12).

Inspect

- Seal (12) for damage. Replace if necessary.
5. Nut (27) and washer (26) from the pitman arm shaft.

NOTICE: Do not hammer on J 9172 as damage to the pitman arm may result.

6. Pitman arm (13) using J 9172.

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Make sure the front wheels are in the straight ahead position.
2. Pitman arm (13) on the pitman arm shaft.
3. New nut (27) and washer (26).

Tighten

- Nut (27) to 243 N.m (179 lb. ft.).

4. Seal (12) to relay rod (14).

5. Relay rod (14) to the pitman arm (13).

6. J 29193 to seat tapers.

Tighten

- J 29193 to 20 N.m (15 lb. ft.).

7. Remove J 29193.

8. Nut (5) to the ball stud.

Tighten

- Nut (5) to 47 N.m (35 lb. ft.).

9. Lower vehicle.

STEERING LINKAGE TIE ROD SEAL REPLACEMENT

Steering Linkage Outer Tie Rod Seal

Figure 2

Tools Required:

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Cotter pin (19) and nut (20) from the outer tie rod (10).
3. Outer tie rod (10) from the steering knuckle and hub (21) by using J 24319-B.
4. Pry the old seal (2) off the outer tie rod (10).

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Wipe the outer tie rod (10) clean.
2. Position a new seal (2) on the outer tie rod stud.
3. Firmly push the flange of the seal (2) over the seat of the housing.
4. Outer tie rod (10) to the steering knuckle and hub (21).

5. Nut (20).
 - A. Nut (20) to 47 N.m (35 lb. ft.).
 - B. Tighten nut (20) again just enough to align slot in outer tie rod (10) with hole in stud. Do not back off nut (20) to insert the cotter pin (19). Turn to the next hole.
6. Cotter pin (19).
7. Lower vehicle.

Steering Linkage Inner Tie Rod Seal

Figure 2

Tools Required:

- J 24319-B Universal Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (22) from the inner tie rod (3).
3. Inner tie rod (3) from the relay rod (14) using J 24319-B.
4. Pry the old seal (31) off inner tie rod (3).

Install or Connect

NOTICE: Refer to "Notice" on page 3B3-1 of this section.

1. Wipe the inner tie rod (3) clean.
2. Position a new seal (31) on the inner tie rod stud.
3. Firmly push the flange of the seal (31) over the seat on the housing.
4. Inner tie rod (3) to the relay rod (14).
5. Nut (22).
6. J 29193 to seat the tapers.

Tighten

- J 29193 to 20 N.m (15 lb. ft.).
7. Remove J 29193.
 8. Nut (22) to the ball stud.

Tighten

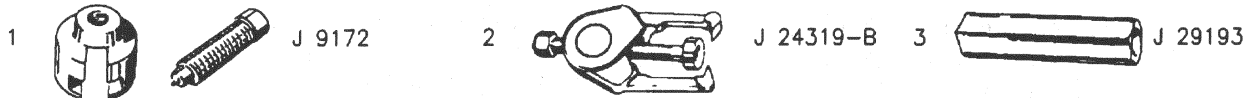
- Nut (22) to 47 N.m (35 lb. ft.).
9. Lower vehicle.

SPECIFICATIONS

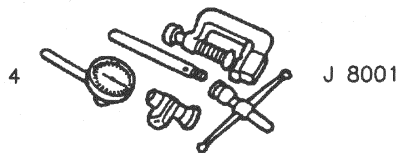
FASTENER TIGHTENING SPECIFICATIONS

Pitman Arm Nut.....	243 N.m (179 lb. ft.)
Steering Linkage Idler Arm Nut.....	83 N.m (61 lb. ft.)
Steering Linkage Inner Tie Rod Nut.....	47 N.m (35 lb. ft.)
Steering Linkage Outer Tie Rod Nut.....	47 N.m (35 lb. ft.)
Steering Linkage Relay Rod-to-Pitman Arm Nut.....	47 N.m (35 lb. ft.)
Steering Linkage Relay Rod-to-Steering Linkage Idler Arm Nut.....	47 N.m (35 lb. ft.)
Steering Linkage Shock Absorber Nut (at Frame).....	54 N.m (40 lb. ft.)
Steering Linkage Shock Absorber Nut (at Relay Rod).....	72 N.m (53 lb. ft.)
Steering Linkage Tie Rod Adjust Clamp Bolt/Screw.....	19 N.m (14 lb. ft.)
Steering Linkage Tie Rod Adjust Clamp Nut.....	19 N.m (14 lb. ft.)

SPECIAL TOOLS



- 1 PITMAN ARM PULLER
- 2 UNIVERSAL STEERING LINKAGE PULLER
- 3 STEERING LINKAGE INSTALLER (12 mm)
- 4 DIAL INDICATOR SET



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SECTION 3B5

VARIABLE EFFORT STEERING

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Do not start the vehicle with the inlet hose or outlet hose disconnected. When disconnected, cap or plug all openings of components. Failure to do so could result in contamination or loss of fluid and damage to the power steering system.

CONTENTS

General Description.....	3B5-1	Steering Wheel Rotation	
Variable Effort Steering Components and		Sensor	Refer to Section 3F
Operation	3B5-1	Power Steering Pump	Refer to Section 3B
Diagnosis	3B5-1	Power Steering Gear and Pump Unit	
Electrical Diagnosis.....	Refer to Section 8A-45	Repair	Refer to Section 3B1A
Mechanical/Hydraulic Diagnosis.....	3B5-2	Power Steering Control Module.....	3B5-4
On-Vehicle Service.....	3B5-3	Specifications.....	3B5-5
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Fitting, and Flow Control Valve	3B5-3		

GENERAL DESCRIPTION

VARIABLE EFFORT STEERING
COMPONENTS AND OPERATION

The variable effort power steering system, optional on Buick only, varies the power steering fluid flow rate from the pump with varying vehicle speeds. Maximum flow rate occurs at 1500 rpm pump speed (engine running a little faster than idle), and thereby minimizes steering effort. As the vehicle speed increases, the flow rate is decreased, thereby increasing the required steering effort which provides the driver with improved "road feel" and directional stability. The variable effort steering system is made up of the following components:

- Power Steering Control Module - Processes vehicle speed information and steering wheel rotation rate information from the steering wheel rotational sensor. It also provides the Pulse Width Modulated (PWM) signal to the power steering solenoid actuator located on the pump.
- Power Steering Solenoid Actuator - upon receiving a signal from the control module, the power steering solenoid actuator moves a pintle into the orifice in the pump to regulate the amount of fluid flow generated from the pump.

- Steering Wheel Rotational Sensor - Sends steering wheel speed information to the power steering control module, allowing full power steering assist during a quick maneuver (fast steering wheel movement).
- Inlet Hose - The inlet hose leads to a check valve on the steering gear. This valve reduces the amount of steering wheel kick when driving over irregular road surfaces, such as railroad tracks and chuck holes, while operating at speeds with reduced flow rate and pressure.

DIAGNOSIS

A variable effort steering electrical system malfunction will cause the power steering system to revert to full-time power assist. If the vehicle is experiencing this condition, refer to SECTION 8A-45. A mechanical/hydraulic steering system malfunction will cause the loss of power steering at all times and/or objectionable noises.

3B5-2 VARIABLE EFFORT STEERING

MECHANICAL/HYDRAULIC DIAGNOSIS

Figure 1

Tools Required:

- J 5176-D Power Steering Pressure Tester 0-2000 PSI and
- J 5176-92 Power Steering Pressure Tester Adapter and
- J 38391-2A Hose, or
- J 25323-A Power Steering System Analyzer and
- J 29525-92 Power Steering Analyzer 18 mm Adapter

If a hydraulic or mechanical malfunction of the pump or steering gear is suspected, perform the following procedure to determine the cause:

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Disconnect inlet hose at steering gear.
 - Place drain pan under steering gear to catch any power steering fluid which may leak.
3. Disconnect power steering solenoid actuator electrical connector.
4. Disconnect idle speed control switch electrical connector.
5. Lower vehicle.
6. Connect J 5176-D, J 5176-92, and J 38391-2A, or J 25323-A and J 29525-92 to steering gear and inlet hose.
 - The power steering system may be tested using J 5176-D or J 25323-A. Testing with J 25323-A will measure flow rate as well as pressure.
7. Open pressure tester valve on J 5176-D or J 25323-A.

CAUTION: After connecting J 5176-D or J 25323-A, ensure that hoses do not contact serpentine belt or pulleys. Personal injury may result.

8. Bleed power steering system. Refer to SECTION 3B.

9. Start engine and allow engine to reach normal operating temperature.

10. With engine at idle and pressure tester valve open on J 5176-D or J 25323-A, pressure should be no more than 1 034 kPa (150 psi).

- If the pressure is more than 1 034 kPa (150 psi), check the inlet and outlet hoses for restrictions and the check valve on the steering gear for proper assembly.

NOTICE: Do not leave the pressure tester valve fully closed for more than 5 seconds as the pump could be damaged.

11. Fully close the pressure tester valve on J 5176-D or J 25323-A three times and record the pressure reading each time. Each reading should be at least 6 895 kPa (1,000 psi). The three readings should be within 345 kPa (50 psi) of each other.

- If the pressure readings are high enough and are within 345 kPa (50 psi) of each other, the pump is functioning properly.

- If the pressure readings are high enough, but are not within 345 kPa (50 psi) of each other, the hydraulic pump flow control valve in the pump is sticking.

- Remove the control valve, clean it and remove any burrs using crocus cloth or fine hone.

- If the power steering system contains some contamination, flush it. Refer to SECTION 3B.

- If the pressure readings are less than 6 895 kPa (1,000 psi), replace the valve and recheck.

- If pressures are still low, replace the rotor and vanes.

- If the pump checks to specification, leave the control valve open and turn the steering wheel (or have someone else turn it) to both stops.

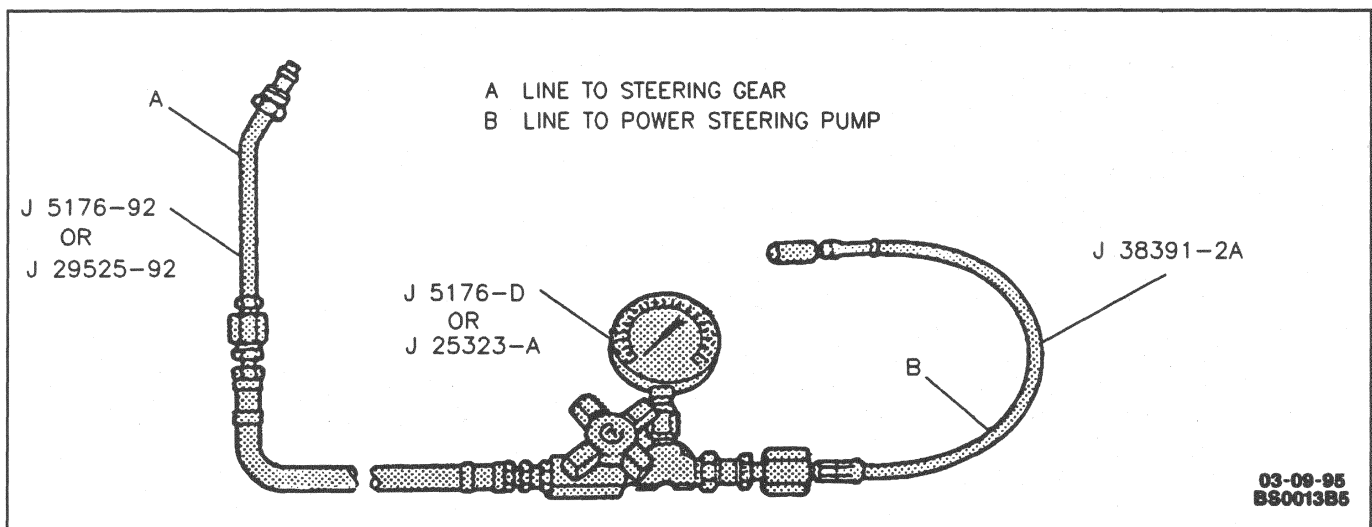


Figure 1 - Power Steering Pressure Tester

- Record the highest pressures and compare with the highest pump pressure recorded earlier.
 - If the pressure at both stops is not the same as maximum pressure, the steering gear is leaking internally and must be repaired. Refer to SECTION 3B1A.

- Turn off the engine.
- Remove J 5176-D, J 5176-92 and J 38391-2A, or J 25323-A and J 29525-92.
- Connect idle speed control switch electrical connector.
- Raise and suitably support vehicle. Refer to SECTION 0A.
- Connect power steering solenoid actuator electrical connector.
- Connect inlet hose to steering gear, and tighten fitting at pump if loosened.



Tighten

- Inlet hose fittings to 28 N.m (21 lb. ft.).
- Lower Vehicle
 - Bleed the power steering system. Refer to SECTION 3B.

ON-VEHICLE SERVICE

CHECKING AND ADDING FLUID

Power steering fluid level is indicated by marks on an indicator on the reservoir cap.

NOTICE: When adding power steering fluid or making a complete fluid change, always use power steering fluid specified in SECTION 0B. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

If the fluid is warmed up, about 77° C (170° F)-hot to the touch, the fluid level should be at the "H" mark. If the fluid is cool, about 21° C (70° F), the fluid level should be at the "C" mark.

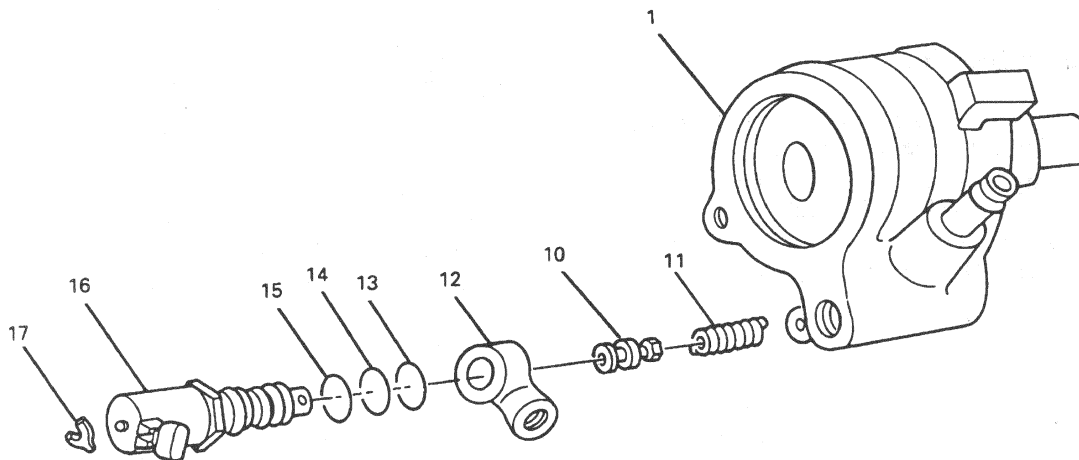
POWER STEERING SOLENOID ACTUATOR, DISCHARGE FITTING, AND FLOW CONTROL VALVE

Figures 2 and 3



Remove or Disconnect

- Power steering pump. Refer to SECTION 3B.
- Match mark power steering pump (1) and discharge fitting (12).
- Retaining clip (17), solenoid actuator (16), and discharge fitting (12) from pump (1).
 - Note the position of the actuator electrical terminal for proper placement during installation.
- Discharge fitting (12) from solenoid actuator (16).
- O-Ring seals (13, 14, and 15) from solenoid actuator (16).
- Flow control valve (10) and spring (11), if necessary, using a magnet.



- | | |
|--|--|
| 1 PUMP, POWER STEERING | 13 SEAL, POWER STEERING PUMP ACTUATOR (O-RING) |
| 10 VALVE, HYDRAULIC PUMP FLOW CONTROL | 14 SEAL, POWER STEERING PUMP ACTUATOR (O-RING) |
| 11 SPRING, HYDRAULIC PUMP FLOW CONTROL VALVE | 15 SEAL, POWER STEERING PUMP ACTUATOR (O-RING) |
| 12 FITTING, VARIABLE EFFORT STEERING DISCHARGE | 16 ACTUATOR, POWER STEERING PUMP 62 N•m (46 LB. FT.) |
| | 17 CLIP, VARIABLE EFFORT STEERING RETAINING |

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Figure 2 - Power Steering Pump Flow Control Valve and Pump Actuator

3B5-4 VARIABLE EFFORT STEERING

Install or Connect

NOTICE: Refer to "Notice" on page 3B5-1 of this section.

1. Spring (11) and flow control valve (10), if removed.
2. Lubricate O-ring seals (13, 14, and 15) with power steering fluid, GM P/N 1050017 or equivalent, meeting GM specification number 9985010.
3. O-ring seals (13, 14, and 15) to solenoid actuator (16).
4. Discharge fitting (12) to solenoid actuator (16).
5. Solenoid actuator (16) and discharge fitting (12) to pump (1).
 - Align match marks on discharge fitting (12) and power steering pump (1).
 - If either pump (1) or fitting (12) were replaced, refer to Figure 3 for correct fitting orientation.

Tighten

- Solenoid actuator (16) to 62 N.m (46 lb. ft.).
6. Retaining clip (17) to correctly positioned solenoid actuator (16).
 - Position solenoid actuator electrical connector so that connector is facing directly to the right of the vehicle (away from the engine) when pump (1) is in installed position.
 7. Power steering pump. Refer to SECTION 3B.

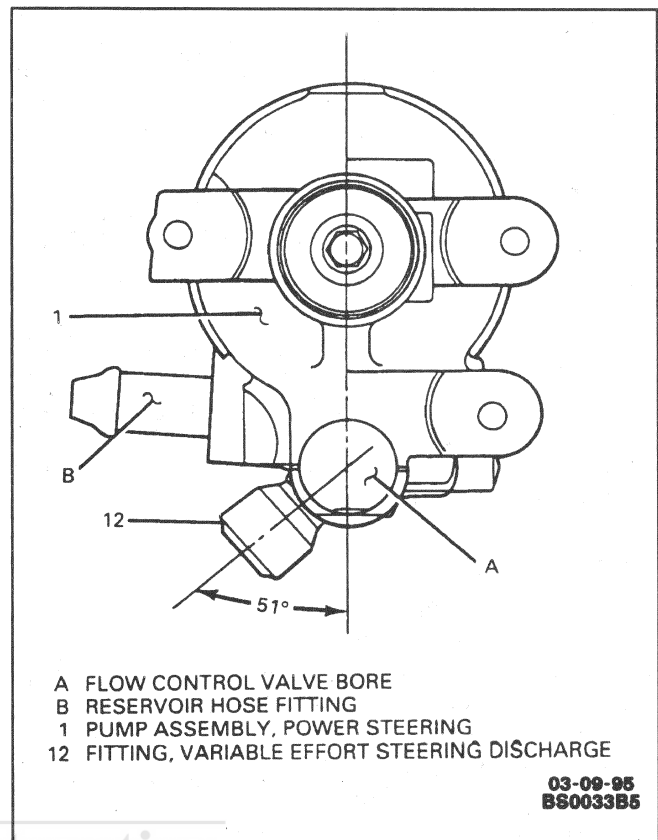


Figure 3 - Variable Effort Steering Discharge Fitting Orientation

Install or Connect

NOTICE: Refer to "Notice" on page 3B5-1 in this section.

1. Two bolts/screws (22) attaching power steering control module (20) to bracket (21).

Tighten

- Bolts/screws (22) to 1.9 N.m (17 lb. in.).
2. Power steering control module connector to power steering control module (20).
 3. Speed alert, seat belt, ignition key, lamps and turn signal alarm to convenience center.

POWER STEERING CONTROL MODULE

Figure 4

Remove or Disconnect

1. Speed alert, seat belt, ignition key, lamps and turn signal alarm at convenience center.
2. Power steering control module connector from power steering control module (20).
3. Two bolts/screws (22) attaching power steering control module (20) to bracket (21).

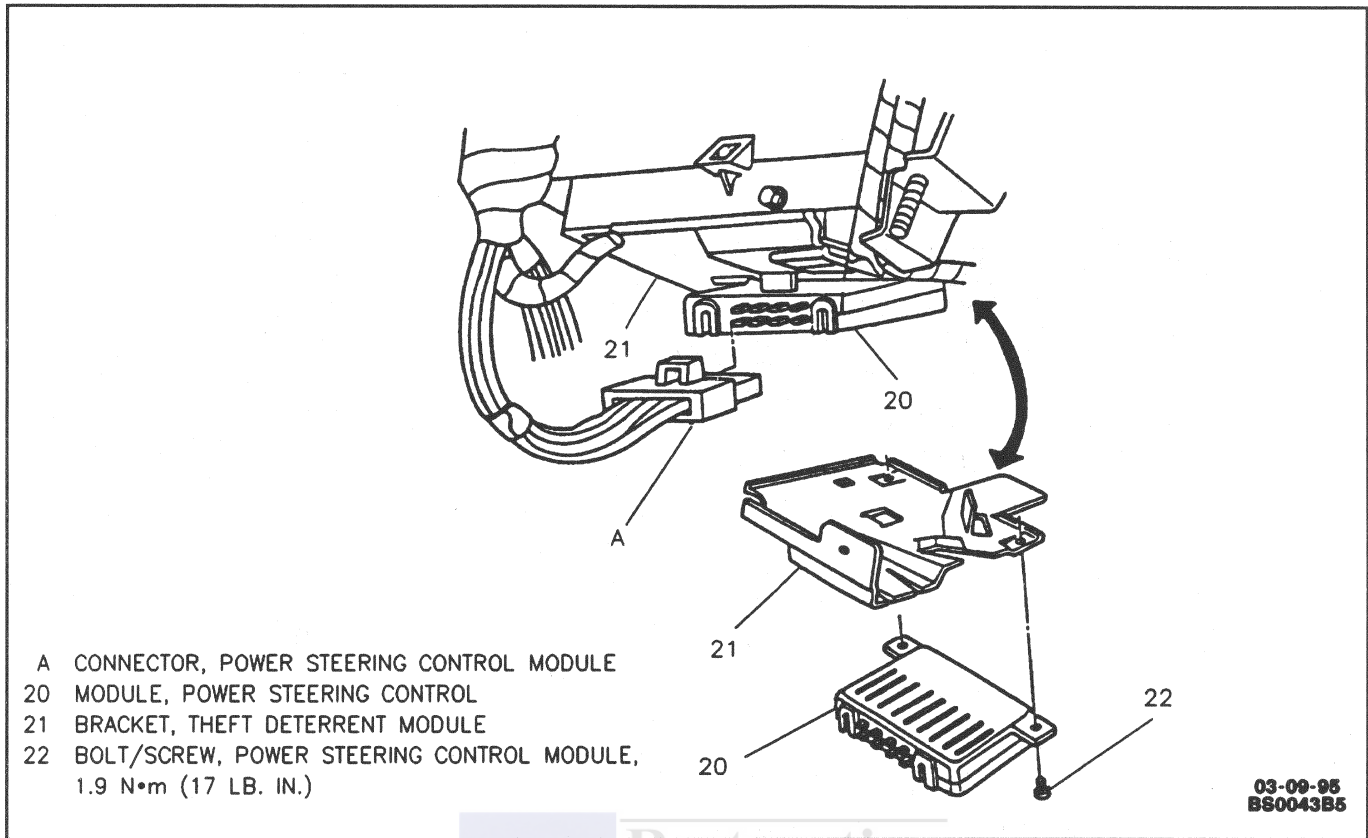


Figure 4 - Power Steering Control Module

SPECIFICATIONS

GENERAL SPECIFICATIONS

Power Steering Fluid Requirement.....Refer to SECTION 0B

FITTING TIGHTENING SPECIFICATIONS

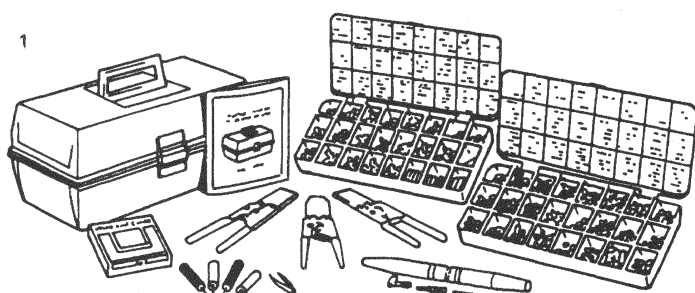
Power Steering Gear Inlet Hose-to-Power Steering Pump Fitting..... 28 N•m (21 lb. ft.)

Power Steering Solenoid Actuator..... 62 N•m (46 lb. ft.)

FASTENER TIGHTENING SPECIFICATIONS

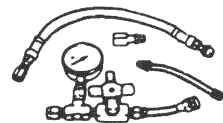
Power Steering Control Module Bolt/Screw.....1.9 N•m (17 lb. in.)

SPECIAL TOOLS

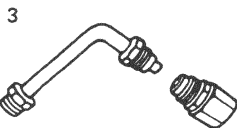


J38125-A

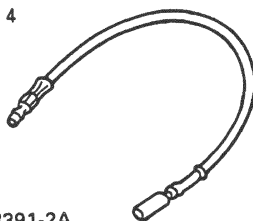
2



J 5176-D

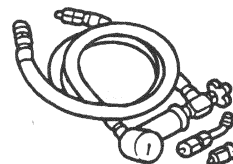


J 5176-92



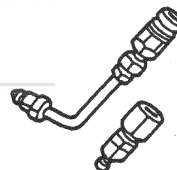
J 38391-2A

5



J 25323-A

6



J 29525-92

- 1. TERMINAL REPAIR KIT
- 2. POWER STEERING PRESSURE TESTER 0-2000 PSI
- 3. POWER STEERING PRESSURE TESTER ADAPTER
- 4. HOSE ASSEMBLY
- 5. POWER STEERING SYSTEM ANALYZER
- 6. POWER STEERING ANALYZER 18 mm ADAPTER

GM Restoration Parts

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SECTION 3C

FRONT SUSPENSION

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The front suspension is designed to allow each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel (Figures 1 and 2). Each wheel is independently connected to the frame by a steering knuckle, control arm ball studs, and control arms. The control arms are specifically designed and positioned to allow the steering knuckles to move in a prescribed three-dimensional arc. The front wheels are held in proper relationship to each other by two tie rods which are connected to steering arms on the steering knuckles and to the relay rod.

Front springs are mounted between the spring housings on the frame and the lower control arms. Ride control is provided by double, direct acting shock absorbers mounted inside the front springs and attached to the lower control arms. The upper portion of each shock absorber extends through the front spring housing and is secured with two insulators, two insulator retainers and a nut.

Side roll of the front suspension is controlled by a spring steel stabilizer shaft. It is mounted to the frame with insulators which prevent road noise from being transmitted to the frame. The ends of the stabilizer shaft are connected to the lower control arms

with links. Stabilizer shaft link insulators at these connections provide flexibility and ride features. The upper control arm is attached to an upper control arm pivot shaft through upper control arm bushings. The upper control arm pivot shaft, in turn, is bolted to frame brackets. An upper control arm ball stud is riveted to the outer end of the upper control arm. It is pre-loaded by a rubber spring to insure proper seating of the ball in the socket. The upper control arm ball stud is attached to the steering knuckle by a taper-lock feature and a nut retained with a cotter pin.

The inner ends of the lower control arm have pressed-in bushings. Control arm bolts/screws, passing through the bushings, attach the lower control arm to the frame. The lower control arm ball stud is a press fit in the lower control arm and attaches to the steering knuckle using a taper-lock feature and a nut that is retained with a cotter pin.

Rubber grease seals are used at control arm ball studs to keep dirt and moisture from entering and damaging the ball stud bearing surfaces.

3C-2 FRONT SUSPENSION

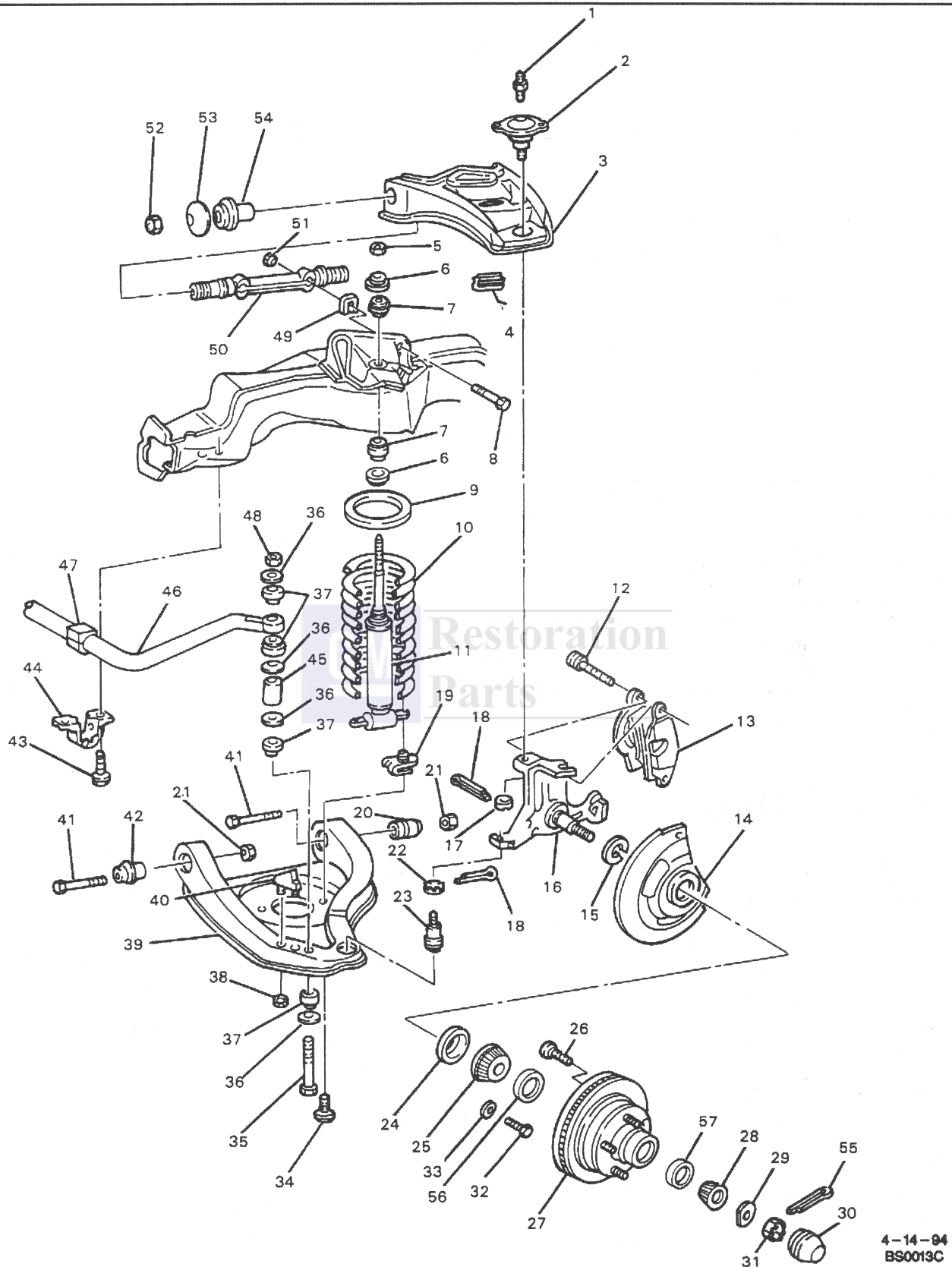


Figure 1 - Front Suspension Components

- | | | | |
|----|-------------------------------------|----|--|
| 1 | FITTING, FRONT SUSPENSION LUBRICANT | 30 | CAP, FRONT WHEEL BEARING LUBRICANT |
| 2 | STUD, FRONT UPPER CONTROL ARM BALL | 31 | NUT, FRONT WHEEL BEARING |
| 3 | ARM, FRONT UPPER CONTROL | 32 | BOLT/SCREW, FRONT BRAKE SHIELD |
| 4 | BUMPER, FRONT UPPER CONTROL ARM | 33 | WASHER, SPRING LOCK |
| 5 | NUT, FRONT SHOCK ABSORBER | 34 | BOLT/SCREW, FRONT SHOCK ABSORBER |
| 6 | RETAINER, FRONT SHOCK ABSORBER | 35 | BOLT/SCREW, FRONT STABILIZER SHAFT |
| 7 | INSULATOR, FRONT SHOCK ABSORBER | 36 | RETAINER, FRONT STABILIZER SHAFT INSULATOR |
| 8 | BOLT/SCREW, FRONT UPPER CONTROL ARM | 37 | INSULATOR, FRONT STABILIZER SHAFT LINK |
| 9 | INSULATOR, FRONT SPRING | 38 | NUT, FRONT LOWER CONTROL ARM BUMPER |
| 10 | SPRING, FRONT | 39 | ARM, FRONT LOWER CONTROL |
| 11 | ABSORBER, FRONT SHOCK | 40 | BUMPER, FRONT LOWER CONTROL ARM |
| 12 | BOLT/SCREW, FRONT BRAKE CALIPER | 41 | BOLT/SCREW, FRONT LOWER CONTROL ARM |
| 13 | HOUSING, FRONT BRAKE CALIPER | 42 | BUSHING, FRONT LOWER CONTROL ARM |
| 14 | SHIELD, FRONT BRAKE | 43 | BOLT/SCREW, FRONT STABILIZER SHAFT CLAMP |
| 15 | GASKET, FRONT BRAKE SHIELD | 44 | CLAMP, FRONT STABILIZER SHAFT |
| 16 | KNUCKLE, STEERING | 45 | SPACER FRONT STABILIZER SHAFT RETAINER |
| 17 | NUT, STEERING KNUCKLE | 46 | SHAFT, FRONT STABILIZER |
| 18 | PIN, STEERING KNUCKLE COTTER | 47 | INSULATOR, FRONT STABILIZER SHAFT |
| 19 | NUT, FRONT SHOCK ABSORBER | 48 | NUT, FRONT STABILIZER SHAFT |
| 20 | BUSHING, FRONT LOWER CONTROL ARM | 49 | SHIM, FRONT UPPER CONTROL ARM |
| 21 | NUT, FRONT LOWER CONTROL ARM | 50 | SHAFT, FRONT UPPER CONTROL ARM PIVOT |
| 22 | NUT, STEERING KNUCKLE | 51 | NUT, FRONT UPPER CONTROL ARM PIVOT SHAFT |
| 23 | STUD, FRONT LOWER CONTROL ARM BALL | 52 | NUT, FRONT UPPER CONTROL ARM |
| 24 | SEAL, FRONT WHEEL HUB | 53 | RETAINER, FRONT UPPER CONTROL ARM BUSHING |
| 25 | BEARING, FRONT WHEEL INNER | 54 | BUSHING, FRONT UPPER CONTROL ARM |
| 26 | BOLT, FRONT WHEEL | 55 | PIN, FRONT WHEEL BEARING NUT COTTER |
| 27 | ROTOR, FRONT BRAKE | 56 | RACE, FRONT WHEEL INNER |
| 28 | BEARING, FRONT WHEEL OUTER | 57 | RACE, FRONT WHEEL OUTER |
| 29 | WASHER, FRONT WHEEL BEARING | | |

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Figure 2 - Front Suspension Components -Legend

ON-VEHICLE SERVICE

CONTROL ARM BALL STUD CHECKING

Before checking control arm ball studs, the front wheel bearings must first be properly adjusted. Refer to "Front Wheel Bearing Adjustment" in this section.



Inspect

- Boots for cuts or tears. Whenever cuts or tears are found, the control arm ball stud **MUST** be replaced.

Lower Control Arm Ball Stud

Figure 3

The lower control arm ball stud has a visual wear indicator. Checking the condition of the lower control arm ball stud is a simple procedure but must be followed accurately to prevent unnecessary replacement.



Inspect

- Vehicle must be supported by the wheels so that weight of vehicle will properly load the ball studs.
- The ball stud is inspected for wear by visual observation alone. Wear is indicated by the position of the 12.7 mm (0.50 inch) diameter nipple into which the front suspension lubricant fitting is threaded. This round nipple projects

1.27 mm (0.050 inch) beyond the surface of the ball stud cover when new. Normal wear will result in the surface of this nipple retreating very slowly inward.

- Wipe the front suspension lubricant fitting and nipple free of dirt and grease. Observe or scrape a screwdriver or fingernail across the cover. If the round nipple is flush or inside the cover surface, replace the ball stud (Figure 3).

Upper Control Arm Ball Stud

Figure 4



Inspect

- Raise the vehicle and position floor stands under the left and right lower control arm as near as possible to each ball stud. Refer to SECTION 0A.



Important

- Vehicle must be stable and should not rock on the floor stands.
 - Upper control arm bumper must not contact frame.
- Position dial indicator against the wheel rim (Figure 4).
 - Grasp wheel, and push in on bottom of tire while pulling out at the top (Figure 4). Read gage, then reverse the push-pull procedure. Horizontal deflection on dial indicator should not exceed 3.18 mm (0.125 inch).

FRONT LOWER CONTROL ARM BALL STUD WEAR INDICATOR

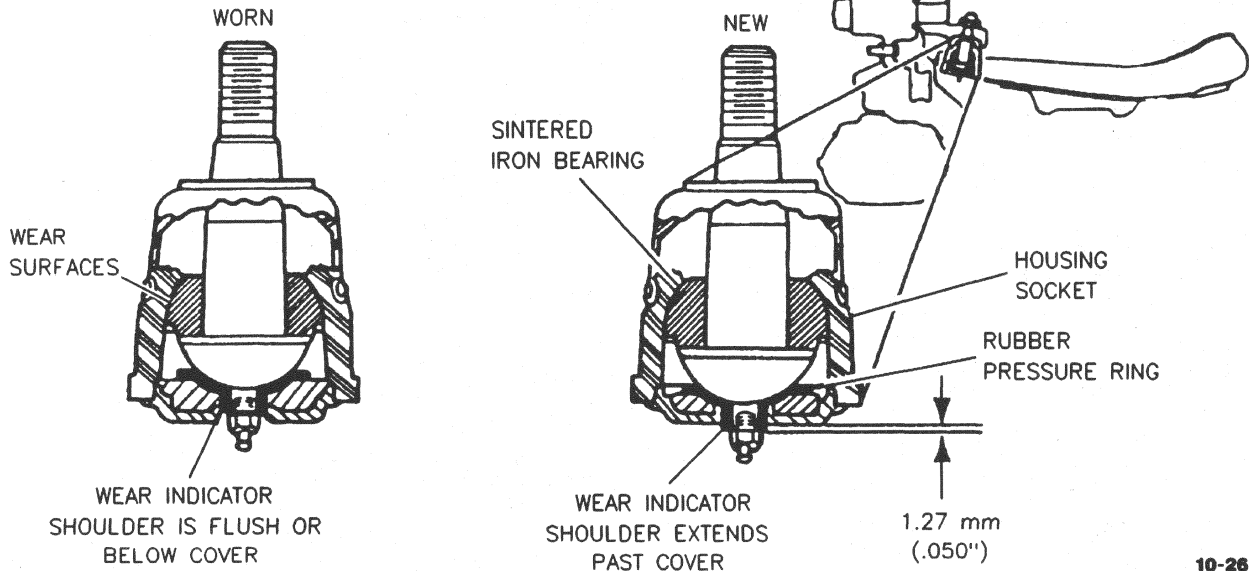


Figure 3 - Front Lower Control Arm Ball Stud Wear Indicator

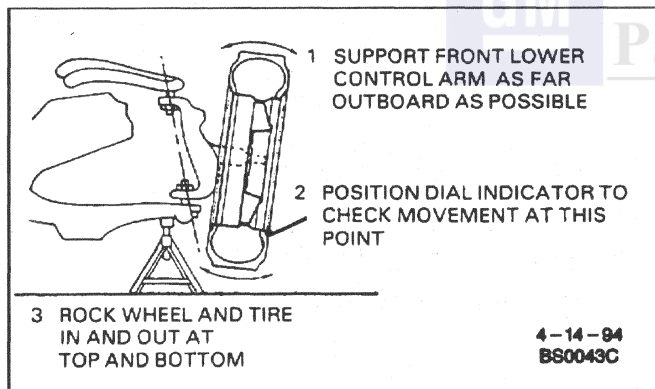


Figure 4 - Checking Front Upper Control Arm Ball Stud

- If the dial indicator reading exceeds 3.18 mm (0.125 inch), replace the ball stud.
- 4. Anytime the ball stud is disconnected from the steering knuckle, check for looseness or if the ball stud can be twisted in its socket with your fingers. If either of these conditions exists, replace the ball stud.
- 5. Lower vehicle.

CONTROL ARM BALL STUD REPLACEMENT

Lower Control Arm Ball Stud

Figures 5 through 8

↔ Remove or Disconnect

Tools Required:

- J 23742 Ball Joint Separator
- J 9519-30 Ball Joint Fixture
- J 9519-16 Ball Joint Installer
- J 21474-13 Control Arm Bushing Installer

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Place floor jack under lower control arm spring seat.

! Important

- Floor jack must remain under lower control arm spring seat during removal and installation to retain front spring and lower control arm in position.
- 4. To disconnect the ball stud from the steering knuckle, remove the cotter pin and ball stud nut. J 23742 can be used to separate the ball stud from the steering knuckle (Figure 5).

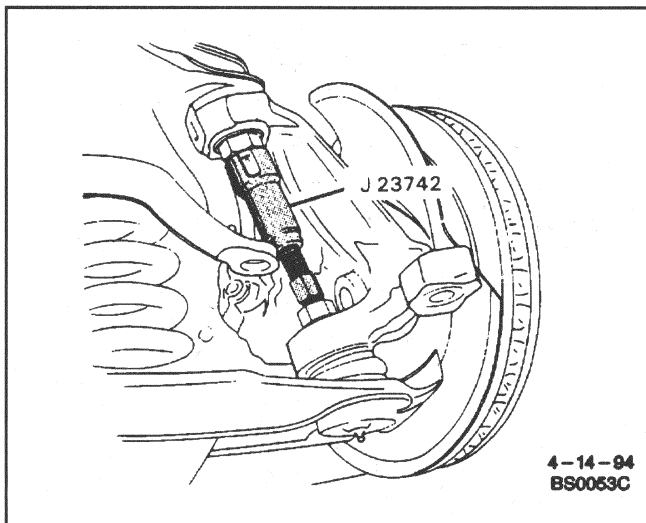


Figure 5 - Disconnecting Front Lower Control Arm Ball Stud

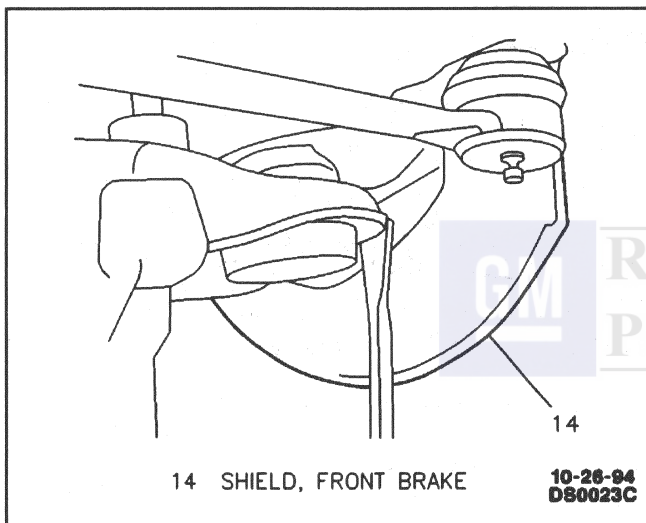


Figure 6 - Guiding Front Lower Control Arm Past Front Brake Shield

5. Guide lower control arm out of opening in brake shield with a putty knife or similar tool (Figure 6).
6. Block steering knuckle out of the way by placing a wooden block between frame and upper control arm.

Inspect

- The tapered hole in the steering knuckle. If out-of-roundness, deformation or damage is noted, the steering knuckle must be replaced.
7. Lower control arm ball stud lubricant fittings.
 8. Install J 9519-16, J 9519-30 and J 21474-13 (Figure 7).
 9. Ball stud from lower control arm.

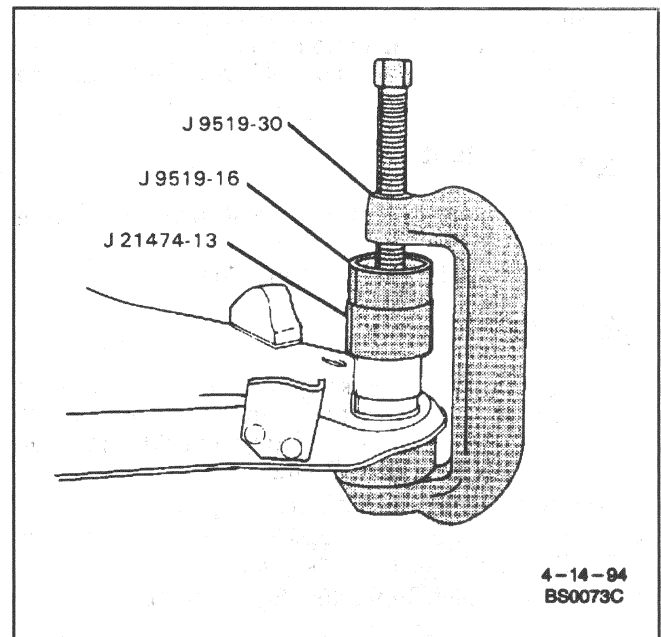


Figure 7 - Removing Front Lower Control Arm Ball Stud

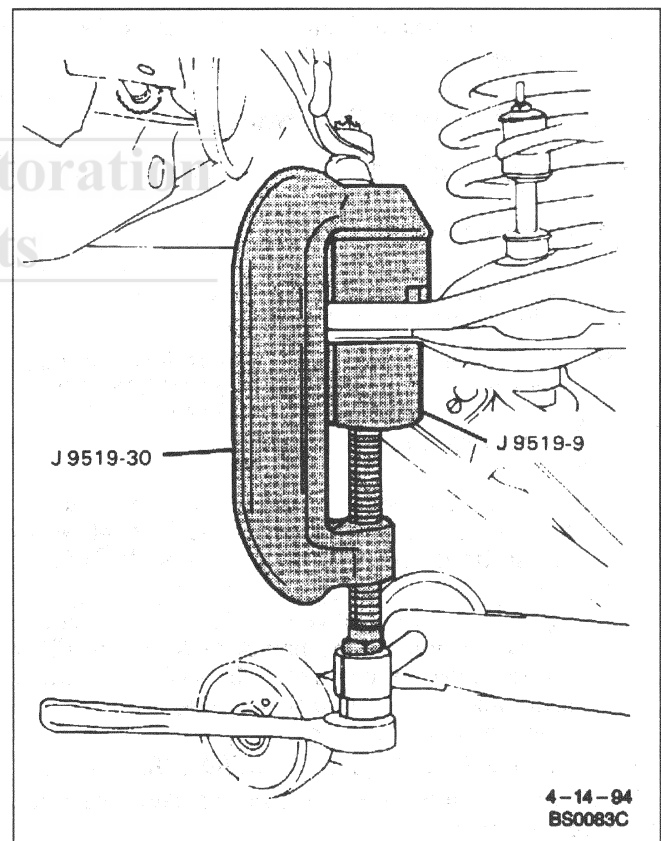


Figure 8 - Installing Front Lower Control Arm Ball Stud

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

Tools Required:
 J 9519-9 Ball Joint Installer
 J 9519-30 Ball Joint Fixture

3C-6 FRONT SUSPENSION

1. Position ball stud into lower control arm and press ball stud in until it bottoms on the lower control arm, using J 9519-9 and J 9519-30 as illustrated in Figure 8.

Important

- Grease purge (hole) in seal must be facing inboard.
2. Place ball stud in steering knuckle.

Tighten

- Lower steering knuckle and hub nut to 112 N.m (83 lb. ft.). Then tighten enough to align slot in lower steering knuckle and hub nut with hole in ball stud.
3. Steering knuckle and hub cotter pin.
 4. Front suspension lubricant fitting and lubricate until grease appears at the seal.
 5. Tire and wheel. Refer to SECTION 3E.

Adjust

- Wheel alignment. Refer to SECTION 3A.
6. Lower vehicle.

Upper Control Arm Ball Stud

Figures 9 through 13

Remove or Disconnect

Tools Required:
J 23742 Ball Joint Separator

1. Raise front of vehicle and support lower control arm with floor stands. Refer to SECTION 0A.

Important

- Floor jack or stand must remain under lower control arm during removal and installation to retain front spring and lower control arm in position.
 - The weight of the vehicle is used to relieve spring tension on the upper control arm. Floor stands must be positioned between the spring seats and lower control arm ball studs of the front lower control arms.
2. Tire and wheel. Refer to SECTION 3E.
 3. Loosen the upper control arm ball stud from the steering knuckle:
 - A. Remove cotter pin (18) and nut (17).
 - B. Install J 23742 (Figure 9).
 - C. Apply pressure on upper control arm ball stud by expanding the tool until the ball stud breaks loose.
 - D. Remove J 23742, then pull upper control arm ball stud free from steering knuckle. Support the steering knuckle to prevent weight of the steering knuckle from damaging the front brake hose or wheel speed sensor wire.

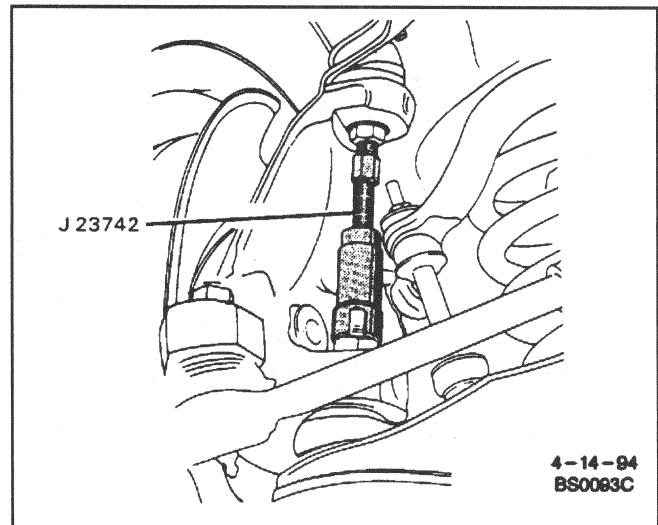


Figure 9 - Disconnecting Front Upper Control Arm Ball Stud

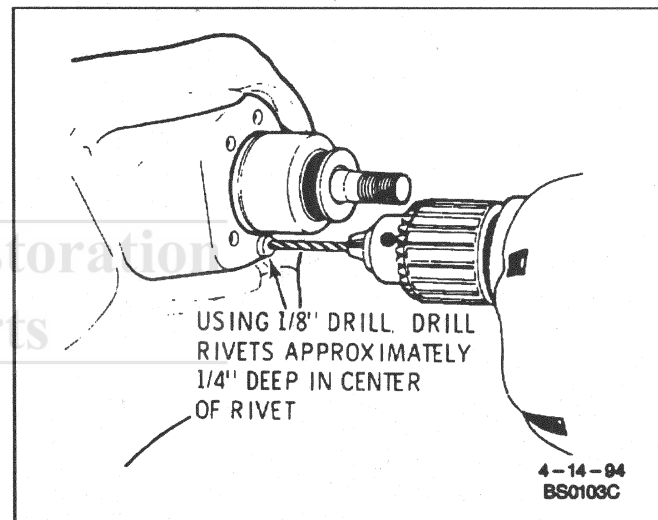


Figure 10 - Drilling Front Upper Control Arm Ball Stud Rivet

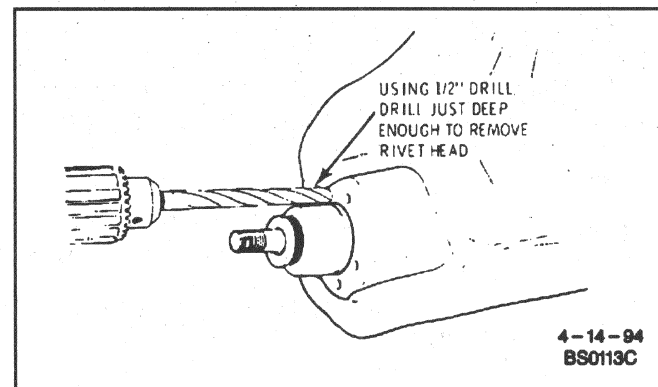


Figure 11 - Drilling Front Upper Control Arm Ball Stud Rivet Heads

4. With upper control arm in the raised position, drill out four rivets approximately 6 mm (1/4 inch) deep, using a 1/8-inch drill bit (Figure 10).
5. Drill off rivet heads, using a 1/2-inch drill bit (Figure 11).

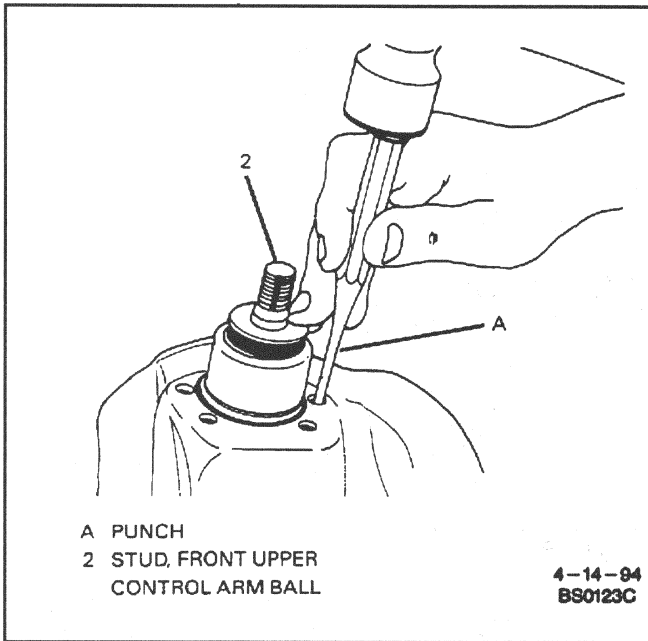


Figure 12 - Removing Front Upper Control Arm Ball Stud

6. Punch out rivets, using a small punch, and remove ball stud (Figure 12).

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

1. Position new upper control arm (3) and install the four service kit bolts (64) and service kit nuts (63) (Figure 13). Use specifications in ball joint kit.
2. Remove the temporary support from steering knuckle, then connect ball stud (2) to steering knuckle (16).

Tighten

- Nut (17) to 83 N·m (61 lb. ft.), then tighten to align the slot in the nut (17) with the hole in the ball stud (2).
3. Cotter pin (18).
 4. Remove jackstands from lower control arms.
 5. Front suspension lubricant fitting and lubricate until grease appears at the seal.
 6. Tire and wheel. Refer to SECTION 3E.
 7. Lower vehicle.

Adjust

- Wheel alignment. Refer to SECTION 3A.

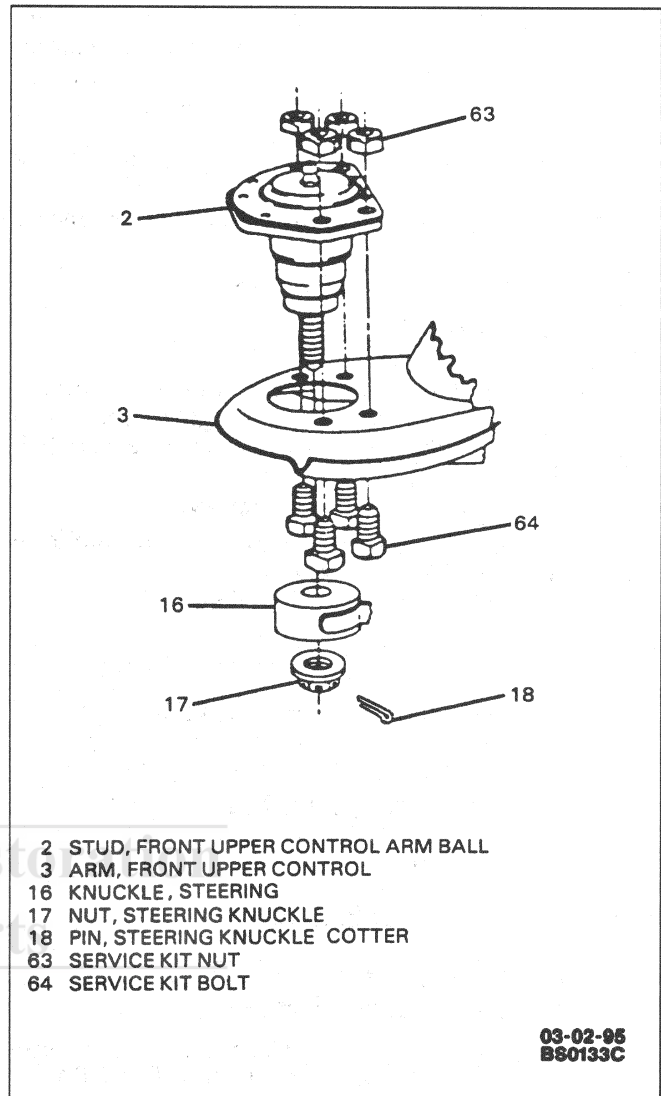


Figure 13 - Front Upper Control Arm Ball Stud Attachment

FRONT WHEEL BEARINGS AND SEALS

Figures 14 through 17

Remove or Disconnect

Tool Required:

J 29117-A Wheel Bearing Cup Remover

1. Front brake rotor. Refer to "Front Brake Rotor" in this section.
2. The outer bearing (28) from front brake rotor (27). The inner bearing (25) will remain in the front brake rotor (27) and may be removed after prying out the hub seal (24). Discard hub seal (24).
3. Drive out old inner and outer races (56 and 57) from front brake rotor (27) with a drift or J 29117-A inserted behind inner and outer races (56 and 57) (Figure 15).

3C-8 FRONT SUSPENSION

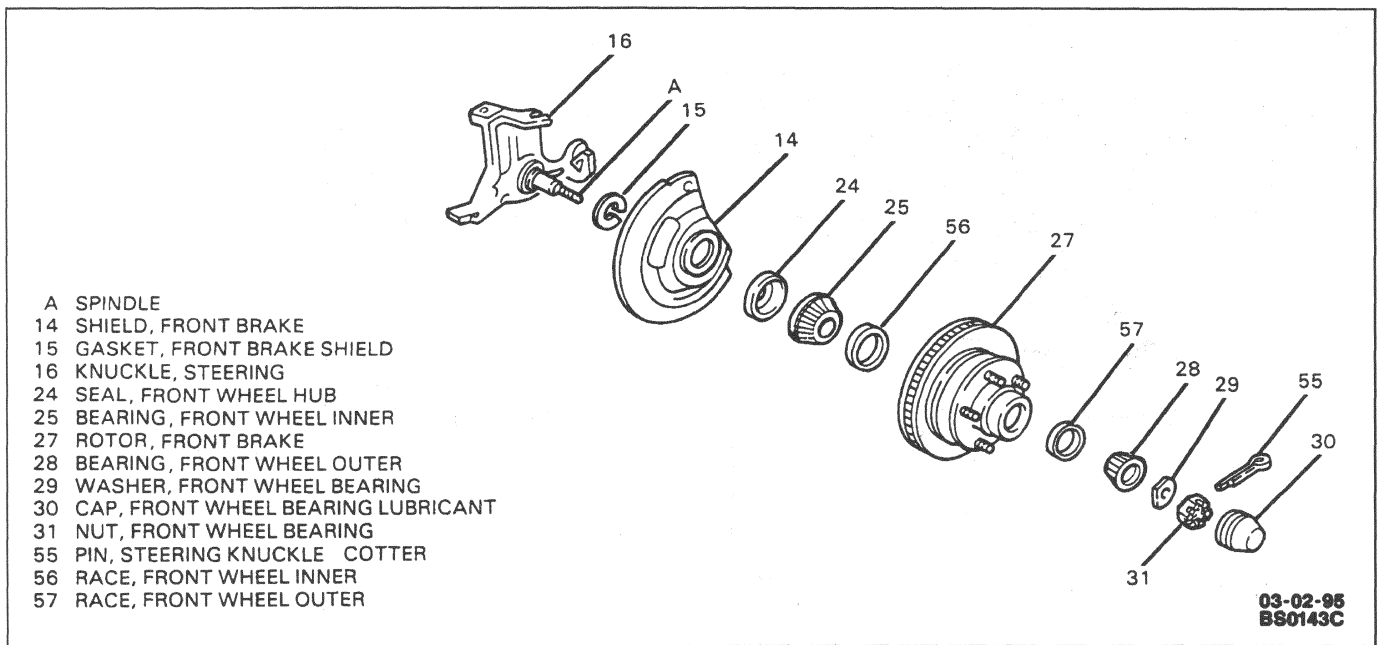


Figure 14 - Steering Knuckle and Front Brake Rotor

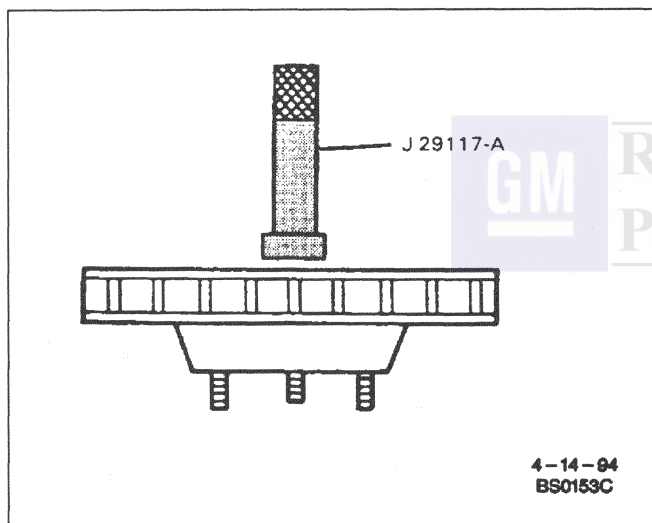


Figure 15 - Removing Front Wheel Inner and Outer Bearings



Clean

- All grease from the front brake rotor (27) and spindle, and thoroughly clean out any grease in the inner and outer bearings (25 and 28). Use clean solvent. Use a small brush with no loose bristles to clean out all old grease.

NOTICE: Do not spin the inner or outer bearing assemblies with compressed air while drying or the bearings may be damaged.



Inspect

- Inner and outer bearings for cracked cage and worn or pitted rollers.
- Inner and outer races for cracks, scores or a brinelled condition. Refer to SECTION 3.

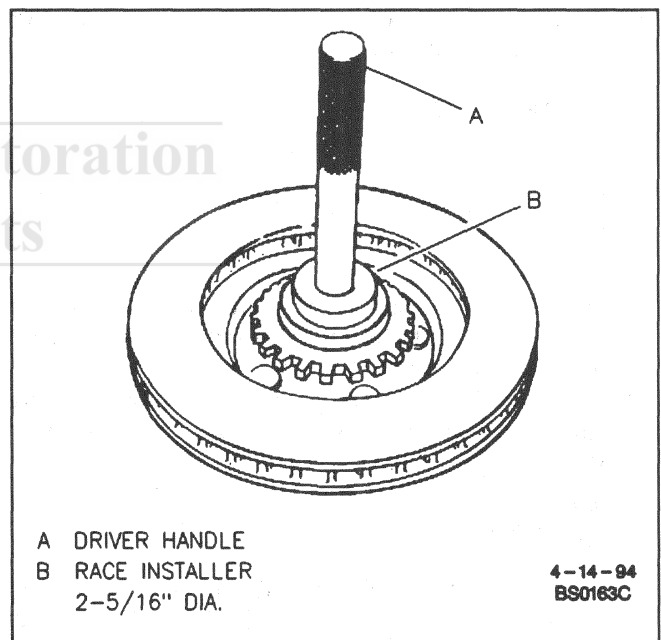


Figure 16 - Installing Front Wheel Inner Bearing Outer Race

- Steering knuckle spindle for excess wear or rough bearing seating area. Replace steering knuckle if necessary.



Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

Tool Required:
 J 33067 Wheel Bearing Packer

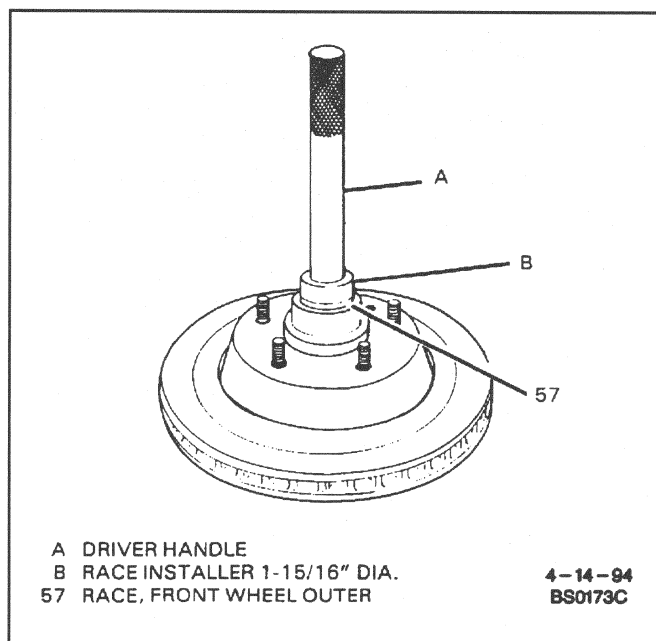


Figure 17 - Installing Front Wheel Outer Bearing Outer Race

1. If the inner and outer races (56 and 57) were removed, drive or press the inner and outer races (56 and 57) into the front brake rotor (27) (Figures 16 and 17).
2. Use an approved high temperature wheel bearing grease. Do not mix greases, mixing may change the grease properties and result in poor performance.
3. Apply a thin film of grease to the spindle at the outer bearing seat and at the inner bearing seat, shoulder, and seal seat.
4. Put a small quantity of grease inboard of each inner and outer bearing cup in the hub. This can be applied with your finger, forming a dam to provide extra grease availability to the inner and outer bearings (25 and 28) and to keep thinned grease from flowing out of the inner and outer bearings (25 and 28).

NOTICE: If hand packing is used, it is extremely important to work the grease thoroughly into the inner and outer bearings between the rollers, cone, and the cage. Failure to do this could result in premature bearing failure.

5. Fill the inner and outer bearing cone and rollers full of grease, using J 33067. If a tool is not available, the inner and outer bearings (25 and 28) can be packed by hand.
6. Place the inner bearing cone and roller in the front brake rotor (27). Then using your finger, put an additional quantity of grease outboard of the inner bearing (25).
7. Install a new hub seal (24) using a flat plate until the hub seal (24) is flush with the front brake rotor (27). Lubricate the lip of the hub seal (24) with a thin layer of grease.

8. Carefully install the front brake rotor, front wheel bearing washer and front wheel bearing nut.



Tighten

- Initially torque the front wheel bearing nut to 16 N.m (12 lb. ft.) while turning the front brake rotor forward by hand.
9. Put an additional quantity of grease outboard of the outer bearing (28). This provides extra grease availability to the outer bearing.
 10. Front brake rotor. refer to "Front Brake Rotor" in this section.



Adjust

- Front wheel bearings. Refer to "Front Wheel Bearing Adjustment" in this section.

SPRINGS

Figures 18 through 21



Remove or Disconnect

Tool Required:

J 6627-A Tie Rod Puller

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Wheel speed sensor and secure. Refer to SECTION 5E1.
4. Shock absorber. Refer to "Shock Absorbers" in this section.
5. Stabilizer shaft linkage from lower control arm. Refer to "Stabilizer Shaft and Insulators" in this section.
6. Steering linkage outer tie rod cotter pin.
7. Steering linkage outer tie rod nut.
8. Steering knuckle from steering linkage outer tie rod end, using J 6627-A (Figure 18).
9. Install universal spring compressor (Figure 19).
 - Compress spring (10).

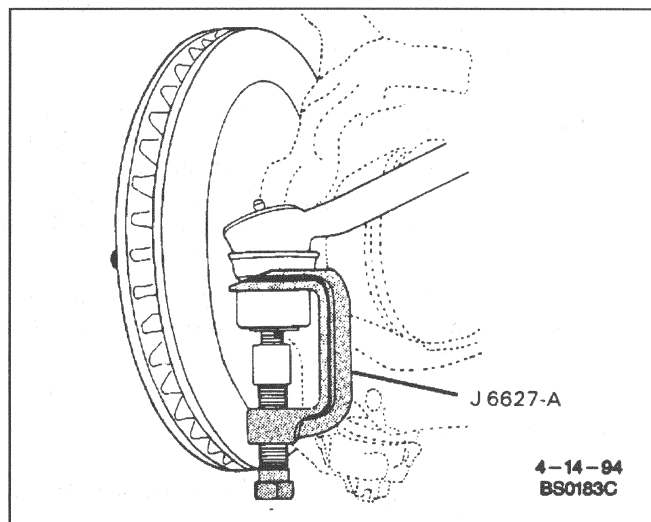


Figure 18 - Separating Steering Linkage Outer Tie Rod End (Typical)

3C-10 FRONT SUSPENSION

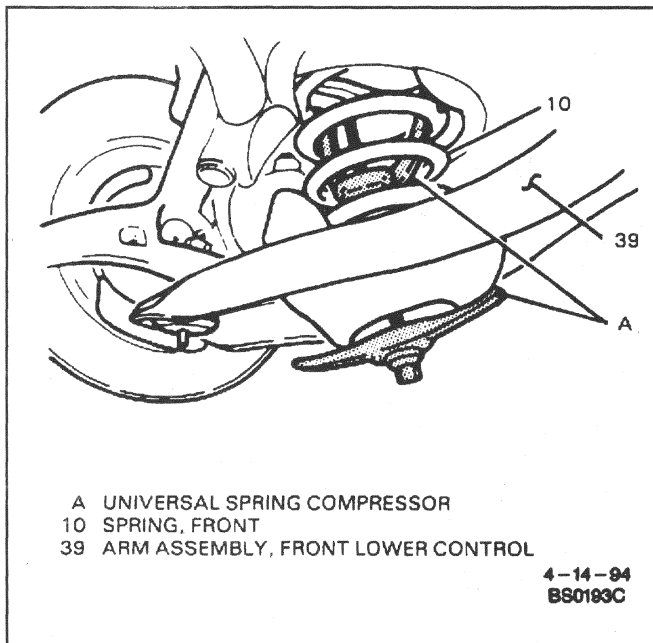


Figure 19 - Removing Front Spring

10. Support lower control arm (39).
11. Nuts (21) and bolts/screws (41).
12. Pivot lower control arm (39) rearward.
13. Universal spring compressor.
14. Spring (10).

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

1. Properly position spring (10) on the lower control arm (39) making sure the spring insulator is in place. Take care that the spring (10) is properly installed (Figure 20).

NOTICE: Handling must not cause any damage to the corrosion protection coating on the springs. Any removal of coating must be repaired.

2. Universal spring compressor (Figure 19).
 - Compress spring (10).
3. Pivot lower control arm (39) forward into position.
4. Position lower control arm (39) into frame and install bolts/screws (41) and nuts (21) (Figure 21).
 - Do not tighten bolts/screws (41) or nuts (21) at this time.
5. Remove universal spring compressor.
6. Steering knuckle to steering linkage outer tie rod end.
7. Steering linkage outer tie rod nut.

Tighten

- Steering linkage outer tie rod nut to 47 N.m (35 lb. ft.).
- Additional tightening may be required to install cotter pin.

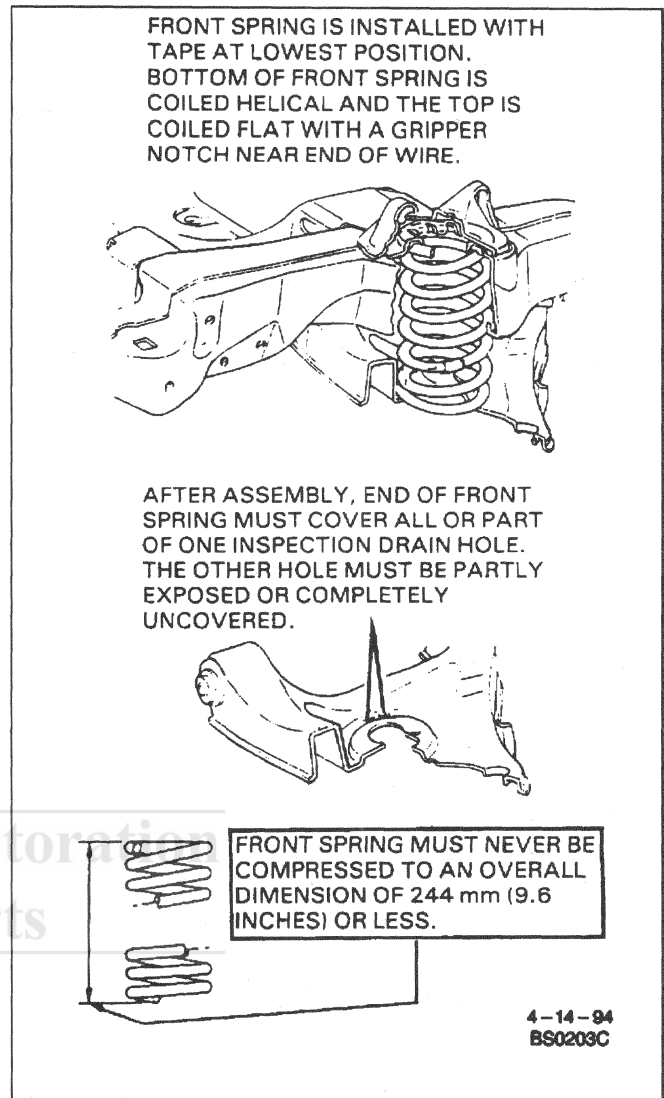


Figure 20 - Front Spring Positioning

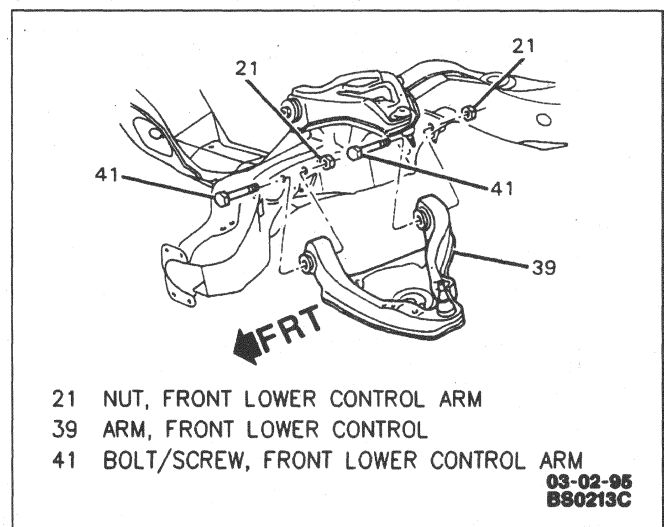


Figure 21 - Installing Front Lower Control Arm Bolt/Screw

8. Steering linkage outer tie rod cotter pin.
9. Remove support from lower control arm (39).
10. Stabilizer shaft linkage to lower control arm. Refer to "Stabilizer Shaft and Insulators" in this section.
11. Shock absorber. Refer to "Shock Absorbers" in this section.
12. Wheel speed sensor in steering knuckle. Refer to SECTION 5E1.
13. Tire and wheel. Refer to SECTION 3E.
14. Lower vehicle.
 - Vehicle must be supported by the wheels before tightening the lower control arm bolts/screws (41) or nuts (21).



Tighten

- Nuts (21) to 145 N.m (107 lb. ft.) or, Bolts/screws (41) to 155 N.m (114 lb. ft.).

STEERING KNUCKLE

Figures 18, 22 and 23



Remove or Disconnect

Tools Required:

- J 6627-A Tie Rod Puller
- J 23742 Ball Joint Separator

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Wheel speed sensor from the steering knuckle and secure. Refer to SECTION 5E1.
4. Front brake caliper. Refer to SECTION 5B1.
5. Front brake rotor.
6. Three brake shield bolts/screws (58) from steering knuckle (16) (Figure 22).
7. Separate steering linkage outer tie rod end from steering knuckle (16), using J 6627-A (Figure 18).
8. Hub seal, if steering knuckle (16) is to be replaced (Figure 23).

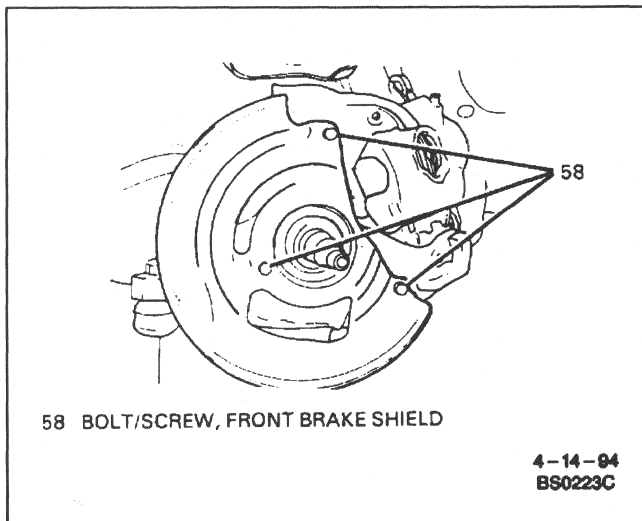


Figure 22 - Front Brake Shield Attachment

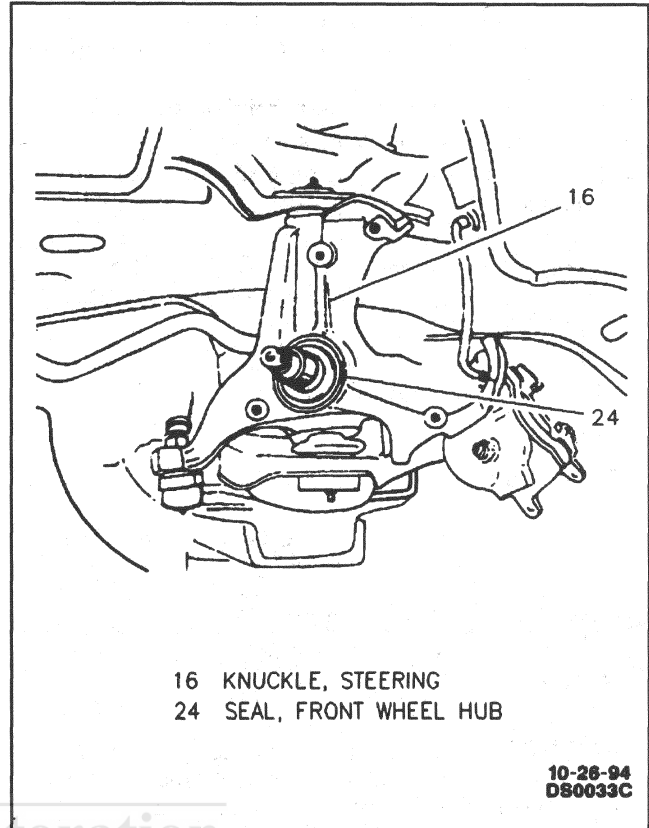


Figure 23 - Front Wheel Hub Seal

9. Position a floor jack under lower control arm near spring seat and raise jack until it supports lower control arm.



Important

- Floor jack must remain under lower control arm spring seat during removal and installation of steering knuckle to retain spring and lower control arm in position.
10. Separate ball studs from steering knuckle (16) using J 23742. Refer to "Control Arm Ball Stud Replacement" in this section.
 11. Raise upper control arm to disengage ball stud from steering knuckle (16).
 12. Raise steering knuckle (16) from ball stud and remove steering knuckle (16).



Inspect

- The tapered holes in the steering knuckle (16). Remove any dirt. If out-of-roundness, deformation, or damage is noted, the steering knuckle (16) must be replaced.
- Ball studs.



Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

3C-12 FRONT SUSPENSION

1. Upper and lower ball studs into steering knuckle. Refer to "Control Arm Ball Stud Replacement" in this section.
2. Front wheel hub seal and front brake shield.
3. Three brake shield bolts/screws (58).
4. Steering linkage outer tie rod end into steering knuckle (16).
5. Front brake rotor.
6. Front brake caliper. Refer to SECTION 5B1.
7. Wheel speed sensor to steering knuckle. Refer to SECTION 5E1.
8. Tire and wheel. Refer to SECTION 3E.
9. Remove jackstands and floor jack.
10. Lower vehicle.



Adjust

- Front wheel alignment. Refer to SECTION 3A.

FRONT BRAKE ROTOR

Figure 14

NOTICE: Whenever a front brake rotor is removed, check the ABS wheel speed sensor and sensor ring for dirt or debris. A dirty sensor may cause intermittent ABS wheel speed sensor fault. Wipe using a clean cloth. Do not use chemicals on the sensor, or the sensor may be damaged.



Remove or Disconnect

(Tire and Wheel Removed)

1. Wheel speed sensor from steering knuckle and secure. Refer to SECTION 5E1.
2. Front brake caliper. Refer to SECTION 5B1.
3. Wheel bearing lubricant cap (30).
4. Cotter pin (55), nut (31) and washer (29) from steering knuckle (16).
5. Carefully pull front brake rotor (27) from steering knuckle spindle.



Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.



Important

- When installing new front brake rotors, do not refinish the surfaces of these parts. New parts have the correct level of surface finish. For more information about refinishing front brake rotors, refer to SECTION 5B1.
1. Front brake rotor (27) to steering knuckle spindle.
 2. Washer (29) and nut (31) to steering knuckle (16).



Adjust

- Front wheel bearing. Refer to "Front Wheel Bearing Adjustment" in this section.
3. Cotter pin (55).
 4. Wheel bearing lubricant cap (30).
 5. Front brake caliper. Refer to SECTION 5B1.
 6. Wheel speed sensor to steering knuckle. Refer to SECTION 5E1.

WHEEL BOLT

Figure 24



Remove or Disconnect

(Front Brake Rotor Removed)

NOTICE: Do not attempt to remove the ABS sensor ring from the rotor or ABS system failure may result. Place a shop cloth between the brake rotor machined surfaces and press to avoid damage to the rotor.

- The wheel bolts with a press.



Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

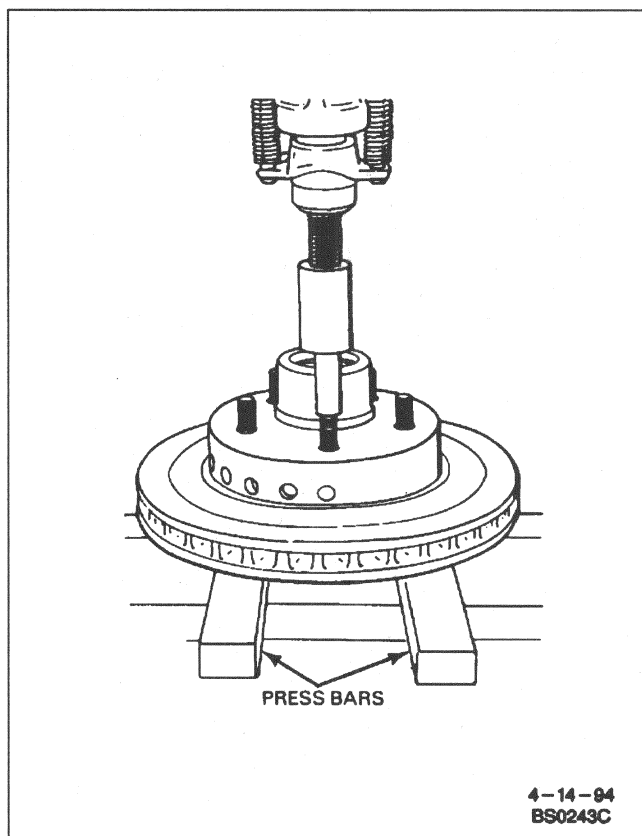


Figure 24 - Pressing Front Wheel Bolt Out

1. New serrated wheel bolt into hole in front brake rotor. Tap lightly with a hammer and punch to start wheel bolt serrations in hole, making sure that wheel bolt is square with front brake rotor flange.
2. Seat bolt using a wheel nut and washer.

LOWER CONTROL ARM

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Spring. Refer to "Springs" in this section.
4. Lower control arm ball stud from steering knuckle. Refer to "Lower Control Arm Ball Stud" under "Control Arm Ball Stud Replacement" in this section.
5. Lower control arm.

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

1. Lower control arm ball stud to steering knuckle. Refer to "Lower Control Arm Ball Stud" under "Control Arm Ball Stud Replacement" in this section.
2. Spring. Refer to "Springs" in this section.
3. Tire and wheel. Refer to SECTION 3E.
4. Lower vehicle.

Adjust

- Wheel alignment. Refer to SECTION 3A.

LOWER CONTROL ARM BUSHINGS

Lower Control Arm Front Bushing

Figures 25 through 27

Disassemble

Tools Required:

- J 21474-5 Bushing Receiver
- J 21474-8 Bushing Remover
- J 21474-19 3/8-Inch Bolt
- J 21474-12 Spacer

1. Remove lower control arm. Refer to "Lower Control Arm" in this section.
2. Using a blunt chisel, drive bushing flare (inside of lower control arm) down flush with rubber of lower control arm front bushing.
3. Remove lower control arm front bushing using J 21474-5, J 21474-8, J 21474-12 and J 21474-19 (Figure 25).

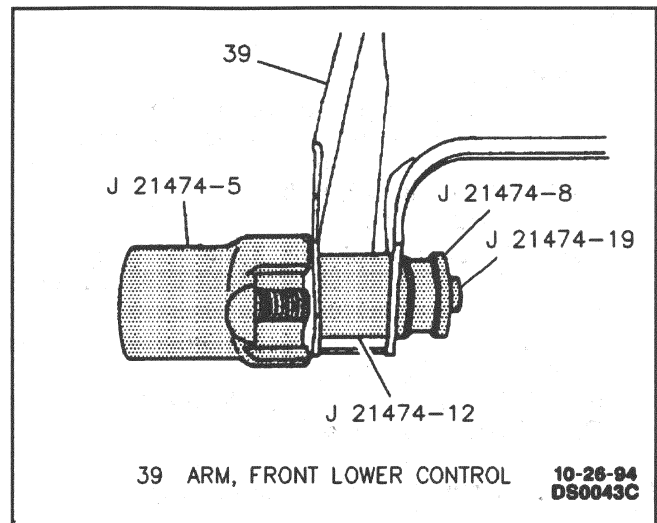


Figure 25 - Removing Front Lower Control Arm Front Bushing

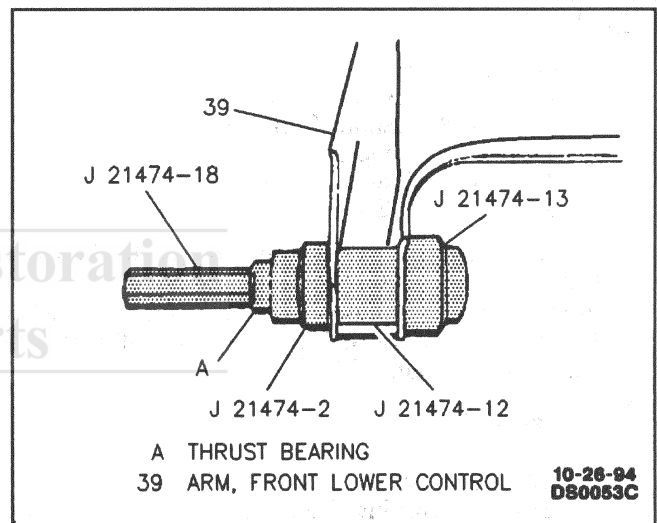


Figure 26 - Installing Front Lower Control Arm Front Bushing

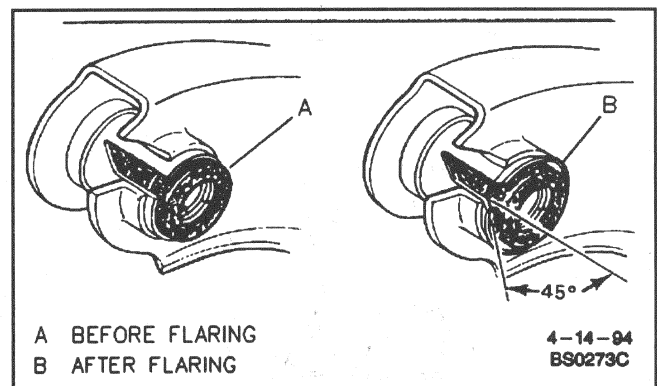


Figure 27 - Front Lower Control Arm Front Bushing Flared

3C-14 FRONT SUSPENSION

Assemble

Tools Required:

J 21474-2 Bushing Remover/Installer
J 21474-13 Control Arm Bushing Installer
J 21474-18 3/8-Inch Nut
J 21474-19 3/8-Inch Bolt
J 21474-12 Spacer

1. Install lower control arm front bushing using J 21474-2, J 21474-12, J 21474-13, and J 21474-18 (Figure 26).
2. Flare lower control arm front bushing using a blunt chisel. (Figure 27).
3. Install lower control arm. Refer to "Lower Control Arm" in this section.

Lower Control Arm Rear Bushing

Figures 28 and 29

Disassemble

Tools Required:

J 21474-5 Bushing Receiver
J 21474-8 Bushing Remover
J 21474-12 Spacer
J 21474-18 3/8-Inch Nut
J 21474-19 3/8-Inch Bolt

1. Remove lower control arm. Refer to "Lower Control Arm" in this section.
2. Remove lower control arm rear bushing using J 21474-5, J 21474-8, J 21474-12, J 21474-18 and J 21474-19 (Figure 28).

Assemble

Tools Required:

J 21474-5 Bushing Receiver
J 21474-12 Spacer
J 21474-13 Control Arm Bushing Installer
J 21474-18 3/8-Inch Nut
J 21474-19 3/8-Inch Bolt

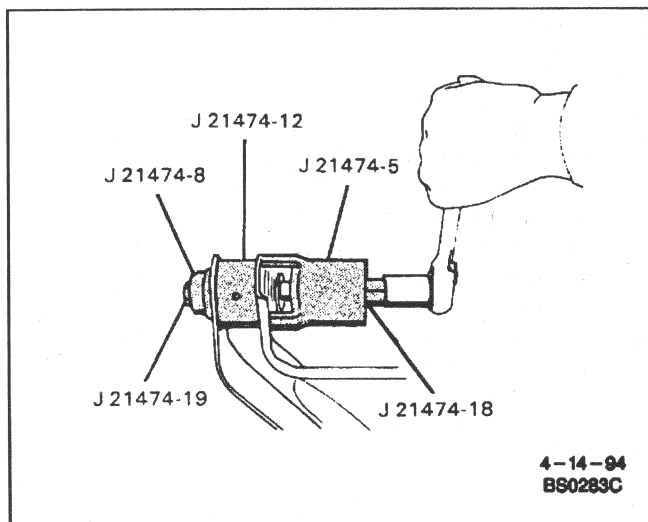


Figure 28 - Removing Front Lower Control Arm Rear Bushing

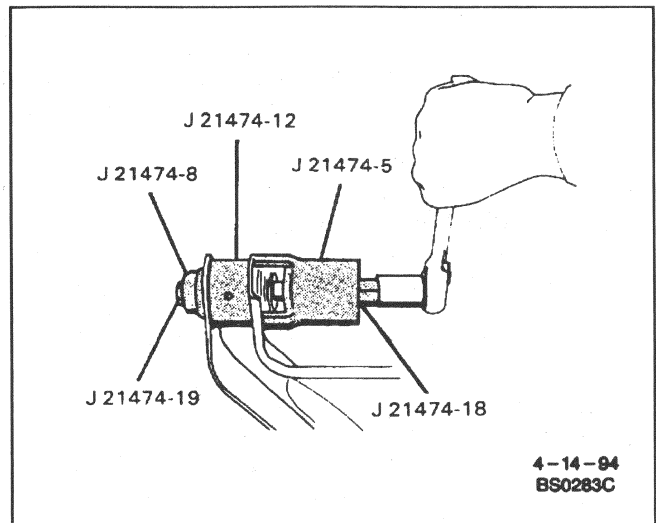


Figure 29 - Installing Front Lower Control Arm Rear Bushing

1. Install front lower control arm rear bushing using J 21474-5, J 21474-12, J 21474-13, J 21474-18 and J 21474-19 (Figure 29).
2. Install lower control arm. Refer to "Lower Control Arm" in this section.

SHOCK ABSORBERS

Figures 30 and 31

Remove or Disconnect

Tool Required:

J 25591 Shock Absorber Nut Wrench

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Hold the shock absorber upper stem using J 25591 to keep it from turning.
3. Nut (5), retainer (6), and insulator (7).
4. Bolts/screws (34).

• Pull the shock absorber out from the bottom.

Inspect

• Lower control arm nuts. Replace if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

1. With the retainer (6) and insulator (7) in place over the upper stem, install the shock absorber (fully extended) up through the lower control arm and spring so that the upper stem passes through the mounting hole in the frame.
2. Insulator (7), retainer (6) and nut (5) over the shock absorber upper stem.
3. Using J 25591, hold the upper stem to keep it from turning and tighten the nut (5).

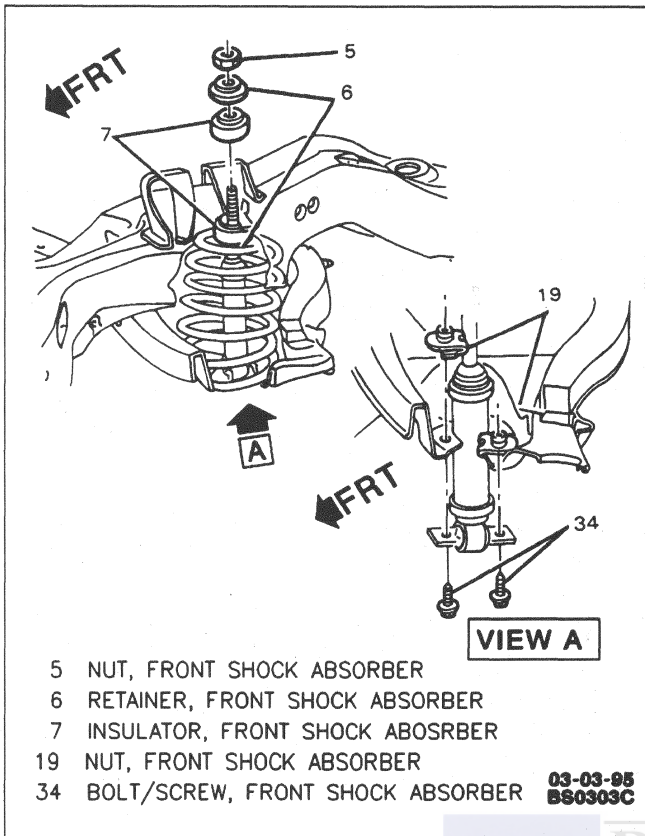


Figure 30 - Front Shock Absorber Attachments

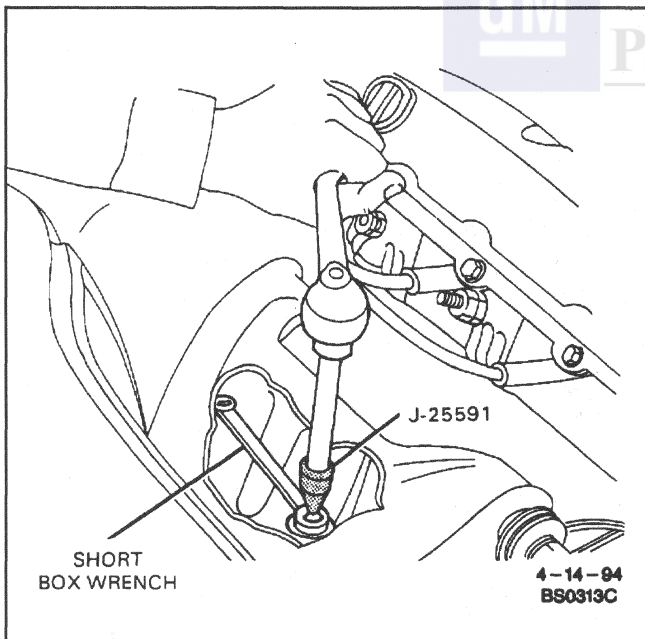


Figure 31 - Removing Shock Absorber Upper Nut



Tighten

- Nut (5) to 11 N.m (97 lb. in.).

- Two bolts/screws (34) attaching the shock absorber lower pivot to the lower control arm.



Tighten

- Bolt/screw (34) to 27 N.m (20 lb. ft.).
- Lower vehicle.

STABILIZER SHAFT AND INSULATORS

Figure 32



Remove or Disconnect

- Raise and suitably support vehicle. Refer to SECTION 0A.
- Each side of stabilizer shaft linkage.
 - Remove nut (48) from bolt/screw (35).
 - Pull bolt/screw (35) from stabilizer shaft linkage.
 - Remove retainers (36), insulators (37) and spacer (45).
- Bolts/screws (43) and clamp (44).
- Stabilizer shaft (46) from frame (62).
- Insulators (47) from stabilizer shaft (46).

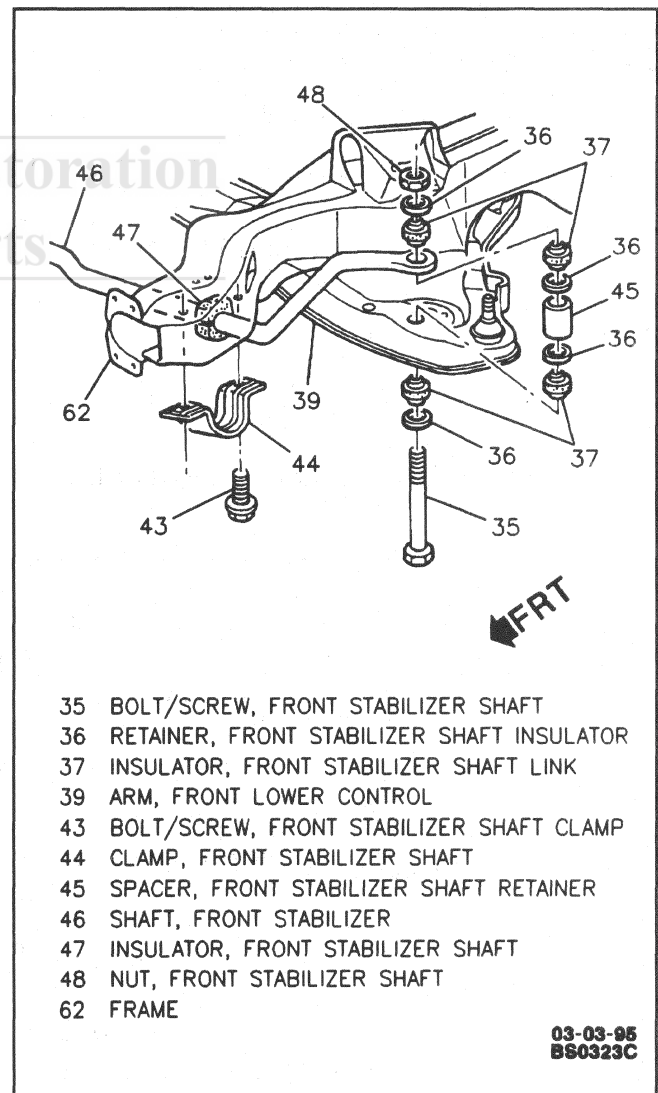


Figure 32 - Front Stabilizer Shaft (Typical)

3C-16 FRONT SUSPENSION

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

1. Insulators (47) to stabilizer shaft (46).
2. Stabilizer shaft (46) to frame (62).
3. Clamp (44) and bolts/screws (43).

Tighten

- Bolts/screws (43) to 33 N.m (24 lb. ft.).
4. Each side of stabilizer shaft linkage.
 - A. Install spacer (45), insulators (37) and retainers (36).
 - B. Insert bolt/screw (35) into stabilizer shaft linkage.
 - C. Install nut (48) to bolt/screw (35).

Tighten

- Nut (48) to 17 N.m (13 lb. ft.).
5. Lower vehicle.

UPPER CONTROL ARM

Figure 33

Remove or Disconnect

Tool Required:
J 23742 Ball Joint Separator

1. Air cleaner and resonator duct, if removing left side upper control arm. Refer to SECTION 6E3-C14.

Important

- Place ignition cylinder in locked position, if removing left side upper control arm, or damage to the SIR coil may result.
2. Intermediate steering shaft, if removing left side upper control arm. Refer to SECTION 3F.
 3. Raise and suitably support vehicle. Refer to SECTION 0A.
 4. Tire and wheel. Refer to SECTION 3E.
 5. Support the lower control arms with jackstands.

Important

- Jack stands must remain under lower control arm spring seat during removal and installation to retain spring and lower control arm in position.
 - The jack stands must be positioned between the spring seat and lower control arm ball stud of the lower control arms for maximum leverage.
6. Wheel speed sensor and secure. Refer to SECTION 5E1.
 7. Loosen nuts (51).

- Remove shims (49) from each bolt/screw (8), tape them together, and mark them for installation to the same position from which they were removed.

8. Steering knuckle and hub upper cotter pin and nut.
9. Separate the upper control arm ball stud from the steering knuckle using J 23742. Refer to "Upper Control Arm Ball Stud" under "Control Arm Ball Stud Replacement" in this section.

NOTICE: Support front brake rotor to prevent weight from damaging front brake hose.

10. Nuts (51).
11. Upper control arm (3).

Install or Connect

NOTICE: Refer to "Notice" on page 3C-1 of this section.

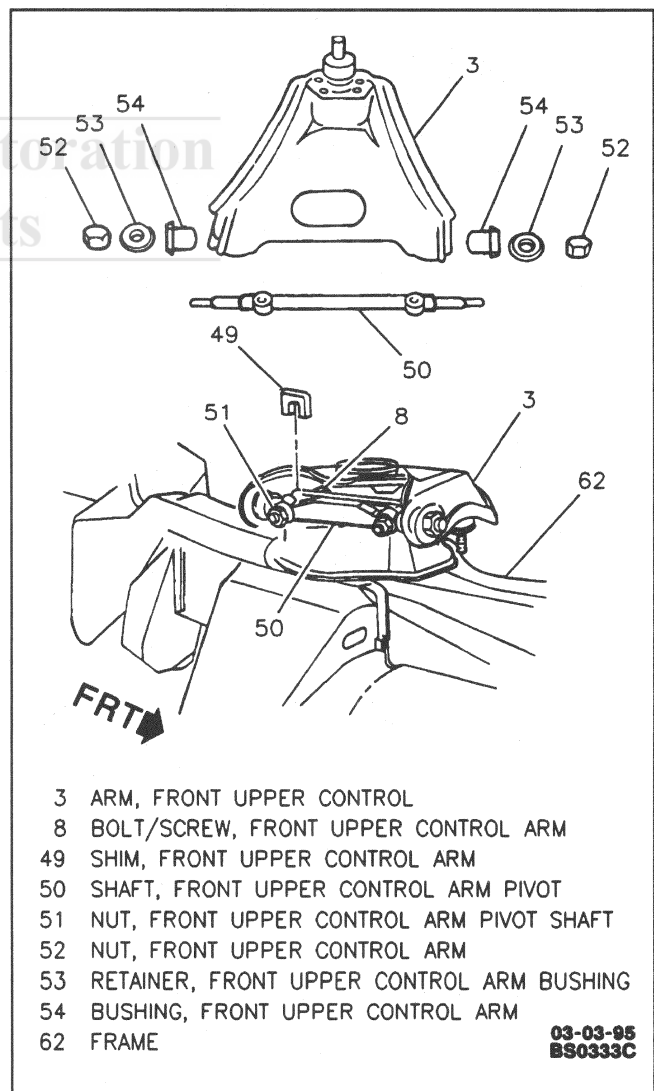


Figure 33 - Front Upper Control Arm

1. Upper control arm (3).
2. Pivot shaft (50) to bolts/screws (8) (Figure 34).
3. Place shims (49) in their original position between the pivot shaft (50) and frame (62) on their respective bolts/screws (8).
4. Nuts (51).

 Tighten

- Nuts (51) to 95 N.m (70 lb. ft.).
5. Remove the temporary support from the front brake rotor, then connect upper control arm ball stud to the steering knuckle. Refer to "Upper Control Arm Ball Stud" under "Control Arm Ball Stud Replacement" in this section.
 6. Wheel speed sensor in steering knuckle. Refer to SECTION 5E1.
 7. Tire and wheel. Refer to SECTION 3E.
 8. Remove jack stands.
 9. Lower vehicle.

 Tighten

- Wheel nuts to 140 N.m (100 lb. ft.).
 - Nuts (52) to 125 N.m (92 lb. ft.) at curb height, only if upper control arm bushings (54) were serviced.
10. Intermediate steering shaft, if removed. Refer to SECTION 3F.
 11. Air cleaner and resonator duct, if removed. Refer to SECTION 6E3-C14.

UPPER CONTROL ARM BUSHINGS

Figures 33, 34 and 35

 Disassemble

Tool Required:

J 22269-01 Tie Rod End Installer

1. Upper control arm. Refer to "Upper Control Arm" in this section.
2. Nuts (52) and retainer (53) (Figure 33).
3. Remove upper control arm bushing (54) from upper control arm (3).
 - A. Position upper control arm (3) and J 22269-01 as shown in Figure 34.
 - B. Push upper control arm bushing (54) from upper control arm (3).

 Assemble

NOTICE: Refer to "Notice" on page 3C-1 of this section.

Tool Required:

J 22269-01 Tie Rod End Installer

1. Upper control arm bushings (54).
 - A. Place pivot shaft (50) in upper control arm (3) with depression in pivot shaft (50) facing inboard.

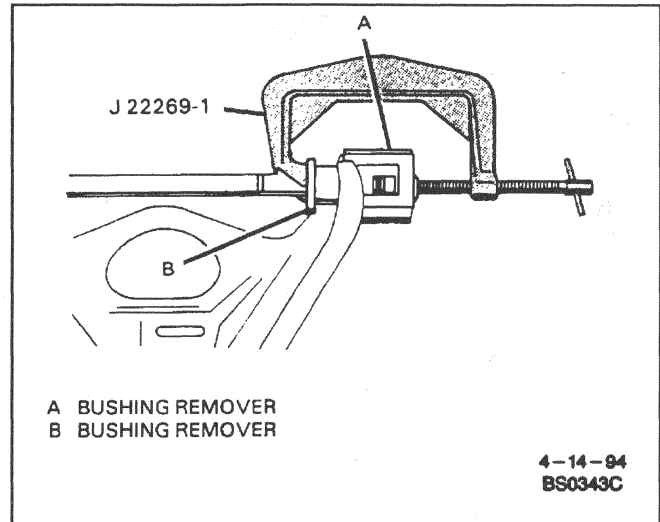


Figure 34 - Removing Front Upper Control Arm Bushing

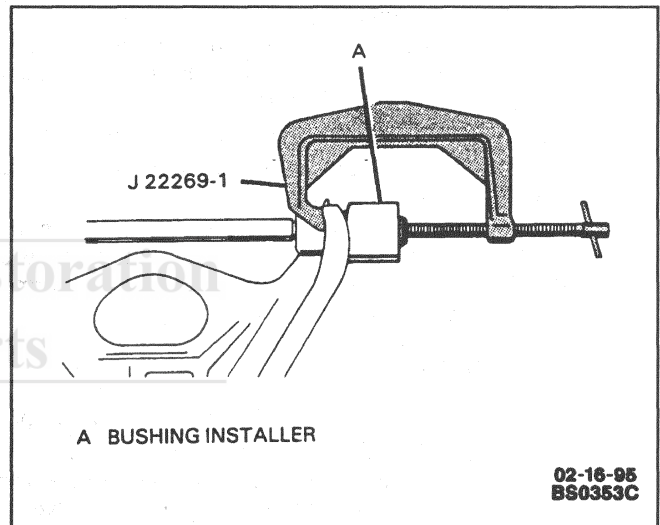


Figure 35 - Installing Front Upper Control Arm Bushing

- B. Push new upper control arm bushing (54) into upper control arm (3) and over end of pivot shaft (50) (Figure 35).
2. Nuts (52) and retainers (53) to both ends of pivot shaft (50).
 - Do not tighten.
 3. Upper control arm to vehicle. Refer to "Upper Control Arm" in this section.
 4. Lower vehicle to curb height.

 Tighten

- Nuts (52) to 125 N.m (92 lb. ft.).

FRONT WHEEL BEARINGS

The proper functioning of the front suspension cannot be maintained unless the wheel bearings are correctly adjusted. Cones must be a slip fit on the spindle and the inside diameter of cones should be lubricated to insure that the cones will creep. Spindle nut must be a free-running fit on the threads.

3C-18 FRONT SUSPENSION

Front Wheel Bearing Adjustment

Figures 14 and 36

Adjust

NOTICE: Refer to "Notice" on page 3C-1 of this section.

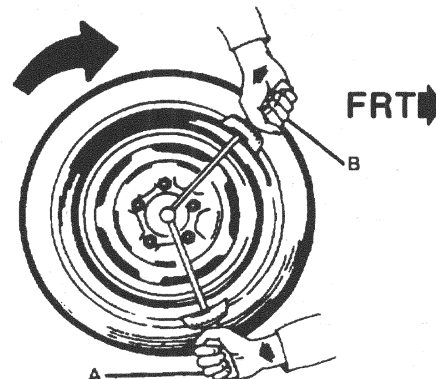
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Remove wheel cover.
3. Remove wheel bearing lubricant cap (30) from front brake rotor (27).
4. Remove cotter pin (55).

Tighten

- Nut (31) to 16 N·m (12 lb. ft.) while turning the tire and wheel forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play later (Figure 36).
5. Back off nut (31) to the "just loose" position.
 6. Hand tighten nut (31). Loosen to next slot in nut (31) to fit cotter pin (55).
 7. Install new cotter pin (55) and bend the ends against the nut (31). Cut off extra length to ensure the ends do not interfere with the wheel bearing lubricant cap (30) (Figure 14).

Measure

- Using a dial indicator, check the front brake rotor end play. Place the dial indicator base on the rotor wheel attachment surface. Place the tip on the end of the spindle. Use a "Push-Pull" motion while observing dial indicator. There should be from 0.03 to 0.13 mm (0.001 to 0.005 inch) end play when properly adjusted.



- A FIRST TIGHTEN FRONT WHEEL BEARING NUT TO 16 N·m (12 LB. FT.) WHILE ROTATING WHEEL FORWARD
B THEN BACK FRONT WHEEL BEARING NUT OFF UNTIL JUST LOOSE

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Figure 36 - Adjusting Front Wheel Inner and Outer Bearing

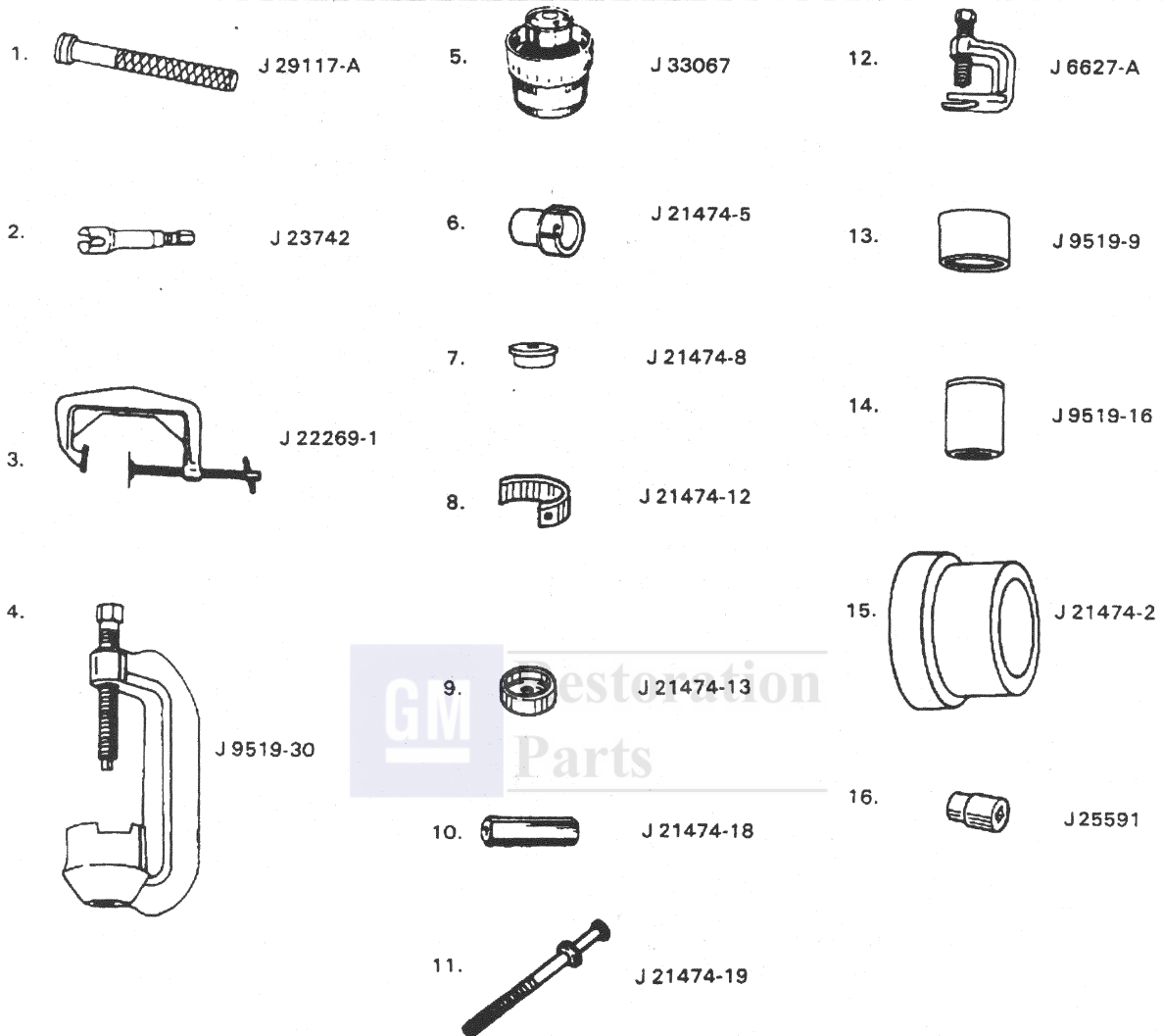
8. Install wheel bearing lubricant cap (30) on front brake rotor (27).
9. Install wheel cover.
10. Lower vehicle.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Lower Control Arm Bumper Nut.....	28 N·m (21 lb. ft.)
Front Lower Control Arm Bolt/Screw.....	155 N·m (114 lb. ft.)
Front Lower Control Arm Nut.....	145 N·m (107 lb. ft.)
Front Shock Absorber Bolt/Screw.....	27 N·m (20 lb. ft.)
Front Shock Absorber Nut.....	11 N·m (97 lb. in.)
Front Stabilizer Shaft Clamp Bolt/Screw.....	33 N·m (24 lb. ft.)
Front Stabilizer Shaft Nut.....	17 N·m (13 lb. ft.)
Front Upper Control Arm Nut.....	125 N·m (92 lb. ft.)
Front Upper Control Arm Pivot Shaft Nut.....	95 N·m (70 lb. ft.)
Front Wheel Bearing Nut.....	16 N·m (12 lb. ft.)
Lower Steering Knuckle and Hub Nut.....	112 N·m (83 lb. ft.)
Steering Linkage Outer Tie Rod Nut.....	47 N·m (35 lb. ft.)
Upper Steering Knuckle and Hub Nut.....	83 N·m (61 lb. ft.)
Wheel Nut.....	140 N·m (100 lb. ft.)

SPECIAL TOOLS



1. WHEEL BEARING CUP REMOVER
2. BALL JOINT SEPARATOR
3. TIE ROD END INSTALLER
4. BALL JOINT FIXTURE
5. WHEEL BEARING PACKER
6. BUSHING RECEIVER
7. BUSHING REMOVER
8. SPACER
9. CONTROL ARM BUSHING INSTALLER
10. $\frac{3}{8}$ " NUT
11. $\frac{3}{8}$ " BOLT
12. TIE ROD PULLER
13. BALL JOINT INSTALLER
14. BALL JOINT INSTALLER
15. BUSHING REMOVER/INSTALLER
16. SHOCK ABSORBER NUT WRENCH



SECTION 3D

REAR SUSPENSION

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

SOLID REAR AXLE SUSPENSION

Figure 1

The rear axle is attached to the frame with a link suspension system. Two rubber-bushed lower control arms (17) are mounted between the rear axle and the frame. The lower control arms (17) keep the rear axle aligned to the chassis forward and rearward. Two rubber-bushed upper control arms (1) are mounted at an angle between the rear frame crossmember and the rear axle. The upper control arms (1) control driving and braking torque and sideways movement of the rear axle. The upper control arms are available in three lengths for driveline angle corrections. Refer to SECTION 4A for more information.

The upper control arms (1) are shorter than the lower control arms (17), causing the differential housing to rock or tilt forward during acceleration or any other time the rear suspension is compressed. A tunnel in the rear floor pan is used to make room for this rocking or tilting.

Two springs (5) support the weight of the vehicle. The springs (5) are held between brackets on the rear axle tube and frame spring seats. An insulator (4) is installed between the spring (5) and the frame

spring seat at the upper end of the spring (5) and another insulator (40) between the spring (5) and the rear axle tube bracket. Shock absorbers (22) are mounted between brackets on the rear axle tube and the frame spring seats. The tops of the shock absorbers (22) are tilted toward the center of the vehicle. The shock absorbers (22) limit movement of the rear axle. For more information, refer to SECTION 3D1.

A rear axle bumper (26) at the center of the rear frame crossmember and a rear axle bumper (6) near the ends of the axle housing, prevent metal-to-metal contact when the rear suspension is compressed. A stabilizer shaft (12) is mounted between the two lower control arms (17). The stabilizer shaft (12) improves side roll stability.

ON-VEHICLE SERVICE

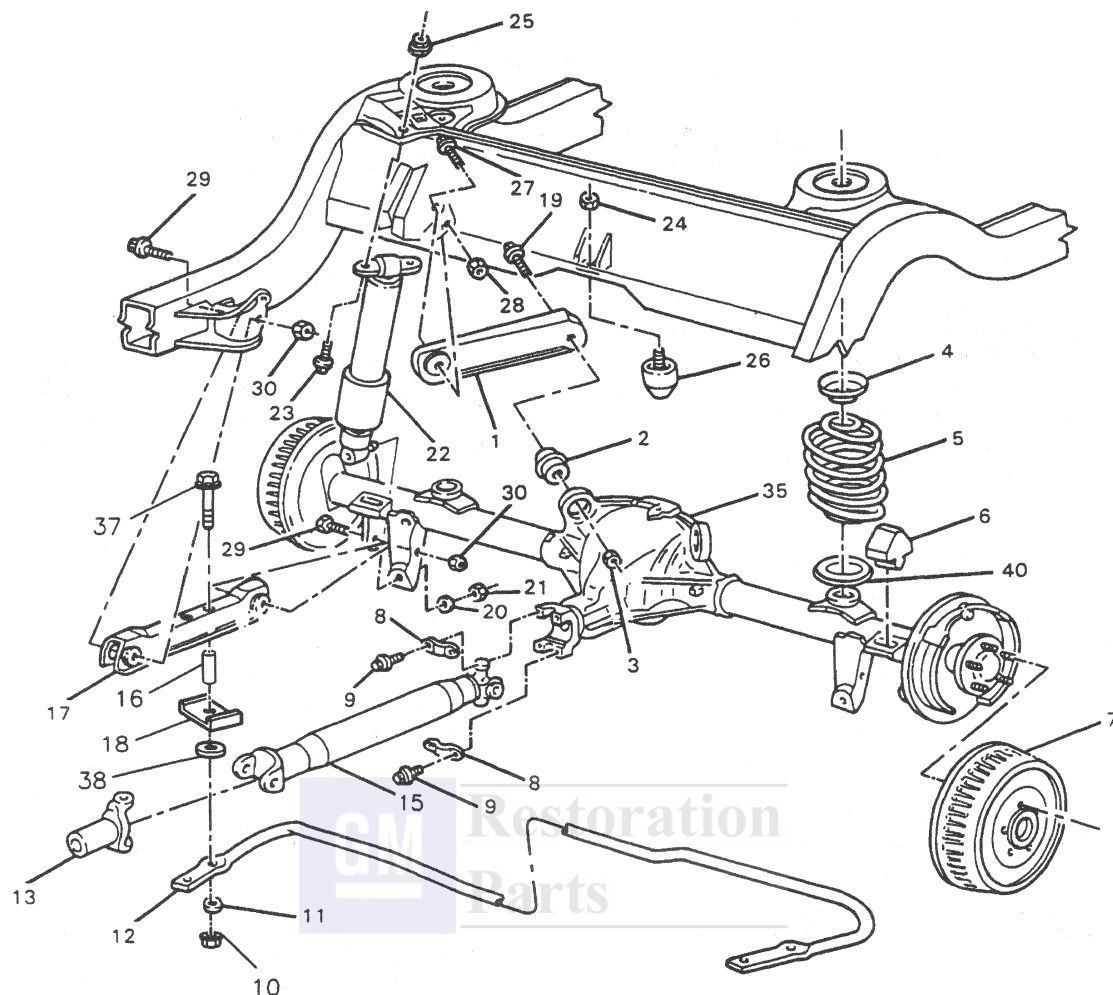
REAR AXLE HOUSING

For removal and installation of the rear axle housing, refer to SECTION 4B.

REAR AXLE BUMPERS

The outboard rear axle bumpers snap into brackets on the rear axle housing. The center rear axle bumper is held onto a bracket on the rear axle crossmember with a nut. If the bumpers are worn or damaged, they must be replaced.

3D-2 REAR SUSPENSION



- | | | | |
|----|--|----|---|
| 1 | ARM, REAR AXLE UPPER CONTROL | 19 | BOLT/SCREW, REAR AXLE UPPER CONTROL ARM |
| 2 | BUSHING, REAR AXLE | 20 | WASHER, REAR SHOCK ABSORBER |
| 3 | NUT, REAR AXLE UPPER CONTROL ARM | 21 | NUT, REAR SHOCK ABSORBER |
| 4 | INSULATOR, REAR SPRING UPPER | 22 | ABSORBER, REAR SHOCK |
| 5 | SPRING, REAR | 23 | BOLT/SCREW, REAR SHOCK ABSORBER, |
| 6 | BUMPER, REAR AXLE | 24 | NUT, REAR AXLE BUMPER |
| 7 | DRUM, REAR BRAKE | 25 | NUT, REAR SHOCK ABSORBER |
| 8 | RETAINER, REAR AXLE | 26 | BUMPER, REAR AXLE |
| 9 | BOLT/SCREW, PROPELLER SHAFT
22 N•m (16 LB. FT.) | 27 | BOLT/SCREW, REAR AXLE UPPER CONTROL ARM |
| 10 | NUT, REAR STABILIZER SHAFT | 28 | NUT, REAR AXLE UPPER CONTROL ARM, |
| 11 | WASHER, REAR STABILIZER SHAFT | 29 | BOLT/SCREW, REAR AXLE LOWER CONTROL ARM |
| 12 | SHAFT, REAR STABILIZER | 30 | NUT, REAR AXLE LOWER CONTROL ARM, |
| 13 | YOKE, PROPELLER SHAFT SLIP | 35 | AXLE, REAR |
| 15 | SHAFT, PROPELLER | 37 | BOLT/SCREW, REAR STABILIZER SHAFT |
| 16 | ADAPTER, REAR STABILIZER SHAFT | 38 | RETAINER, REAR SUSPENSION SUPPORT |
| 17 | ARM, REAR AXLE LOWER CONTROL | 40 | INSULATOR, REAR SPRING LOWER |
| 18 | BRACKET, REAR STABILIZER SHAFT | | |

Figure 1 - Rear Suspension (Typical)

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Rear Axle Bumper (Center)

Figure 2

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (24).
3. Rear axle bumper (26).

Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

1. Rear axle bumper (26).
2. Nut (24).

Tighten

- Nut (24) to 20 N.m (15 lb. ft.).
3. Lower vehicle.

Rear Axle Bumper (Outboard)

Figure 2

Remove or Disconnect

- Rear axle bumper (6) by unsnapping it from rear axle bumper bracket.

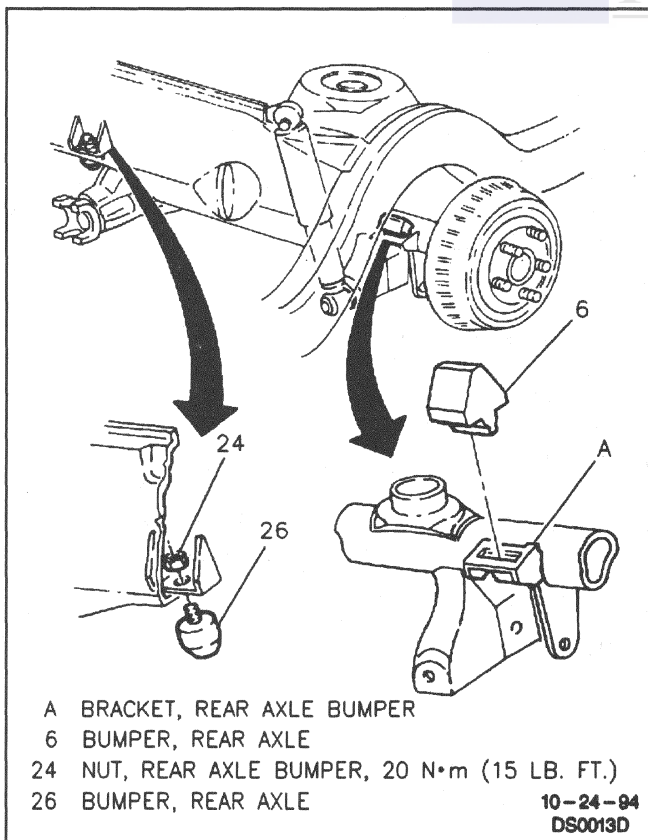


Figure 2 - Rear Axle Bumpers

Install or Connect

- Rear axle bumper (6) by snapping it into rear axle bumper bracket.

CONTROL ARM BUSHINGS

Figures 3 through 5

Rubber control arm bushings are located at the end of the upper and lower control arms. If the control arm bushings become worn or damaged, they must be replaced.

Remove or Disconnect

Tools Required:

- J 21465-8 Bushing Remover
- J 25317-2 Bushing Remover
- J 25317-1 Bushing Installer

1. Affected control arm. Refer to "Upper Control Arm" or "Lower Control Arm" in this section.

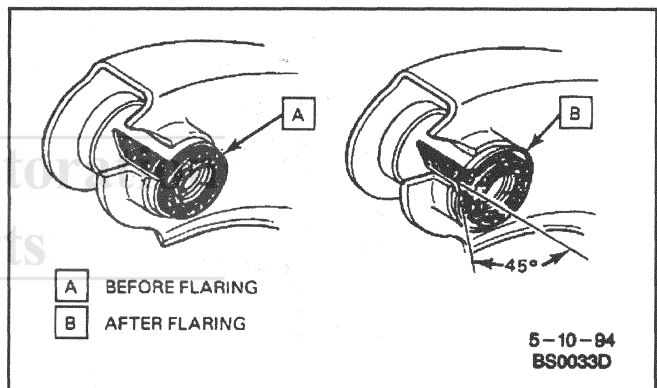


Figure 3 - Rear Axle Control Arm Bushing Flared

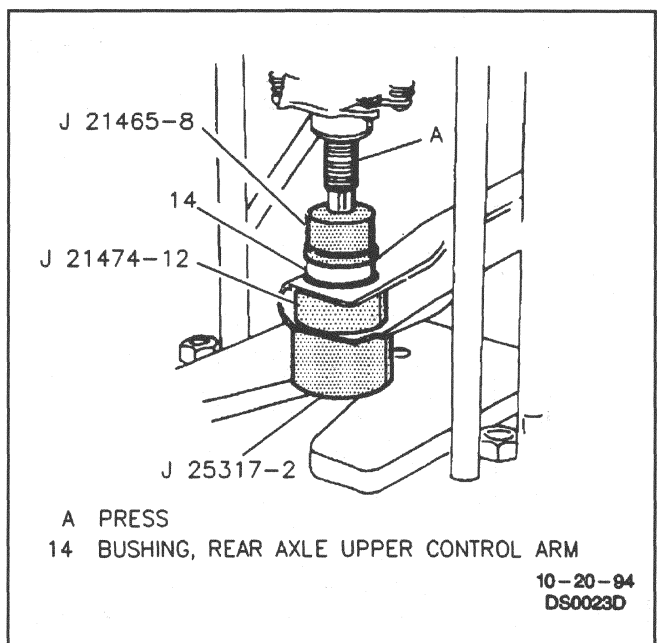


Figure 4 - Removing Rear Axle Upper and Lower Control Arm Bushings (Typical)

3D-4 REAR SUSPENSION

- Using a blunt chisel, drive bushing flare (inside of upper or lower control arm) down flush with rubber of upper or lower control arm bushing.
- Upper or lower control arm bushing using J 21465-8, J 25317-2 and a press.

Install or Connect

- Upper or lower control arm bushing using J 25317-1, J 25317-2 and a press.
- Flare front upper or lower control arm bushing using a drift punch.
- Control arm. Refer to "Upper Control Arm" or "Lower Control Arm" in this section.

REAR AXLE BUSHINGS

Figures 1, 6 and 7

Rubber rear axle bushings are installed where the upper control arms are attached to the rear axle. If the rear axle bushings become worn or damaged, they must be replaced.

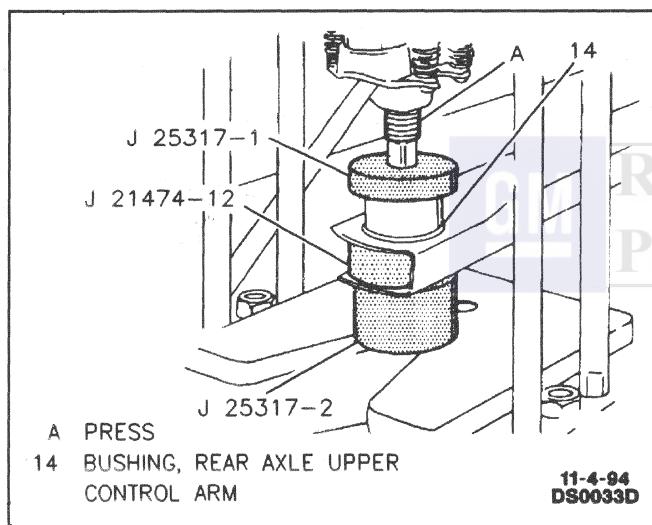


Figure 5 - Installing Rear Axle Upper and Lower Control Arm Bushings

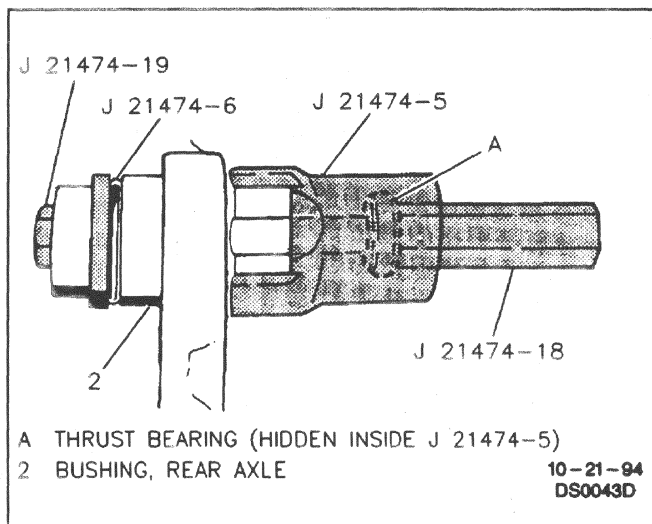


Figure 6 - Removing Rear Axle Bushing

Tools Required:

- J 21474-19 3/8-Inch Bolt
- J 21474-6 Bushing Carrier
- J 21474-5 Receiver
- J 21474-18 3/8-Inch Nut
- J 21474-20 Bushing Installer

- Raise and suitably support vehicle. Refer to SECTION 0A.
- Support rear axle.
- Automatic level control sensor link from upper control arm (1).
- Nut (3) and bolt/screw (19) holding upper control arm (1) to rear axle (35).
- Move upper control arm out of the way.
- Rear axle bushing (2) using J 21474-19, J 21474-6, J 21474-5 and J 21474-18.

Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

- Rear axle bushing (2) using J 21474-19, J 21474-5, J 21474-20 and J 21474-18.
- Upper control arm (1) to rear axle (35).
- Bolt/screw (19) and nut (3) loosely to upper control arm (1).
- Automatic level control sensor link to upper control arm (1).
- Remove support from rear axle.
- Support tires and lower vehicle until weight of vehicle is on tires.

Tighten

- Bolt/screw (19) to 113 N.m (83 lb. ft.) or nut (3) to 100 N.m (74 lb. ft.).
— Either the bolt/screw (19) or the nut (3) must be tightened. Tighten whichever one is easier to reach while holding the other stationary.

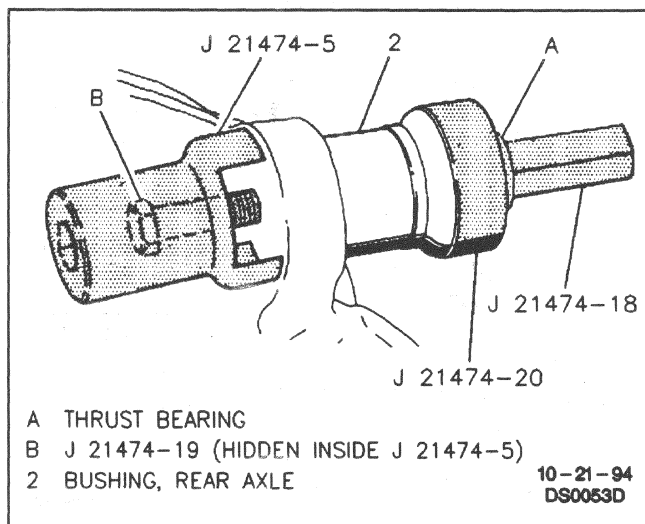


Figure 7 - Installing Rear Axle Bushing

7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Remove tire supports.
9. Lower vehicle.

SPRINGS

Figures 1, 8 and 9

The springs (5) are held between the rear axle tube and frame spring seat by the weight of the vehicle.

! Important

- If removing both springs (5), remove and replace one spring (5) at a time to prevent the rear axle from moving.

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle with an adjustable lifting device.
3. Automatic level control sensor link from upper control arm (1).
4. Rear brake hose fitting bolt/screw at center of rear axle.
 - The rear brake rear pipes do not need to be disconnected. The rear brakes do not have to be bled after this procedure.
5. Nut (21) and washer (20) from shock absorber (22).

6. Shock absorber (22) from bracket.
7. Using adjustable lifting device, lower rear axle enough so spring (5) can be removed.
8. Spring (5) and insulator (4).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

! Important

- Be sure spring leg is installed with tape facing the top. If spring leg is improperly installed, or insulator is missing or damaged, noises may occur.

1. Insulator (4) and spring (5) to bracket on frame spring seat (Figure 8).
 - Point spring leg toward left side of vehicle, perpendicular to centerline of chassis within 5 degrees rearward and 15 degrees forward.
2. Raise rear axle using adjustable lifting device.
3. Shock absorber (22) to bracket.
4. Washer (20) and nut (21) to shock absorber (22).

⌚ Tighten

- Nut (21) to 85 N·m (63 lb. ft.).
5. Rear brake hose fitting bolt/screw.

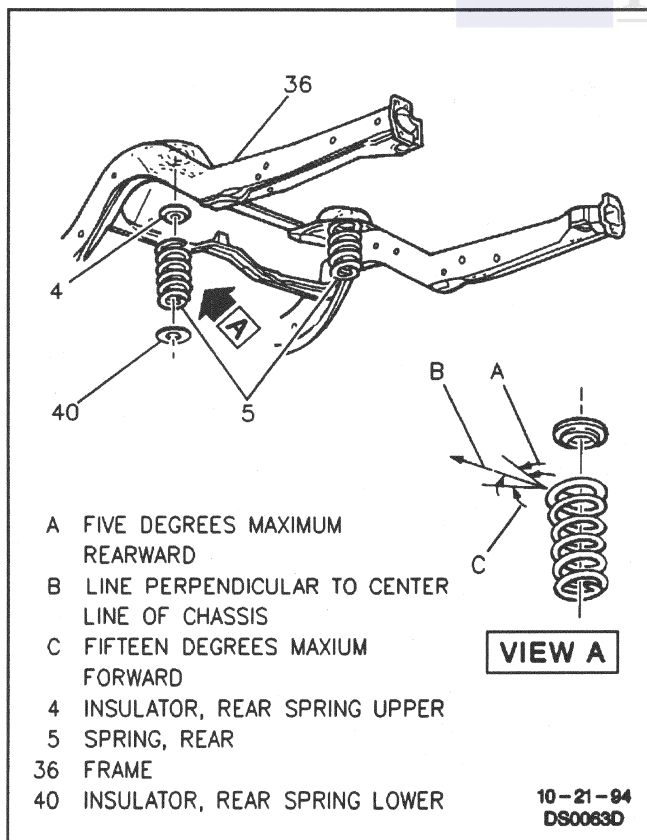


Figure 8 - Rear Springs

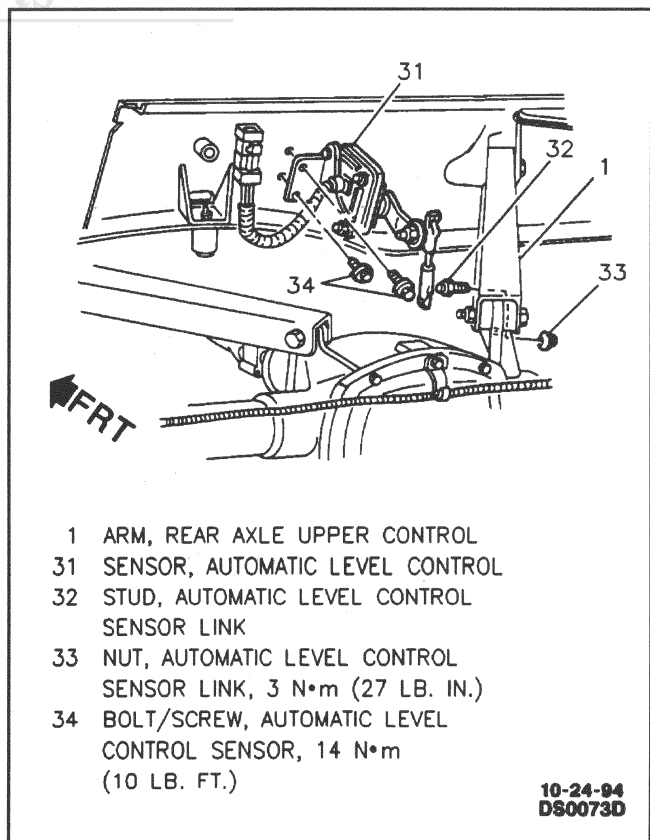


Figure 9 - Automatic Level Control Sensor

3D-6 REAR SUSPENSION



Tighten

- Rear brake hose fitting bolt/screw to 27 N.m (20 lb. ft.).
6. Automatic level control sensor link to upper control arm (1).
 7. Remove adjustable lifting device from under rear axle.
 8. Lower vehicle.



Adjust

- Automatic level control sensor. Refer to SECTION 3D1.

CONTROL ARMS

The upper and lower control arms are held in position with nuts and bolts/screws. When tightening the fasteners, one must be held stationary, while the other is torqued to specification.

Upper Control Arm

Figures 9 and 10



Important

- If both upper control arms (1) are being replaced, remove and replace one at a time to prevent the rear axle from moving sideways.



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support the nose of the rear axle with a jackstand.
3. Automatic level control sensor link from upper control arm (1).
4. Nut (3) and bolt/screw (19) at rear axle housing.

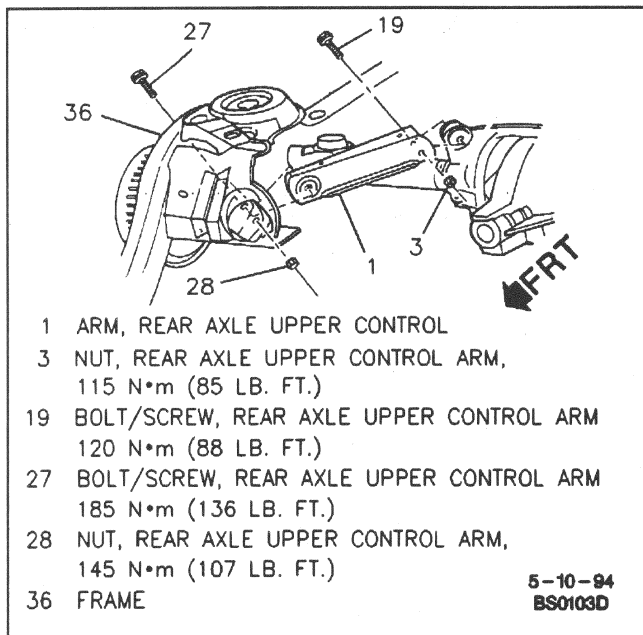


Figure 10 - Rear Axle Upper Control Arm

5. Upper control arm (1) from rear axle housing.
6. Nut (28) and bolt/screw (27).
7. Upper control arm (1) from rear frame crossmember.



Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

1. Upper control arm (1) to rear frame crossmember.
2. Bolt/screw (27) and nut (28) loosely.
3. Upper control arm (1) to rear axle housing.
4. Bolt/screw (19) and nut (3) loosely.
5. Remove jackstand from rear axle.
6. Support the tires and lower the vehicle until the weight of the vehicle is on the tires.



Tighten

- Bolt/screw (27) to 155 N.m (114 lb. ft.) or nut (28) to 130 N.m (95 lb. ft.). Either the bolt/screw (27) or the nut (28) must be tightened. Tighten whichever one is easier to reach while holding the other stationary.
- Bolt/screw (19) to 113 N.m (83 lb. ft.) or nut (3) at rear axle housing to 100 N.m (74 lb. ft.). Either the bolt/screw (19) or the nut (3) must be tightened. Tighten whichever one is easier to reach while holding the other stationary.

7. Automatic level control sensor link to upper control arm (1).



Adjust

- Automatic level control sensor. Refer to SECTION 3D1.
8. Raise and suitably support vehicle. Refer to SECTION 0A.
 9. Remove tire and wheel supports.
 10. Lower vehicle.

Lower Control Arm

Figure 11



Important

- If both lower control arms (17) are being replaced, remove and replace one at a time to prevent the rear axle from moving.



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle.
3. Stabilizer shaft, if equipped. Refer to "Stabilizer Shaft" in this section.

4. Wheel speed sensor harness from lower control arm (17).
5. Nuts (30) and bolts/screws (29) from bracket on rear axle housing.
6. Nut (30) and bolt/screw (29) from frame (36).
7. Lower control arm (17).

Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

1. Lower control arm (17).
2. Nuts (30) and bolts/screws (29) loosely to bracket on rear axle housing.
3. Nuts (30) and bolts/screws (29) loosely to frame (36).
4. Wheel speed sensor harness to lower control arm (17).
5. Stabilizer shaft to lower control arm, if equipped. Refer to "Stabilizer Shaft" in this section.
6. Remove support from rear axle.
7. Support tires and lower vehicle until weight of vehicle is on the tires.

Tighten

- Bolts/screws (29) to 155 N·m (114 lb. ft.) or nuts (30) to 123 N·m (91 lb. ft.). Either the lower control arm bolts/screws (29) or the lower control arm nuts (30) must be tightened. Tighten the one that is easier to reach while holding the other stationary.
8. Raise and suitably support vehicle. Refer to SECTION 0A.
 9. Remove tire supports.
 10. Lower vehicle.

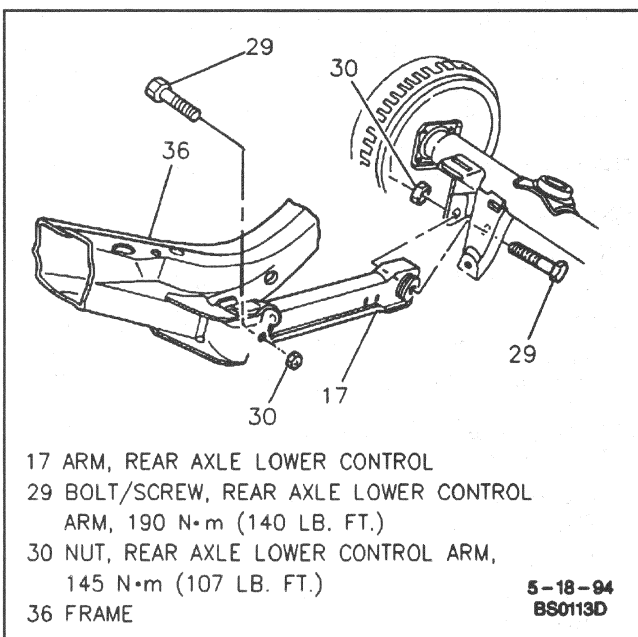


Figure 11 - Rear Axle Lower Control Arm

STABILIZER SHAFT

Figure 12

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nuts (10) and washers (11) from bolts/screws (37).
3. Stabilizer shaft (12) from bracket (18).
4. Retainers (38), if necessary.
5. Brackets (18), adapters (16) and bolts/screws (37), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on a page 3D-1 of this section.

1. Brackets (18), adapters (16) and bolts/screws (37), if removed.
2. Retainers (38), if removed.
3. Stabilizer shaft (12) to bracket (18).
4. Washers (11) and nuts (10) to bolts/screws (37).

Tighten

- Nuts (10) to 50 N·m (37 lb. ft.) while holding bolts/screws (37) stationary.
5. Lower vehicle.

SHOCK ABSORBERS

Figure 13

Shock absorbers are filled with fluid and sealed during production. If a shock absorber is worn, damaged or leaking oil, it must be replaced. For operation and diagnosis of shock absorbers, refer to SECTION 3.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle.
3. Air line from air adjustable shock absorber (22), by turning spring clip 90 degrees and pulling gently on air line housing.
4. Nuts (25) and bolts/screws (23) from shock absorber (22) at the frame (36).

NOTICE: When removing the lower attaching rear shock absorber nut the stud must not turn. A hex is located on the stud between the rear axle tube bracket and the shock absorber so that a wrench can be used to keep the stud from turning. Failure to hold the stud may cause damage to the mechanical bond between the shock absorber bushing and the stud.

5. Nut (21) and washer (20) from the shock absorber (22) at the rear axle.

3D-8 REAR SUSPENSION

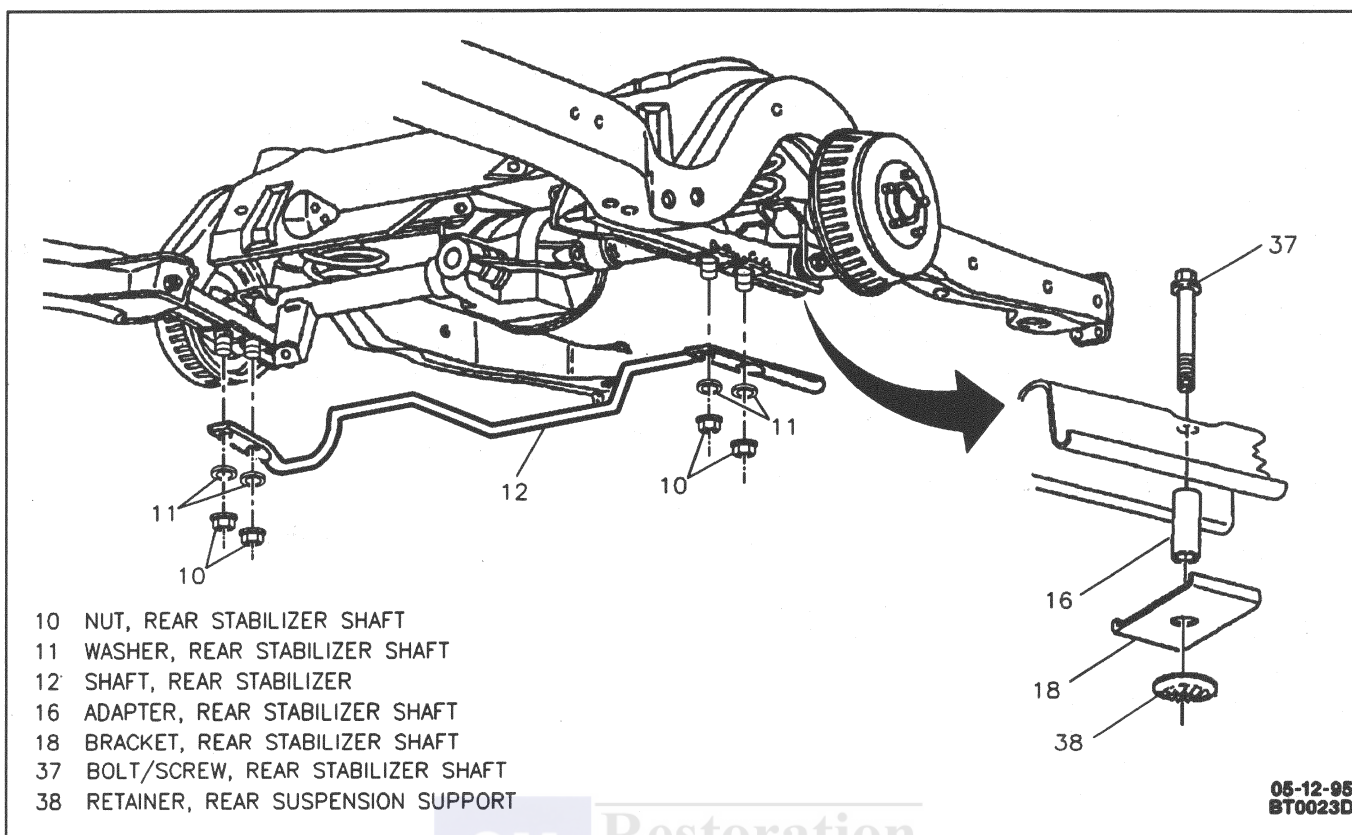


Figure 12 - Rear Stabilizer Shaft

6. Shock absorber (22).
7. Shield (39) from shock absorber (22), if equipped.

Install or Connect

NOTICE: Refer to "Notice" on page 3D-1 of this section.

1. Shield (39) to shock absorber (22), if removed.
 - Position so that "V" notch near clamp is 180° from air tube fitting and rim of shield is seated against rubber rim of shock absorber boot.
2. Shock absorber (22).
3. Bolts/screws (23) and nuts (25) loosely at frame (36).

NOTICE: When tightening lower attaching rear shock absorber nut, the stud must not turn. A hex is located on the stud between the rear axle tube bracket and the shock absorber so a wrench can be used to keep the stud from turning. Failure to hold the stud may cause damage to the mechanical bond between the shock absorber bushing and the stud.

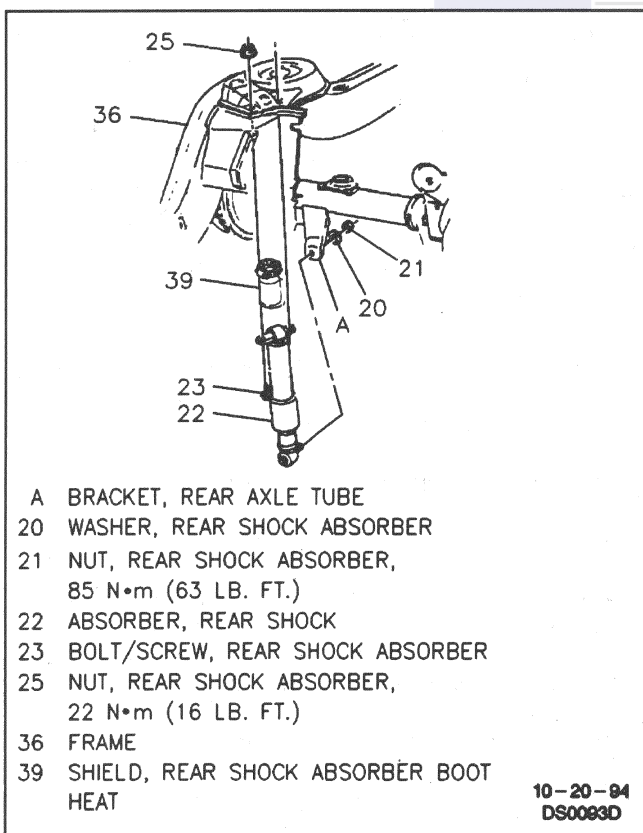


Figure 13 - Rear Leveling Shock Absorber

4. Washer (20) and nut (21) at rear axle.



Tighten

- Bolt/screw (23) at frame (36) to 24 N.m (18 lb. ft.) or nut (25) at frame (36) to 18 N.m (13 lb. ft.).
- Either the bolt/screw (23) or the nut (25) must be tightened. Tighten whichever one is easier to reach while holding the other stationary.

- Nut (21) at rear axle to 85 N.m (63 lb. ft.).

5. Air line to air adjustable shock absorber (22).

6. Remove support from rear axle.

7. Lower vehicle.

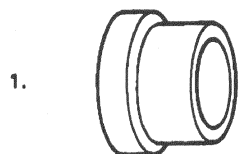
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Automatic Level Control Sensor Bolt/Screw	14 N.m (10 lb. ft.)
Automatic Level Control Sensor Link Nut	3 N.m (27 lb. in.)
Frame-to-Rear Shock Absorber Bolt/Screw	24 N.m (18 lb. ft.)
Frame-to-Rear Shock Absorber Nut	18 N.m (13 lb. ft.)
Propeller Shaft Bolt/Screw	22 N.m (16 lb. ft.)
Rear Axle-to-Rear Shock Absorber Nut	85 N.m (63 lb. ft.)
Rear Axle Bumper Nut	20 N.m (15 lb. ft.)
Rear Axle Housing-to-Rear Axle Upper Control Arm Bolt/Screw	113 N.m (83 lb. ft.)
Rear Axle Housing-to-Rear Axle Upper Control Arm Nut	100 N.m (74 lb. ft.)
Rear Axle Lower Control Arm Bolt/Screw	155 N.m (114 lb. ft.)
Rear Axle Lower Control Arm Nut	123 N.m (91 lb. ft.)
Rear Brake Hose Fitting Bolt/Screw	27 N.m (20 lb. ft.)
Rear Frame Crossmember-to-Rear Axle Upper Control Arm Bolt/Screw	155 N.m (114 lb. ft.)
Rear Frame Crossmember-to-Rear Axle Upper Control Arm Nut	130 N.m (95 lb. ft.)
Rear Stabilizer Shaft nut	50 N.m (37 lb. ft.)



SPECIAL TOOLS



J 21474-2



J 21474-6



J 21474-12



J 21474-20



J 25317-1



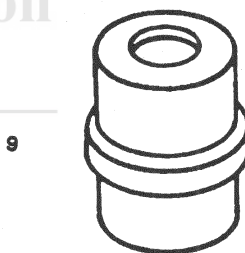
J 25317-2



J 21474-18



J 21474-19



J 21465-8



J 21474-5



- 1. BUSHING REMOVER/INSTALLER
- 2. BUSHING CARRIER
- 3. CONTROL ARM SPACER
- 4. BUSHING INSTALLER
- 5. BUSHING INSTALLER
- 6. BUSHING REMOVER
- 7. 3/8-INCH NUT
- 8. 3/8-INCH BOLT
- 9. BUSHING REMOVER
- 10. RECEIVER

SECTION 3D1

ELECTRONIC LEVEL CONTROL SYSTEM

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

AUTOMATIC LEVEL CONTROL SYSTEM

The Electronic Level Control (ELC) system is referred to as the automatic level control (ALC) system. The ALC system keeps the rear of the vehicle level by automatically adjusting the rear trim height with varying vehicle loads. The system is activated when the ignition is on and excess weight is added to the vehicle. When the excess weight is removed from the vehicle, a solenoid valve allows air to be released from the system, even with the ignition off. The ALC system, powered by both ignition and battery leads, will be activated until 6 minutes after ignition switch is turned off.

SYSTEM COMPONENT DESCRIPTION

Compressor

Figures 1 and 2

The compressor is a positive displacement rocking piston air pump powered by a 12-volt direct current permanent magnet motor. The compressor head casting contains piston intake and exhaust valves, and is mounted to the left front frame rail by a bracket.

Compressor Relay

Figures 1 and 2

The compressor relay is a single-pole, single-throw type that completes the 12-volt circuit to the compressor motor when energized. The compressor relay is located on the compressor bracket next to the compressor.

[illegible]

Figure 1 - Automatic Level Control Air Compressor

- | | |
|--|--|
| A HOUSING | 9 TUBE, AUTOMATIC LEVEL CONTROL |
| B FITTING | AIR COMPRESSOR |
| C FITTING | 10 FILTER, AUTOMATIC LEVEL CONTROL |
| D FITTING | AIR COMPRESSOR |
| E GROUND WIRE | 14 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR |
| F CLIP | COMPRESSOR SHIELD |
| G TUBING | 15 SHIELD, AUTOMATIC LEVEL CONTROL AIR |
| H CONNECTOR | COMPRESSOR |
| J CLIP | 16 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR |
| K CONNECTOR | COMPRESSOR SHIELD, 3 N·m (27 LB. IN.) |
| L O-RING | 17 GASKET, AUTOMATIC LEVEL CONTROL AIR |
| 3 DRYER, AUTOMATIC LEVEL CONTROL | COMPRESSOR HEAD |
| AIR COMPRESSOR AIR | 18 MOTOR, AUTOMATIC LEVEL CONTROL |
| 4 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR | AIR COMPRESSOR |
| COMPRESSOR BRACKET, 17 N·m (13 LB. FT.) | 19 HEAD, AUTOMATIC LEVEL CONTROL |
| 5 SEAL, AUTOMATIC LEVEL CONTROL AIR | AIR COMPRESSOR |
| COMPRESSOR AIR DRYER (O-RING) | 20 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR |
| 6 BRACKET, AUTOMATIC LEVEL CONTROL AIR | COMPRESSOR HEAD COVER, 4 N·m (35 LB. IN.) |
| COMPRESSOR AIR DRYER | 22 RELAY, AUTOMATIC LEVEL CONTROL AIR |
| 7 BRACKET, AUTOMATIC LEVEL CONTROL AIR | COMPRESSOR |
| COMPRESSOR | 24 RETAINER, AUTOMATIC LEVEL CONTROL AIR |
| 8 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR | COMPRESSOR AIR DRYER |
| COMPRESSOR AIR DRYER, 3.8 N·m (34 LB. FT.) | 25 BOLT/SCREW, AUTOMATIC LEVEL CONTROL AIR |
| | COMPRESSOR AIR DRYER RETAINER |

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Figure 2 - Automatic Level Control Air Compressor - Legend

Sensor

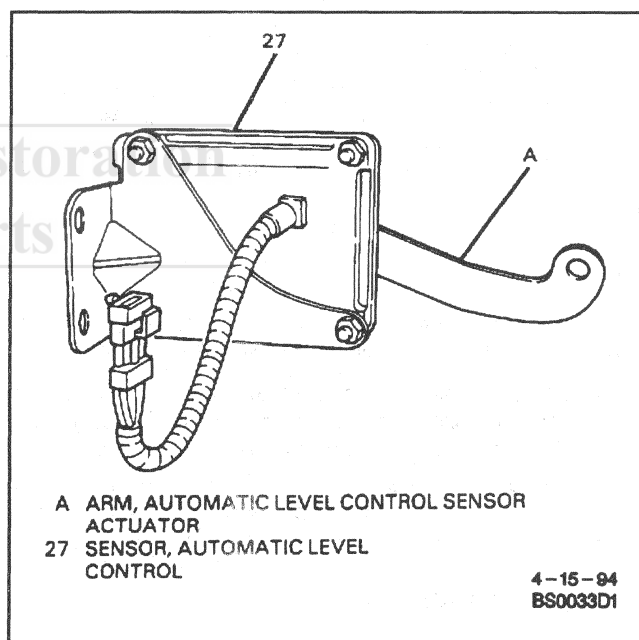
Figure 3

The sensor is an electronic device that controls two basic circuits:

- A. Compressor relay coil.
- B. Exhaust solenoid valve coil ground circuit.

To prevent falsely actuating the compressor relay or solenoid valve circuits during normal ride motions, the sensor circuitry provides an 8 to 15 second delay before either circuit can be completed.

The sensor also limits compressor run time or solenoid valve energized time to a maximum of 6 minutes. This time limit function is necessary to prevent continuous compressor operation in case of severe system leak or continuous exhaust valve operation. Turning the ignition off and on resets the electronic timer to renew the 6-minute maximum run time. The sensor is mounted on the rear crossmember above the rear axle housing. The actuator arm of the sensor is attached to the rear right-hand upper control arm by a link.



- A ARM, AUTOMATIC LEVEL CONTROL SENSOR ACTUATOR
27 SENSOR, AUTOMATIC LEVEL CONTROL

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Figure 3 - Automatic Level Control Sensor

Rear Leveling Shock Absorbers

Figure 4

The shock absorber is essentially a conventional shock absorber enclosed in an air chamber. The shock absorbers are constructed with a rubber-like sleeve attached to the dust tube and shock reservoir. This makes a flexible chamber which will extend the shock when air pressure in the chamber is increased. When air pressure is reduced, the weight of the vehicle collapses the shock absorber. To maintain proper operation and reliability of the shock absorber, a minimum pressure of 55-97 kPa (8-14 psi) is maintained at all times by the air dryer. Due to the

close routing of the exhaust system, a heat shield has been placed around the shock absorber boot to protect it from being burned.

Solenoid Valve

Figure 5

The solenoid valve is located within the compressor head and provides two functions:

1. Exhaust air from the system when the coil is energized.
2. Limit maximum output pressure of the compressor by acting as a pressure relief valve.

3D1-4 ELECTRONIC LEVEL CONTROL SYSTEM

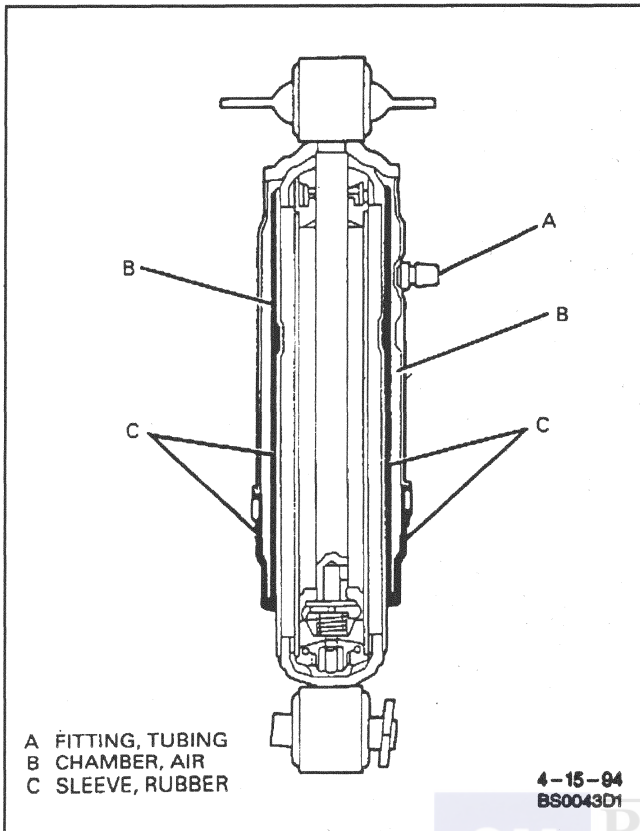


Figure 4 - Rear Leveling Shock Absorber

Air Dryer

Figure 6

The air dryer is attached externally to the compressor output and provides two functions:

1. Absorbs moisture from the air being delivered to the shock absorbers and then returns this moisture to the atmosphere when the air is released.
2. Maintains a 55 - 97 kPa (8 - 14 psi) minimum air pressure in the shock absorbers by means of a valve contained within the air dryer housing.

Tubing and Fittings

Figure 7

Snap-on connectors are used to attach the tubing to the rear shock absorbers. The connector housings contain retainer clips. When a tubing is attached to a shock fitting, the retainer clip snaps into a groove in the shock fitting, locking the tubing in position. All tubing fittings are sealed with two O-rings.

Air Compressor Filter

Figures 1, 2 and 8

Air enters the ALC system through the filter (10) mounted to the outer air compressor bracket. The filter housing contains a foam filter which prevents contaminants from entering the ALC system.

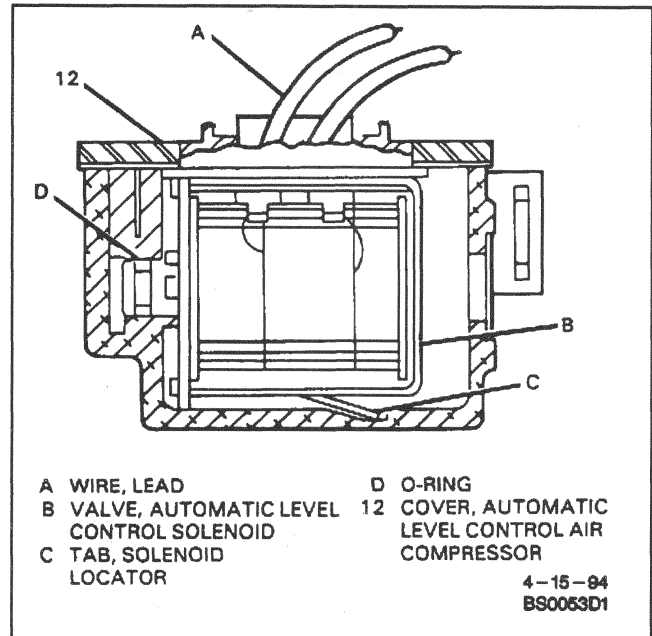


Figure 5 - Automatic Level Control Solenoid Valve

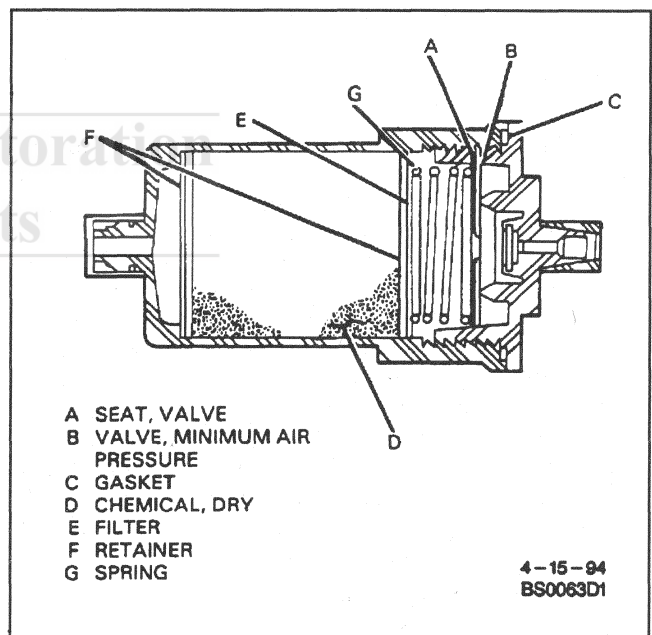


Figure 6 - Automatic Level Control Air Compressor Air Dryer

SYSTEM OPERATION

Raising Vehicle

When a load is added to the vehicle, the vehicle body is forced downward, causing the sensor actuating arm to rotate upward. The upward movement of the sensor actuating arm activates the internal timing circuit. After an initial delay of 8 to 15 seconds, the sensor completes the compressor relay circuit to ground. With the relay energized, the circuit to the compressor is complete and the compressor runs, taking in air through the air compressor filter and sending it through the tubings to the shock absorbers.

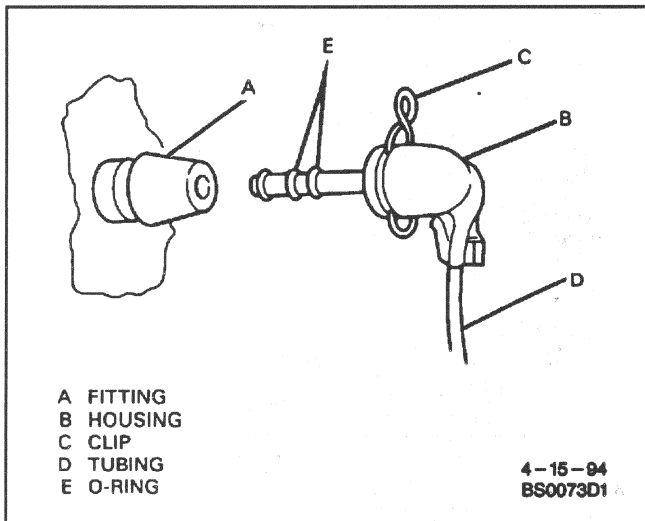


Figure 7 - Automatic Level Control Tubing and Fittings

As the shock absorbers inflate, the rear of the vehicle moves upward, rotating the sensor actuating arm back toward its original position prior to the load addition. Once the body reaches its original height (+/- 1 inch), the sensor opens the compressor relay circuit and shuts off the compressor.

Lowering Vehicle

When an excess load is removed from the rear of the vehicle, the body is forced upward, causing the sensor actuating arm to rotate downward. The downward rotation of the actuating arm activates the internal timing circuit. After an initial delay of 8 to 15 seconds, the sensor completes the solenoid valve circuit to ground. With the solenoid valve energized, air begins to exhaust out of the shock absorbers back through the air dryer, the solenoid valve, the air compressor filter and into the atmosphere. As the rear of the vehicle lowers, the sensor actuating arm is rotated downward toward its original position. When the vehicle body reaches its original height (+/- 1 inch), the sensor opens the solenoid circuit, de-energizing the solenoid valve, which prevents any further air from escaping.

Air Replenishment Cycle

The air replenishment cycle serves to ensure that the shock absorbers are filled with at least minimum residual pressure. The sensor commands an air replenishment cycle each time the ignition switch is turned on. Sensor position is checked when the ignition switch is turned on. If the sensor indicates that it is not necessary to raise or lower the vehicle, an internal timer circuit is activated. After a 35 to 40 second delay, the compressor is turned on for approximately 4 seconds. This ensures that the shock absorbers are filled with adequate residual pressure.

If weight is added to, or removed from, the vehicle during the initial 35 to 40 second delay, the air replenishment cycle will be overridden and the vehicle will raise or lower after the normal delay.

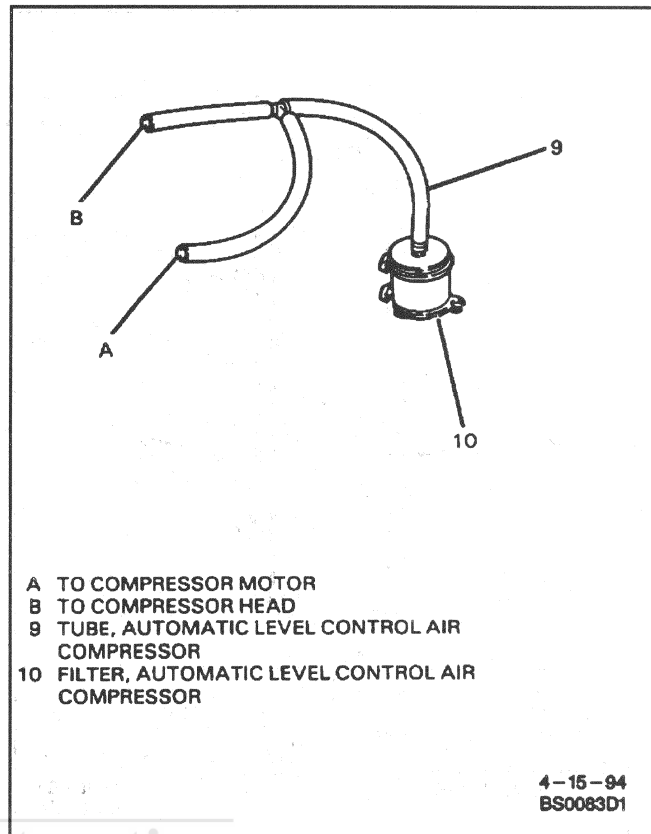


Figure 8 - Automatic Level Control Air Compressor Filter

Compressor Head Relief

To ensure low compressor motor starting current, a 1.5 second actuation of the solenoid valve will occur each time the compressor is to start. The 1.5 second actuation of the solenoid valve reduces the air pressure in the compressor head cavity.

Short Circuit Protection

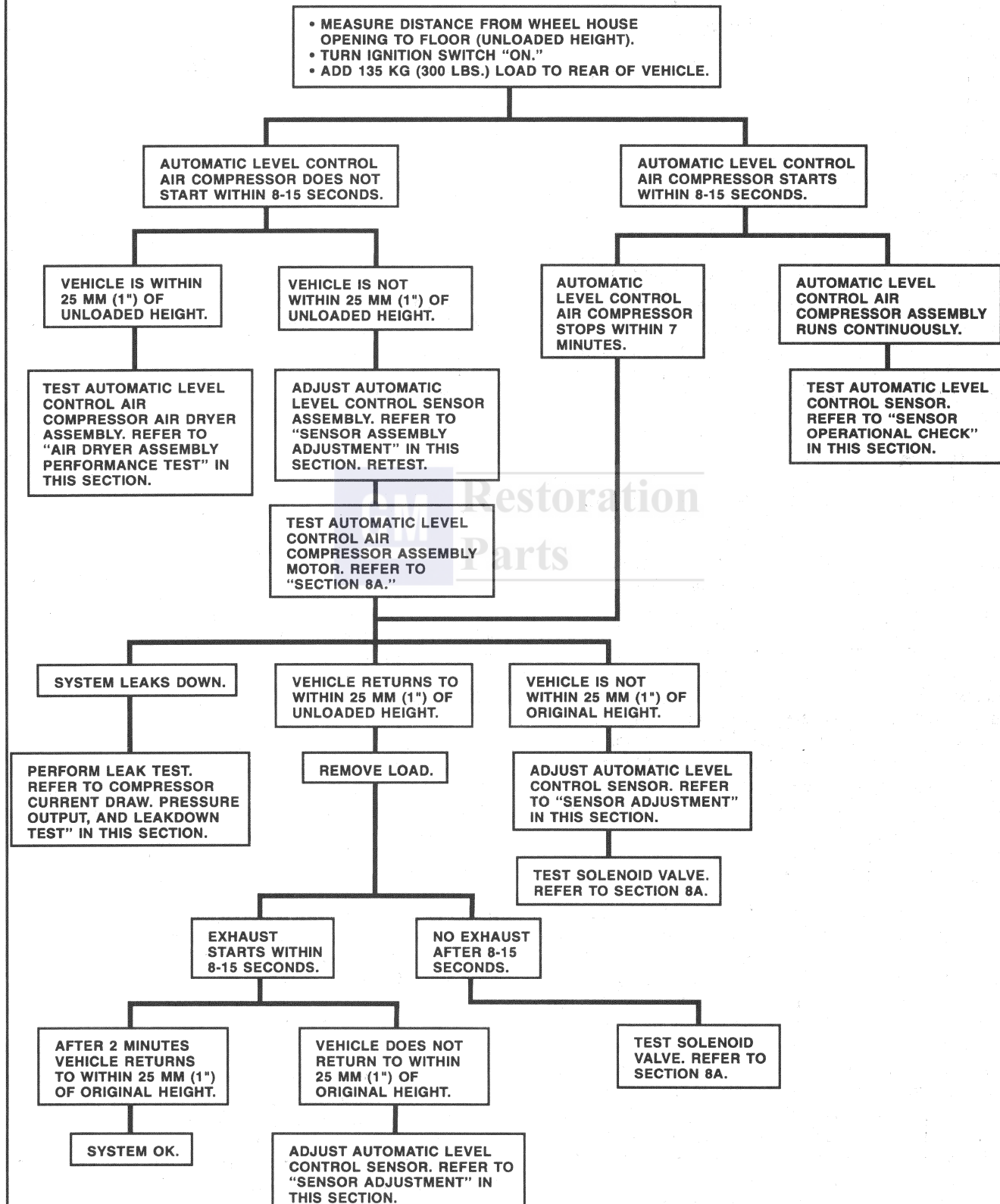
To protect against a short circuit in the relay, exhaust valve or wiring harness, self-protection is built into the sensor output circuits. When an overcurrent condition is detected, the respective output is turned off for an additional time delay (10 to 20 seconds). The circuit is again turned on. If the fault is still there, the protection circuit will repeat through the time delay. This will continue for 32 cycles at which time the shortened output will be disabled until an ignition reset. If used with the tester J 34825, the presence of an output fault (short circuit) as described above will be indicated on the tester by flashing the trim output light until the fault is removed.

DIAGNOSIS

When certain tests require raising the vehicle on a hoist, the hoist should support the rear wheels or axle housing. When a frame type hoist is used, two additional jack stands are required to support the rear axle housing in its normal curb weight position. Refer to SECTION 3 for trim height specifications.

Refer to SECTION 8A for electrical troubleshooting of the ALC system.

ALC SYSTEM OPERATIONAL CHECK



ALC SYSTEM OPERATIONAL CHECK

Perform the following preliminary inspections before doing the system operation check.

**Inspect**

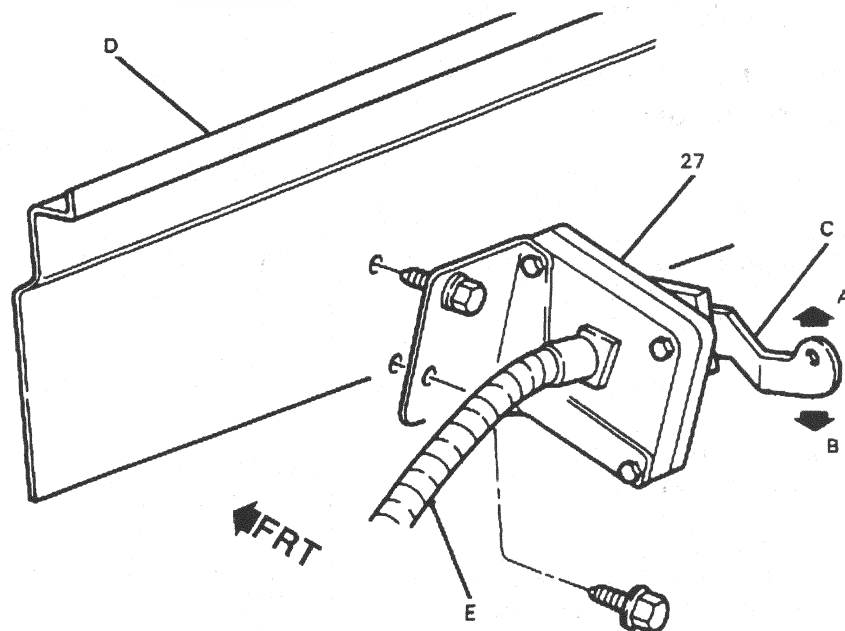
1. ALC sensor connector and ensure connection is secure.
2. ALC sensor link and ensure that link is properly secured to actuator arm.
3. ALC sensor actuator arm for damage.
4. Select suitable location at rocker panel just in front of rear wheel and measure distance to floor.
5. Turn ignition switch to "RUN" position.
6. Add load of 135 to 158 kg (300 to 350 lbs.) to rear of vehicle.
 - A. After 8 to 15 seconds, compressor should turn on and vehicle should begin to rise.
 - B. By the time compressor shuts off, vehicle should rise within 19 mm (3/4 inch) of unloaded measurement made in step 4.
7. Remove load applied in step 6.
 - A. After 8 to 15 seconds, vehicle should start to lower.
 - B. The vehicle should lower to within 19 mm (3/4 inch) of unloaded measurement made in step 4 in less than 8 to 15 seconds.

SENSOR OPERATIONAL CHECK**Figure 9**

1. Turn ignition switch to "OFF" then "RUN" position to reset sensor timing circuit.
2. Raise and suitably support vehicle. Refer to SECTION 0A.

**Important**

- Ensure rear wheels or axle housing are supported so that vehicle is at its normal trim height.
3. Disconnect link from sensor arm.
 4. Ensure that sensor wiring harness connectors are secure.
 5. Move sensor arm up.
 - A. After 8 to 15 seconds, compressor should turn on and shock absorbers should start to inflate.
 - B. If compressor does not run, refer to SECTION 8A.
 6. As soon as shock absorbers are filled, move sensor arm down until compressor stops.
 7. Move sensor arm down below position where compressor stopped.
 - After 8 to 15 seconds, shock absorbers should start to deflate.
 8. Connect link to sensor arm.
 9. Lower vehicle.



A SHOCKS INFLATE
B SHOCKS DEFLATE
C ARM, ACTUATOR

D CROSSMEMBER, REAR
E HARNESS, WIRING
27 SENSOR, AUTOMATIC LEVEL CONTROL

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Figure 9 - Checking Automatic Level Control Sensor Operation

3D1-8 ELECTRONIC LEVEL CONTROL SYSTEM

SYSTEM LEAK TEST

Figure 10

Tool Required:

J 22124-B Pressure Gage

The following test will determine if there is a leak in the system and whether the leak is internal or external to the compressor.

1. Connect air tube supplied with J 22124-B to air dryer fitting with shut-off valve placed between air dryer fitting and J 22124-B gage.
2. Connect air tube leading to shock absorbers to other end of J 22124-B.
3. With shut-off valve open (up), apply shop air pressure through service valve on gage until gage reads 690 to 827 kPa (100 to 120 psi).
4. If leak is indicated, close shut-off valve and continue to observe for pressure drop. This isolates compressor from remainder of system.
 - A. If gage pressure continues to drop, leak is external to compressor. Leak test all ALC system and shock absorber connections with soap and water or leak test solution.
 - B. If gage pressure does not drop further, leak is internal to compressor. Refer to "Compressor Leak Test" in this section.
5. If pressure builds up rapidly but vehicle does not raise, check for pinched air tubes and/or restriction to the shock absorbers.

COMPRESSOR PERFORMANCE TESTS

Compressor Current Draw, Pressure Output and Leakdown Test

Figure 10

Tool Required:

J 22124-B Pressure Gage

The compressor performance tests check the operation of the compressor by measuring compressor current draw, compressor output and pressure leakdown. Perform the following test set-up:

1. Remove compressor from vehicle. Refer to "Compressor" under "On-Vehicle Service" in this section.
2. Connect air tube supplied with J 22124-B to air dryer fitting so that gage on J 22124-B is situated between air dryer fitting and shut-off valve.
3. Disconnect air compressor relay.
4. Connect ammeter to a 12-volt source and to compressor. Refer to Figure 10.
5. Refer to the following chart.

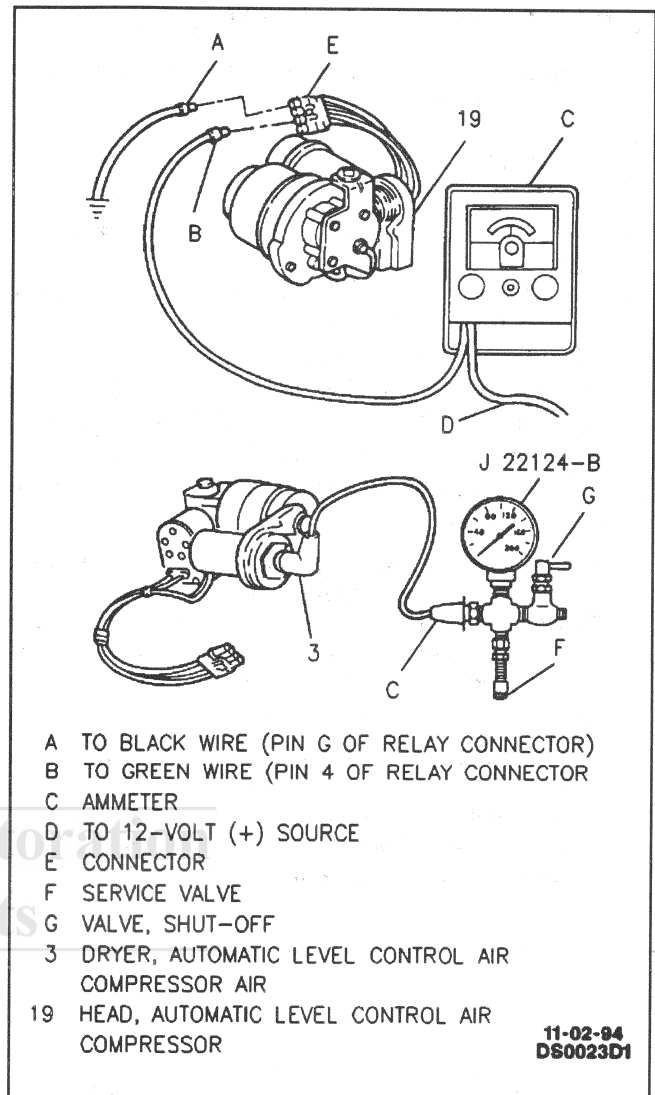


Figure 10 - Automatic Level Control Air Compressor Current Draw, Pressure Output and Leakdown Test Connections

Compressor Leak Test

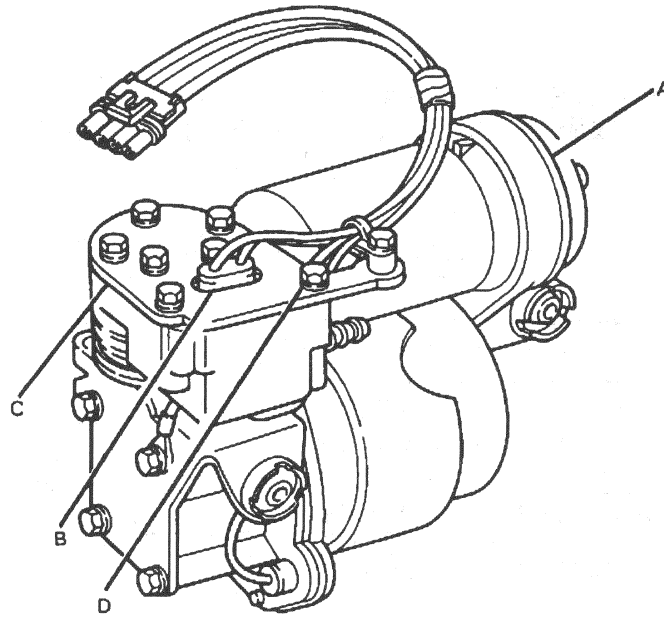
Figures 1, 2, 10 and 11

Tool Required:

J 22124-B Pressure Gage

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Remove compressor from vehicle. Refer to "Compressor" under "On-Vehicle Service" in this section.
2. Connect J 22124-B to air dryer and close valve before applying shop air.
3. Apply 690 kPa (100 psi) of compressed air through service valve on J 22124-B.
4. Using soap bubble solution, inspect following items for leaks:



A EDGE OF AUTOMATIC LEVEL CONTROL AIR
COMPRESSOR AIR DRYER COVER
B AUTOMATIC LEVEL CONTROL SOLENOID VALVE
ENTRANCE

C EDGE OF AUTOMATIC LEVEL CONTROL AIR
COMPRESSOR HEAD COVER GASKET
D EDGE OF AUTOMATIC LEVEL CONTROL AIR
COMPRESSOR HEAD COVER BOLT/SCREW

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Figure 11 - Automatic Level Control Air Compressor Leak Test



Inspect

- Air dryer cover.
- Area around air dryer port.
- Edge of compressor head cover gasket.
- Edge of solenoid valve terminal housing and lead entrance.
- Head casting air intake and exhaust opening.
- Head cover bolts/screws (20) for proper tightening.



Tighten

- Bolts/screws (20) on head cover, if required, to 4 N.m (35 lb. in.).

3. Connect air tube leading to shock absorbers to other end of J 22124-B.
4. Turn ignition switch to "RUN" position.
5. Disconnect link from crank arm and move crank arm upward to inflate shock absorber.
6. Move crank arm downward to deflate shock absorber.
7. Read pressure on J 22124-B.
8. Turn ignition switch to "OFF" position and deflate system through service valve on J 22124-B.

A. Pressure gage should read 55 - 97 kPa (8 - 14 psi) after system is deflated.

B. If pressure is not within specification, replace air dryer.

9. Lower vehicle.

AIR DRYER PERFORMANCE TEST

Residual Air Check

Tool Required:

J 22124-B Pressure Gage

The air dryer has a valve arrangement that maintains 55 - 97 kPa (8 - 14 psi) in the shock absorbers to improve the ride under light load conditions. To test this function, perform the following procedures:

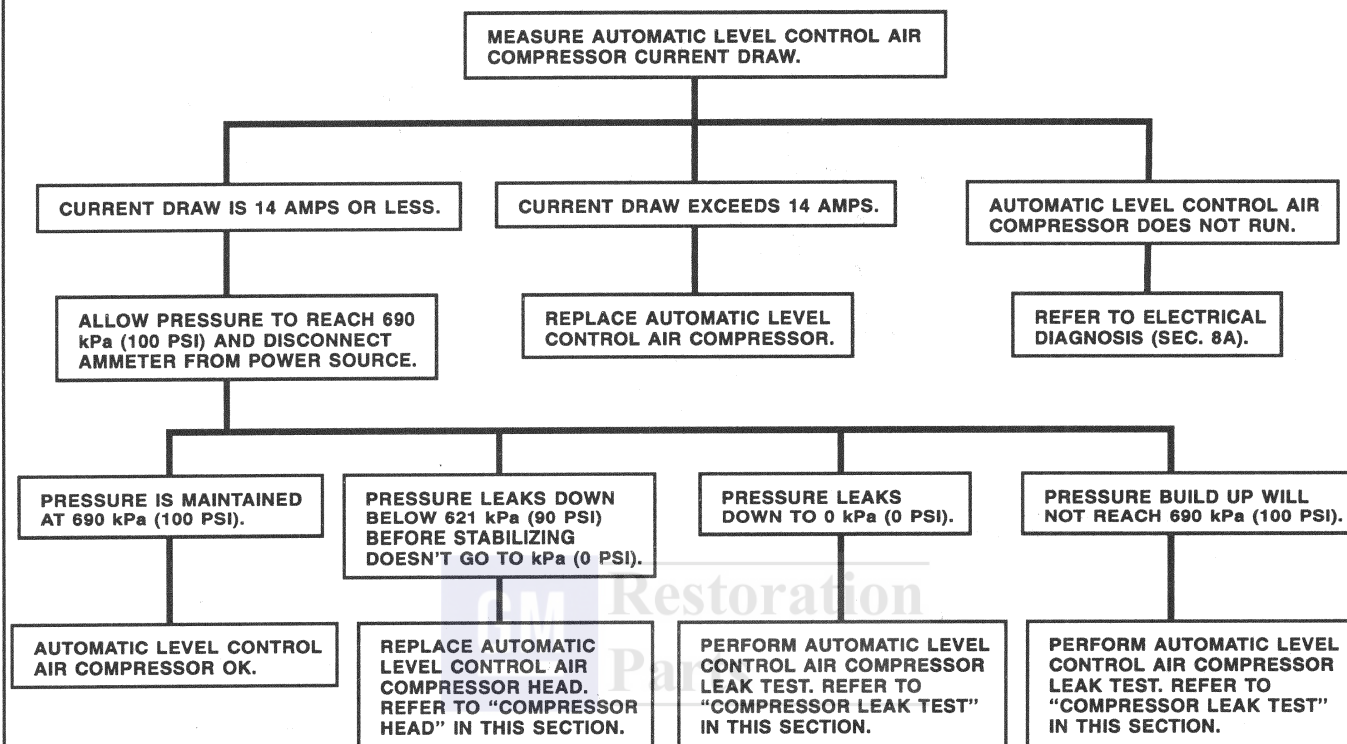
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Remove tubing connector from air dryer fitting and connect tube supplied with J 22124-B to air dryer fitting.

ON-VEHICLE SERVICE

TUBING AND FITTINGS

The tubing is connected to the air dryer and routed to the left rear shock absorber along the length of the left-hand frame by snap-in provisions on the brake/fuel/vapor clips. Another tubing connects the rear shock absorbers and is routed along the rear crossmember. The tubing includes spring clip connections with molded sealing shoulders in the retainer. On the end of each tubing is double O-ring seals.

AUTOMATIC LEVEL CONTROL AIR COMPRESSOR CURRENT DRAW, PRESSURE OUTPUT AND LEAKDOWN TEST



Before making any tubing disconnections, clean the connector and surrounding area. Turn the spring clip to release the connector. To reassemble, lubricate the O-rings with petroleum jelly and push the tubing and connector fully into the fitting.

TUBING REPAIR

Figure 12

Service repair kits contain a length of tubing with a snap-on type fitting and the necessary parts for splicing the tubing to an existing line.

1. Detach existing tubing from air filter and cut and remove all leaking hose areas.
2. Cut the new tubing to length, using a razor blade or very sharp knife.
3. Splice the new tubing to the existing tubing.
4. Remove plastic retainer pin from one of nuts and slide replacement tubing into nut until it bottoms in rubber seal.
5. Maintaining tubing in position described above, tighten nut securely onto service coupling.
 - During tightening of nut a collar on internal metal sleeve breaks loose. When collar breaks loose, continue to tighten nut until it's secure.
6. Attach original tubing to other end of coupling as described above.
7. Using tie strap, secure tubing to vehicle in location where it will not be pinched or contact exhaust system.

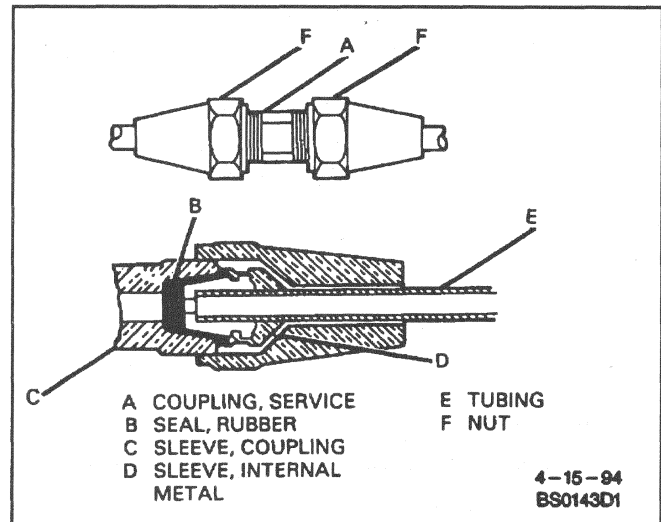


Figure 12 - Automatic Level Control Tubing Repair

SENSOR

Figure 13

↔ Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Raise and suitably support vehicle. Refer to SECTION 0A.

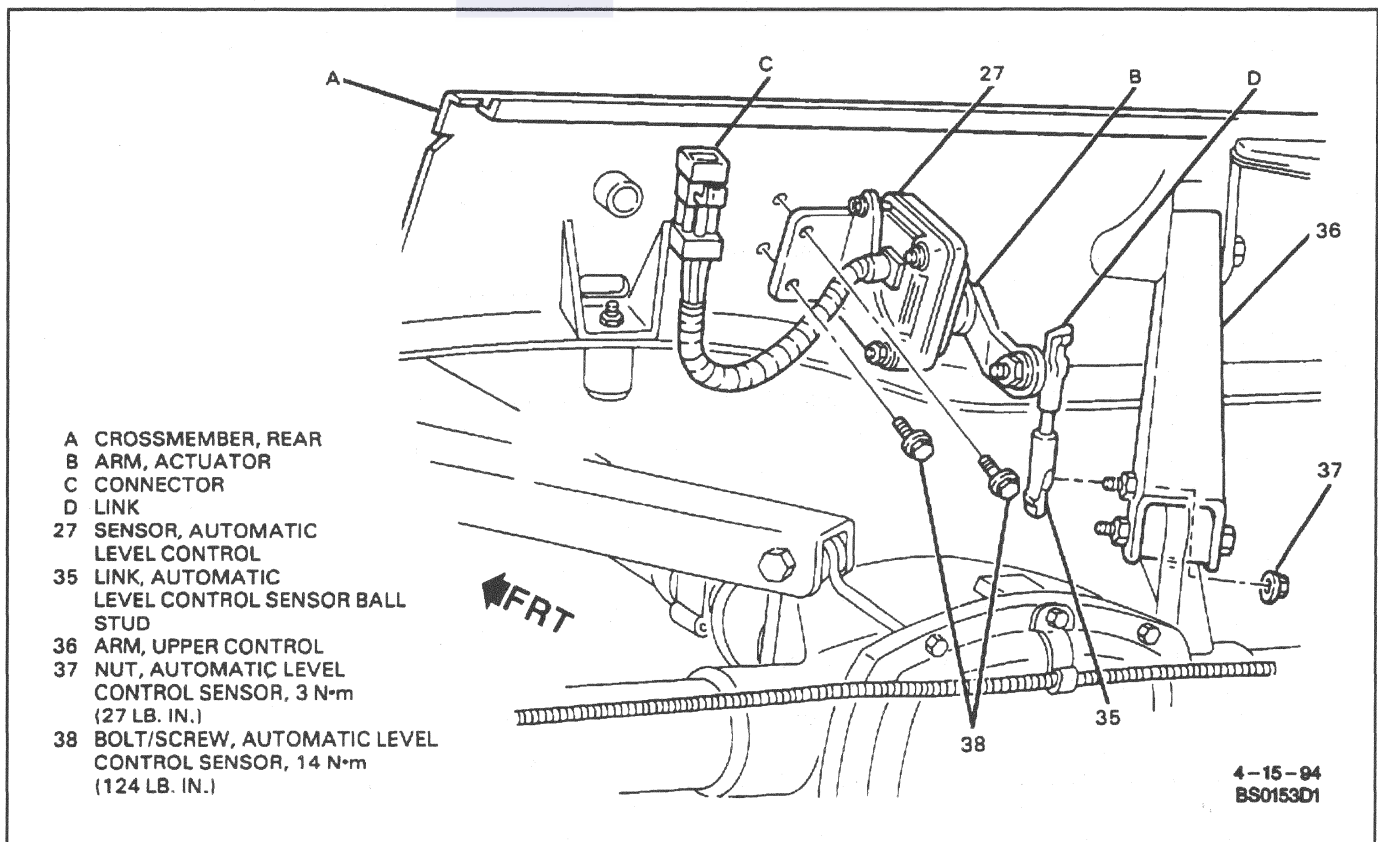


Figure 13 - Replacing Automatic Level Control Sensor

3D1-12 ELECTRONIC LEVEL CONTROL SYSTEM

3. Electrical connector from rear harness.
4. Nut (37) retaining link (35) to upper control arm (36).
5. Bolts/screws (38) retaining sensor (27) to rear crossmember.
6. Sensor (27) from rear crossmember.

 Install or Connect

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Sensor (27) to rear crossmember.
2. Bolts/screws (38) retaining sensor (27) to rear crossmember.

Tighten

- Bolts/screws (38) to 14 N.m (124 lb. in.).
3. Link (35) to upper control arm (36).
 4. Nut (37) retaining link (35) to upper control arm (36).

 Tighten

- Nut (37) to 3 N.m (27 lb. in.).
5. Electrical connector to rear harness.
 6. Lower vehicle.
 7. Battery negative cable.
 8. Adjust sensor. Refer to “Sensor Adjustment” in the following procedure.

Sensor Adjustment

Figure 14

The attaching link should be securely connected to the sensor arm when any adjustments are made. For every 1 degree change in the arm angle, the trim height will change by approximately 6 mm (1/4 inch). The arm angle may be changed a total of 5 degrees, resulting in a trim height change of approximately 32 mm (1 1/4 inch).



Adjust

1. Sensor (27).
 - A. Loosen nut (29) securing metal arm to plastic arm.
 - B. To decrease amount of rear suspension travel required to turn on compressor (to raise vehicle trim height), move plastic arm to top of slot and tighten nut (29).
 - C. To increase amount of travel required to turn on compressor (to lower vehicle trim height), move plastic arm to bottom of slot and tighten nut (29).

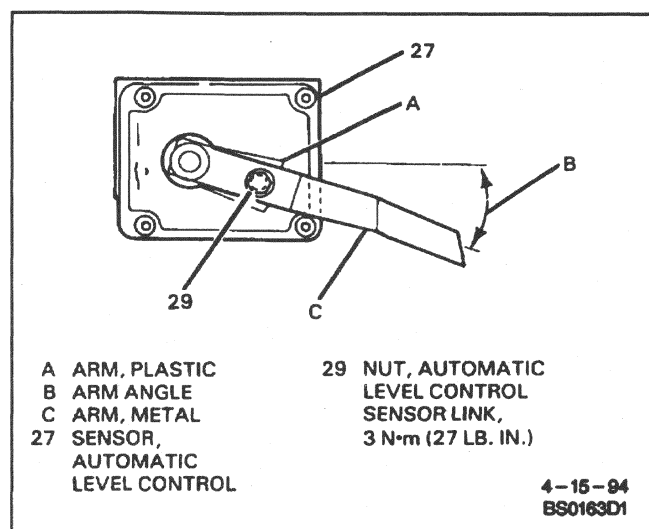


Figure 14 - Automatic Level Control Sensor Adjustment

COMPRESSOR

Figures 1, 2 and 15

 Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector.
4. Tubing from filter.
5. Bolts/screws (42).
6. Nut (44) and bolt/screw (43).
7. Compressor from left front frame rail.

Install or Connect

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Position compressor to left front frame rail.
2. Nut (44) and bolt/screw (43).
3. Bolts/screws (42).

Tighten

- Bolts/screws (42 and 43) to 17 N.m (13 lb. ft.).
- 4. Tubing to filter (10).
- 5. Electrical connector.
- 6. Lower vehicle.
- 7. Battery negative cable.

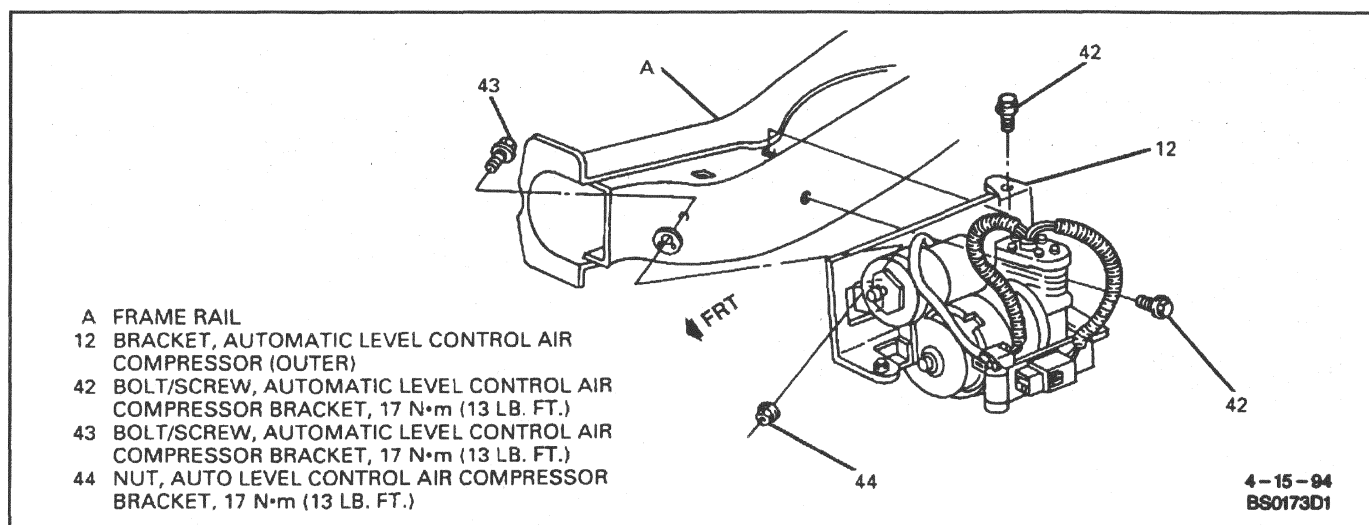


Figure 15 - Removing Automatic Level Control Air Compressor

Compressor Relay

Figures 1, 2, 15 and 16

1. Compressor from vehicle. It is not necessary to remove compressor from bracket. Refer to "Compressor" under "On-Vehicle Service" in this section.
2. Bolt/screw retaining compressor relay (22) from bracket (12).
3. Compressor relay (22) from electrical connector.

Install or Connect

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Compressor relay (22) to electrical connector.
2. Position compressor relay (22) to bracket (12).
3. Bolt/screw retaining compressor relay (22) to bracket (12).

Tighten

- Bolt/screw to 3.8 N·m (34 lb. in.).
4. Compressor to left front frame rail. Refer to "Compressor" under "On-Vehicle Service" in this section.

AIR COMPRESSOR FILTER

Figures 1, 2 and 15

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Compressor. Refer to "Compressor" under "On-Vehicle Service" in this section.
3. Tube (9) from filter (10).
4. Filter (10) from bracket (12).

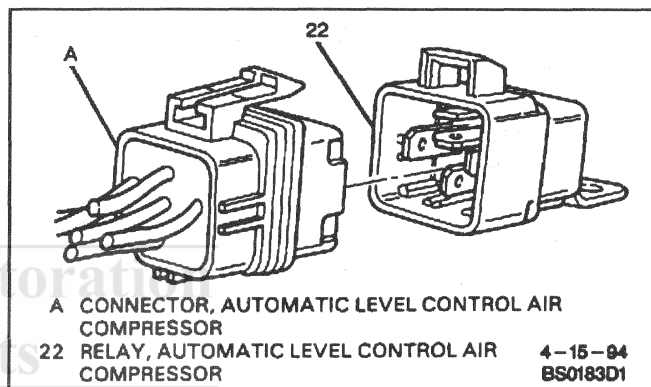


Figure 16 - Automatic Level Control Air Compressor Relay and Connector

Install or Connect

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Filter (10) to bracket (12).
2. Tube (9) to filter (10).
3. Compressor. Refer to "Compressor" under "On-Vehicle Service" in this section.
4. Lower vehicle.

UNIT REPAIR

AIR DRYER

Figures 1, 2 and 17

Remove or Disconnect

1. Compressor from vehicle. Refer to "Compressor" under "On-Vehicle Service" in this section.
2. Bolts/screws (8) retaining air dryer (3) and brackets (6 and 7) to compressor.
3. Air dryer (3) from cylinder casting.
 - A. Rotate clip 90 degrees.
 - B. Rotate air dryer (3) and pull to remove.
4. Seal (5) from cylinder casting.

3D1-14 ELECTRONIC LEVEL CONTROL SYSTEM

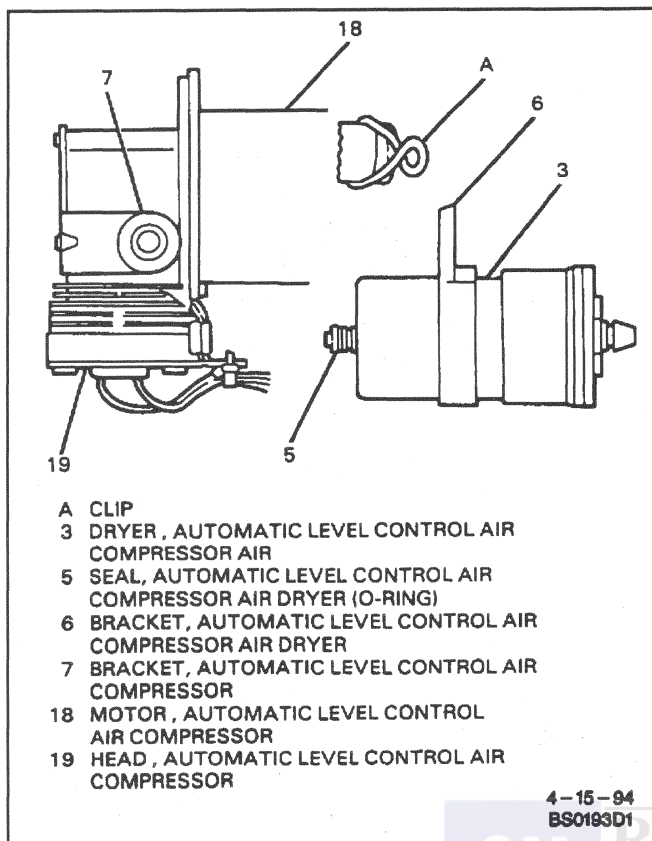


Figure 17 - Replacing Automatic Level Control Air Compressor Air Dryer

Install or Connect

NOTICE: Refer to "Notice" on page 3D1-1 of this section.

1. Lubricate seal (5) lightly with petroleum jelly.
2. Seal (5) to air dryer port.
3. Clip to air dryer fitting.
4. Air dryer (3) to cylinder casting.
 - Slide air dryer (3) into cylinder casting and rotate it into proper position.
5. Bolts/screws (8).



Tighten

- Bolts/screws (8) to 3.8 N·m (34 lb. in.).
6. Compressor to vehicle. Refer to "Compressor" under "On-Vehicle Service" in this section.

COMPRESSOR HEAD

Figures 18 and 19

Remove or Disconnect

1. Air dryer. Refer to "Air Dryer" in this section.
2. Three bolts/screws (20) attaching compressor head (19) to cylinder casting.
3. Head gasket (17) from cylinder casting.
4. Discard head gasket (17).

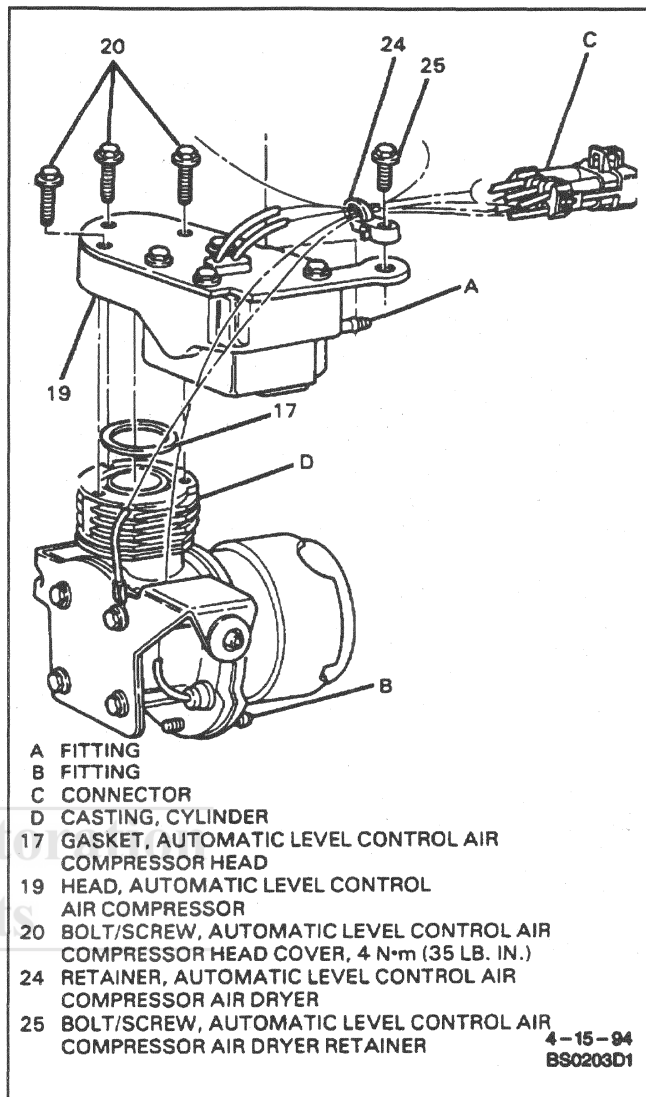


Figure 18 - Replacing Automatic Level Control Air Compressor Head

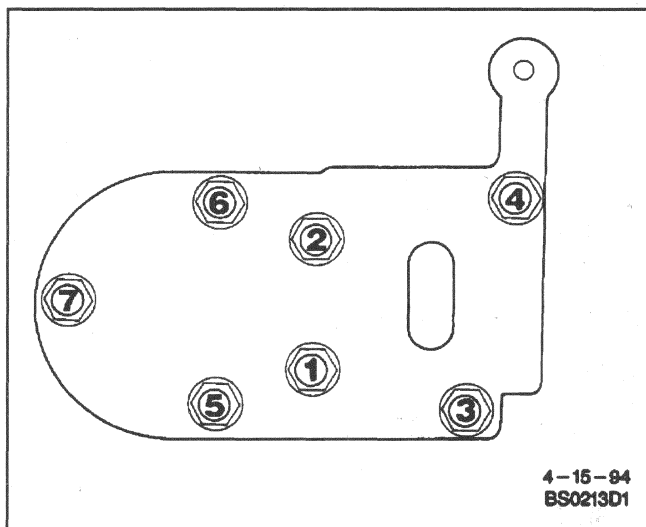


Figure 19 - Automatic Level Control Air Compressor Head Bolt Tightening Sequence

**Clean**

- Head gasket sealing surface.

**Install or Connect**

NOTICE: Refer to “Notice” on page 3D1-1 of this section.

1. New head gasket (17) to cylinder casting.
2. Compressor head (19) to cylinder casting.
3. Three bolts/screws (20) attaching compressor head (19) to cylinder casting.

**Tighten**

- Bolts/screws (20) to 4 N.m (35 lb. in.) in sequence shown in Figure 19.
4. Air dryer. Refer to “Air Dryer” in this section.

SOLENOID VALVE

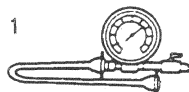
The solenoid valve is not serviceable. If the solenoid valve requires replacement, replace the complete compressor head. Refer to “Compressor Head” in this section.

MOTOR AND CYLINDER

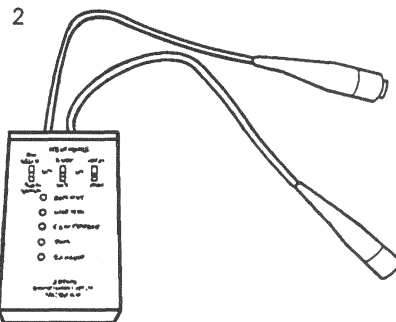
If the motor and cylinder requires replacement, replace the complete compressor, including the air dryer and the compressor head. Refer to “Compressor” under “On-Vehicle Service” in this section.

SPECIFICATIONS**FASTENER TIGHTENING SPECIFICATIONS**

Automatic Level Control Air Compressor Air Dryer Bolt/Screw	3.8 N.m (34 lb. in.)
Automatic Level Control Air Compressor-to-Bracket Bolt/Screw	5 N.m (44 lb. in.)
Automatic Level Control Air Compressor Bracket-to-Frame Bolt/Screw	17 N.m (13 lb. ft.)
Automatic Level Control Air Compressor Head Cover Bolt/Screw	4 N.m (35 lb. in.)
Automatic Level Control Air Compressor Relay-to-Bracket Bolt/Screw	3.8 N.m (34 lb. in.)
Automatic Level Control Air Compressor Shield Bolt/Screw	3 N.m (27 lb. in.)
Automatic Level Control Ball Sensor Stud Link-to-Upper Control Arm Nut	3 N.m (27 lb. in.)
Automatic Level Control Sensor-to-Rear Crossmember Bolt/Screw	14 N.m (124 lb. in.)

SPECIAL TOOLS

J 22124-B



J 34825

- 1 PRESSURE GAGE
- 2 ALC TESTER

BLANK



SECTION 3E

TIRES AND WHEELS

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The factory-installed tires and wheels are designed to operate satisfactorily with loads up to and including the full load capacity when inflated to the recommended inflation pressures. Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessarily sharp braking increase tire wear.

REPLACEMENT TIRES

Figure 1

A tire performance criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets GM's performance standards for traction, endurance, dimension, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

Replacement tires should be the same size, speed rating, load range and construction as the original tires. Replace the original tires with tires of the same

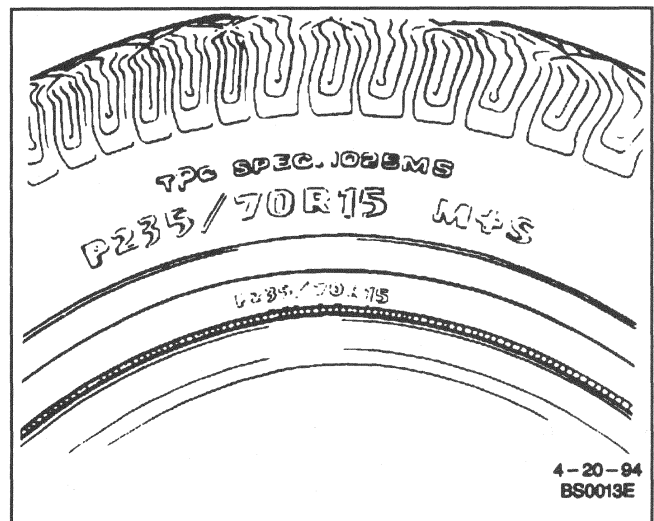


Figure 1 - Tire Identification

3E-2 TIRES AND WHEELS

TPC specification number. Use of any other tire size, speed rating or type may seriously affect ride, handling, speedometer/odometer calibration, antilock brake system, vehicle ground clearance, trailering capability, and tire clearance to the body and chassis. Listed below are common speed rating symbols and corresponding maximum speeds.

Speed Symbol	Maximum Speed (km/h)	Maximum Speed (mph)
S	160	112
T	190	118
U	200	124
H	210	130
V	240	149
Z	Over 240	Over 149

CAUTION: Do not mix different types of tires on the same vehicle, such as radial, bias, and bias-belted tires, except in emergencies because vehicle handling may be seriously affected and may result in loss of control. This caution does not apply to the compact spare furnished with the vehicle.

Tires Should Be Replaced When:

1. They are worn to a point where 1.6 mm (1/16 inch) or less tread remains, or the cord or fabric is showing. To help detect this condition, tires have built-in tread wear indicators that appear between the tread grooves when the tread is worn to 1.6 mm (1/16 inch) or less. When the indicators appear in two or more adjacent grooves at three spots around the tire, the tire should be replaced.
2. The tread or sidewall is cracked, cut or snagged deeply enough to expose the cord or fabric.
3. The tire has a bump, bulge or split. Slight sidewall indentations are normal and should not affect ride.
4. The tire has a puncture, cut or other damage that cannot be correctly repaired because of the size or location of the damage.

It is recommended that new tires be installed in pairs on the same axle. If only one tire is replaced, it should be paired with the tire having the most tread.

ALL SEASON TIRES

Figure 1

All Chevrolet Caprices, Impalas and Buick Roadmasters are equipped with steel belted all season radial tires as standard equipment. These tires qualify as snow tires, with a 37 percent higher average rating for snow traction than non-all season radial tires used previously. Other performance areas, such as wet traction, rolling resistance, tread life and air retention, were also improved slightly. These improvements were

made by changing both tread design and tread compounds. These tires are identified by an "M + S" molded in the tire sidewall following the size. The suffix "MS" is also molded in the sidewall after the TPC specification number.

PUNCTURE SEALING TIRES

(Buick Wagon)

Figure 2

The puncture sealing tire is designed to permanently seal most tread punctures up to 3/16 inch in diameter, so that the tire remains inflated. The actual sealant is made up of a special rubber compound, which is applied to the tire in the tire manufacturing plant. The sealant only covers the inside of the tire under the tread area. The sealant is designed to surround the imbedded object and seal the puncture at the inner surface of the tire below the tread. When an object 3/16 or less penetrates the tire, it picks up a coating of sealant. As the puncturing object is either removed or thrown out by centrifugal force, the sealant sticks to it and is pulled into the puncture opening in the tread. This sealant fills the puncture and permanently seals the tire, keeping it completely inflated.

P-METRIC TIRES

Figure 3

All Chevrolet Caprices, Impalas and Buick Roadmasters use passenger-metric (P-metric) sized tires. P-metric tires are available in two load ranges: standard load and extra load. All models use standard load tires, hearses use extra load tires. The words "STANDARD LOAD" or "EXTRA LOAD" are molded into the tire, usually near the tire bead, or the letters "XL" may appear after the tire size.

The metric term for tire inflation pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and psi. One psi equals 6.9 kPa. Refer to the tire placard or "Specifications" in this section for tire inflation pressures.

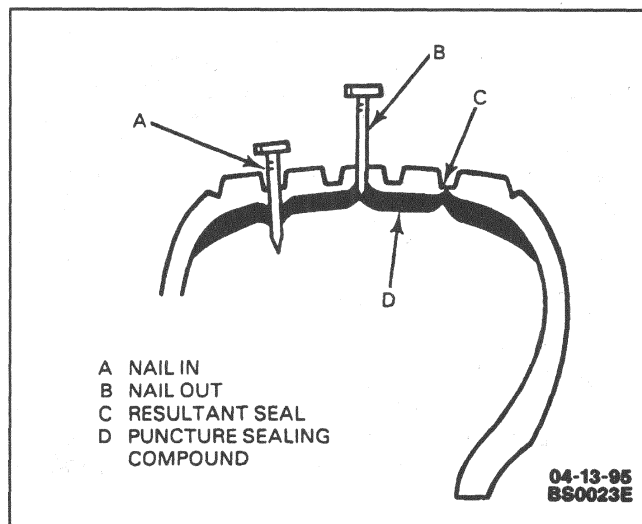


Figure 2 - Puncture Sealing Tires (Buick Wagon)

TIRE CHAIN USAGE

Use of chains may adversely affect vehicle handling. Due to limited tire-to-body clearance on this vehicle, tire chain usage recommendations have been published in the Owner's Manual. When chains are to be used, use SAE Class "S" tire chains. These chains are specially designed to limit the "fly off" effect that occurs when the wheel rotates. Manufacturers of tire chains have a specific chain size for each tire size to ensure proper fit when installed. Therefore, specific chains should be obtained for the tire on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains which are loose due to incorrect size. Always follow the chain manufacturers installation instructions.

WHEN CHAINS ARE INSTALLED:

1. Adjust speed to road conditions
2. Avoid sharp turns
3. Install the chains on the front tires as tightly as possible, then tighten them again after driving 0.4 to 0.8 km (1/4 to 1/2 mile).

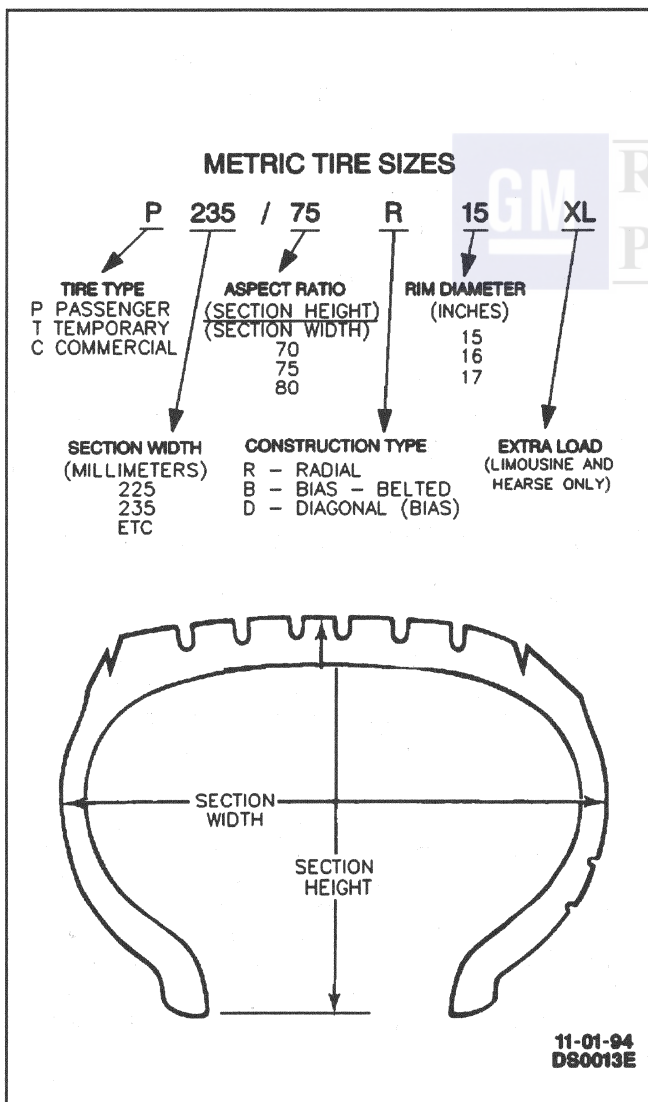


Figure 3 - Metric Tire Size Format

4. Do not exceed 70 km/h (45 mph), or the chain manufacturer's speed limit, if lower.
5. Drive in a restrained manner and avoid large bumps, potholes, severe turns and other maneuvers which could cause the tires to bounce up and down.
6. Follow any other instructions of the chain manufacturer which do not disagree with the above.
7. If you can hear the chains contacting the vehicle, stop and retighten them. If the contact continues, slow down until it stops. Additional specific information is published in the Owner's Manual.

TIRE PLACARD

Figure 4

The tire placard is permanently located on the rear face of the driver's door, and should be referred to for tire information. The placard lists the maximum vehicle load, tire size (including spare), and cold inflation pressure (including spare).

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds (porosity leaks in aluminum wheels can be repaired), have elongated bolt holes, or if the wheel nuts will not stay tight. Wheels with runout greater than specified may cause objectionable vibrations.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of incorrect size or type may affect bearing life, brake cooling, speedometer/odometer calibration, antilock brake system, vehicle ground clearance and tire clearance to the body and chassis.

ON-VEHICLE SERVICE

WHEEL REPAIR

Wheel repairs that use welding, heating or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires. Porosity in aluminum wheels can be repaired. Refer to "Aluminum Wheel Porosity Repair" in this section.

METRIC WHEEL NUTS AND WHEEL BOLTS

A metric wheel nut is identified by the word "Metric" stamped on its face. The wheel bolt has the letter "M" stamped into its end. The thread size of the metric wheel nuts and bolts are indicated by a code, such as M12 x 1.5 which designates the diameter (12 mm), and the distance between threads (1.5 mm).

3E-4 TIRES AND WHEELS

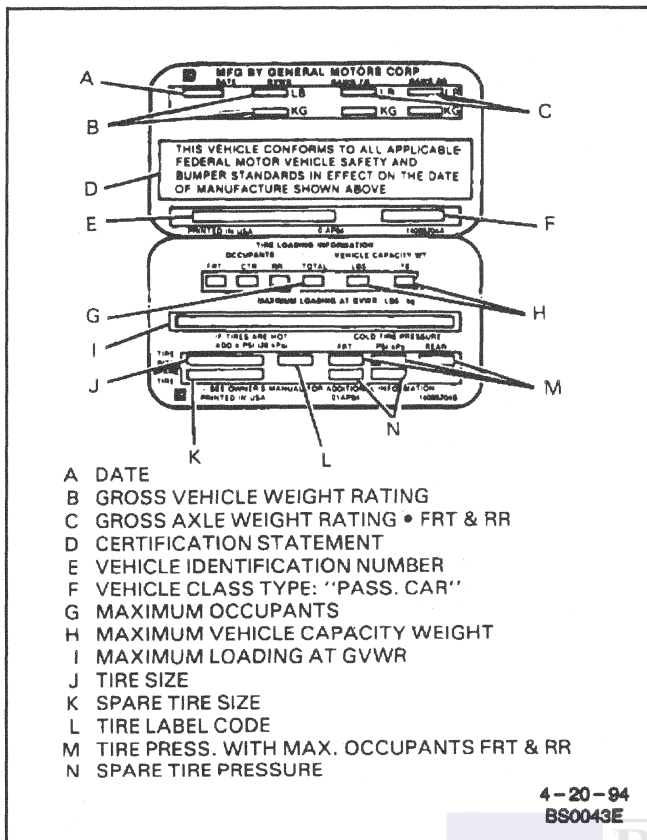


Figure 4 - Tire Placard

WHEEL BOLT REPLACEMENT

CAUTION: If any wheel bolt is damaged by a loose-running tire and wheel, all the wheel bolts for that wheel should be replaced. A loose-running wheel may break only one wheel bolt, but the other wheel bolts may be damaged internally. Replacing only the broken wheel bolt and remounting the wheel may cause further damage and personal injury.

Front Wheel Bolt

For the front wheel bolt replacement procedure, refer to SECTION 3C.

Rear Wheel Bolt

For the rear wheel bolt replacement procedure, refer to SECTION 4B.

TIRE INFLATION

The pressure recommended for all models is carefully calculated to give a comfortable ride, responsive steering, and maximum tread wear, tire life and resistance to bruises. Valve stem caps or extensions should be installed on the valve stems to keep out dust and water. Tire pressure, with tires cold (after vehicle has set for three hours or more, or

driven less than one mile), should be checked monthly or before any extended trip and set to the specifications on the tire placard located on the rear face of driver's door or in "Specifications" in this section. Tire pressure will increase about 6.9 kPa (1 psi) for every 5.5° C (10° F) temperature increase.

For sustained high-speed driving, tires should be set at the pressures recommended. Sustained driving at high speeds, where permitted by law, is not advised unless vehicle has special high-speed tires.

HIGHER THAN RECOMMENDED PRESSURE CAN CAUSE:

1. Hard ride.
2. Reduced handling.
3. Tire bruising or carcass damage.
4. Rapid tread wear at center of tire.

LOWER THAN RECOMMENDED PRESSURE CAN CAUSE:

1. Tire squeal on turns.
2. Hard steering.
3. Rapid and uneven wear on the edge of the tread.
4. Tire rim bruises and rupture.
5. Tire cord breakage.
6. High tire temperatures.
7. Reduced handling.
8. High fuel consumption.

UNEQUAL PRESSURE ON SAME AXLE CAN CAUSE:

1. Uneven braking.
2. Steering lead.
3. Reduced handling.
4. Swerve on acceleration.

WHEEL REMOVAL AND INSTALLATION

Figures 5 and 6

Penetrating oil has not been found to be effective in removing tight wheels. However, if it is used, it should be applied sparingly to the wheel center hole area only.

CAUTION: If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum, it could cause the wheel to work loose as the vehicle is driven, resulting in a loss of control and an injury accident. Never use heat to loosen a tight wheel. It can shorten the life of the wheel, wheel bolts, spindle and bearing and/or seals.

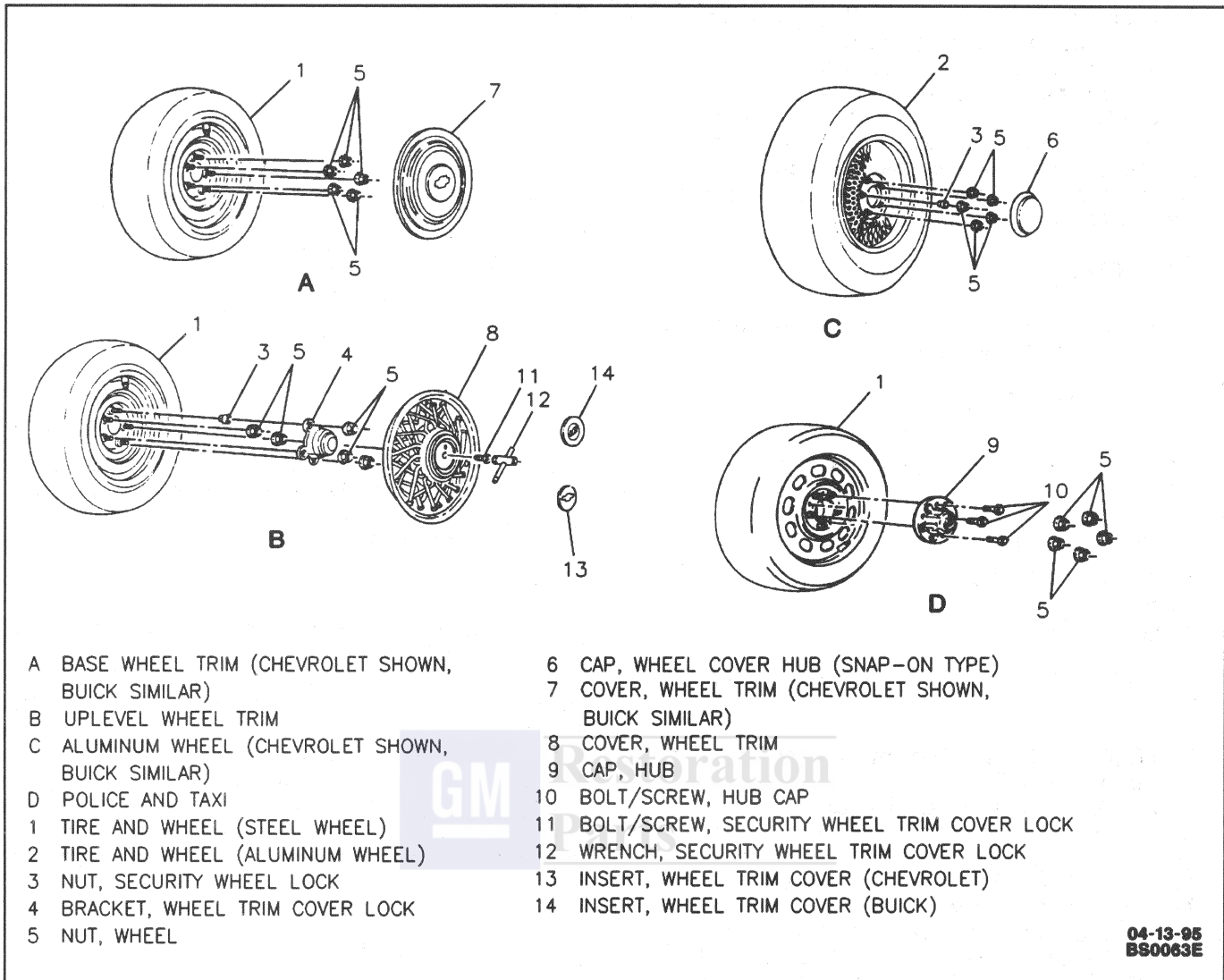


Figure 5 - Tires and Wheels

Wheel nuts must be tightened in sequence and to the proper torque to avoid bending the wheel or rotor. Sometimes wheels can be difficult to remove due to foreign material or a tight fit between the wheel centerhole and the rotor. Excessive force such as hammering the wheel can cause damage and is not recommended. Slight tapping on the tire sidewall using a large rubber mallet is acceptable. The wheel can be removed without damage as follows:

REMOVING TIGHT WHEEL

1. Retighten all wheel nuts on the affected wheel. Then loosen each wheel nut two turns. Rock the vehicle side to side. If this is not effective, go to step 2.
2. Rock the vehicle from "DRIVE" to "REVERSE" allowing the vehicle to move several feet in each direction. Apply quick hard jabs on the brake pedal to loosen the wheel. If the wheel still does not free up, then rock the vehicle again from side to side as hard as possible using one or more person's body weight. If the wheel is still tight, repeat the procedure.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Cover insert (13 or 14) if equipped.
 - Pry off cover insert.
3. Bolt/screw (11), if equipped.
 - Use wrench (12) located in instrument panel compartment to remove bolt/screw (11).
4. Cover (7, 8 or 9), if equipped.
 - Pry off cover (7, 8 or 9).
5. Hub cap (6) on aluminum wheel, if equipped.
 - Pry off.
6. Wheel nuts (5).
7. Bracket (4), if equipped.
8. Security wheel lock nut (3), if equipped.
9. Tire and wheel (1 or 2).
10. Bolts/screws (10), if equipped.
11. Hub cap (9), if equipped.

3E-6 TIRES AND WHEELS

CAUTION: Before installing a wheel, remove any buildup of corrosion on the wheel mounting surface and drum or rotor by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which may later allow the wheel to come off while the vehicle is in motion.



Clean

- Wheel nuts (5), wheel bolts and drum or rotor mounting surfaces.



Install or Connect

NOTICE: Refer to "Notice" on page 3E-1 of this section.

1. Hub cap (9), if removed.
2. Bolts/screws (10), if removed.



Tighten

- Bolts/screws (10) to 25 N.m (18 lb. ft.).
3. Tire and wheel (1 or 2).

CAUTION: Never use oil or grease on wheel bolts or wheel nuts. Tighten the wheel nuts with your fingers until they are snug. Then, tighten the wheel nuts (in the sequence shown) to the specified torque. Refer to "Specifications" in this section. Improperly tightened wheel nuts could eventually allow the wheel to come off while the vehicle is moving, possibly causing loss of control, personal injury and property damage.

4. Security wheel lock nut (3), if equipped.



Tighten

- Security wheel lock nut (3) to 140 N.m (100 lb. ft.).
5. Bracket (4), if removed.
 6. Wheel nuts (5).



Tighten

- Wheel nuts (5) in sequence to 140 N.m (100 lb. ft.).
7. Hub cap on aluminum wheel, if removed.
 - Use a rubber mallet to fully seat.
 8. Cover (7, 8 or 9), if removed.
 - Use a rubber mallet to fully seat.
 9. Bolt/screw (11), if removed.
 - Use wrench in instrument panel compartment to install bolt/screw (11).
 10. Cover insert (13 or 14), if removed.
 11. Lower vehicle.

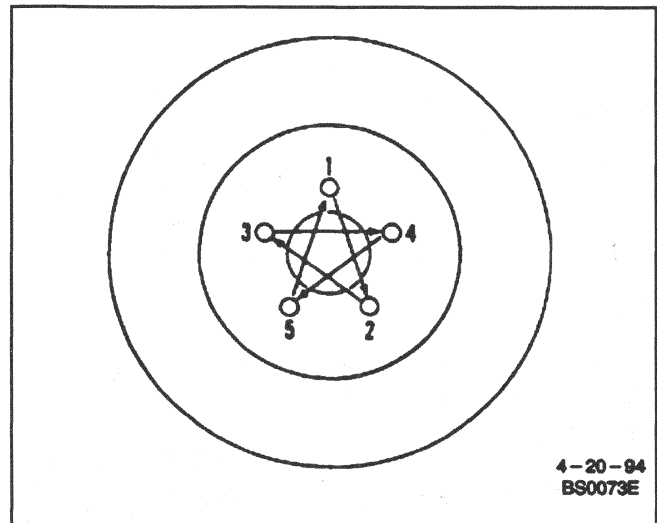


Figure 6 - Five Hole Wheel Nut Tightening Sequence

TIRE ROTATION

Figure 7

To equalize wear, rotate tires at intervals specified in SECTION 0B. Whenever uneven tire wear is noticed, the cause should be investigated. Figure 7 shows the only methods of tire rotation recommended. Due to their design, radial tires tend to wear faster in the shoulder area, particularly in drive locations. Radial tires in non-drive locations may develop an irregular wear pattern that can generate tire noise. This wear makes regular rotation especially important.

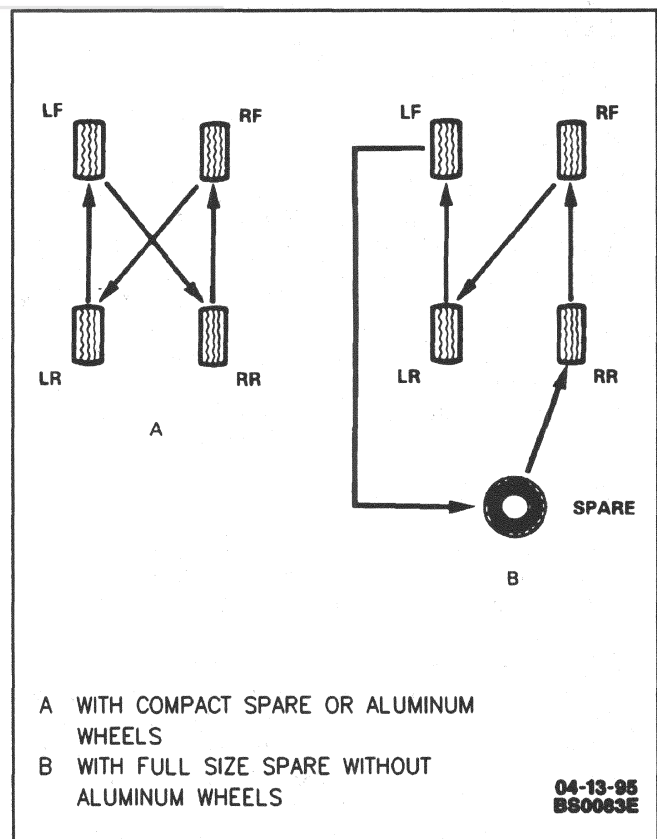


Figure 7 - Tire Rotation

If the vehicle has a compact spare tire, use four wheel rotation. If the vehicle is equipped with a full-size spare tire and wheel, include the spare tire and wheel in the rotation. After rotation, be sure to check wheel nut torque and set tire pressure. Never use oil or grease on wheel bolts or wheel nuts. Refer to "Wheel Removal and Installation" in this section.

TIRE MOUNTING AND DISMOUNTING

Figure 8

Use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change a tire as they may damage the tire beads, wheel rim or flanges.

NOTICE: Do not lubricate the tire beads or wheel rim with a lubricant containing silicone. Silicone will allow the tire to rotate on the rim, throwing the wheel and tire out of balance. Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove old rubber and light rust or corrosion. Before mounting or dismounting a tire, the bead area should be well lubricated with GM P/N 9985555 (50 percent lubricant and 50 percent water) or equivalent. After mounting, inflate tire so that beads are completely seated, but never exceed 280 kPa (40 psi).

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. The bead may break when it snaps over safety hump. Do not exceed 280 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 280 kPa (40 psi) pressure will not seat beads, deflate, relubricate and inflate. Overinflation may cause the bead to break and cause serious personal injury.

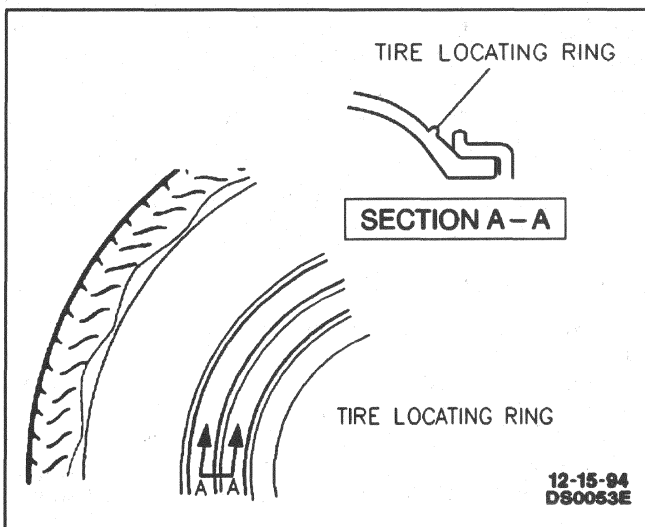


Figure 8 - Tire Locating Ring

Install the valve stem and inflate to the pressure specified on the tire placard. Check the locating rings of the tire and wheel to be sure they show around the rim flanges on both sides of the tire and wheel.

TIRE REPAIR

There are many different materials and techniques on the market to repair tires, but not all work on some types of tires. Tire manufacturers have published detailed instructions on how and when to repair tires. The instructions can be obtained from the tire manufacturer. Repair to the compact spare tire is not recommended.

MEASURING WHEEL RUNOUT

Figure 9

Wheel runout should be measured with an accurate dial indicator. Measurements may be taken with the wheel installed on the vehicle, or off the vehicle using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. With the dial indicator firmly in position, slowly rotate the wheel one revolution and record the total indicator reading. If any measurement exceeds specifications, and there is a vibration that wheel balancing will not correct, the wheel should be replaced. Disregard any indicator readings caused by welds, paint runs, or scratches.

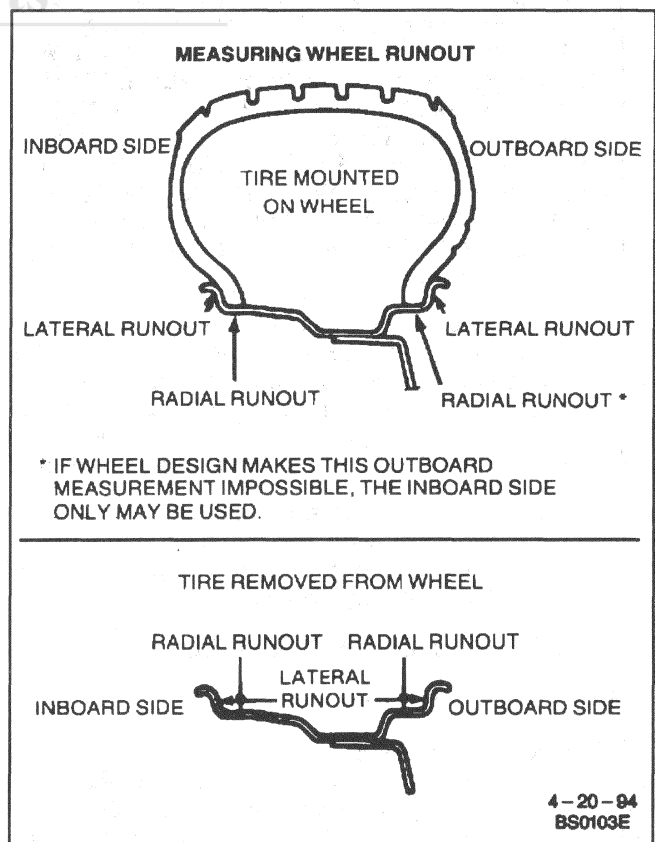


Figure 9 - Wheel Runout

3E-8 TIRES AND WHEELS

ALUMINUM WHEEL RUNOUT SPECIFICATION

- Radial runout 0.76 mm (0.030 inch)
- Lateral runout 0.76 mm (0.030 inch)

STEEL WHEEL RUNOUT SPECIFICATION

- Radial runout 1.01 mm (0.040 inch)
- Lateral Runout 1.14 mm (0.045 inch)

SPARE TIRE

All vehicles are equipped with either a compact spare tire or a full-size spare tire. The full-size spare tire is the same as the other tires but the wheels may be different (steel vs aluminum) on the vehicle. The compact spare tire uses a narrow 4-inch wide rim, although the wheel diameter is usually one inch larger than the road wheels.

NOTICE: The compact spare tire should not be used with standard tires and wheels, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the vehicle may occur. The compact spare tire should be used only on vehicles that offer it as original equipment.

Inflation pressure of the compact spare tire must be periodically checked and maintained at 420 kPa (60 psi). It can be mounted and dismounted from its wheel using present tire changing equipment and procedures. As with other tires, the beads should completely seat at 280 kPa (40 psi).

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when it snaps over safety hump. Do not exceed 280 kPa (40 psi) pressure when inflating any tire, including compact spare tires if beads are not seated. If 280 kPa (40 psi) pressure will not seat beads, deflate, relubricate and inflate. Overinflation may cause bead to break and cause serious personal injury.

The compact spare tire is designed to weigh less than standard tires and wheels and is easier to handle when need arises. Check inflation pressure as soon as practical after installing compact spare tire and adjust to 420 kPa (60 psi). Replacement of the compact spare tire should be made only by an authorized tire dealer.

NOTICE: Do not take the vehicle through an automatic car wash with the compact spare tire installed. The vehicle may get caught, which could result in property damage.

BALANCING TIRE AND WHEEL

Figures 10, 11 and 12

There are two methods used to balance tires and wheels: static and dynamic. Static balance is the equal distribution of weight around the wheel. Tires and wheels that are statically unbalanced cause a bouncing action called tramp.

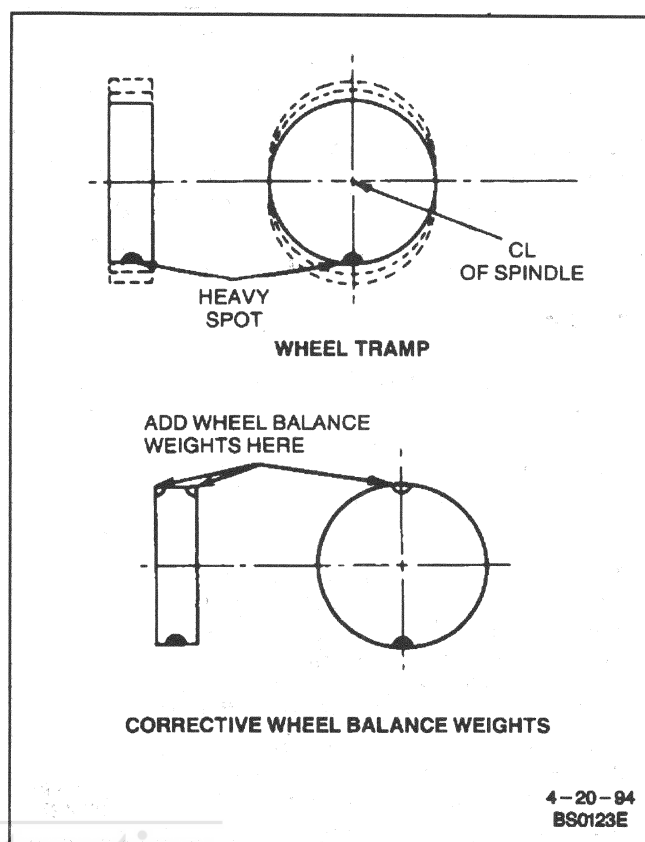


Figure 10 - Static Unbalance Correction

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the tire and wheel spins there is no tendency for the tire and wheel to move from side to side. tires and wheels that are dynamically unbalanced may cause shimmy.

General Balance Precautions

CAUTION: It is recommended that eye protection be used to prevent personal injury.

Deposits of foreign material must be cleaned from the inside of the wheel. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire and wheel should be inspected for any damage, then balanced according to the equipment manufacturer's recommendations. Only polyester coated "MC" type wheel weights should be used on aluminum wheels.

Off-Vehicle Balancing

When balancing tires and wheels off the vehicle, use a balancer that pilots the wheel by the centerhole (not the wheel bolt holes) if possible. Always follow the equipment manufacturer's instructions. Some electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers, but do not correct for rotor unbalance. If the vibration is not corrected by the off-vehicle balance, an on-vehicle balance may also be needed.

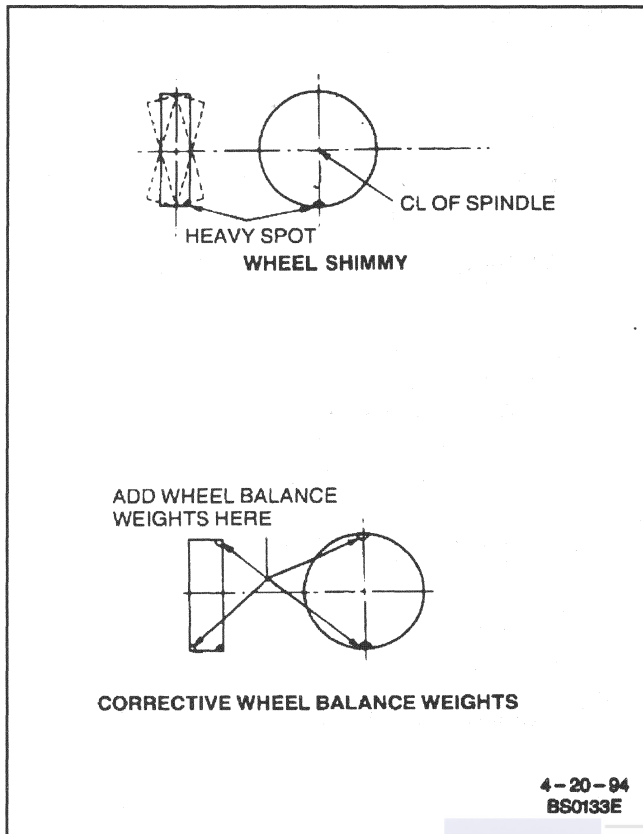


Figure 11 - Dynamic Unbalance Correction

On-Vehicle Balancing

When needed, on-vehicle balancing will help correct vibrations due to drum or rotor imbalance.

When balancing on-vehicle, do not remove the wheel balance weights from the off-vehicle dynamic balance. If more than one ounce of additional weight is required, it should be split between the inner and outer rim flange.

The driven tires and wheels should be spun using the engine. Limit speed as stated in the following "Caution."

CAUTION: On vehicles equipped with limited slip rear axles, do not attempt to balance a tire and wheel on a drive wheel with the other drive wheel on the ground. The vehicle may drive through this wheel and cause the vehicle to move unexpectedly, resulting in personal injury and property damage.

CAUTION: Do not spin the drive wheels faster than 55 km/h (35 mph) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Personal injury and damage may result from high speed spinning.

! Important

- The vehicle may be equipped with a limited-slip rear axle. To distinguish between a standard rear axle and a limited-slip rear axle, raise the rear of vehicle so both tires are clear of the ground. With the transmission in "PARK," attempt to turn one wheel by hand. If the wheel can be turned easily, it is a standard rear axle; if the tire and wheel cannot be turned easily, it is a limited-slip rear axle. Also, check for limited-slip rear axle (G80) on the Service Parts Identification label.

Wheel Balance Weights

Figure 12

When static balancing, if more than 85 grams (3.0 ounces) are needed, the wheel balance weights should be split as equally as possible between the inboard and outboard flanges.

Aluminum wheels must be balanced using special polyester-coated clip-on wheel balance weights. These wheel balance weights are designed to fit over the thicker inboard and outboard rim flanges of the aluminum wheel and should be installed with a teflon coated hammer.

CORRECTING NON-UNIFORM TIRES

There are two ways to correct tires which cause a vibration even though they are properly balanced. One method uses an automatic machine which loads

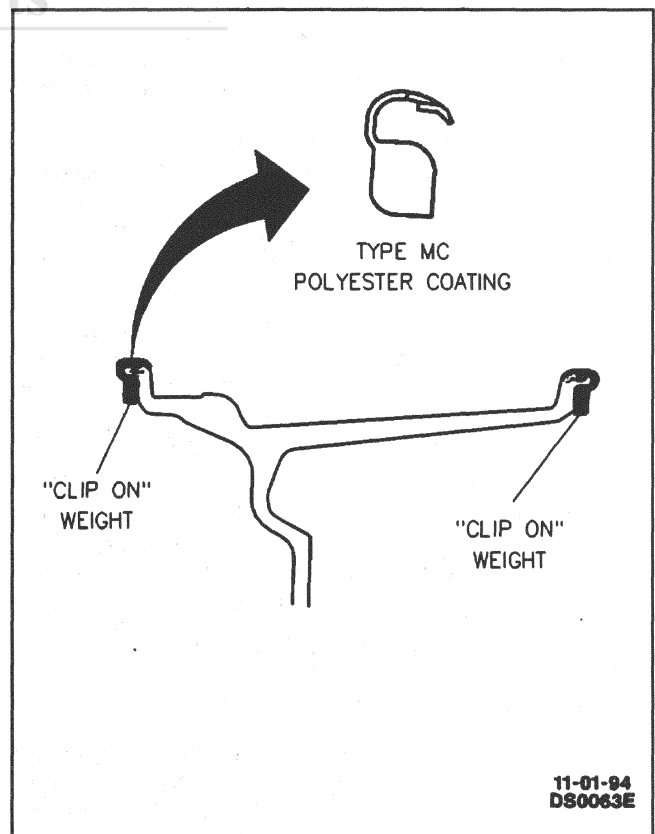


Figure 12 - Aluminum Wheel Balance Weight

3E-10 TIRES AND WHEELS

the tire and buffs small amounts of rubber from the stiff spots on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing for free runout with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem. Another method is to dismount the tire and rotate it 180 degrees on the rim. It is important that this be done only on tires and wheels which are known to be causing a vibration as it is just as likely to cause good tires and wheels to vibrate. Refer to SECTION 3 for more details.

ALUMINUM WHEELS

Porosity Repair

Remove or Disconnect

1. Tire and wheel. Refer to "Wheel Removal and Installation" in this section.
2. Locate leaking areas by inflating tire to 280 kPa (40 psi) and dipping into water bath.
3. Mark leak areas.
4. Mark the tire at the tire valve stem.
5. Tire from wheel. Refer to "Tire Mounting and Dismounting" in this section.
6. Scuff inside rim surface at leak area with number 80 grit sandpaper and clean area with general purpose cleaner such as 3M® P/N 08984 or equivalent.
7. Apply 3 mm (1/8-inch) thick layer of adhesive/sealant GM P/N 1052366 or equivalent to leak test area and allow six hours of drying time.

Install or Connect

1. Tire to wheel. Refer to "Tire Mounting and Dismounting" in this section.
2. Align the match mark on the tire with the tire valve stem.
3. Pressurize to 280 kPa (40 psi) and check for leaks.
4. Adjust tire pressure to meet specifications on tire placard.
5. Balance tires and wheels. Refer to "Balancing Tire and Wheel" in this section.
6. Tire and Wheel. Refer to "Wheel Removal and Installation" in this section.

Wheel Refinishing

A protective clear or color coating is applied to the surface of original equipment cast aluminum wheels. A surface degradation condition can begin to develop if frequent, repeated automatic car wash cleaning abrades or wears off the factory applied protective clear coating. Once the protective clear coating is damaged, exposure to caustic cleaners and/or road salt further causes surface degradation. The service procedures detail how to strip, clean and recoat aluminum wheels that are affected by the above

condition. Select and follow only those procedures for the conditions that apply to the wheels you are refinishing.

REQUIRED MATERIALS

- Amchem Alumi Prep number 33 - stock number DX533 or equivalent - cleaning and conditioning chemical for aluminum.
- Amchem Alodine number 1001 - stock number DX501 or equivalent - coating chemical for aluminum.
- Ditzler Delclear Acrylic Urethane Clear - stock number DAU-75 or equivalent.
- Ditzler Delthane Ultra-Urethane Additive - stock number DXR-80 or equivalent.

INITIAL PREPARATION

Remove or Disconnect

1. Tire and wheel from the vehicle. Refer to "Wheel Removal and Installation" in this section.
2. Outboard wheel balance weights.



Clean

- Wheel inside and out with a water base all purpose cleaner. Remove grease or oil with a solvent cleaner.

ACCENT COLOR PREPARATION

- Sand over painted areas that do not require recoloring with number 400 grit wet or dry sandpaper to promote adhesion of clear coat.

SURFACE DAMAGE

CAUTION: Do not use vehicle power to rotate the wheel while sanding or personal injury may result.

1. Mount wheel on brake lathe and spin slowly.

NOTICE: Do not use abrasive coarser than 80 grit or wheel may be damaged.

2. Sand wheel with backing block or pad by holding abrasive flat to surface of wheel and moving slowly back and forth from center to outer edge to remove imperfections.
 - A. First, sand with number 80 grit sandpaper.
 - B. Follow with number 150 grit sandpaper.
 - C. Finish with number 240 grit sandpaper.

SLIGHT CLEAR COAT DAMAGE ON UNPAINTED WHEELS

CAUTION: Use of rubber gloves and eye protection is necessary to prevent personal injury.

1. Apply chemical stripper.
 - A. Allow stripper to penetrate coating.

- B. Use a small 1/4-inch detail brush dipped in stripper to apply material around the perimeter and spoke-like areas.
2. Remove stripper, following the manufacturer's recommendations.

CAUTION: Do not use vehicle power to rotate the wheel while sanding or personal injury may result.

3. Sand the wheel with number 240 grit sandpaper while rotating the wheel on a slowly spinning brake lathe or by mounting it on the vehicle and spinning it by hand.
- This restores the machined appearance and promotes adhesion of the finish coats.

RECOATING PROCEDURE

CAUTION: Use of rubber gloves and eye protection is necessary to prevent personal injury.

1. Clean the surface of contaminants by washing with soap and water.
2. Spray the wheel with Amchem number 33 or equivalent.
 - A. Let the wheel soak for 1 to 3 minutes.
 - B. Rinse with water and blow dry.
3. Spray the wheel with Amchem number 1001 or equivalent.
 - A. Let the wheel soak 1 to 3 minutes.
 - B. Rinse with water and blow dry.
4. Mask off the tire.

CAUTION: When applying any two part component paint system, wear proper respiratory protection such as Easi-Air Respirator, part number 06986, or equivalent. Follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.

5. Finish the wheel with Ditzler Delclear acrylic urethane clear and Ditzler ultra urethane additive, or equivalent. Refer to labels for specific directions.
- A. First coat - light mist coat, let flash.
 - B. Second coat - light, let flash.
 - C. Third coat - heavy duty, wet coat.
6. Let the wheel dry for 24 hours or flash for 30 minutes. Force dry at 60° C (140° F) for 30 minutes, and allow to cool for 30 minutes before mounting.



Install or Connect

1. Balance tire and wheel. Refer to "Balancing Tire and Wheel" in this section.
 - Replace the original wheel balance weights with polyester-coated wheel balance weights to avoid discoloration of the wheel.
2. Tire and Wheel. Refer to "Wheel Removal and Installation" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Wheel Nut (All Models) 140 N.m (100 lb. ft.)

RUNOUT SPECIFICATIONS

Aluminum Wheel

Maximum Lateral Runout 0.76 mm (0.030 inch)
 Maximum Radial Runout 0.76 mm (0.030 inch)

Steel Wheel

Maximum Lateral Runout 1.01 mm (0.040 inch)
 Maximum Radial Runout 1.14 mm (0.045 inch)

TIRE PRESSURES

Sedan

Front 210 kPa (30 psi)
 Rear 210 kPa (30 psi)
 Compact Spare 420 kPa (60 psi)
 Full-Size Spare 240 kPa (35 psi)

Wagon

Front 210 kPa (30 psi)
 Rear 240 kPa (35 psi)
 Compact Spare 420 kPa (60 psi)
 Full-Size Spare 240 kPa (35 psi)

Impala SS

Front 210 kPa (30 psi)
 Rear 210 kPa (30 psi)
 Full-Size Spare 240 kPa (35 psi)



SECTION 3F

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic trouble codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

STEERING COLUMN

Figure 1

The locking energy-absorbing steering column includes three important features in addition to the steering function.

1. In a front-end collision, the energy-absorbing steering column is designed to collapse, minimizing the possibility of injury to the driver.
2. The ignition switch, steering column lock and ignition cylinder are column mounted, allowing the steering wheel and ignition to be locked, to inhibit theft of the vehicle.

3F-2 STEERING WHEEL AND COLUMN - ON VEHICLE SERVICE

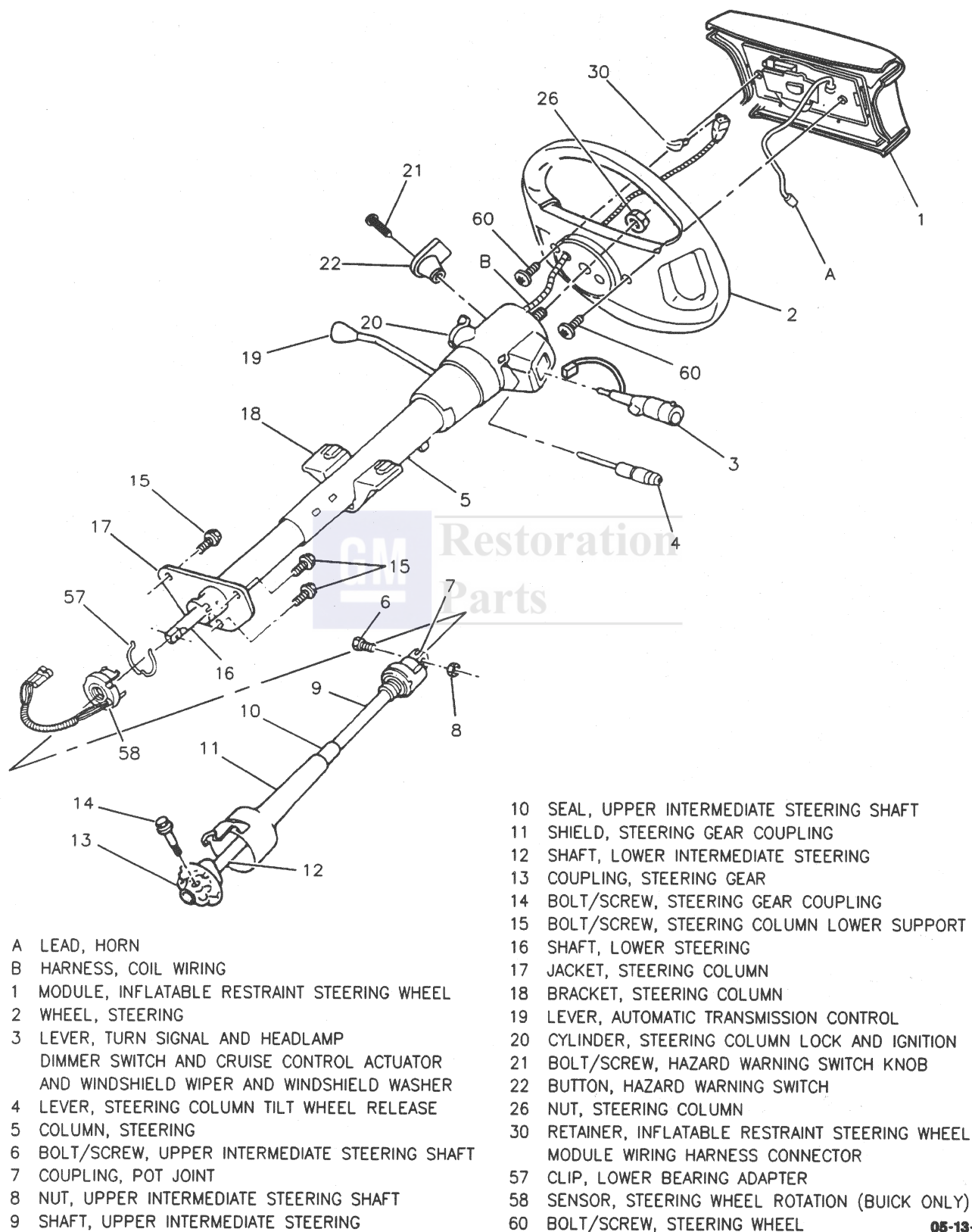


Figure 1 - Steering Column with SIR and Steering Wheel Rotation Sensor

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3. The turn signals, headlamp dimmer switch, cruise control system, windshield wiper and windshield washer system can all be controlled through the multi-function lever on the steering column.

To ensure the energy-absorbing action, use only the specified bolts/screws and nuts and tighten them to the specified torque. Apply a thin coat of lithium grease to all friction points when reassembling.

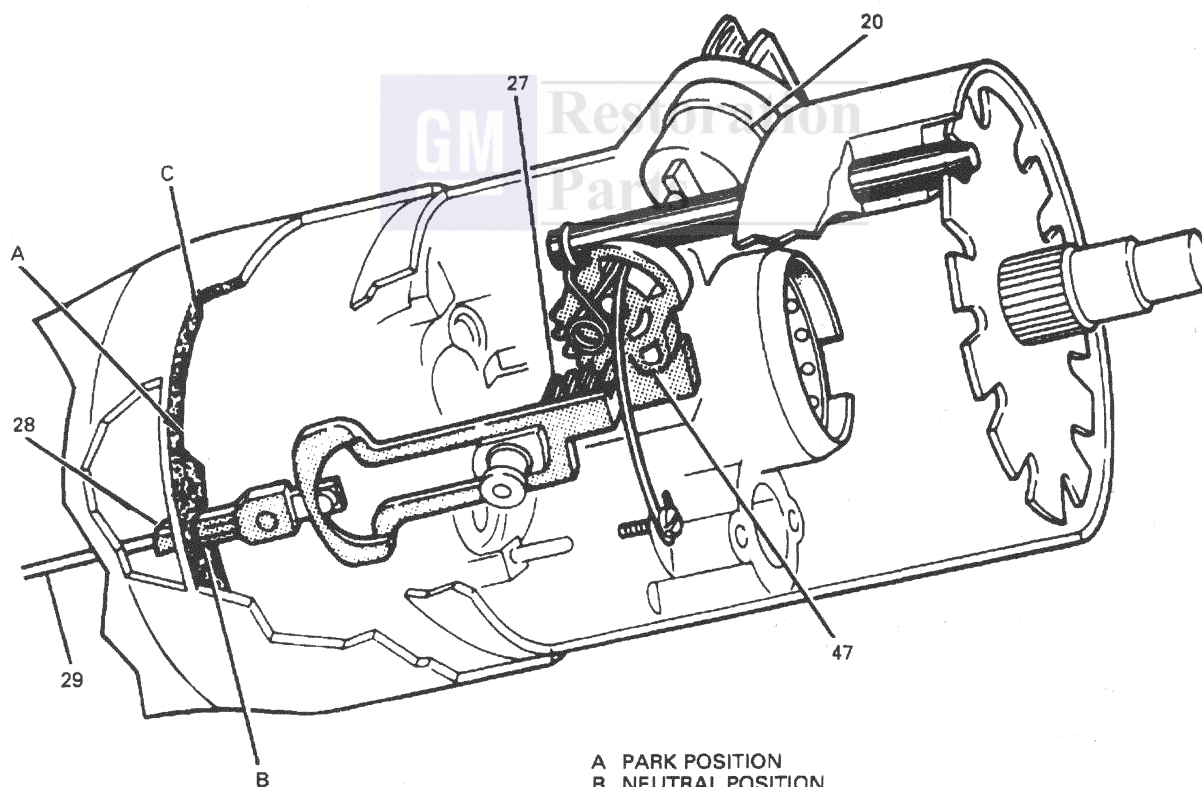
When the steering column is removed from the vehicle, handle it with special care. Using a steering wheel puller other than the one recommended in this manual, hitting the end of the steering shaft or automatic transmission control lever sharply, leaning on the steering column, or dropping the steering column could shear or loosen the plastic fasteners that keep the steering column rigid.

The Variable Effort Steering (VES) steering wheel rotation sensor (available as Buick option only), senses the rotational speed of the steering shaft, to return to full assist, during sudden directional changes at highway speeds.

IGNITION LOCK SYSTEM

Figure 2

All column shift automatic transmission vehicles contain a mechanical neutral start system. This system relies on a mechanical block to prevent starting the engine in other than "PARK" or "NEUTRAL." The mechanical block is a wedge shape finger added to the ignition switch actuator rod. In either "PARK" or "NEUTRAL," the wedge shape finger passes through the bowl plate slots, allowing the steering column lock and ignition cylinder to turn to start the engine. If the automatic transmission control lever is in any position other than "PARK" or "NEUTRAL," the wedge shape finger will not pass through the bowl plate preventing the ignition switch rod from moving the ignition switch to the start position.



- A PARK POSITION
- B NEUTRAL POSITION
- C PLATE, BOWL
- 20 CYLINDER, STEERING COLUMN LOCK AND IGNITION
- 27 RACK, SWITCH ACTUATOR
- 28 FINGER, WEDGE SHAPE
- 29 ROD, SWITCH ACTUATOR
- 47 SECTOR, SWITCH ACTUATOR

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Figure 2 - Mechanical Neutral Start System

**BRAKE TRANSMISSION SHIFT
INTERLOCK (BTSI)**

The Brake Transmission Shift Interlock (BTSI) system prevents the driver from shifting out of "PARK" without pressing the brake pedal. The BTSI solenoid is energized when the ignition is on and the vehicle is in "PARK." When energized, the BTSI solenoid on column shift vehicles, moves a cable which mechanically locks the gear shift bowl to the column. On floor shift vehicles, the solenoid is mounted to the floor shifter, and mechanically locks the shifter from moving. When pressure is applied to the brake pedal, the BTSI solenoid is de-energized, and releases the gearshift lever bowl, or floor shifter.

**SUPPLEMENTAL INFLATABLE RESTRAINT
(SIR)**

The Supplemental Inflatable Restraint (SIR) helps supplement the protection offered by the driver's seat belt by deploying an air bag from the center of the steering wheel during certain frontal crashes. Refer to SECTION 9J for passenger side airbag information. The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle.

The steering column is collapsible and should be inspected after an accident whether or not a deployment has occurred.

The SIR system components in the steering wheel and column are the:

1. Inflatable restraint steering wheel module.
2. The SIR coil.

To obtain a detailed description of these components refer to SECTION 9J.

LUBRICATION

Apply a thin coat of lithium grease to all friction points when reassembling components.

DIAGNOSIS**REPAIRS AND INSPECTIONS REQUIRED
AFTER AN ACCIDENT**

To obtain a detailed explanation of the repairs and inspections which must be performed after an accident on SIR-equipped vehicles, whether or not a deployment has occurred, refer to SECTION 9J.

**SUPPLEMENTAL INFLATABLE RESTRAINT
(SIR)**

To diagnose faults within the SIR System, refer to SECTION 9J.

IGNITION LOCK SYSTEM

To diagnose faults within the Ignition Lock System, refer to SECTION 3.

**BRAKE TRANSMISSION SHIFT
INTERLOCK (BTSI)**

To diagnose the BTSI refer to SECTION 8A.

ON-VEHICLE SERVICE**SERVICE PRECAUTIONS**

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The Sensing and Diagnostic Module (SDM) can maintain sufficient voltage to cause a deployment after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflatable restraint steering wheel module circuits from the deployment loops to avoid an accidental deployment.

Disabling the SIR System**Remove or Disconnect**

1. Turn steering wheel so that vehicle's wheels are pointing straight ahead.
2. Turn ignition switch to "LOCK."
3. "AIR BAG" fuse from fuse block.
4. Left-hand sound insulator (Buick only). Refer to SECTION 8C.
5. Connector Position Assurance (CPA) and yellow 2-way connector for both connectors located near base of steering column.

**Important**

- With "AIR BAG" fuse removed and ignition switch in "RUN," the "AIR BAG" lamp in the instrument cluster will light. This is normal operation and does not indicate an SIR fault.

Enabling the SIR System**Install or Connect**

1. Turn ignition switch to "LOCK."
2. Both yellow 2-way connectors located near base of steering column and corresponding Connector Position Assurance (CPA).
3. Left-hand sound insulator (Buick only). Refer to SECTION 8C.
4. "AIR BAG" fuse to fuse block.
5. Turn ignition switch to "RUN" and verify that the "AIR BAG" lamp in the instrument cluster flashes 7 times and then turns off. If it does not operate as described, perform "SIR" Diagnostic System Check. Refer to SECTION 9J.

LIVE (UNDEPLOYED) INFLATABLE RESTRAINT STEERING WHEEL MODULE

Special care is necessary when handling and storing a live (undeployed) inflatable restraint steering wheel module. The rapid gas generation produced during deployment of the air bag could cause the inflatable restraint steering wheel module, or an object in front of it, to be thrown through the air in the unlikely event of an accidental deployment.

CAUTION: When carrying a live inflatable restraint steering wheel module, make sure the bag opening is pointed away from you. Never carry the inflatable restraint steering wheel module by the wires or electrical connector on the underside of it. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflatable restraint steering wheel module on a bench or other surface, always face the bag and trim cover up, away from the surface. Never rest a steering column on the steering wheel with the inflatable restraint steering wheel module face down and steering column vertical. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment.

DEPLOYED INFLATABLE RESTRAINT STEERING WHEEL MODULE

After the inflatable restraint steering wheel module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of corn starch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with many service procedures, you should wear gloves and safety glasses.

INFLATABLE RESTRAINT STEERING WHEEL MODULE SHIPPING PROCEDURES

Service personnel should refer to the latest service bulletins for proper SIR inflatable restraint steering wheel module shipping procedures. For further information, refer to SECTION 9J

INFLATABLE RESTRAINT STEERING WHEEL MODULE SCRAPPING PROCEDURES

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) inflatable restraint steering wheel module. This information covers proper

procedures for disposing of a live inflatable restraint steering wheel module. Before a live inflatable restraint steering wheel module can be disposed of, it must be deployed. Live inflatable restraint steering wheel modules must not be disposed of through normal refuse channels.

CAUTION: Failure to follow proper Supplemental Inflatable Restraint (SIR) steering wheel module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflatable restraint steering wheel modules must not be disposed of through normal refuse channels. The undeployed inflatable restraint steering wheel module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state, and/or local laws.

If a vehicle is the subject of a Product Liability Report related to the SIR system and is subject to a Preliminary Investigation (GM-1241), DO NOT DEPLOY the inflatable restraint steering wheel module and DO NOT ALTER the SIR system in any manner. Refer to the applicable service bulletin on SIR shipping procedures for details on handling SIR systems involved with GM-1241. If a vehicle is the subject of a campaign affecting inflatable restraint steering wheel modules, DO NOT DEPLOY the inflatable restraint steering wheel module. Follow instructions in the campaign service bulletin for proper disposition of the inflatable restraint steering wheel module.

If an inflatable restraint steering wheel module is replaced under warranty, DO NOT DEPLOY the air bag. The inflatable restraint steering wheel module may need to be returned, undeployed, to Inland Fisher Guide. Refer to procedures shown in the appropriate service bulletin regarding SIR shipping procedures. In situations which require deployment of a live (undeployed) inflatable restraint steering wheel module, deployment may be accomplished inside or outside the vehicle. The method employed depends upon the final disposition of the particular vehicle, as noted in "Deployment Outside Vehicle" and "Deployment Inside Vehicle" in SECTION 9J.

WIRING REPAIRS

If the wiring pigtail (wires attached directly to the component, not by a connector) on either the inflatable restraint steering wheel module or the SIR coil is damaged, the entire component must be replaced. Absolutely no wire, connector, or terminal repairs are to be attempted on either the inflatable restraint steering wheel module or the SIR coil. For more information, refer to SECTION 9J.

3F-6 STEERING WHEEL AND COLUMN - ON VEHICLE SERVICE

SHIFT INDICATOR ADJUSTMENT

Figure 3

↔ Remove or Disconnect

Instrument panel steering column opening filler.
Refer to SECTION 8C.

🔑 Adjust

- Shift indicator.
 - A. Steering column attachment should be complete before adjusting shift indicator.
 - B. Automatic transmission control lever should be in "N" gate notch.
 - C. Position shift indicator clip (115) on edge of gearshift lever bowl (49) to centrally position the "N" indicator. (Chevrolet - between dots on bottom of "N," Buick - orange indicator completely filling "T").
 - D. Push shift indicator clip (115) onto gearshift lever bowl (49).

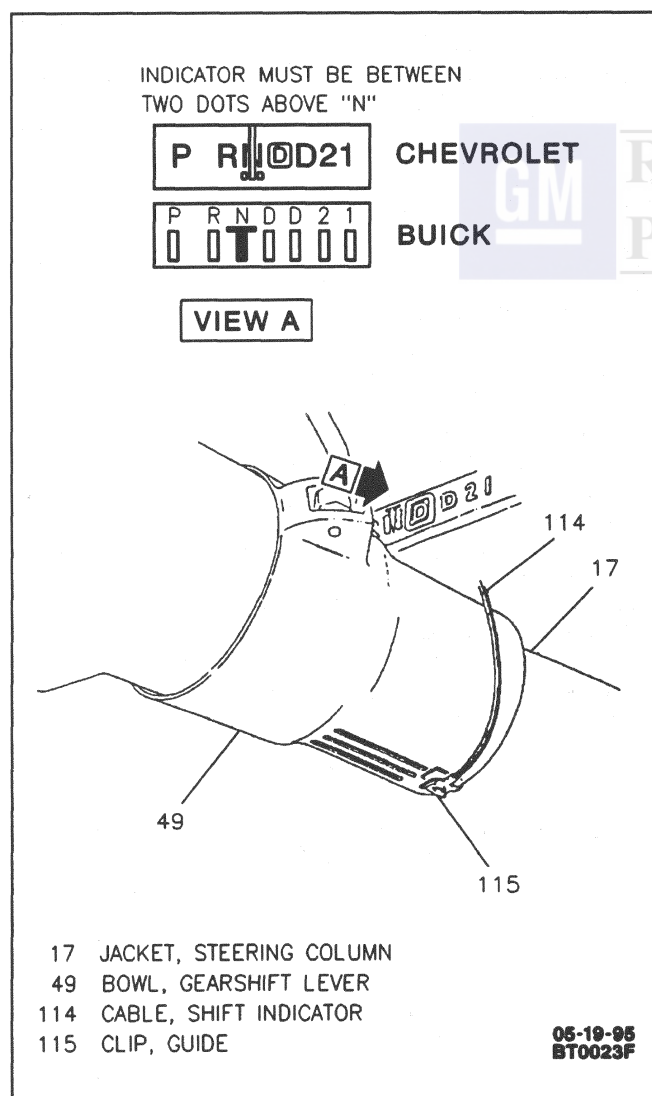


Figure 3 - Shift Indicator Adjustment

- E. Make sure shift indicator cable (114) rests on gearshift lever bowl (49), not on jacket (17).

↔ Install or Connect

Instrument panel steering column opening filler.
Refer to SECTION 8C.

IGNITION AND DIMMER SWITCHES

Figures 2 through 6 and 15

↔ Remove or Disconnect

1. Disable SIR system. Refer to "Disabling the SIR System" in this section.
2. Instrument panel driver knee bolster and deflector. Refer to SECTION 8C.
3. Ensure cylinder (20) is in "LOCK" position.
4. Shift indicator cable (114).
5. Nuts (56) from steering column bracket (18).
6. Lower steering column (5).
7. Electrical connectors from dimmer switch (87) and ignition switch (81).
8. BTSI solenoid. Refer to SECTION 3F5A or 3F5B.
9. BTSI solenoid bracket. Refer to SECTION 3F5A or 3F5B.
10. Bolt/screw (82) from dimmer switch (87).
11. Actuator rod (84).

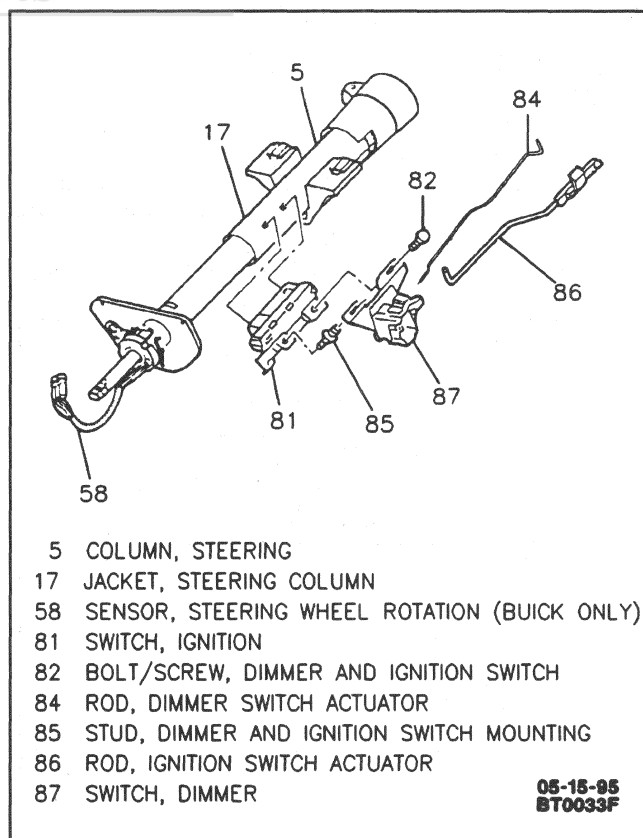


Figure 4 - Removing Ignition and Dimmer Switches

12. Dimmer switch (87).
13. Stud (85) from ignition switch (81).
14. Actuator rod (86).
15. Ignition switch (81).

Install or Connect

1. Ensure ignition switch (81) is in "LOCK" position.
 - Move switch slider to extreme right position (accessory), and then move slider one detent to left.
2. Ensure cylinder (20) is in "LOCK" position.
3. Ignition switch (81) to jacket (17).
4. Actuator rod (86) to ignition switch (81).
5. Stud (85) to ignition switch (81) until snug.
6. Dimmer switch (87) to ignition switch (81).
7. Bolt/screw (82) to dimmer switch (87).
8. Cycle cylinder (20) through all switch positions to ensure correct ignition switch adjustment.

Adjust

- Ignition switch (81), if necessary. Loosen bolt/screw (82) and stud (85) and slide ignition switch (81) up or down until cylinder (20) functions properly in all switch positions.

Tighten

- Bolt/screw (82) to 4 N.m (35 lb. in.).
 - Stud (85) to 4 N.m (35 lb. in.).
9. Actuator rod (84) to dimmer switch (87).

Adjust

- Dimmer switch (87), if necessary.
 - A. Loosen bolt/screw (82).
 - B. Insert a 3/32 in. drill bit into dimmer switch (87) to limit dimmer switch travel as shown in figure 6.
 - C. Slide dimmer switch (87) up until all slack is removed.

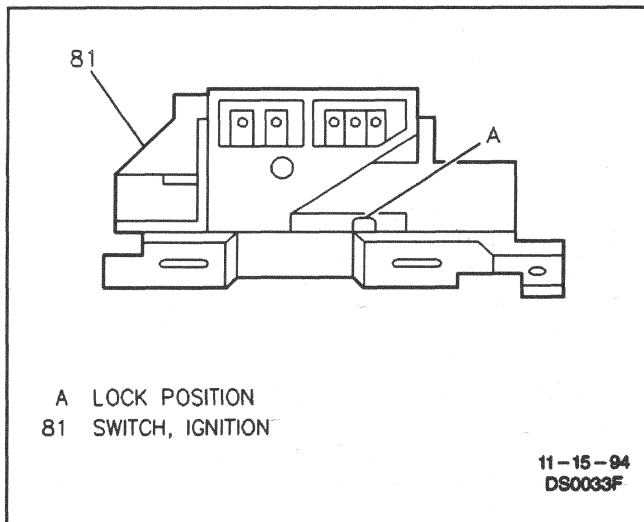


Figure 5 - Ignition Switch Adjustment

Tighten

- Bolt/screw (82) to 4 N.m (35 lb. in.).
10. Verify proper operation by pulling back on multi-function lever.
 - A click should be heard when lever is pulled to activate high and low beams.
 11. BTSI solenoid bracket. Refer to SECTION 3F5A or 3F5B.
 12. BTSI solenoid. Refer to SECTION 3F5A or 3F5B.
 13. Electrical connectors to dimmer switch (87) and ignition switch (81).
 14. Raise steering column (5).
 15. Nuts (56) to steering column bracket (18).

Tighten

- Nuts (56) to 27 N.m (20 lb. ft.).
16. Shift indicator cable (114).

Adjust

- Shift indicator. Refer to "Shift Indicator Adjustment," in this section.
17. Instrument panel driver knee bolster deflector. Refer to SECTION 8C.
 18. Enable SIR system. Refer to "Enabling the SIR System" in this section.

TURN SIGNAL LEVER

Figure 7

Remove or Disconnect

1. Tilt wheel release lever by grasping firmly and turning counterclockwise.
2. Cap (45).
3. Electrical connector.
4. Lever (3) by pulling straight out of turn signal switch.
 - Make sure that lever (3) is in center or "OFF" position.

Install or Connect

1. Lever (3) by pushing into turn signal switch.

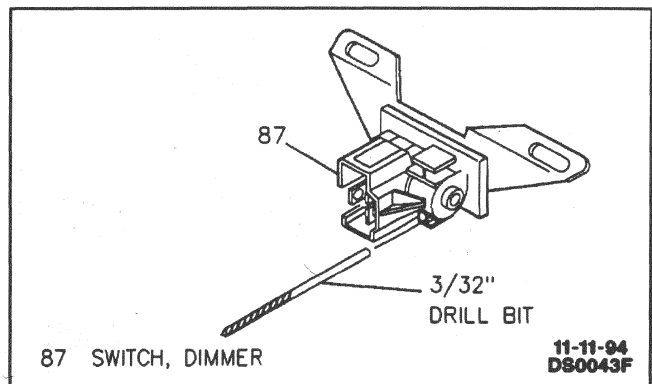


Figure 6 - Dimmer Switch Adjustment

3F-8 STEERING WHEEL AND COLUMN - ON VEHICLE SERVICE

2. Electrical connector.
3. Cap (45).
4. Tilt wheel release lever by grasping firmly and turning clockwise.

HAZARD WARNING SWITCH

Refer to SECTION 3F5A or 3F5B. The hazard warning switch does not require removal of the steering column for replacement.

HAZARD WARNING SWITCH KNOB

Figure 8

Remove or Disconnect

1. Bolt/screw (21).
2. Button (22).

Install or Connect

NOTICE: Refer to "Notice" on page 3F-1 of this section.

1. Button (22).
2. Bolt/screw (21).

Tighten

- Bolt/screw (21) to 0.7 N·m (6 lb. in.).

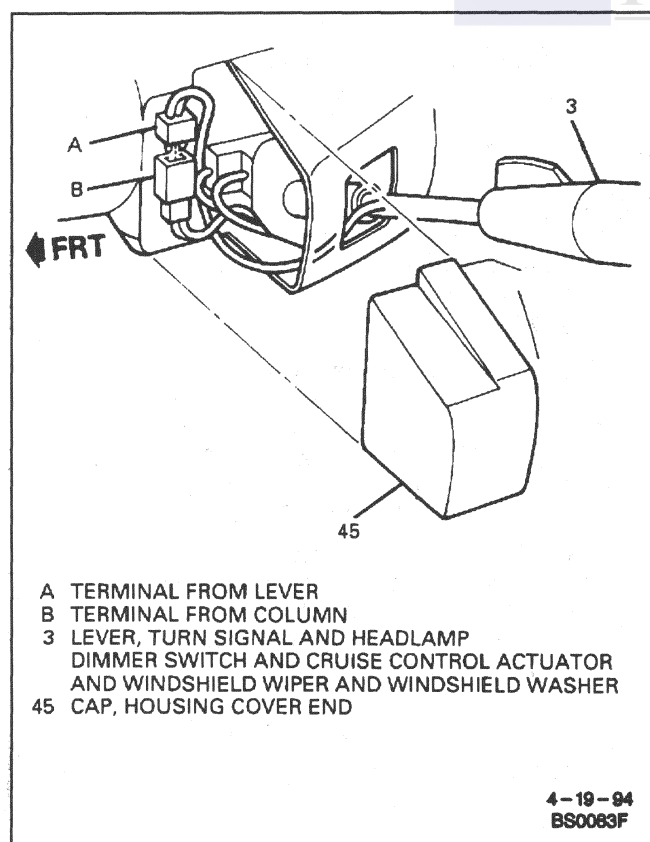


Figure 7 - Turn Signal Lever Wiring Connection

AUTOMATIC TRANSMISSION CONTROL LEVER

Figure 9

Remove or Disconnect

1. Pin (202) from housing (200).
2. Transmission control lever (19) and spring (203) out of housing (200), being careful not to lose spring (203).

Install or Connect

1. Spring (203).
2. Transmission control lever (19).
 - A shim may be used to aid in installation by holding spring (203) in place.
3. Pin (202).
4. Remove shim if used.

INFLATABLE RESTRAINT STEERING WHEEL MODULE

Figure 10

Remove or Disconnect

1. Disable SIR system. Refer to "Disabling the SIR System" in this section.
2. Loosen bolts/screws (60) from back of steering wheel (2) using number T30 TORX® driver (or equivalent) until module (1) can be released from steering wheel (2).
3. Module (1) from steering wheel (2).

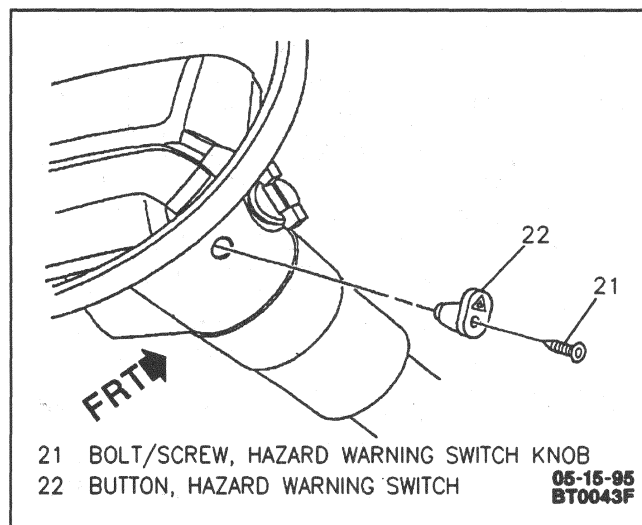


Figure 8 - Removing Hazard Warning Switch Knob

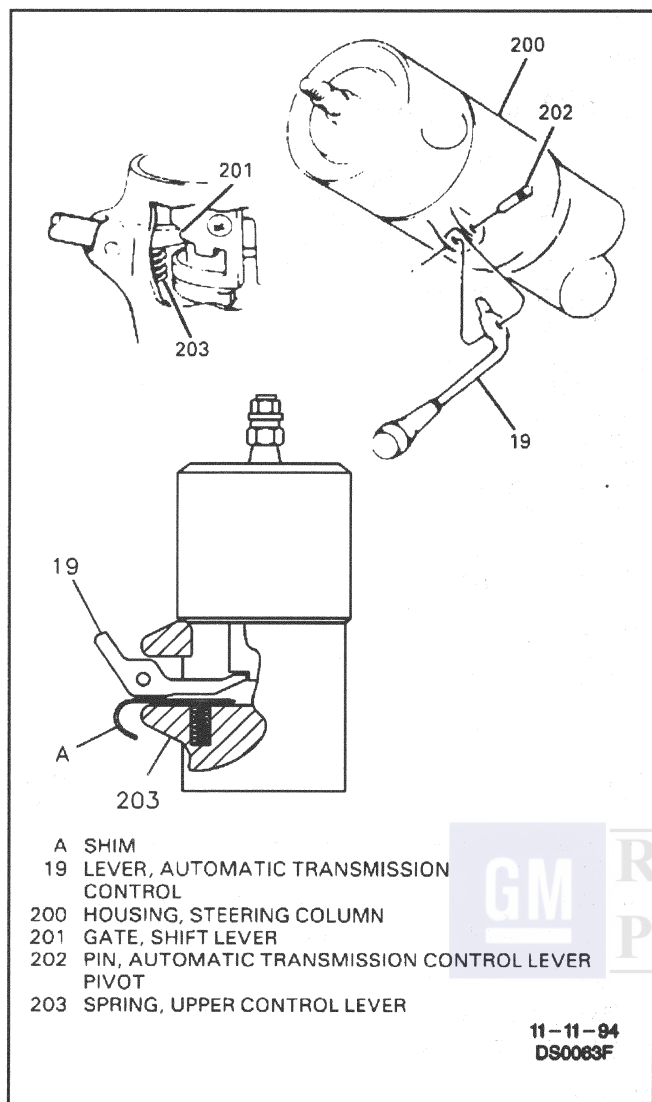


Figure 9 - Automatic Transmission Control Lever

CAUTION: When carrying a live inflatable restraint steering wheel module, make sure the bag opening is pointed away from you. Never carry the inflatable restraint steering wheel module by the wires or electrical connector on the underside of it. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflatable restraint steering wheel module on a bench or other surface, always face the bag and trim cover up, away from the surface. Never rest a steering column on the steering wheel with the inflatable restraint steering wheel module face down and steering column vertical. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment.

4. Electrical connector and retainer (30) from module (1).

5. Module (1) horn lead from horn contact/canceling cam tower.

- Push in and rotate counter clockwise 1/4 turn, then pull out.

Install or Connect

NOTICE: Refer to "Notice" on page 3F-1 of this section.

1. Module (1) horn lead to horn contact/canceling cam tower.
 - Push in and rotate clockwise 1/4 turn.
2. Electrical connector and retainer (30) to module (1).
3. Route coil lead around mounting post and secure under clip.
4. Module (1) to steering wheel (2).

Important

- Ensure that wiring is not exposed or trapped between module (1) and steering wheel (2).

Tighten

- Bolts/screws (60) to 6 N.m (53 lb. in.).
5. Enable SIR system. Refer to "Enabling the SIR System" in this section.

STEERING WHEEL

Figures 1 and 11

Tools Required:

- J 1859-A Steering Wheel Puller
- J 38720 Steering Wheel Puller Bolts
(Part of J 1859-A)

Remove or Disconnect

1. Inflatable restraint steering wheel module. Refer to "Inflatable Restraint Steering Wheel Module" in this section.
2. Nut (26).

NOTICE: When removing the steering wheel, use only the specified steering wheel puller. Under no conditions should the end of the steering shaft be hammered on, as hammering could loosen the plastic injections which maintain steering column rigidity.

NOTICE: When attaching J 1859-A and J 38720 to the steering wheel, use care to prevent threading J 38720 (bolts) all the way through the steering wheel hub and into the SIR coil, damaging the SIR coil.

3. Steering wheel (2), using J 1859-A and J 38720.

Install or Connect

NOTICE: Refer to "Notice" on page 3F-1 of this section.

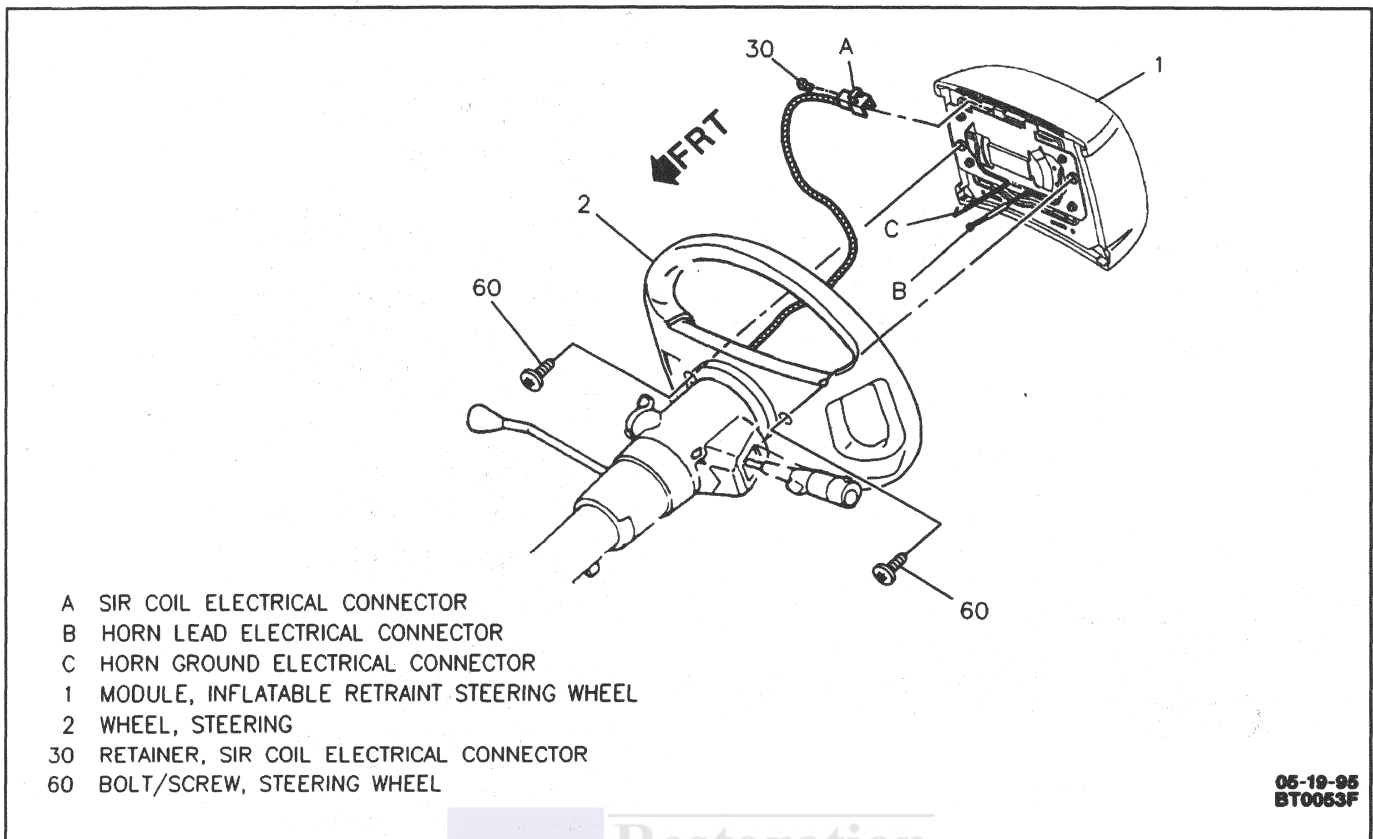


Figure 10 - Inflatable Restraint Steering Wheel Module

1. Route SIR coil electrical connector through steering wheel (2).
2. Steering wheel (2).
 - Align index mark on steering wheel (2) with index mark on steering shaft.
3. Nut (26).



Tighten

- Nut (26) to 41 N.m (30 lb. ft.).

4. Inflatable restraint steering wheel module. Refer to "Inflatable Restraint Steering Wheel Module" in this section.

STEERING WHEEL ROTATION SENSOR (BUICK OPTION)

Figure 12



Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

NOTICE: Ensure that the vehicle's wheels are pointing straight ahead and the ignition switch is in the "LOCK" position. Failure to do so may allow the steering wheel to rotate, causing damage to the SIR coil.

1. Battery negative cable.
2. Bolt/screw (6) and nut (8) from coupling (7) attaching upper intermediate steering shaft (9) to lower steering shaft (16).
3. Upper intermediate steering shaft (9) from lower steering shaft (16).
4. Electrical connector.
5. Clip (57).
6. Sensor (58).

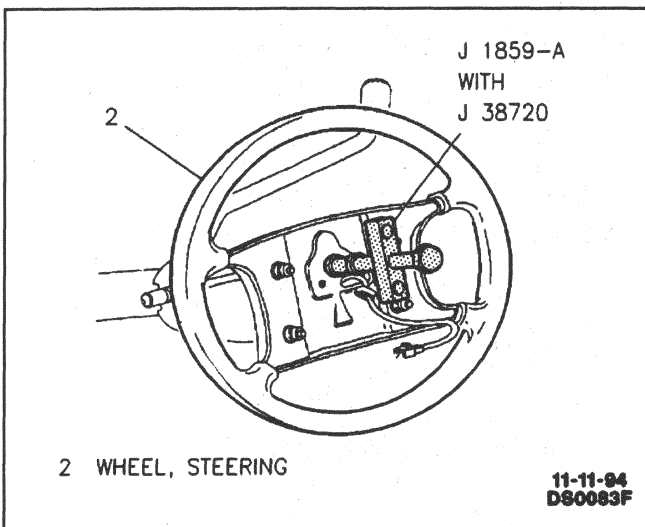


Figure 11 - Removing Steering Wheel

 Install or Connect

NOTICE: Refer to "Notice" on page 3F-1 of this section.

1. Sensor (58).
2. Clip (57).
3. Upper intermediate steering shaft (9) to lower steering shaft (16).
4. Electrical connector.
 - Secure connector.
5. Bolt/screw (6) and nut (8) to coupling (7).

 Tighten

- Nut (8) to 54 N.m (40 lb. ft.).
- 6. Battery negative cable.

INTERMEDIATE STEERING SHAFT*Figures 13 and 14*
 Remove or Disconnect

NOTICE: Ensure that the vehicle's wheels are pointing straight ahead and the ignition switch is in "LOCK" position. Failure to do so may cause the steering wheel to rotate, causing damage to the SIR coil.

1. Shield (11) from steering gear return pipe nut.
2. Bolt/screw (14) from coupling (13) attaching lower intermediate steering shaft (12) to steering gear (55).
 - Push lower intermediate steering shaft (12) rearward to disengage latch from steering gear (55).
3. Bolt/screw (6) and nut (8) from coupling (7) attaching upper intermediate steering shaft (9) to steering column.
4. Intermediate steering shaft.

 Disassemble

1. Upper intermediate steering shaft (9) and lower intermediate steering shaft (12) by pressing a 3/8 in. diameter rod up through bottom of coupling (13).
2. Seal (10), spring (54) and shield (11).

 Assemble

1. Before assembling the lower intermediate steering shaft (12) and upper intermediate steering shaft (9), apply lithium grease to spring (54).
2. Spring (54), seal (10) and shield (11).
3. Upper intermediate steering shaft (9) and lower intermediate steering shaft (12).
 - Align slot in coupling (13) in relation to coupling (7).
 - Press together.

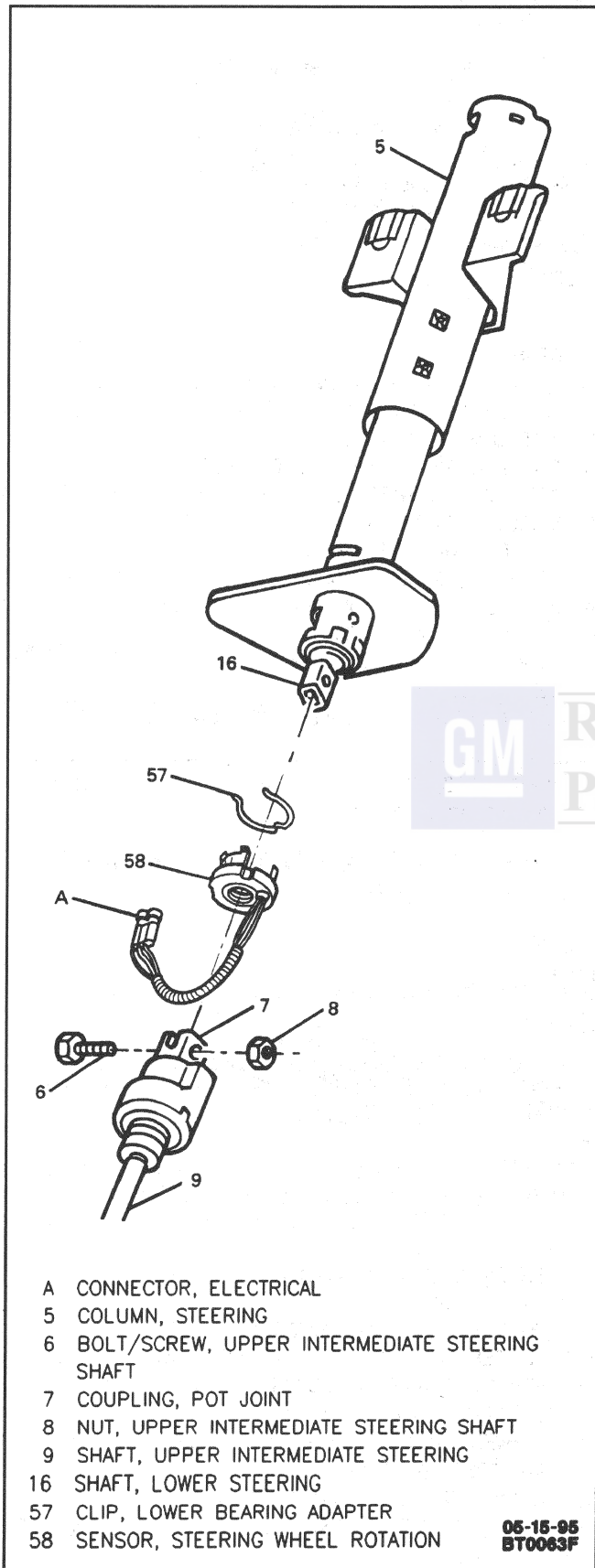


Figure 12 - Steering Wheel Rotation Sensor (Buick)

3F-12 STEERING WHEEL AND COLUMN - ON VEHICLE SERVICE

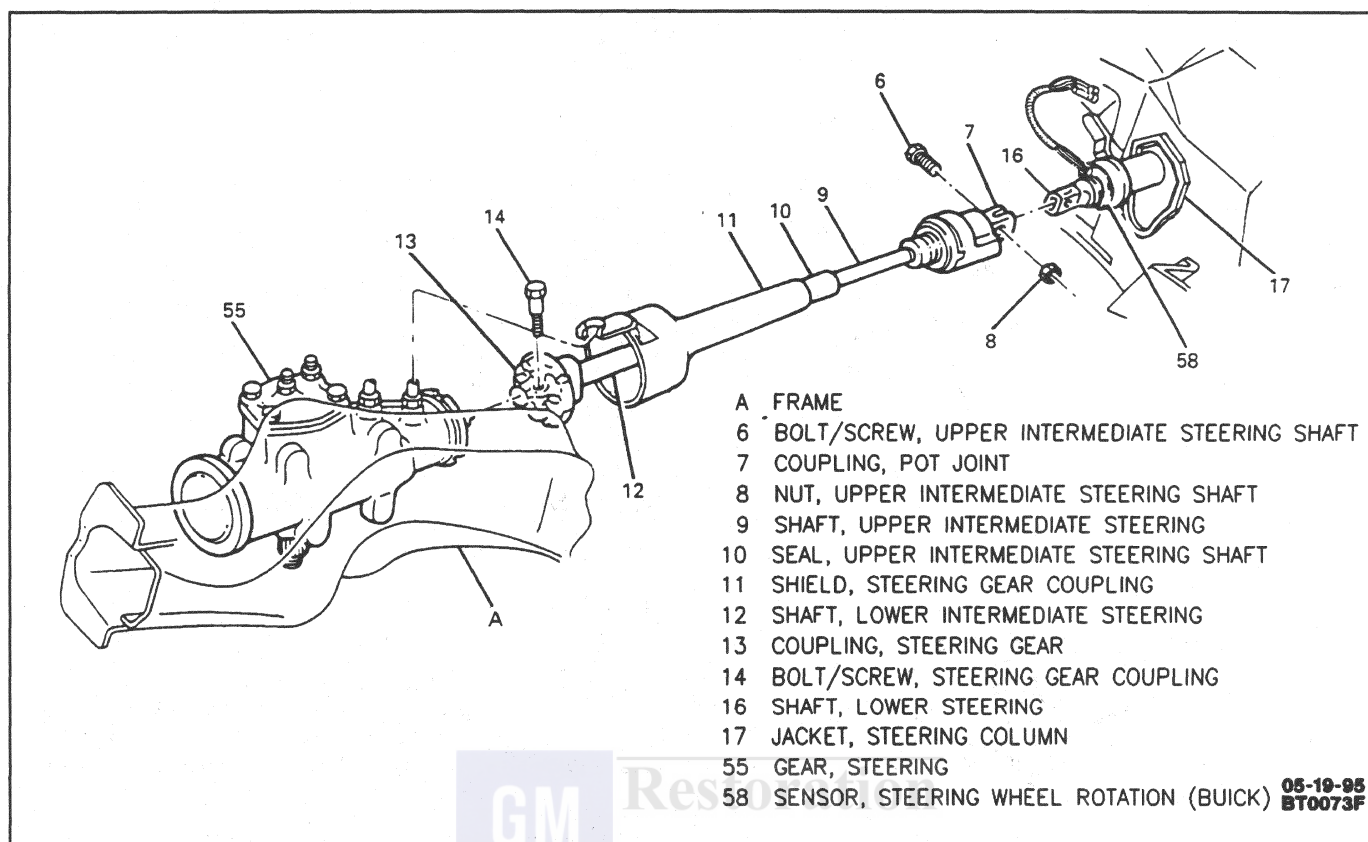


Figure 13 - Replacing Intermediate Steering Shaft

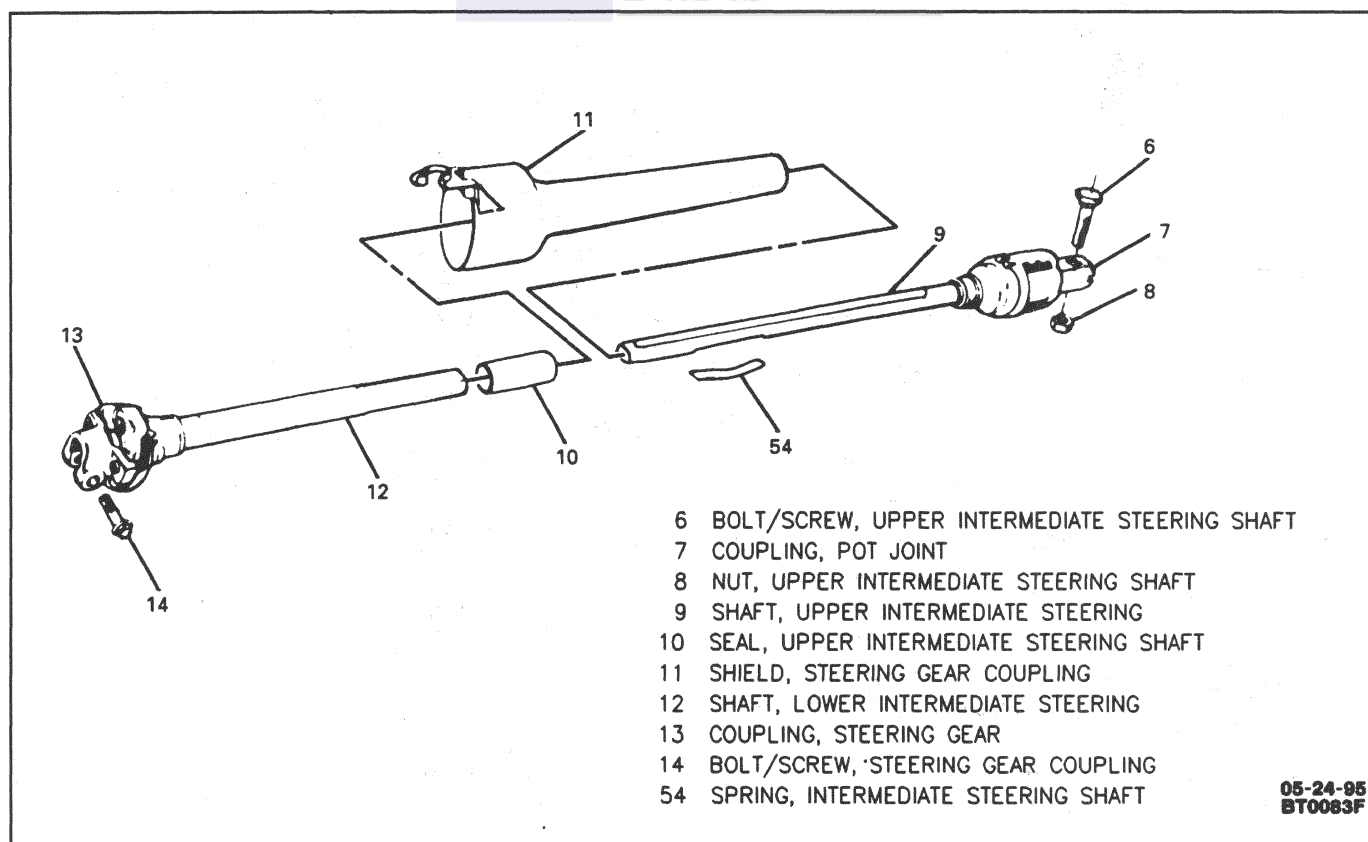


Figure 14 - Disassembling Intermediate Steering Shaft

Install or Connect

NOTICE: Refer to "Notice" on page 3F-1 of this section.

1. Coupling (13) to steering gear worm-shaft splined ends.
 - Align the flat on coupling (13) with the flat on wormshaft.

Important

- Ensure vehicle's wheels are pointing straight ahead.
2. Bolt/screw (14).

Tighten

- Bolt/screw (14) to 31 N.m (23 lb. ft.).
3. Bolt/screw (6) and nut (8) to coupling (7) attaching upper intermediate steering shaft (9) to steering column.

Tighten

- Nut (8) to 54 N.m (40 lb. ft.).
4. Shield (11).
 - Latch of shield (11) must be seated around steering gear return pipe nut.

STEERING COLUMN REMOVAL

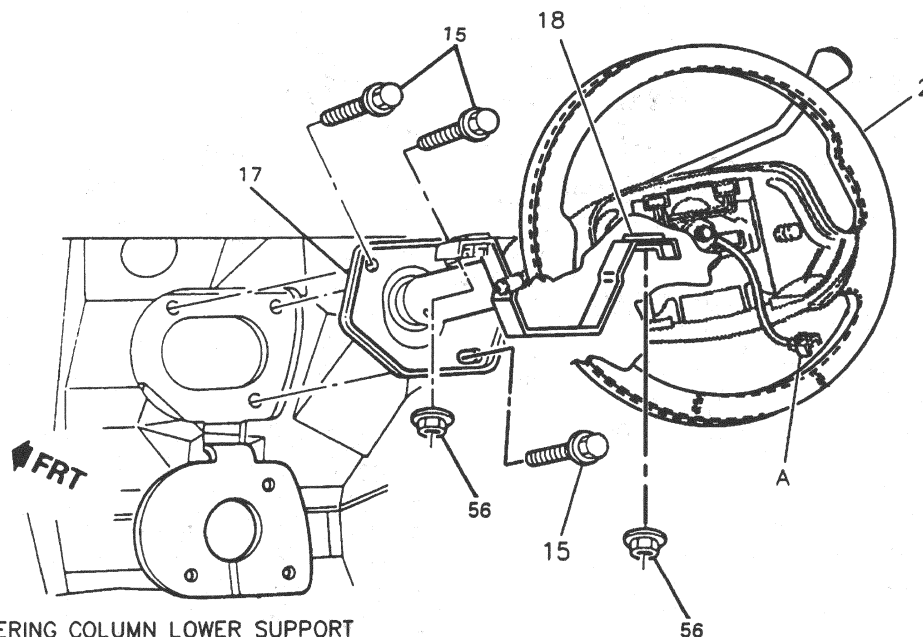
Figures 1, 3, 6, 15 and 16

NOTICE: The wheels of the vehicle must be straight ahead and the ignition switch in the "LOCK" position before disconnecting the steering column or intermediate steering shaft from the steering gear. Failure to do so will cause the SIR coil to become uncentered, which will cause damage to the SIR coil.

NOTICE: When the steering column is removed from the vehicle, it is extremely susceptible to damage. Dropping the steering column on its end could collapse the steering shaft or loosen plastic injections that keep the steering column rigid. Leaning on the steering column could cause jacket to bend or deform. Any of the above conditions could impair steering column's collapsible design. If the steering wheel must be removed, use only the specified steering wheel puller and steering wheel puller bolts. Never hammer on the end of the shaft because hammering could loosen plastic injections that keep the steering column rigid.

Remove or Disconnect

1. Disable the SIR system. Refer to "Disabling the SIR System" in this section.

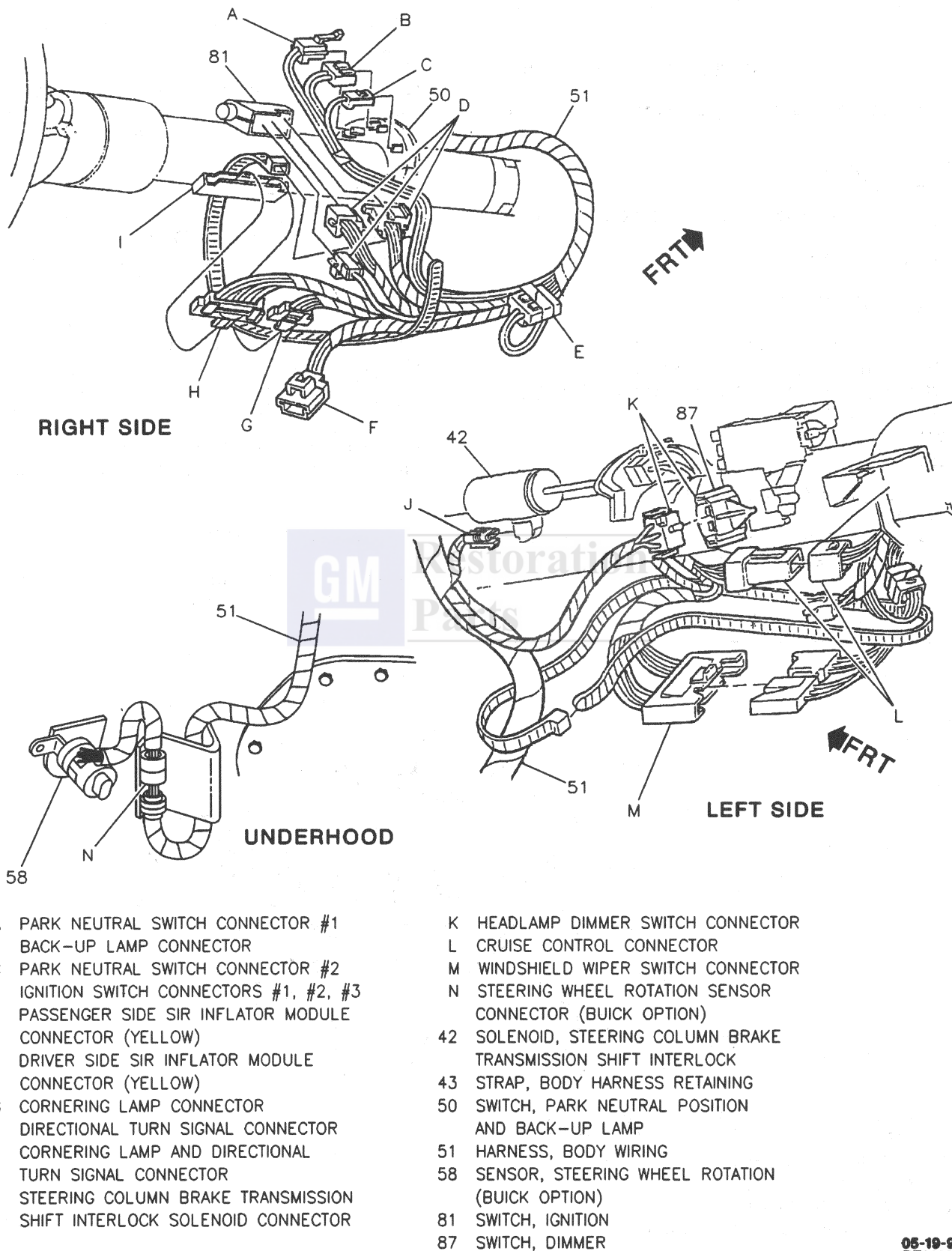


- A SIR CONNECTION
- 2 WHEEL, STEERING
- 15 BOLT/SCREW, STEERING COLUMN LOWER SUPPORT
- 17 JACKET, STEERING COLUMN
- 18 BRACKET, STEERING COLUMN
- 56 NUT, STEERING COLUMN BRACKET

05-19-95
BT0093F

Figure 15 - Removing Steering Column

3F-14 STEERING WHEEL AND COLUMN - ON VEHICLE SERVICE



05-19-95
BT0103F

Figure 16 - Steering Column Wiring Connections

NOTICE: Remove the stoplamp switch before removing the steering column. Failure to do so may cause the stoplamp switch to be damaged or thrown out of adjustment, resulting in a malfunctioning stoplamp switch or premature brake wear.

2. Stoplamp switch. Refer to SECTION 5.
3. Instrument panel steering column opening filler. Refer to SECTION 8C.
4. Instrument panel driver knee bolster and deflector. Refer to SECTION 8C.
5. Steering wheel rotation sensor electrical connector (Buick option).
6. Bolt/screw (6) and nut (8) from pot joint coupling (7) attaching upper intermediate steering shaft (9) to steering column (5).
7. Shift indicator cable (114) from steering column (5).
8. Nuts (56) attaching steering column bracket (18) to instrument panel carrier and lower the steering column (5).
9. Park lock cable from steering column (Impala SS only). Refer to SECTION 7A.
10. Electrical connectors.
11. Automatic transmission range selector rod from steering column (except Impala SS). Refer to SECTION 7A.
12. Bolts/screws (15) attaching jacket (17) to the cowl.
13. Steering column (5) from vehicle.

Install or Connect

NOTICE: If a service replacement steering column is being installed, do not remove the anti-rotation pin until after the steering column has been connected to the steering gear. Removing the anti-rotation pin before the steering column is connected to the steering gear may damage the SIR coil.

NOTICE: Refer to "Notice" on page 3F-1 of this section.

1. Steering column (5) into vehicle.

2. Bolts/screws (15) attaching jacket (17) to cowl.



Tighten

- Bolts/screws (15) to 6.5 N-m (58 lb. in.).
3. Electrical connectors.
 4. Park lock cable to steering column (Impala SS only). Refer to SECTION 7A.
 5. Nuts (56) attaching steering column bracket (18).



Tighten

- Nuts (56) to 27 N-m (20 lb. ft.).
6. Shift indicator cable (114) to steering column (5).
 7. Bolt/screw (6) and nut (8) to coupling (7) attaching upper intermediate steering shaft (9) to steering column (5).



Tighten

- Nut (8) to 54 N-m (40 lb. ft.).
8. Remove anti-rotation pin if service replacement steering column (5) is being installed.
 9. Steering wheel rotation sensor electrical connector (Buick option).
 10. Automatic transmission range selector rod to steering column (except Impala SS). Refer to SECTION 7A.



Adjust

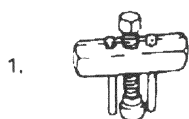
- Shift linkage. Refer to SECTION 7A.
11. Stoplamp switch. Refer to SECTION 5.
 12. Instrument panel driver knee bolster and deflector. Refer to SECTION 8C.
 13. Instrument panel steering column opening filler. Refer to SECTION 8C.
 14. Remove hexagon locking nut, if a service replacement steering column is being installed.
 15. Remove SIR coil shipping cover and disengage connector from cover, if a service replacement steering column is being installed.
 16. Steering wheel, if removed. Refer to "Steering Wheel" in this section.
 17. Enable SIR system. Refer to "Enabling the SIR System" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Dimmer and Ignition Switch Bolt/Screw	4 N.m (35 lb. in.)
Dimmer and Ignition Switch Mounting Stud.....	4 N.m (35 lb. in.)
Hazard Warning Switch Knob Bolt/Screw	0.7 N.m (6 lb. in.)
Steering Column Nut.....	41 N.m (30 lb. ft.)
Steering Column Bracket Nut.....	27 N.m (20 lb. ft.)
Steering Column Lower Support Bolt/Screw	6.5 N.m (58 lb. in.)
Steering Gear Coupling Bolt/Screw.....	31 N.m (23 lb. ft.)
Steering Wheel Bolt/Screw	6 N.m (53 lb. in.)
Upper Intermediate Steering Shaft Nut	54 N.m (40 lb. ft.)

SPECIAL TOOLS



J 1859-A

2.



J 38720

1. STEERING WHEEL PULLER
2. STEERING WHEEL PULLER BOLTS

GM

Restoration
Parts

4-19-84
BS0193F

SECTION 3F5A

SUPPLEMENTAL INFLATABLE RESTRAINT TILT STEERING COLUMN COLUMN SHIFT UNIT REPAIR

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

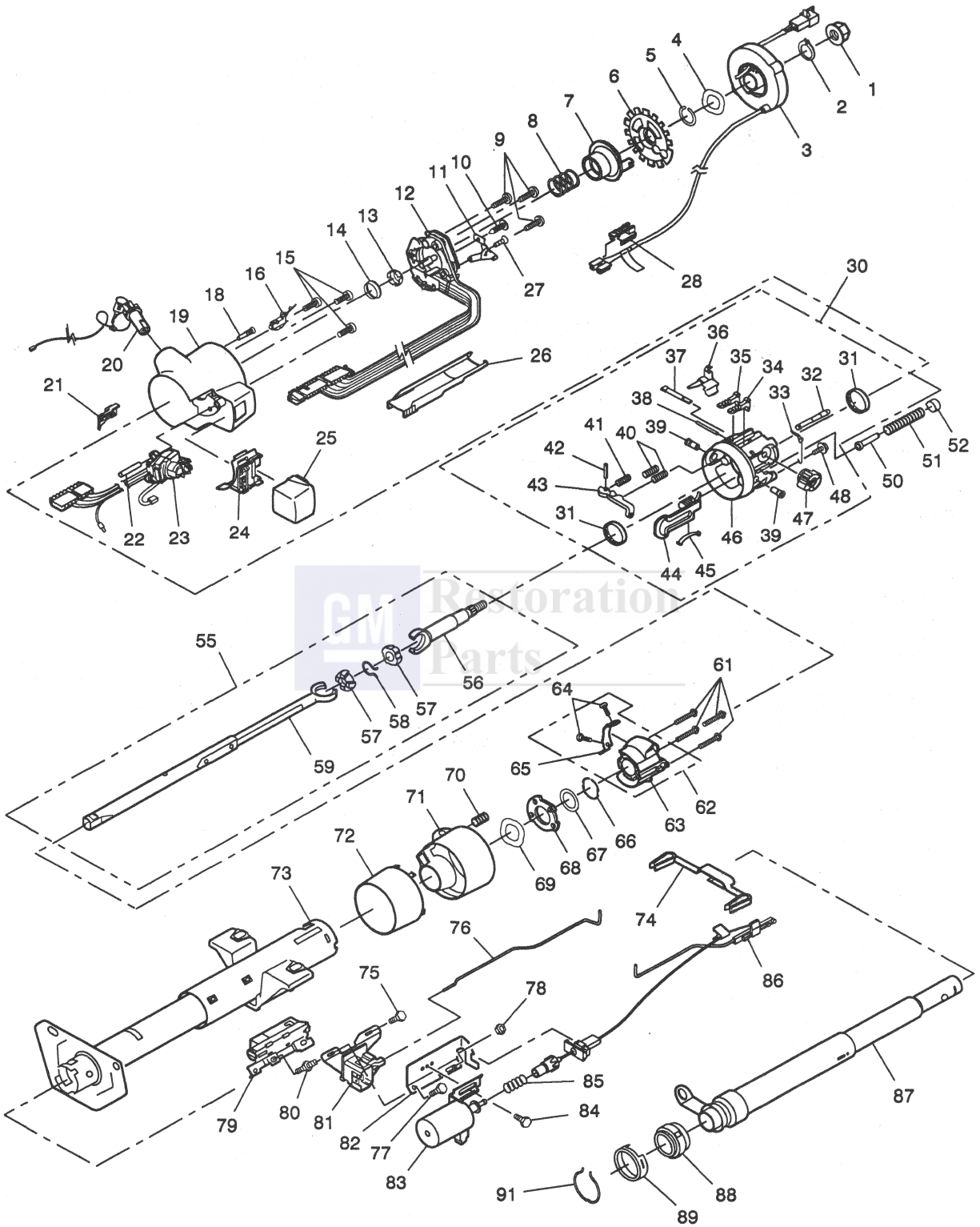
CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "off" or "lock" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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Inflatable Restraint Coil Assembly		Lock Bolt	
Shaft Lock		Strg Column Housing Support Asm	
Turn Signal Cancelling Cam Asm		Steering Shaft Assembly	
Upper Bearing Spring		Shift Tube Assembly	
Upper Bearing Inner Race Seat		Sub Section D - Lower Column	3F5A-17
Inner Race		Interlock Solenoid Assembly	
Turn Signal Switch Assembly		Interlock Solenoid Adjustment	
Buzzer Switch Assembly		Dimmer Switch Assembly	
Strg Col Pass Key Lock Cylinder Set		Dimmer Switch Adjustment	
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Steering Column Housing Assembly			

3F5A-2 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)



C94B02-0

Figure 1 - Tilt Steering Column

1-NUT, HEX LOCKING (M14x1.5)	52-RETAINER, SPRING
2-RING, RETAINING	55-SHAFT ASM, STEERING
3-COIL ASM, SIR	56-SHAFT ASM, RACE & UPPER
4-WASHER, WAVE	57-SPHERE, CENTERING
5-RING, RETAINING	58-SPRING, JOINT PRELOAD
6-LOCK, SHAFT	59-SHAFT ASM, LOWER STEERING
7-CAM ASM, TURN SIG CANCEL	61-SCREW, SUPPORT
8-SPRING, UPPER BEARING	62-SUPPORT ASM, STRG COL HSG
9-SCREW, BNDG HD CR RECESS	63-SUPPORT, STRG COL HSG
10-SCREW, FLAT HD TAP	64-SCREW, OVL HD CROSS RECESS
11-ARM, SIGNAL SWITCH	65-GATE, SHIFT LEVER
12-SWITCH ASM, TURN SIGNAL	66-RING, SHIFT TUBE RETAINING
13-SEAT, UPPER BRG INNER RACE	67-WASHER, THRUST
14-RACE, INNER	68-PLATE, LOCK
15-SCREW, PAN HD SOC TAP	69-WASHER, WAVE
16-SWITCH ASM, BUZZER	70-SPRING, SHIFT LEVER
18-SCREW, LOCK RETAINING	71-BOWL ASM, GEARSHIFT LEVER
19-COVER ASM, LOCK HOUSING	72-SHROUD, GEARSHIFT BOWL
20-LOCK CYLINDER SET, STRG COL PASS KEY	73-JACKET ASM, STRG COL
21-ACTUATOR, DIMMER SW ROD	74-RETAINER, CABLE
22-PIN, SWITCH ACTUATOR PIVOT	75-SCREW, WASH HD (#10-24x.25)
23-SWITCH ASM, PIVOT & (PULSE)	76-ROD, DIMMER SWITCH
24-BASE PLATE, COL HSG CVR END	77-SCREW, HEX WASH HD TAP
25-CAP, COL HSG COVER END	78-NUT, HEXAGON
26-PROTECTOR, WIRING	79-SWITCH ASM, IGNITION
27-SCREW, C/S TAP (#8-18)	80-STUD, DIMR & IGN SWITCH MTG
28-SHROUD, CONNECTOR	81-SWITCH ASM, DIMMER
30-HOUSING ASM, STRG COLUMN	82-BRACKET, SOLENOID
31-BEARING ASM	83-SOLENOID ASM, INTERLOCK
32-BOLT, LOCK	84-SCREW, HEX WASH HD (10-24X.25)
33-SPRING, LOCK BOLT	85-SPRING, BALL JOINT
34-SHOE, STEERING WHEEL LOCK	86-ACTUATOR ASM, IGN SWITCH
35-SHOE, STEERING WHEEL LOCK	87-TUBE ASM, SHIFT
36-SHIELD, WIRE PROTECTOR	88-BUSHING ASM, STRG SHAFT
37-SHAFT, DRIVE	89-RETAINER, BEARING ADAPTER
38-PIN, DOWEL	91-CLIP, LOWER BEARING ADAPTER
39-PIN, PIVOT	
40-SPRING, SHOE	
41-SPRING, RELEASE LEVER	
42-PIN, RELEASE LEVER	
43-LEVER, SHOE RELEASE	
44-RACK, SWITCH ACTUATOR	
45-SPRING, RACK PRELOAD	
46-HOUSING, STRG COLUMN	
47-SECTOR, SWITCH ACTUATOR	
48-SCREW, HEX WASHER HEAD	
50-GUIDE, SPRING	
51-SPRING, WHEEL TILT	
	Service Kits
	201-RACK SERV KIT, COL SECTOR & -INCLUDES: 14,31,33,44,47,48
	202-SPRING SERV KIT, TILT COLUMN -INCLUDES: 13,14,39,50,51,52
	203-COIL SERV KIT, INFL RESTRAINT -INCLUDES: 3,28
	204-SPHERE SERV KIT, TILT COLUMN -INCLUDES: 57,58
	205-GREASE SERV KIT, (SYNTHETIC)
	206-GREASE SERV KIT, BTSI

Figure 2 - Tilt Steering Column - Legend

SUB SECTION A - UPPER COLUMN

INCLUDES:

DISABLING THE SIR SYSTEM
ENABLING THE SIR SYSTEM
INFLATABLE RESTRAINT COIL ASSEMBLY
SHAFT LOCK
TURN SIGNAL CANCELLING CAM ASM
UPPER BEARING SPRING
UPPER BEARING INNER RACE SEAT
INNER RACE
TURN SIGNAL SWITCH ASSEMBLY
BUZZER SWITCH ASSEMBLY
STRG COL PASS KEY LOCK CYL SET
CENTERING INFL RESTRAINT COIL

Tools Required:

J 23653-SIR Lock Plate Compressor

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or unneeded SIR repairs.

The SDM can maintain sufficient voltage to cause a deployment for up to 10 seconds after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

Disabling The SIR System

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
 - Turn ignition switch to "LOCK" and remove key
1. "AIR BAG" fuse from I/P fuse block.
 2. Left-hand sound insulator assembly, refer to SECTION 8C.
 3. Both connector position assurance (CPA) retainers and yellow 2-way SIR connectors located near base of the steering column.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON", the "AIR BAG" warning lamp will be "ON". This is normal operation and does not indicate an SIR system malfunction.

Enabling The SIR System

Install or Connect

- Turn ignition switch to "LOCK" and remove key.
1. Both yellow 2-way SIR connectors and corresponding (CPA) retainers located near base of steering column.
 2. Left-hand sound insulator assembly, refer to SECTION 8C.
 3. "AIR BAG" fuse to I/P block.
 - Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes 7 times and then turns "OFF". If it does not operate as described, perform the "SIR Diagnostic System Check" in SECTION 9J-A.

Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

Remove or Disconnect *Figures 1 through 8 and 12*

NOTICE: Place ignition to "LOCK" position to prevent uncentering SIR coil assembly (3).

1. Disable the SIR system; refer to "Disabling the SIR System" in this Section.
2. Negative (-) battery cable.

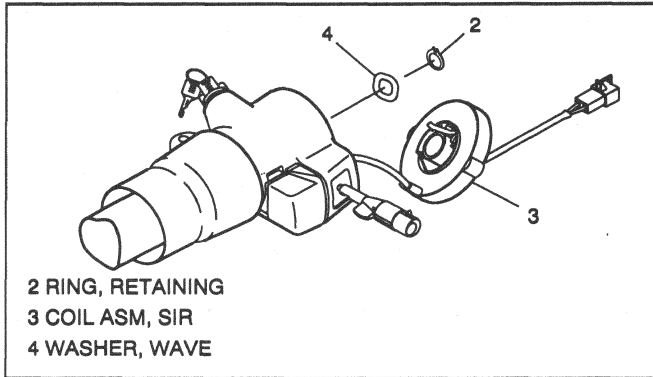


Figure 3 - Removing Coil Assembly Off Shaft

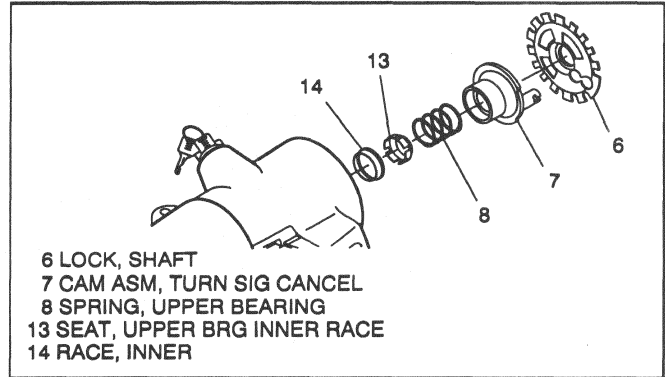


Figure 5 - Removing Components from Upper Shaft

3. Coil assembly retaining ring (2).
4. Inflatable restraint coil assembly (3).
 - Let switch hang freely if removal is not needed.
 - To remove coil assembly (3), do steps 5 through 17 in this section.
5. Wave washer (4).
6. Shaft lock retaining ring (5) using J 23653-SIR to push down shaft lock (6).
 - Dispose of ring (5).
7. Shaft lock (6).
8. Turn signal cancelling cam assembly (7).
9. Upper bearing spring (8).

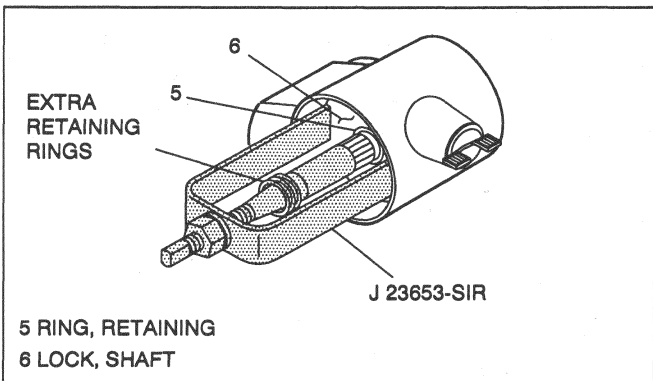


Figure 4 - Removing Shaft Lock Retaining Ring

10. Upper bearing inner race seat (13).
11. Inner race (14).
12. Turn signal to "RIGHT TURN" position (up).
13. Multi-function lever and hazard knob assembly. (See Section 3F)
14. Flat head tapping screw (10), cross recess tapping screw (27) and signal switch arm (11).
15. Turn signal switch screws (9).

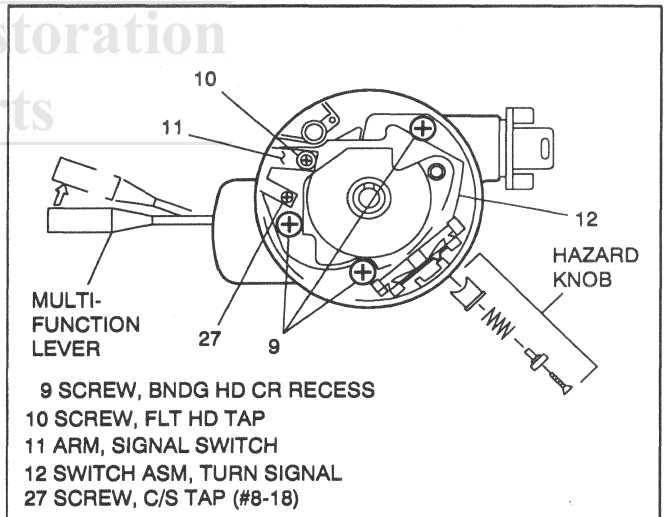


Figure 6 - Turn Signal Switch Removal Preparation

16. Turn signal switch assembly (12).
 - Let switch hang freely if removal is not needed.
 - To remove switch (12):
 - A. Turn signal switch connector from vehicle wire harness.
 - B. Wiring protector (26).
 - C. Gently pull wire harness through column.

3F5A-6 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

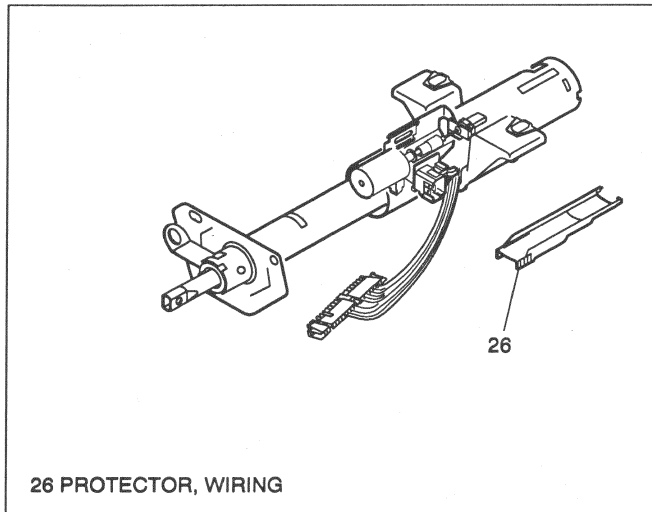


Figure 7 - Removing Turn Signal Switch

NOTICE: Coil assembly (3) will become uncentered if:

- 1) Steering column is separated from steering gear and is allowed to rotate, or
- 2) Centering spring is pushed down, letting hub rotate while coil (3) is removed from steering column. (If this occurs, see Figure 12)

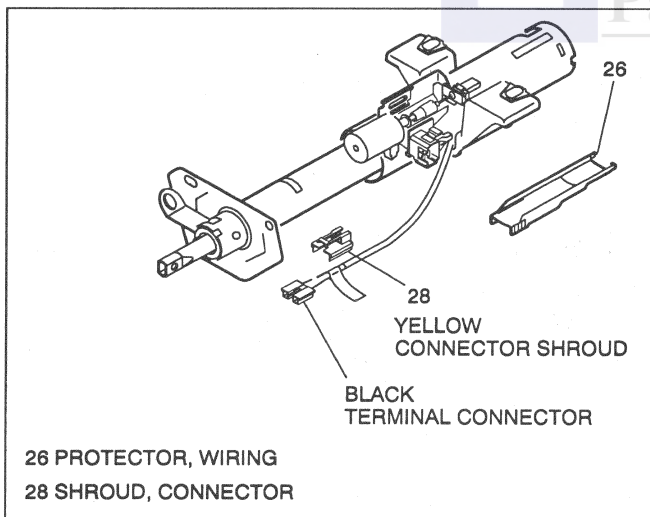


Figure 8 - Removing Coil Assembly Switch

17. Inflatable restraint coil assembly (3) with wire harness from column assembly.
 - A. Wiring protector (26).
 - B. Attach a length of mechanics wire to terminal connector harness to aid in reassembly.
 - C. Gently pull wire through column.

18. Key from steering column pass key lock cylinder set (20).
19. Buzzer switch assembly (16).
20. Reinsert key in pass key lock cylinder (20).
 - Key in "LOCK" position.
21. Lock retaining screw (18).
22. Pass key lock cylinder (20) and harness.
 - To remove lock cylinder.
 - A. Cylinder harness connector from vehicle wire harness.
 - B. Wiring protector (26).
 - C. Attach a length of mechanics wire to terminals to aid in reassembly.
 - D. Gently pull wire harness through column.



Install or Connect

Figures 1,2,9 through 14,25

NOTICE: See "Notice" on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

NOTICE: Route wire from pass key lock cylinder as shown and snap retaining clip into hole lock in housing cover assembly (19). (See Figures 9 and 10) Failure to do so may result in component damage or malfunction of pass key lock cylinder (20).

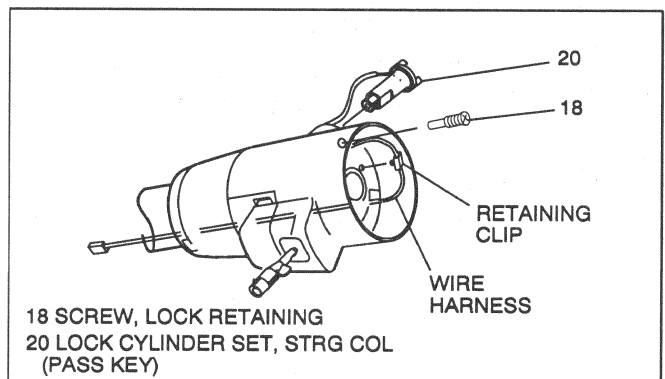


Figure 9 - Installing Pass Key Lock Cylinder Set

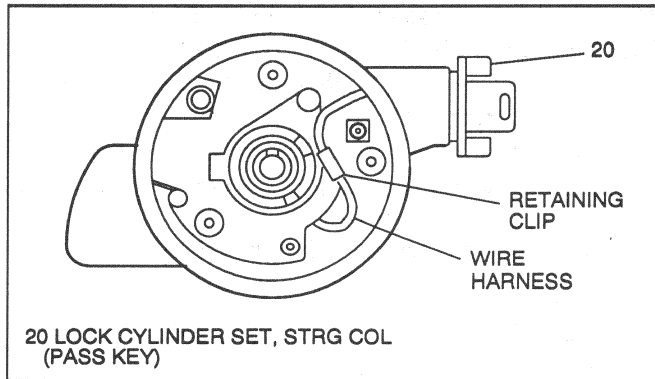


Figure 10 - Routing Pass Key Wire Harness

1. Steering column pass key lock cylinder set (20).
 - A. Wire terminals through column and snap retaining clip into hole in lock housing cover assembly (19).
 - B. Cylinder harness connector to vehicle wire harness.

2. Lock retaining screw (18).

Tighten

- Tighten screw (18) to 2.5 N·m (22 lb.in.).

3. Key from pass key lock cylinder set (20).
4. Buzzer switch assembly (16).
5. Reinsert key in pass key lock cylinder set (20).
 - Key in "LOCK" position.
6. Turn signal switch assembly (12) wire harness through steering column.
 - Let switch hang freely.
 - Switch connector to vehicle wire harness.

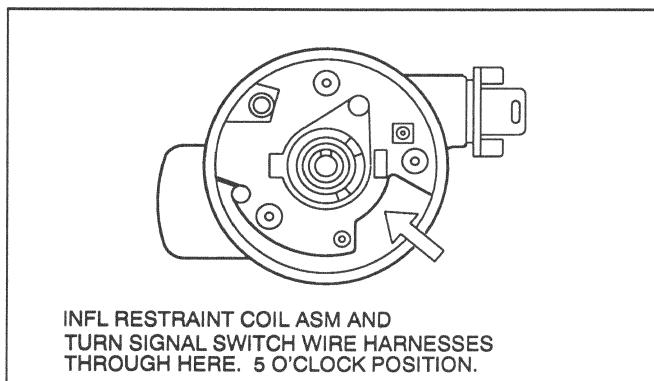


Figure 11 - Wire Harnesses through Column

7. Coil assembly (3) wire harness through column. (See Figure 13)
 - Let coil hang freely.
8. Turn signal switch assembly (12) and binding head cross recess screws (9).

Tighten

- Tighten screws (9) to 3.4 N·m (30 lb.in.).

9. Signal switch arm (11), flat head screw (10) and cross recess tapping screw (27).

Tighten

- Tighten screw (10) and screw (27) to 2.3 N·m (20 lb.in.).

10. Hazard knob assembly and multi-function lever. (See Section 3F)
11. Inner race (14).
12. Upper bearing inner race seat (13).
13. Upper bearing spring (8).
14. Turn signal cancelling cam assembly (7).
 - Lubricate with grease, synthetic (service kit).
15. Shaft lock (6).
16. New shaft lock retaining ring (5) using J 23653-SIR to push down shaft lock (6).
 - Ring (5) must be firmly seated in groove on shaft.

NOTICE: Set steering shaft so that block tooth on upper steering shaft (56) is at the 12 o'clock position, wheels on vehicle should be straight ahead, then set ignition switch to "LOCK" position, to ensure no damage to coil assembly (3). (Refer to Figure 25)

17. Wave washer (4).

NOTICE: Coil assembly (3) will become uncentered if:

- 1) Steering column is separated from steering gear and is allowed to rotate, or
- 2) Centering spring is pushed down, letting hub rotate while coil is removed from column. (If this occurs, see Figure 12)

3F5A-8 TILT STRG COL UNIT REPAIR (SIR, COL SHFT)

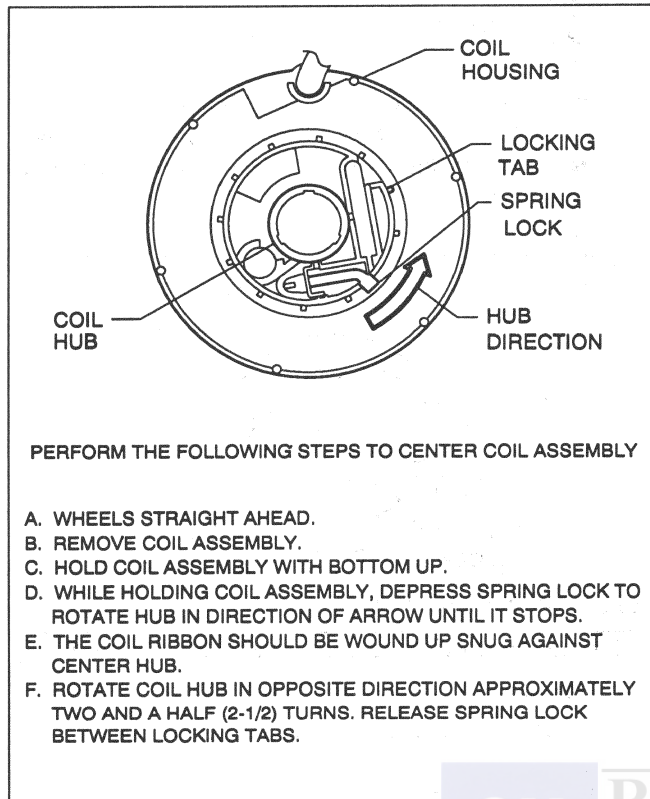


Figure 12 - Centering Coil Assembly

NOTICE: If a new coil assembly (3) is being installed, assemble pre-centered coil assembly (3) to steering column. Remove centering tab and dispose. (See Figure 12)

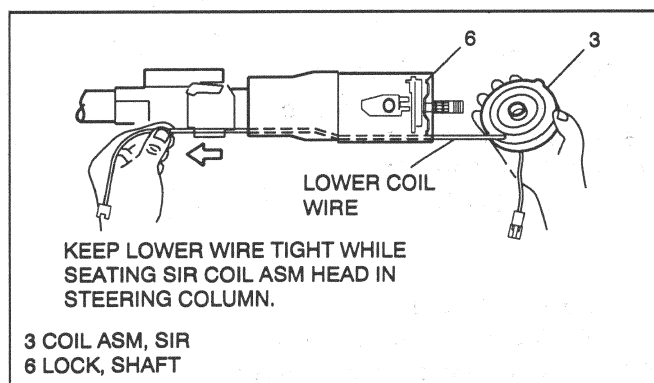


Figure 13 - Routing Coil Assembly Wire

NOTICE: SIR coil assembly wire must be kept tight with no slack while installing SIR coil assembly. Failure to do so may cause wire to be kinked near shaft lock area and cut when steering wheel is turned.

18. Ensure coil assembly (3) hub is centered.
19. Coil assembly (3).
 - Pull wire tight while positioning SIR coil to steering shaft. (See Figure 13)
 - Align opening in coil with horn tower and "Locating bump" between two tabs on housing cover. (See Figure 14)
 - Seat coil assembly into steering column.

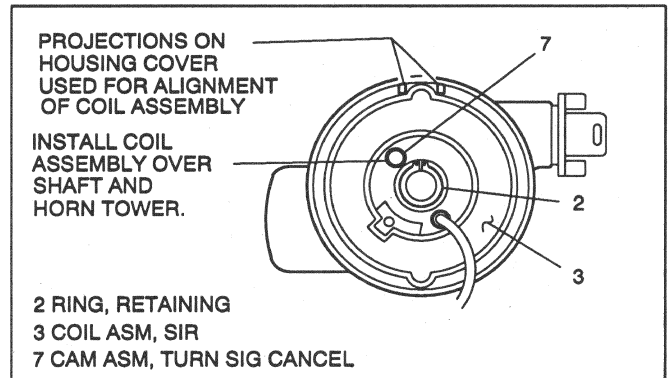


Figure 14 - Coil Assembly Installed

20. Coil assembly retaining ring (2).
 - Ring (2) must be firmly seated in groove on shaft.

NOTICE: Gently pull lower coil assembly, turn signal, and pass key wires to remove any wire kinks that may be inside steering column assembly. Failure to do so may cause damage to wire harness.

21. Wiring protector (26).
22. Refer to Section 3F to complete remaining steering column assembly.
23. Negative (-) battery cable.
24. If all service operations are completed, enable the SIR system; refer to "Enabling SIR System" in this Section.

SUB SECTION B - HOUSING COVER

Figures 1,2,15 through 19

INCLUDES:

**COL HSG COVER END CAP
LOCK HOUSING COVER ASSEMBLY
PIVOT & (PULSE) SWITCH ASSEMBLY
DIMMER SWITCH ROD ACTUATOR
TILT SPRING ASSEMBLY**

Tools Required:

J 23653-SIR Lock Plate Compressor

Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

Important

- Remove only those components necessary to do repairs.

Remove or Disconnect

- Do all steps, "Remove or Disconnect", Sub Section A.
- Column housing cover end cap (25).

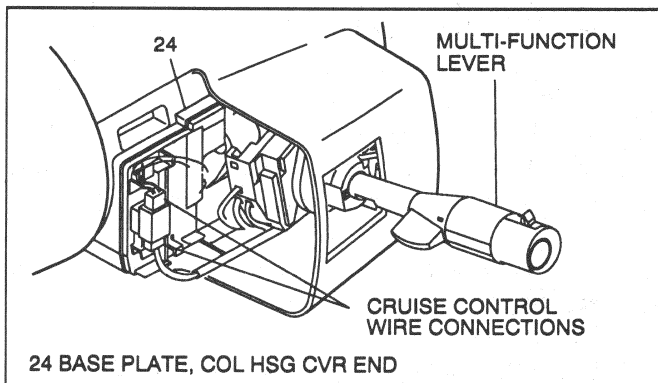


Figure 15 - Cruise Control Equipped Steering Columns

Important

- Remove cruise control and multi-function lever connectors from base plate (24) and disconnect.
- Remove multi-function lever. (See Section 3F)

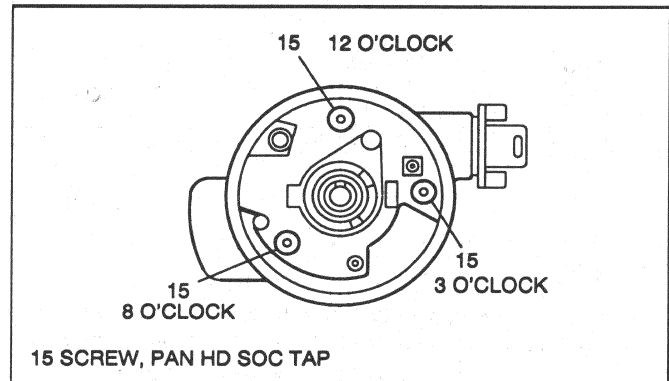


Figure 16 - Lock Housing Cover Screw Positions

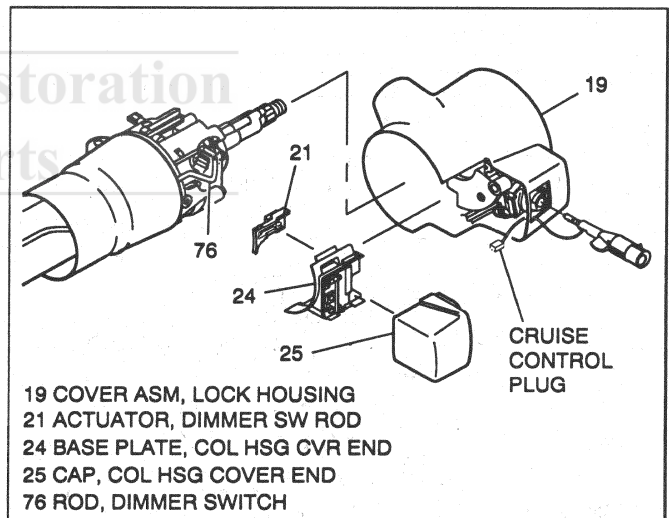


Figure 17 - Removing Lock Housing Cover

- Cover screws (15).
- Tilt lever. (See Section 3F)
- Lock housing cover assembly (19).
- Column housing cover end base plate (24) and dimmer switch rod actuator (21).
- Wire protector shield (36).

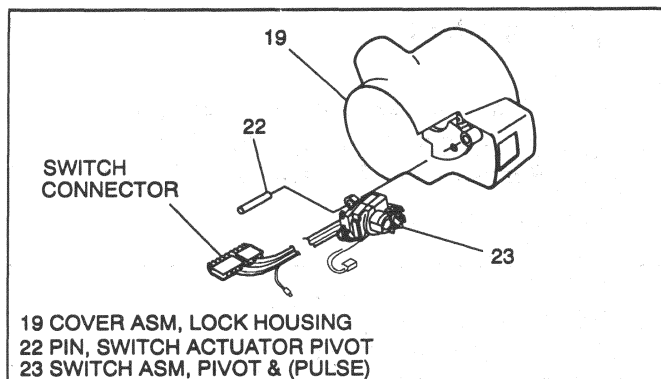


Figure 18 - Removing Pivot & (Pulse) Switch

8. Switch actuator pivot pin (22).
9. Pivot & (pulse) switch assembly (23).
 - Let switch hang freely if removal is not needed.
 - To remove switch (23):
 - A. Pivot & (pulse) switch connector from vehicle wire harness.
 - B. Gently pull wire harness through column.

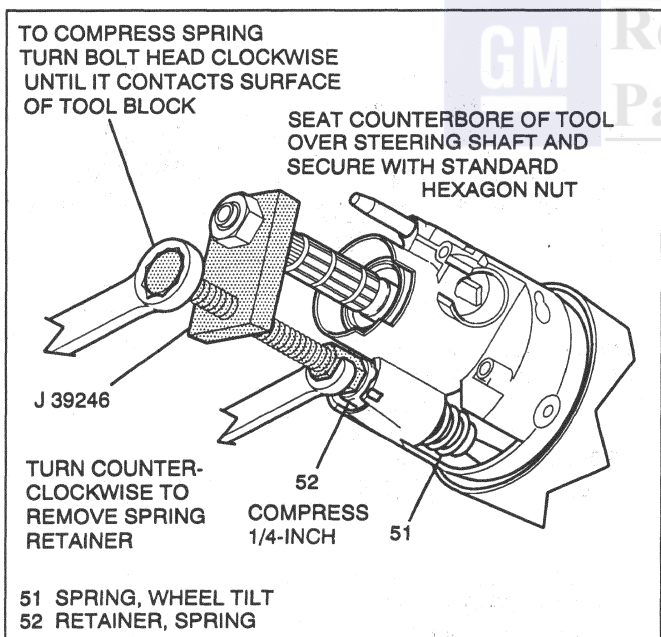


Figure 19 - Removing Tilt Spring Assembly

10. Seat counterbore of tool J 39246 over end of race & upper shaft assembly (56).
11. Thread and seat standard hexagon nut on shaft (56) to secure tool.
12. Align square extension on end of tool bolt with square hole in spring retainer (52) and seat.

13. Rotate tool bolt clockwise with wrench until it contacts surface of tool block.

Inspect

- Spring retainer (52) must be compressed approximately 1/4-inch into steering column housing (46).

Important

- Square hole in spring retainer (52) may become striped. Ensure spring retainer (52) is compressed at least 1/4-inch and is turned no more than 1/4 turn.

14. Rotate hexagon section on end of tool bolt counter clockwise approximately 1/4 turn.
15. Unscrew tool bolt until wheel tilt spring (51) and retainer (52) are loose and free of tool.
16. Remove retainer (52), spring (51), spring guide (50), and tool J 39246.

Install or Connect

NOTICE: See "Notice" on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

NOTICE: If new wheel tilt spring (51) is to installed, grease spring (51) and spring guide (50).

1. Install spring (51), spring guide (50), and spring retainer (52) to steering column housing (46).
2. Align securing tabs on spring retainer (52) with slots in tilt spring hole.
3. Tool J 39246 to steering shaft (56) and retainer (52).
 - Do steps 10 through 13, **Inspect**, and **Important** to setup tool and compress spring (51).
4. Rotate hexagon section on end of tool bolt clockwise approximately 1/4 turn to lock retainer (52) into place.
5. Unscrew tool bolt and remove from shaft (56).
 - Spring (51) and retainer (52) must be locked into position in housing (46).

 Inspect

- Tilt housing (46) to all positions to ensure smooth and proper operation of tilt spring.
6. Pivot & (pulse) switch assembly (23) to lock housing cover assembly (19).
 7. Switch actuator pivot pin (22) to switch (23) and cover (19).
 8. Pivot & (pulse) switch wire harness through steering column.
 - Switch connector to vehicle wire harness.
 - Wire protector shield (36).
 9. Dimmer switch rod actuator (21) to base plate (24).
 - Lubricate with lithium grease.
 10. Base plate (24) to lock housing cover assembly (19).
 - Bottom edge of dimmer switch rod actuator (21) must rest on bend in dimmer switch rod (76).
 11. Lock housing cover assembly (19).
 12. Screws (15). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 3 o'clock position third.

 Tighten

- Tighten screws (15) in same order to 9.0 N·m (80 lb.in.).
13. Install multi-function lever and tilt lever. (See Section 3F)
 14. Plug multi-function lever and cruise control connectors together and mount on base plate (24).
 15. Column housing cover end cap (25).
 16. Do all steps, "Install or Connect", Sub Section A.

SUB SECTION C - MID COLUMN**INCLUDES:**

**STEERING COLUMN HOUSING ASM
STEERING WHEEL LOCK SHOE
SWITCH ACTUATOR SECTOR
SWITCH ACTUATOR RACK
BEARING ASSEMBLY
LOCK BOLT
STEERING COL HSG SUPPORT ASM
STEERING SHAFT ASSEMBLY
SHIFT TUBE ASSEMBLY**

Tools Required:

J 23653-SIR Lock Plate Compressor
J 21854-01 Pivot Pin Remover
J 22635 Lock Shoe and Release Lever Pin
Remover and Installer
J 8092 Driver Handle
J 38639 Strg Col Housing Bearing Installer
J 23072 Shift Tube Remover
J 23073-01 Shift Tube Installer

 Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

 Remove or Disconnect

Figures 1,2,20 through 29,34 and 39

1. Disable the SIR system; refer to "Disabling the SIR System" in this section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

3F5A-12 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

Inspect

- Steering column for accident damage. (See Figure 39)
- Do all steps, "Remove or Disconnect", Sub Section B.

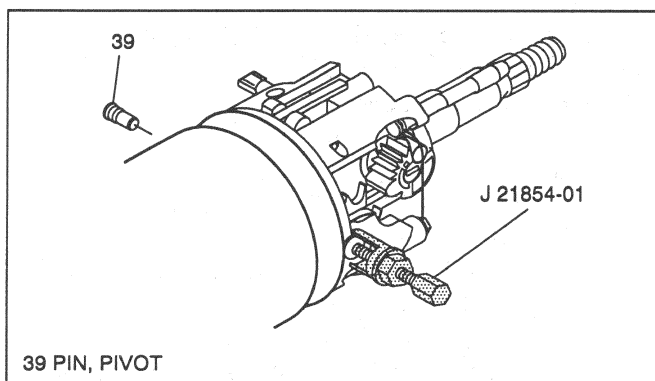


Figure 20 - Removing Pivot Pin

- Pivot pins (39) using J 21854-01.
 - Reinstall tilt lever. (See Section 3F)
- Steering column housing assembly (30).
 - Pull back on tilt lever and pull steering column housing assembly (30) down and away from column.

Important

- Remove only those components necessary to do repairs.

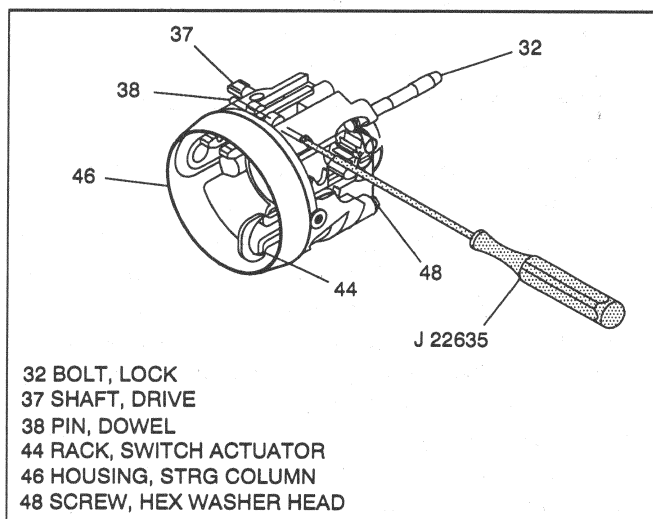


Figure 21 - Lock Housing Cover Components, Exterior

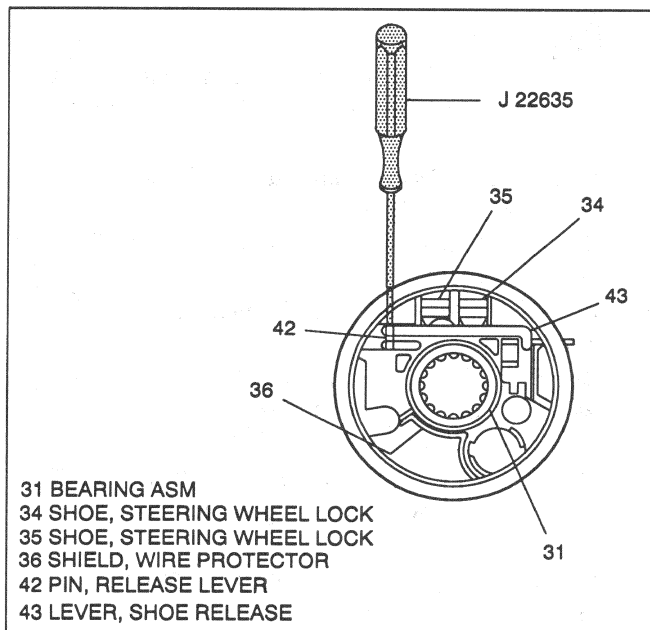


Figure 22 - Lock Housing Cover Components, Interior

Disassemble

Steering Column Housing Assembly

- Bearing assembly (31).
- Hexagon head screw (48).
- Lock bolt spring (33).
- Lock bolt (32).
- Switch actuator rack (44) and rack preload spring (45).
- Drive shaft (37).
- Switch actuator sector (47).
- Release lever pin (42) using J 22635.
- Shoe release lever (43).
- Release lever spring (41).
- Dowel pin (38) using J 22635.
- Lock shoes (34) and (35).
- Shoe springs (40).

Assemble

Steering Column Housing Assembly

- Shoe springs (40).
- Lock shoes (34) and (35).
- Dowel pin (38) using J 22635.
- Release lever spring (41).

- E. Shoe release lever (43).
- F. Release lever pin (42) using J 22635.
- G. Switch actuator sector (47).
- H. Drive shaft (37).
- I. Rack preload spring (45).
- J. Switch actuator rack (44) to actuator sector (47).
- K. Bearing assembly (31) lubricated with lithium grease to column housing (46) using J 38639 and J 8092.
- L. Lock bolt (32).
- M. Lock bolt spring (33). (Refer to Figure 34)
- N. Hexagon head screw (48).

Tighten

- Tighten screw (48) to 4.0 N·m (35 lb.in.).

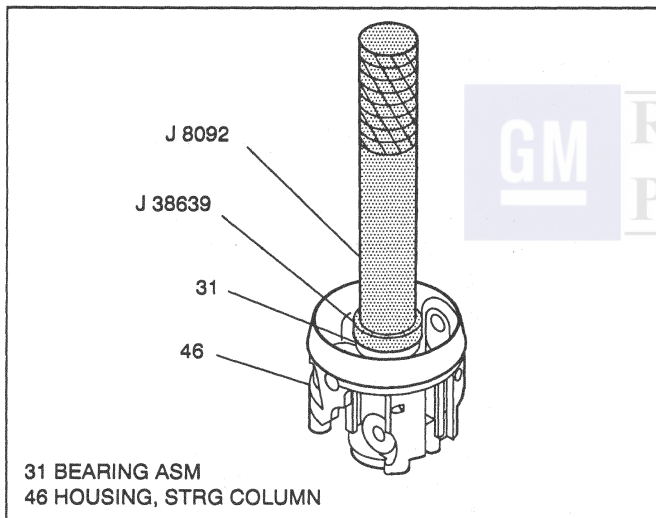


Figure 23 - Installing Bearings

- 7. Lower bearing adapter clip (91).
- 8. Bearing adapter retainer (89).
- 9. Steering shaft bushing assembly (88).
- 10. Steering shaft assembly (55).

Inspect

- Steering shaft assembly (55) for accident damage. (See Figure 39)

Important

- Mark race & upper shaft assembly (56) and lower steering shaft asm (59) to ensure proper assembly. Failure to assemble properly will cause steering wheel to be turned 180 degrees. (See Figures 24 and 25)

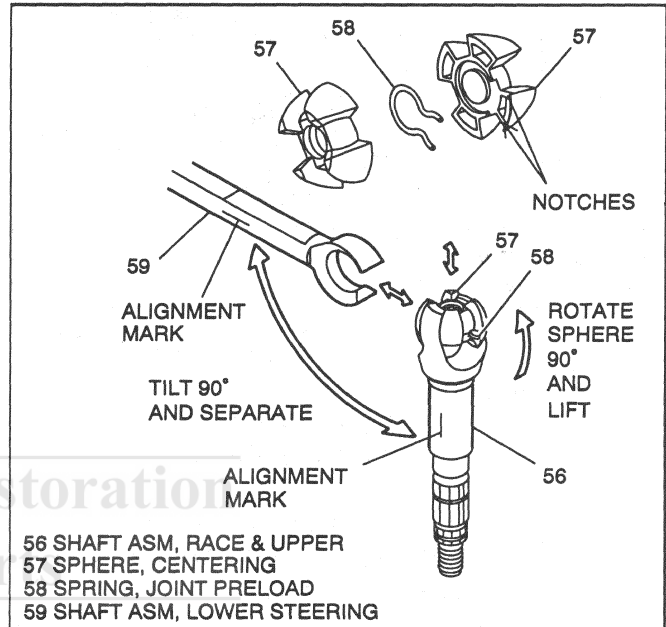


Figure 24 - Removing Steering Shaft Components

Important

- Remove only those components necessary to do repairs.

Disassemble

Steering Shaft Assembly

- A. Race & upper shaft assembly (56), lower steering shaft assembly (59).
 - Tilt 90 degrees to each other and disengage.
- B. Centering sphere (57) from upper shaft assembly (56).
 - Rotate sphere 90 degrees and slip out.
- C. Joint preload spring (58) from centering sphere (57).

3F5A-14 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

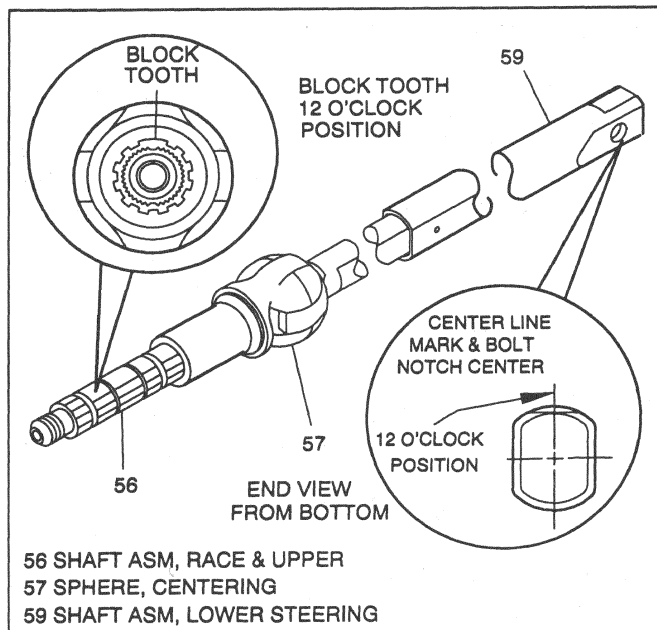


Figure 25 - Correct Upper to Lower Shaft Orientation

Assemble

Steering Shaft Assembly

- A. Joint preload spring (58) to two centering sphere (57).
- B. Centering sphere (57).
 - Lubricate with lithium grease, slip into upper shaft assembly (56), and rotate sphere 90 degrees.
- C. Race & upper shaft assembly (56) to lower steering shaft assembly (59).
 - Line up marks and tilt assemblies 90 degrees to each other.

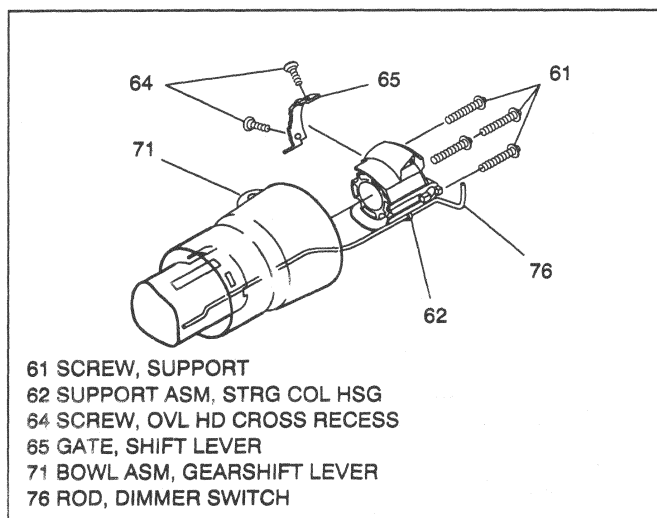


Figure 26 - Removing Column Housing Support

11. Support screws (61).
 - Dispose of screws (61).
12. Column housing support assembly (62) with dimmer switch rod (76) from steering column jacket assembly (73).
 - Rod (76) from support (63).
13. Oval head cross recess screws (64) and shift lever gate (65) from support (63).
14. Shift tube retaining ring (66).
15. Thrust washer (67).

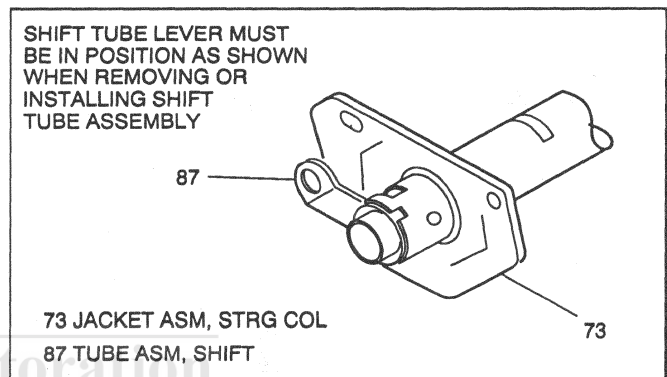


Figure 27 - Shift Tube Lever Position

NOTICE: Shift tube lever must be in position to clear jacket assembly (73) when removing shift tube (87). Forcing lever against jacket may cause damage to jacket assembly (73). (See Figure 27)

16. Shift tube (87) using J 23072.
17. Lock plate (68).
18. Wave washer (69).
19. Gearshift lever bowl assembly (71) with gearshift bowl shroud (72).
20. Shift lever spring (70) from bowl (71).
21. Shroud (72) from bowl (71).

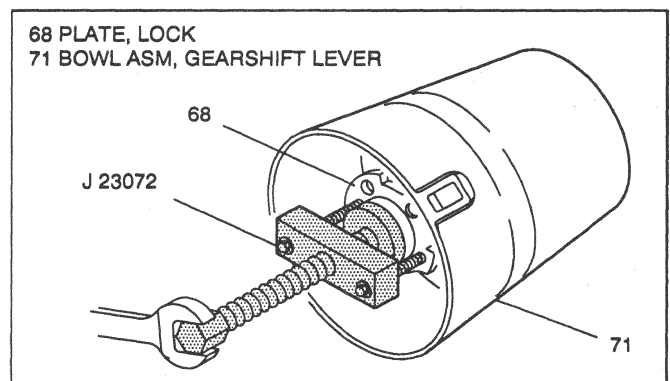


Figure 28 - Removing Shift Tube

! Important

- Solenoid cable must remain straight and must not be kinked during removing and installing.
22. Solenoid cable assembly from interlock solenoid assembly (83).
 - A. Cable mounting clip from solenoid bracket (82).
 - B. Ball joint socket from solenoid (83).
 - C. Ball joint spring (85).
 23. Hexagon washer head screw (84).
 - Solenoid assembly (83).
 24. Hexagon head tapping screw (77) and hexagon nut (78).
 - Solenoid bracket (82).

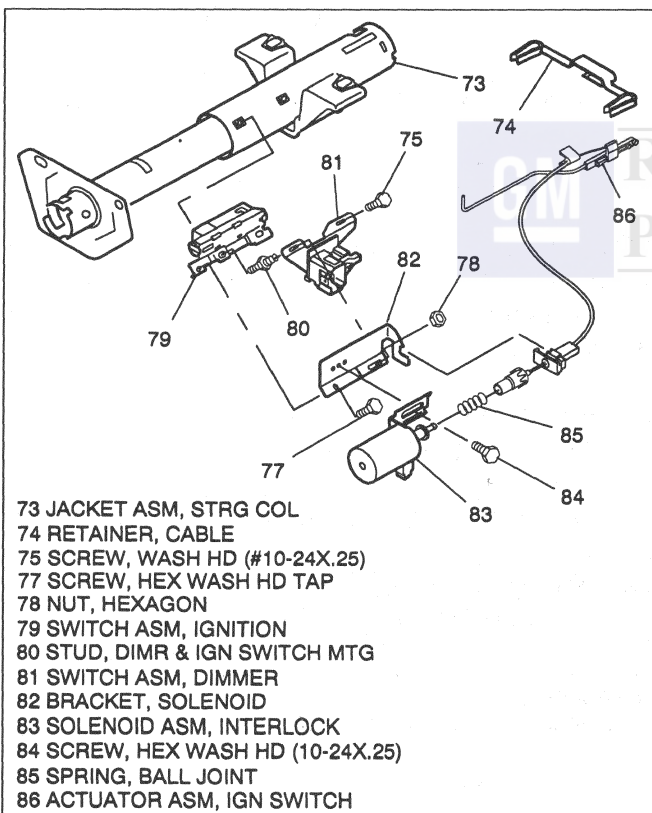


Figure 29 - Removing Ignition, Dimmer Switches, and Solenoid Assembly

25. Washer head screw (75).
 - Dimmer switch assembly (81).
26. Dimmer & ignition switch mounting stud (80).

27. Ignition switch assembly (79) from ignition switch actuator assembly (86).
28. Cable assembly with ignition switch actuator assembly (86).
 - Cable clip from upper location of steering column jacket assembly (73).
 - Cable retainer (74).

↔ Install or Connect

Figures 1,2,27,30 through 37

NOTICE: See "Notice" on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Cable assembly with ignition switch actuator assembly (86).
 - A. Cable retainer (74).
 - B. Cable clip to upper location of jacket assembly (73).
 - C. Lubricate with grease at location where cable lug attaches to switch actuator.
 - D. Let lower cable hang freely.
2. Bowl (71) to shroud (72).
3. Spring (70) to bowl (71).
4. Shroud (72) with bowl (71) to jacket (73).
5. Wave washer (69).
 - Lubricate with lithium grease.
6. Lock plate (68).

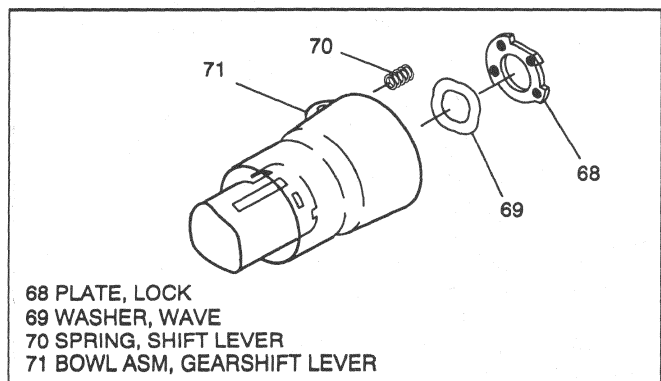


Figure 30 - Installing Lock Plate, Wave Washer

3F5A-16 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

NOTICE: Shift tube lever must be in position to clear jacket assembly (73) when installing shift tube (87). Forcing lever against jacket may cause damage to jacket assembly (73). (See Figure 27)

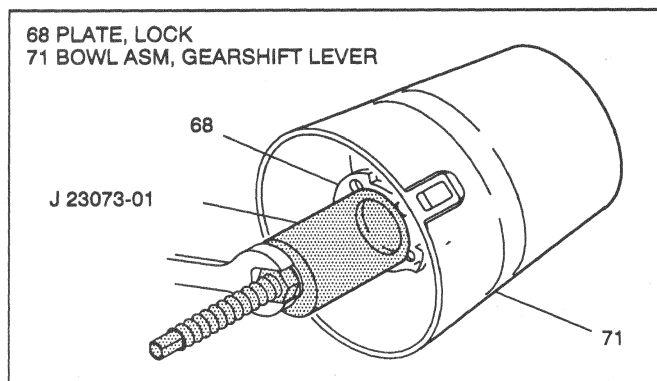


Figure 31 - Installing Shift Tube

7. Shift tube (87) using J 23073-01.
8. Thrust washer (67).
9. Retaining ring (66).

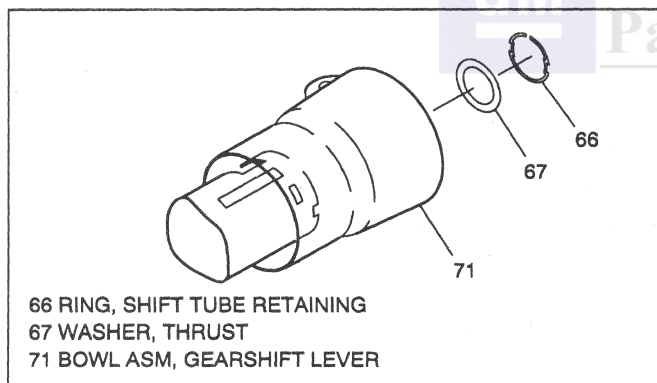


Figure 32 - Installing Shift Tube Retaining Ring, Thrust Washer

10. Shift lever gate (65) and screws (64) to support (63).

Tighten

- Tighten screws (64) to 3.7 N·m (33 lb.in.).

11. Dimmer switch rod (76) to column housing support assembly (62).

NOTICE: Support screws (61) require thread locking compound. New screws must be used when reassembling steering column housing support assembly (62).

12. Support assembly (62) with new support screws (61).

Tighten

- Tighten screws (61) to 8.8 N·m (78 lb.in.).

13. Column shaft assembly (55) to jacket assembly (73).
 - Lubricate with lithium grease.
14. Tilt lever. (See Section 3F)
15. Steering column housing assembly (30) to column.
 - A. Position column housing (30) and align switch actuator rack (44) with pin on end of ignition switch actuator assembly (86).
 - B. Pull back on tilt lever, pushing column housing assembly (30) onto column housing support assembly (62).
 - C. Release tilt lever to lock shoes (34) and (35) onto dowel pins.
 - D. Remove tilt lever. (See Section 3F)

16. Pivot pins (39).
 - Lubricate with lithium grease.
 - Press pin until firmly seated, two places.
 - Stake, three places.

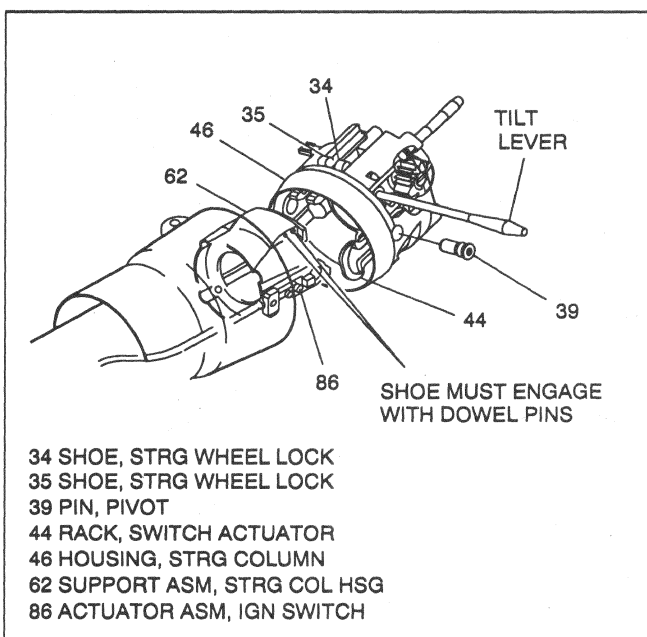


Figure 33 - Installing Column Housing to Housing Support

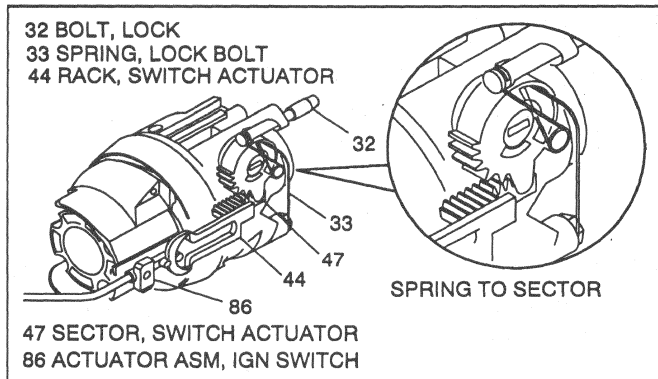


Figure 34 - Actuator Assembly to Actuator Rack Installed

17. Steering shaft bushing assembly (88) to jacket assembly (73).
 - Lubricate inner surface of bushing (88) with lithium grease.
18. Bearing adapter retainer (89).
19. Lower bearing adapter clip (91).
20. Do steps 1 through 15, "Install or Connect", Sub Section B.
21. Do steps 1 through 21, "Install or Connect", Sub Section A.
22. Do all steps, "Install or Connect", **Ignition Switch Assembly**, Sub Section D.

SUB SECTION D - LOWER COLUMN

INCLUDES:

INTERLOCK SOLENOID ASSEMBLY
 INTERLOCK SOLENOID ADJUSTMENT
 DIMMER SWITCH ASSEMBLY
 DIMMER SWITCH ADJUSTMENT
 IGNITION SWITCH ASSEMBLY
 IGNITION SWITCH ADJUSTMENT
 STEERING SHAFT BUSHING ASM

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.



- Steering column for accident damage. (See Figure 39)

Interlock Solenoid Assembly

Figures 1,2,29 and 35



Remove or Disconnect

1. Disable the SIR system; refer to "**Disabling the SIR System**" in this Section.
2. Negative (-) battery cable.
3. Vehicle wire harness connector from interlock solenoid assembly (83).



Important

- Solenoid cable must remain straight and must not be kinked during removing and installing.

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4. Solenoid cable assembly from interlock solenoid assembly (83).
 - A. Mounting clip from solenoid bracket (82).
 - B. Ball joint socket from solenoid (83).
 - C. Ball joint spring (85) from solenoid (83).
5. Washer head screw (84) and solenoid assembly (83).

Install or Connect

NOTICE: See “Notice” on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Interlock solenoid assembly (83) to solenoid bracket (82).
2. Washer head screw (84).

Tighten

- Tighten screw (84) to 4.0 N·m (35 lb.in.)
3. Unlock solenoid cable.
 - Disengage locking button to allow cable movement during adjustment.
 4. Cable assembly to solenoid bracket (82) with locking button disengaged.
 5. Ball joint spring (85) and ball joint socket to solenoid (83).

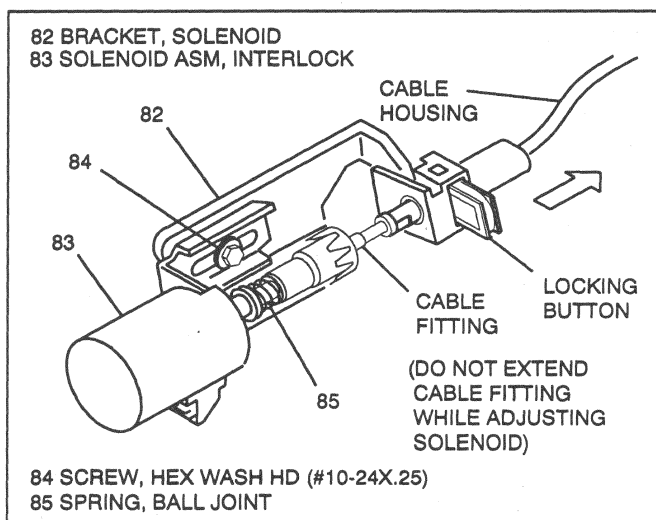


Figure 35 - Interlock Solenoid Adjustment

Adjust

- Interlock solenoid assembly (83).
 - A. Lock cylinder to “Run” position.
 - B. Shift column out “Park” position.
 - C. The locking button must be disengaged to allow cable movement. Pull cable away from solenoid (83) until cable fitting starts to extend, compressing spring inside joint socket. (Do not extend cable fitting)
 - Let cable move back 1.0 to 2.0 mm.
 - Engage locking button.

6. Vehicle wire harness connector to solenoid assembly (83).
7. Negative (-) battery cable.

IMPORTANT: During **Inspection** and **Adjustment** of interlock & solenoid assembly, solenoid will become hot.

Inspect

- Function check interlock solenoid assembly (83) for proper operation.
 - Solenoid (83) must lock gearshift lever bowl assembly (71) whenever steering column is in “PARK” and when trying to shift from “PARK” without pressing brake pedal (Solenoid is energized).
 - Solenoid (83) must release gearshift lever bowl assembly (71) when pressure is applied to brake pedal. (Solenoid is de-energized).
 - Readjust if needed.
8. If all service operations are completed, enable the SIR system; refer to “Enabling the SIR System” in this Section.

Dimmer Switch Assembly Dimmer Switch Adjustment

Remove or Disconnect

Figures 1,2 and 29

1. Disable the SIR system; refer to **“Disabling the SIR System”** in this Section.
2. Negative (-) battery cable.
3. Hexagon head tapping screw (77) and hexagon nut (78).
4. Interlock solenoid assembly (83) with solenoid bracket (82) from dimmer & ignition switch mounting stud (80).
5. Vehicle wire harness from dimmer switch (81).
6. Washer head screw (75).
7. Dimmer Switch assembly (81) from dimmer switch rod (76).

Install or Connect

Figures 1,2,29,35 and 36

NOTICE: See “Notice” on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Dimmer Switch assembly (81) to dimmer switch rod (76) and stud (80).
2. Solenoid (83) with bracket (82).
3. Tapping screw (77) hexagon nut (78) and washer head screw (75).
 - Tighten finger tight.

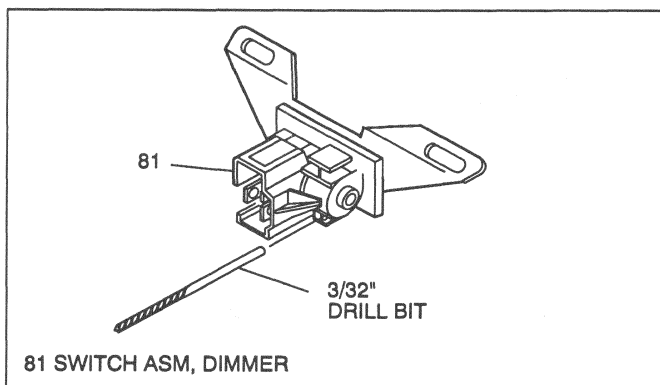


Figure 36 - Adjusting Dimmer Switch

Adjust

- Dimmer switch (81). (See Figure 36)
 - A. Place 3/32-inch drill bit in hole on switch to limit travel.
 - B. Position switch on column and push against dimmer switch rod (76) to remove all lash.
 - C. Remove drill bit.

Tighten

- Tighten screw (75) and nut (78) to 4.0 N·m (35 lb.in.)
 - Tighten screw (77) to 2.5 N·m (22 lb.in.)
4. Vehicle wire harness to dimmer switch (81).
 5. Negative (-) battery cable.
 6. Do **Inspect**, “Install or Connect”, **Interlock Solenoid Assembly**, in this section.
 7. If all service operations are completed, enable the SIR system; refer to **“Enabling the SIR System”** in this Section.

Ignition Switch Assembly Ignition Switch Adjustment

Remove or Disconnect

Figures 1,2 and 29

1. Disable the SIR system; refer to **“Disabling the SIR System”** in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Solenoid cable assembly from interlock solenoid assembly (83) and solenoid bracket (82).
 - Ball joint spring (85).
5. Washer head screw (84).
 - Interlock solenoid assembly (83).

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6. Hexagon head tapping screw (77) and hexagon nut (78).
 - Solenoid bracket (82).
7. Washer head screw (75).
 - Dimmer switch assembly (81).
8. Dimmer & ignition switch mounting stud (80).
 - Ignition switch assembly (79).
 - Ignition switch (79) from vehicle wire harness.

Install or Connect Figures 1,2,29,35 through 37

NOTICE: See “Notice” on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder (20) to “OFF-LOCK” position.

NOTICE: Install ignition switch assembly (79) with switch in “OFF-LOCK” position. (See Figure 37) New ignition switch will be pinned in “OFF-LOCK” position. Remove plastic pin after switch is assembled to column. Failure to do so may cause switch damage.

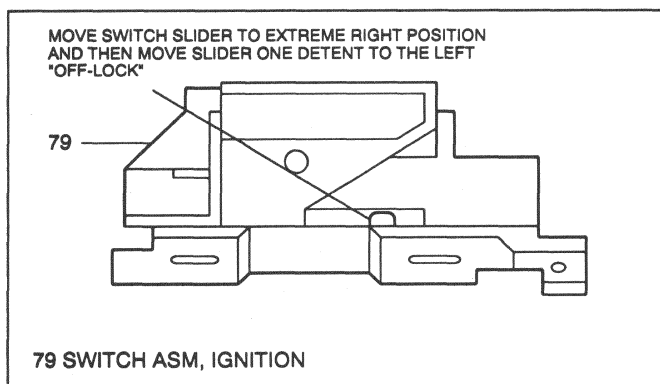


Figure 37 - Adjusting Ignition Switch

Adjust

- Ignition switch assembly (79). (See Figure 37)
 - A. Move switch slider to extreme right position.
 - B. Move switch slider one detent to left “OFF-LOCK” position.
 - C. Install 3/32 inch drill bit in hole on switch to limit travel.
- 2. Ignition switch assembly (79) to ignition switch actuator assembly (86).
- 3. Dimmer & ignition switch mounting stud (80).

Tighten

- Tighten stud (80) to 4.0 N·m (35 lb.in.)
- 4. Remove drill bit from ignition switch (79).
- 5. Dimmer switch assembly (81) to dimmer switch rod (76) and stud (80).
- 6. Washer head screw (75).
 - Tighten finger tight.
- 7. Solenoid bracket (82) to stud (80).
- 8. Hexagon nut (78) and hexagon head tapping screw (77).
 - Tighten finger tight.

Adjust

- Dimmer switch (81). (See Figure 36)
 - A. Place 3/32-inch drill bit in hole on switch to limit travel.
 - B. Position Switch (81) on column and push to remove all lash.
 - C. Remove drill bit.

Tighten

- Tighten screw (75) and nut (78) to 4.0 N·m (35 lb.in.).
- Tighten screw (77) to 2.5 N·m (22 lb.in.).
- 9. Interlock solenoid assembly (83) to bracket (82).

10. Washer head screw (84).

Tighten

- Tighten screw (84) to 4.0 N·m (35 lb.in.).
11. Steering column to vehicle. (See Section 3F)
 12. Vehicle wire harness to ignition switch (79), dimmer switch (81), and solenoid assembly (83).
 13. Negative (-) battery cable.
 14. Do **Adjust** and **Inspect**, "Install or Connect", **Interlock Solenoid Assembly**, in this section.
 15. If all service operations are completed, enable the SIR system; refer to "**Enabling the SIR System**" in this Section.

Steering Shaft Bushing Asm

Remove or Disconnect Figures 1,2,38 and 39

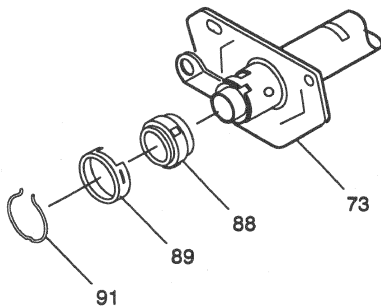
1. Disable the SIR system; refer to "**Disabling the SIR System**" in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Lower bearing adapter clip (91).
5. Bearing adapter retainer (89).
6. Steering shaft bushing assembly (88).

Install or Connect Figures 1,2 and 38

NOTICE: See "Notice" on page 3F5A-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Steering shaft bushing assembly (88) to jacket assembly (73).
 - Lubricate inner surface of bushing (88) with lithium grease.
2. Bearing adapter retainer (89).
3. Lower bearing adapter clip (91).
4. Steering column to vehicle. (See Section 3F)
5. Negative (-) battery cable.
6. If all service operations are completed, enable the SIR system; refer to "**Enabling the SIR System**" in this Section.



73 JACKET ASM, STRG COL
88 BUSHING ASM, STRG SHAFT
89 RETAINER, BEARING ADAPTER
91 CLIP, LOWER BEARING ADAPTER

38 - Removing Steering Shaft Bushing

3F5A-22 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

NOTICE: Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, or where supplemental inflatable restraints systems deployed may also have a damaged or misaligned steering column.

CHECKING PROCEDURE

JACKET ASM, STEERING COLUMN

- Check capsules on steering column bracket assembly; all should be within 1.59mm from the bottom of the slots (View A). If not, bracket should be replaced if bracket is bolted to the jacket asm or the jacket asm should be replaced if bracket is welded to jacket asm.
- Check contact surface "A" on capsules (View B). The bolt head must not contact surface "A" or shear load would be increased. If contact is made, replace bracket asm or jacket asm.
- Check for jacket asm collapse by measuring the distance from the lower edge of upper jacket to a defined point on the lower jacket (View E). If measured dimensions are not within specifications, a new jacket must be installed.

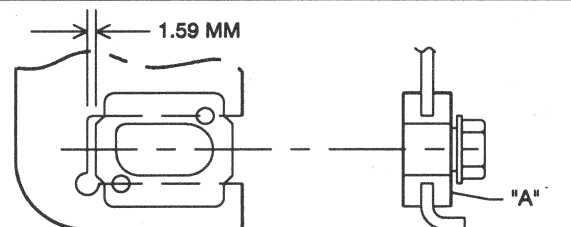
SHIFT TUBE ASM

- Visually inspect shift tube for sheared injected plastic (View C). If shift tube shows sheared plastic, a new shift tube must be installed.
- Check operation of shift lever. If you can move lever to "Park" position without raising lever, it is an indication that upper shift tube plastic bearing is broken.

NOTICE: Inflatable restraint coil asm must be removed from steering column and allowed to hang freely before shaft is rotated. Failure to do so could damage coil assembly.

STEERING SHAFT ASM

- Visually inspect steering shaft for sheared injected plastic (View D). If steering shaft shows sheared plastic, a new steering shaft must be installed.
- Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Using a dial indicator at lower end of steering shaft, have steering wheel rotated. Runout must not exceed 1.59mm.



VIEW A

(CAPSULES)

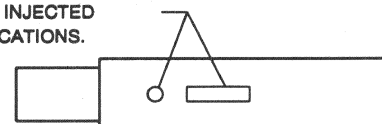
VIEW B

CAPSULES MUST BE WITHIN 1.59 MM FROM BOTTOM OF SLOTS; IF NOT, REPLACE BRACKET OR JACKET.

THE BOLT HEAD MUST NOT CONTACT SURFACE "A". IF CONTACT IS MADE, THE CAPSULE SHEAR LOAD WILL BE INCREASED. REPLACE BRACKET OR JACKET.

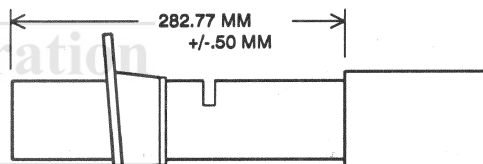
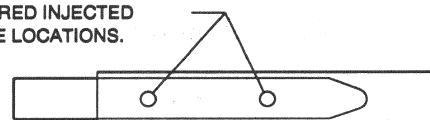
CHECK FOR SHEARED INJECTED PLASTIC AT THESE LOCATIONS.

VIEW C
(SHIFT TUBE)



CHECK FOR SHEARED INJECTED PLASTIC AT THESE LOCATIONS.

VIEW D
(STEERING SHAFT)



VIEW E

(METHOD TO DETERMINE COLUMN COLLAPSE) WITH LOWER BEARING REMOVED MEASURE DISTANCE BETWEEN ARROWS.

Figure 39 - Checking for Accident Damage

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

(1) Steering Wheel-to-Shaft Nut	41.0 N·m (30 lb.ft.)
(9) Turn Signal Switch Connecting Screws	3.4 N·m (30 lb.in.)
(10) Turn Signal Switch Arm Screw	2.3 N·m (20 lb.in.)
(15) Lock Housing Cover Screws	9.0 N·m (80 lb.in.)
(18) Lock Retaining Screw	2.5 N·m (22 lb.in.)
(27) Turn Signal Switch Arm Screw	2.3 N·m (20 lb.in.)
(48) Lock Bolt Spring Screw	4.0 N·m (35 lb.in.)
(61) Support-to-Lock Plate Screws	8.8 N·m (78 lb.in.)
(64) Shift Lever Gate Connecting Screws	3.7 N·m (33 lb.in.)
(75) Upper Ignition & Dimmer Switch Screw	4.0 N·m (35 lb.in.)
(77) Lower Solenoid Bracket Mounting Screw	2.5 N·m (22 lb.in.)
(78) Lower Dimmer Switch & Solenoid Bracket Nut	4.0 N·m (35 lb.in.)
(80) Lower Ignition & Dimmer Switch Stud	4.0 N·m (35 lb.in.)
(84) Solenoid Mounting Screw	4.0 N·m (35 lb.in.)

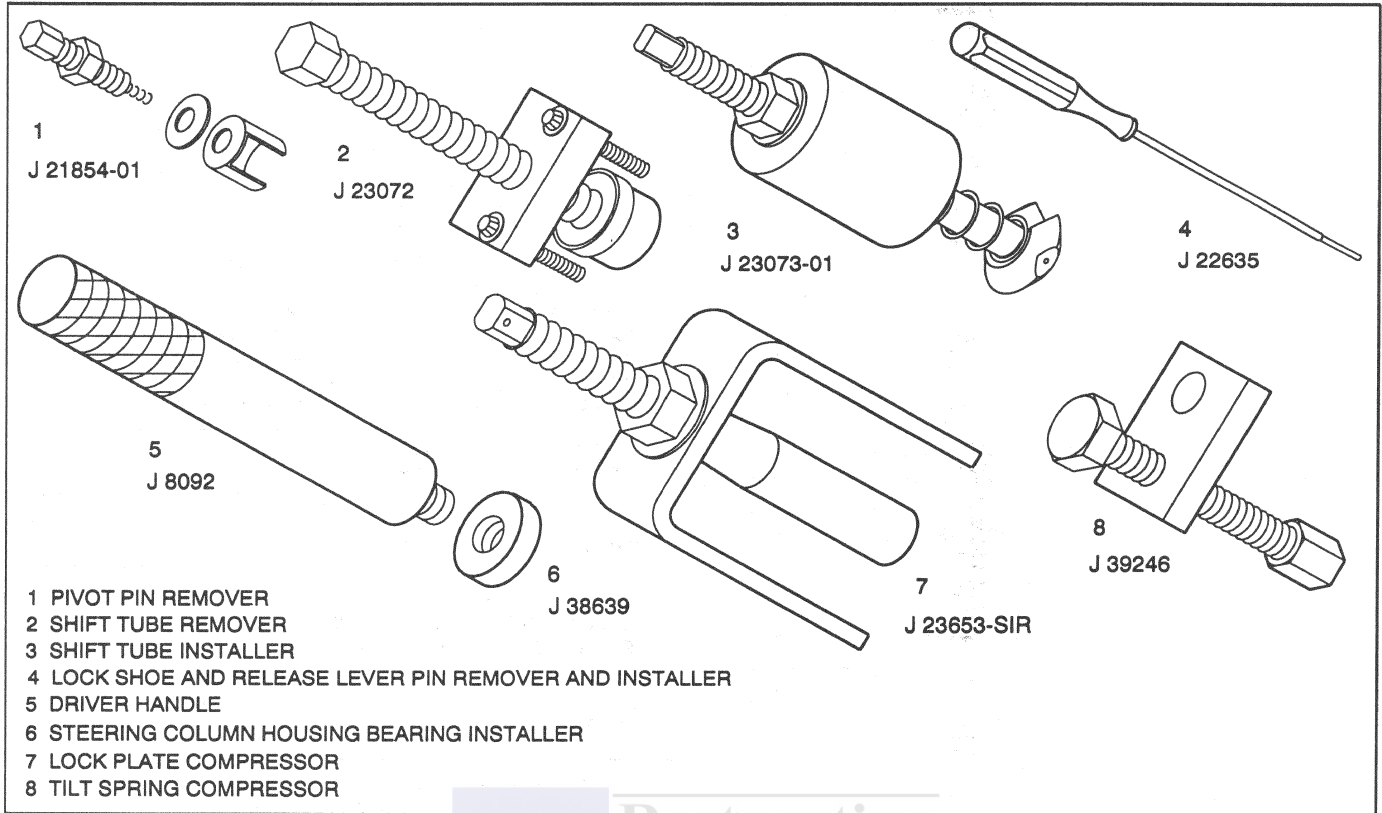


Figure 40 - Special Tools

3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)
3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)
3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)
3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)
3F5A-24 TILT STRG COL UNIT REPAIR (SIR,COL SHFT)

BLANK



**Restoration
Parts**

SECTION 3F5B

SUPPLEMENTAL INFLATABLE RESTRAINT TILT STEERING COLUMN FLOOR SHIFT UNIT REPAIR

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

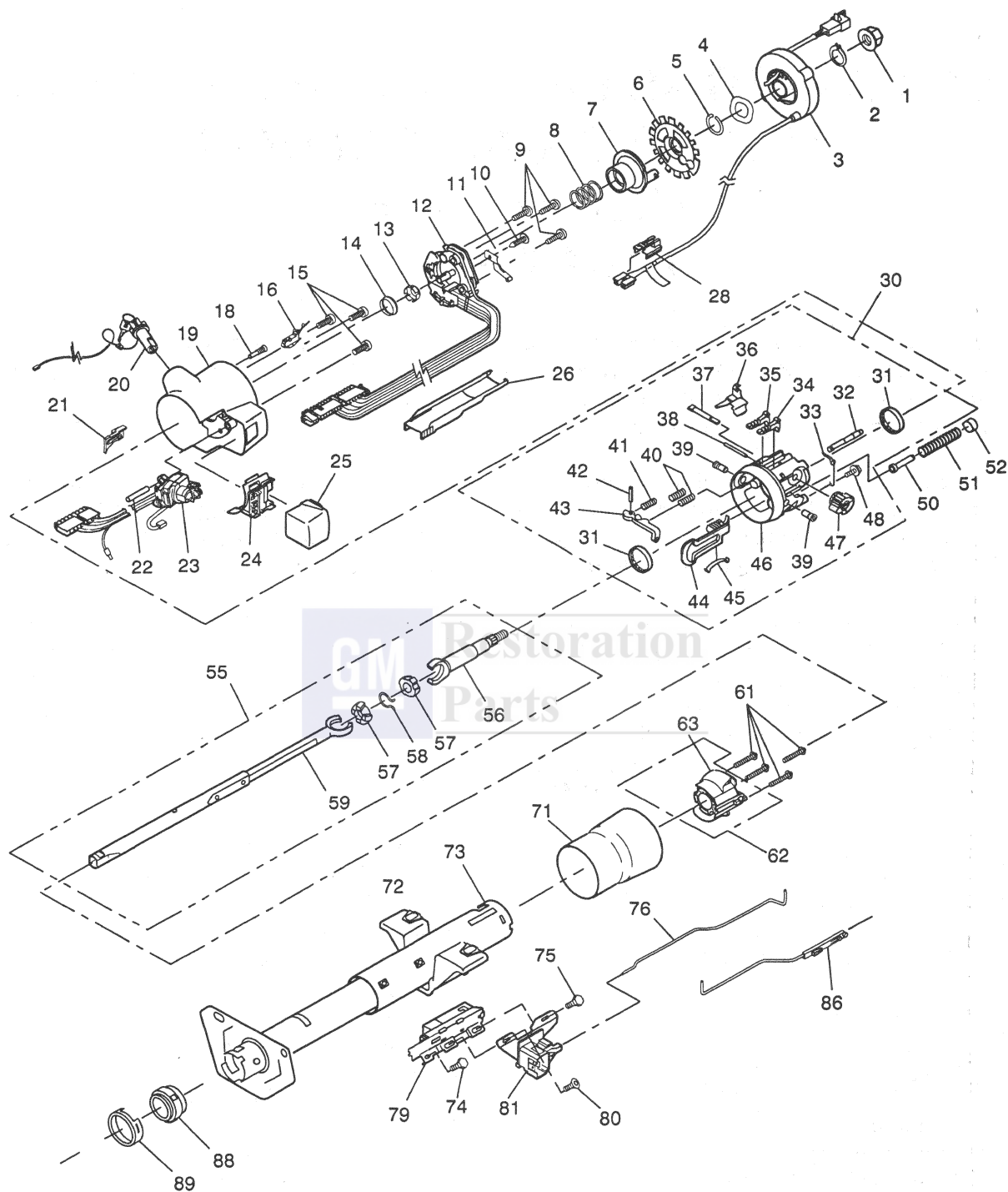
CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "off" or "lock" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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Tilt Spring Assembly			

3F5B - 2 TILT STRG COL UNIT REP AIR (SIR, FLR SHFT)



C95B01

Figure 1 - Tilt Steering Column

- | | |
|---|----------------------------------|
| 1- NUT, HEXAGON LOCKING (M14x1.5) | 51- SPRING, WHEEL TILT |
| 2- RING, RETAINING | 52- RETAINER, SPRING |
| 3- COIL ASM, SIR | 55- SHAFT, ASM STEERING |
| 4- WASHER, WAVE | 56- SHAFT, ASM RACE & UPPER |
| 5- RING, RETAINING | 57- SPERE, CENTERING |
| 6- LOCK, SHAFT | 58- SPRING, JOINT PRELOAD |
| 7- CAM ASM, TURN SIG CANCEL | 59- SHAFT ASM, LOWER STEERING |
| 8- SPRING, UPPER BEARING | 61- SCREW, HEX WASHER HD TAPPING |
| 9- SCREW ,BNDG HD CR RECESS | 62- RETAINER, SPRING |
| 10- SCREW, RD WASHER HEAD (M4.2x1.41) | 63- SUPPORT, STRG COLUMN HSG |
| 11- ARM ASM, SIGNAL SWITCH | 71- SHROUD, STRG COL HSG |
| 12- SWITCH ASM, TURN SIGNAL | 73- JACKET ASM, STRG COL |
| 13- SEAT, UPPER BRG INNER RACE | 75- SCREW, WASH HD (#10-24x.25) |
| 14- RACE, INNER | 76- ROD, DIMMER SWITCH |
| 15- SCREW, PAN HD SOC TAP | 79- SWITCH ASM, IGNITION |
| 16- SWITCH , ASM BUZZER | 80- SCREW, FLAT HD (#10-24x.31) |
| 18- SCREW, LOCK RETAINING | 81- SWITCH ASM, DIMMER |
| 19- COVER ASM, LOCK HOUSING | 86- ACTUATOR ASM, IGN SWITCH |
| 20- LOCK CYLINDER SET, STRG COL
PASS KEY | 88- BUSHING ASM, STRG SHAFT |
| 21- ACTUATOR, DIMMER SW ROD | 89- RETAINER, BEARING ADAPTER |
| 22- PIN, SWITCH ACTUATOR PIVOT | |
| 23- SWITCH ASM,PIVOT & (PULSE) | |
| 24- BASE PALTE, COL HSG CVR END | |
| 25- CAP, COL HSG COVER END | |
| 26- PROTECTOR, WIRING | |
| 28- SHROUD , CONNECTOR | |
| 30- HOUSING ASM, STRG COLUMN | |
| 31- BEARING ASM | |
| 32- BOLT, LOCK | |
| 33- SPRING, LOCK BOLT | |
| 34- SHOE, STEERING WHEEL LOCK | |
| 35- SHOE, STEERING WHEEL LOCK | |
| 36- SHIELD, WIRE PROTECTOR | |
| 37- SHAFT, DRIVE | |
| 38- PIN, DOWEL | |
| 39- PIN, PIVOT | |
| 40- SPRING, SHOE | |
| 41- SPRING, RELEASE LEVER | |
| 42- PIN, RELEASE LEVER | |
| 43- LEVER, SHOE RELEASE | |
| 44- RACK, SWITCH ACTUATOR | |
| 45- SPRING, RACK PRELOAD | |
| 46- HOUSING, STRG COLUMN | |
| 47- SECTOR, SWITCH ACTUATOR | |
| 48- SCREW, HEX WASHER HEAD | |
| 50- GUIDE, SPRING | |

Figure 2 - Tilt Steering Column - Legend

SUB SECTION A - UPPER COLUMN

INCLUDES:

DISABLING THE SIR SYSTEM
ENABLING THE SIR SYSTEM
INFLATABLE RESTRAINT COIL ASSEMBLY
SHAFT LOCK
TURN SIGNAL CANCELLING CAM ASM
UPPER BEARING SPRING
UPPER BEARING INNER RACE SEAT
INNER RACE
TURN SIGNAL SWITCH ASSEMBLY
BUZZER SWITCH ASSEMBLY
STRG COL PASS KEY LOCK CYL SET
CENTERING INFL RESTRAINT COIL

Tools Required:

J 23653-SIR Lock Plate Compressor

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or unneeded SIR repairs.

The SDM can maintain sufficient voltage to cause a deployment for up to 10 seconds after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

Disabling The SIR System

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
 - Turn ignition switch to "LOCK" and remove key
1. "AIR BAG" fuse from I/P fuse block.
 2. Left-hand sound insulator assembly, refer to SECTION 8C.
 3. Both connector position assurance (CPA) retainers and yellow 2-way SIR connectors located near base of the steering column.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON", the "AIR BAG" warning lamp will be "ON". This is normal operation and does not indicate an SIR system malfunction.

Enabling The SIR System

Install or Connect

- Turn ignition switch to "LOCK" and remove key.
1. Both yellow 2-way SIR connectors and corresponding (CPA) retainers located near base of steering column.
 2. Left-hand sound insulator assembly, refer to SECTION 8C.
 3. "AIR BAG" fuse to I/P block.
 - Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes 7 times and then turns "OFF". If it does not operate as described, perform the "SIR Diagnostic System Check" in SECTION 9J-A.

Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

Remove or Disconnect *Figures 1 through 8 and 12*

NOTICE: Place ignition to "LOCK" position to prevent uncentering SIR coil assembly (3).

1. Disable the SIR system; refer to "Disabling the SIR System" in this Section.
2. Negative (-) battery cable.

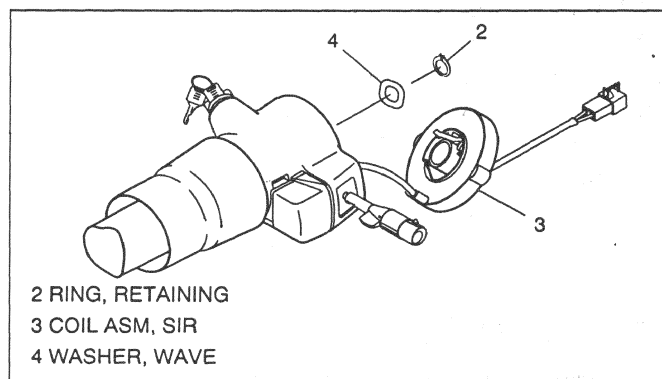


Figure 3 - Removing Coil Assembly Off Shaft

3. Coil assembly retaining ring (2).
4. Inflatable restraint coil assembly (3).
 - Let switch hang freely if removal is not needed.
 - To remove coil assembly (3), do steps (5) through (17) in this section.
5. Wave washer (4).
6. Shaft lock retaining ring (5) using J 23653-SIR to push down shaft lock (6).
 - Dispose of ring (5).
7. Shaft lock (6).
8. Turn signal cancelling cam assembly (7).
9. Upper bearing spring (8).

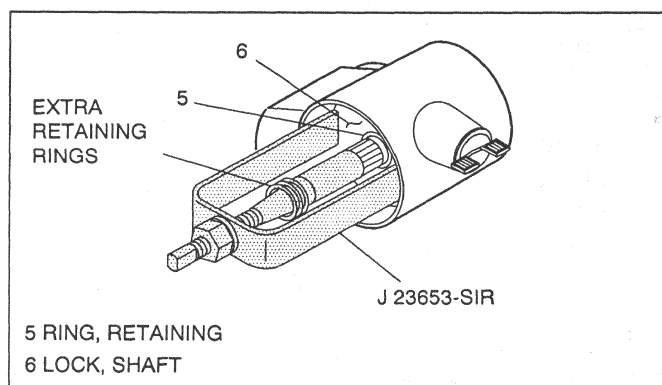


Figure 4 - Removing Shaft Lock Retaining Ring

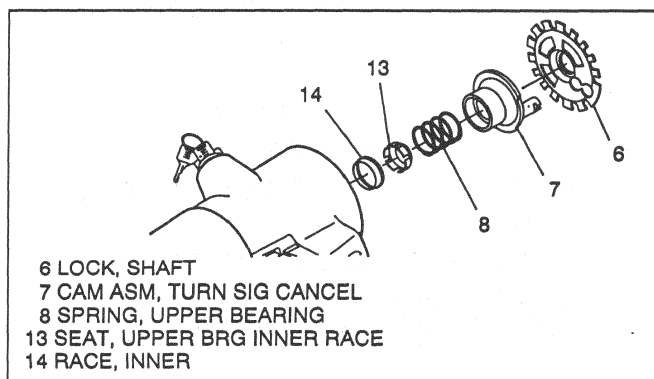


Figure 5 - Removing Components from Upper Shaft

10. Upper bearing inner race seat (13).
11. Inner race (14).
12. Turn signal to "RIGHT TURN" position (up).
13. Multifunction lever and hazard knob assembly. (See Section 3F)
14. Round washer head screw (M42x1.41) (10), and turn signal switch arm asm(11).
15. Turn signal switch screws (9).

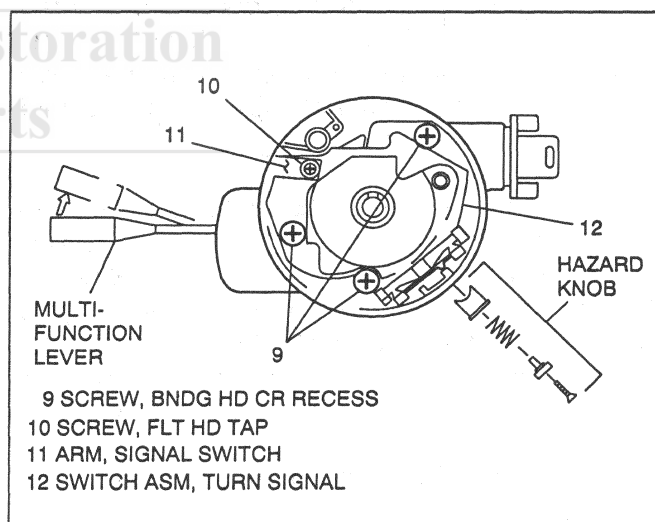


Figure 6 - Turn Signal Switch Removal Preparation

16. Turn signal switch assembly (12).
 - Let switch hang freely if removal is not needed.
 - To remove switch (12):
 - A. Turn signal switch connector from vehicle wire harness.
 - B. Wiring protector (26).
 - C. Gently pull wire harness through column.

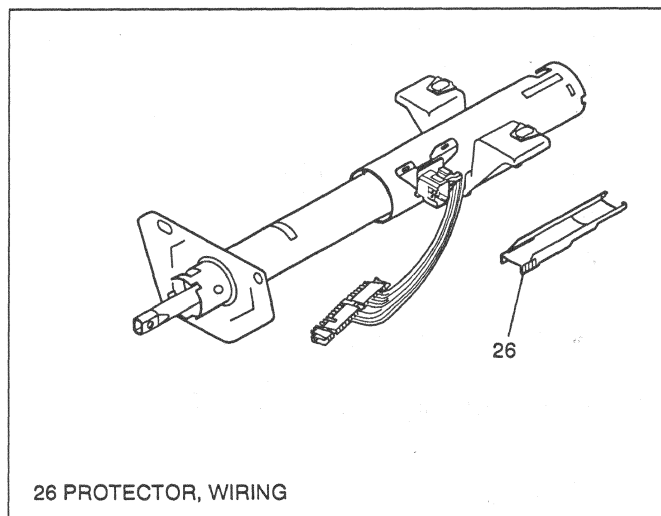


Figure 7 - Removing Turn Signal Switch

NOTICE: Coil assembly (3) will become uncentered if:

- 1) Steering column is separated from steering gear and is allowed to rotate, or
- 2) Centering spring is pushed down, letting hub rotate while coil (3) is removed from steering column. (If this occurs, see Figure 12)

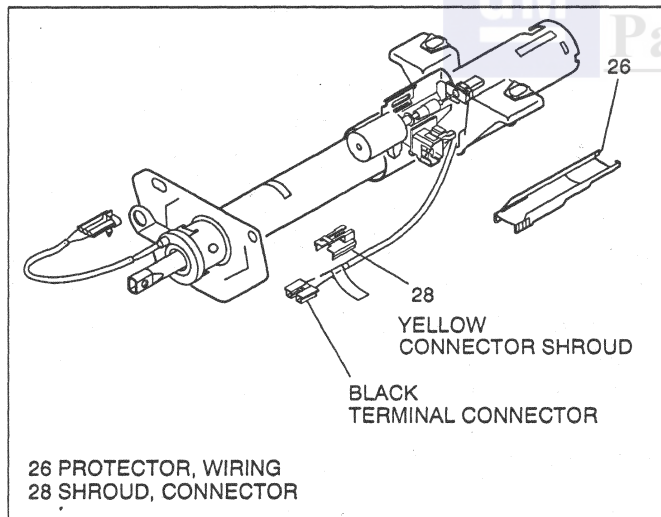


Figure 8 - Removing Coil Assembly Switch

17. Inflatable restraint coil assembly (3) with wire harness from column assembly.
 - A. Wiring protector (26).
 - B. Attach a length of mechanics wire to terminal connector harness to aid in reassembly.
 - C. Gently pull wire through column.

18. Key from steering column pass key lock cylinder set (20).
19. Buzzer switch assembly (16).
20. Reinsert key in pass key lock cylinder (20).
 - Key in "LOCK" position.
21. Lock retaining screw (18).
22. Pass key lock cylinder (20) and harness.
 - To remove lock cylinder.
 - A. Cylinder harness connector from vehicle wire harness.
 - B. Wiring protector (26).
 - C. Attach a length of mechanics wire to terminals to aid in reassembly.
 - D. Gently pull wire harness through column.



Install or Connect

Figures 1,2,9 through 14,25

NOTICE: See "Notice" on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

NOTICE: Route wire from pass key lock cylinder as shown and snap retaining clip into hole lock in housing cover assembly (19). (See Figures 9 and 10) Failure to do so may result in component damage or malfunction of pass key lock cylinder (20).

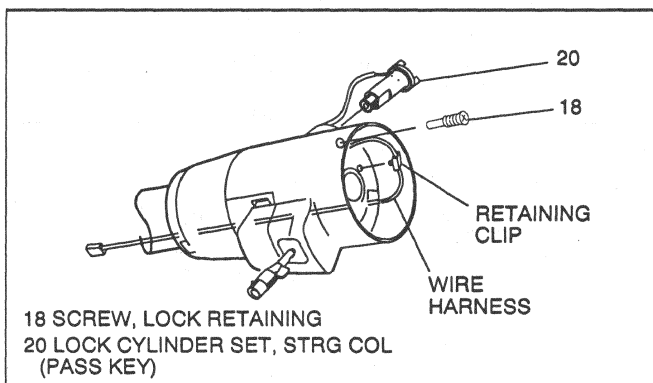


Figure 9 - Installing Pass Key Lock Cylinder Set

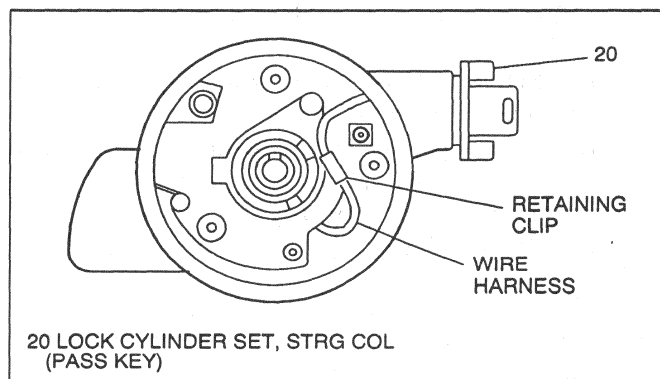


Figure 10 - Routing Pass Key Wire Harness

1. Steering column pass key lock cylinder set (20).
 - A. Wire terminals through column and snap retaining clip into hole in lock housing cover assembly (19).
 - B. Cylinder harness connector to vehicle wire harness.

2. Lock retaining screw (18).

Tighten

- Tighten screw (18) to 2.5 N·m (22 lb.in.).
3. Key from pass key lock cylinder set (20).
 4. Buzzer switch assembly (16).
 5. Reinsert key in pass key lock cylinder set (20).
 - Key in "LOCK" position.
 6. Turn signal switch assembly (12) wire harness through steering column.
 - Let switch hang freely.
 - Switch connector to vehicle wire harness.

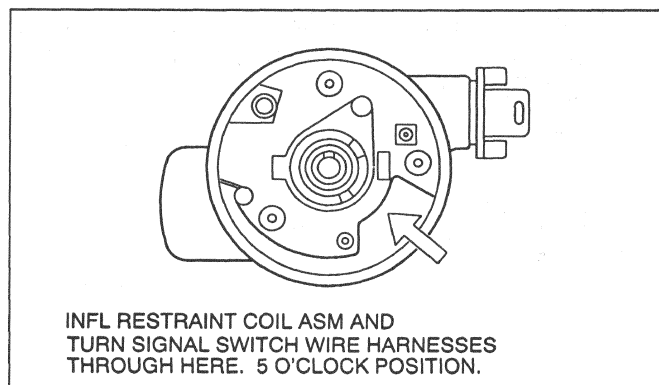


Figure 11 - Wire Harnesses through Column

7. Coil assembly (3) wire harness through column. (See Figure 13)
 - Let coil hang freely.
8. Turn signal switch assembly (12) and binding head cross recess screws (9).

Tighten

- Tighten screws (9) to 3.4 N·m (30 lb.in.).
9. Signal switch arm (11), Round washer head screw (10).

Tighten

- Tighten screw (10) to 2.3 N·m (20 lb.in.).
10. Hazard knob assembly and multifunction lever. (See Section 3F)
 11. Inner race (14).
 12. Upper bearing inner race seat (13).
 13. Upper bearing spring (8).
 14. Turn signal cancelling cam assembly (7).
 - Lubricate with grease, synthetic.
 15. Shaft lock (6).
 16. New shaft lock retaining ring (5) using J 23653-SIR to push down shaft lock (6).
 - Ring (5) must be firmly seated in groove on shaft.

NOTICE: Set steering shaft so that block tooth on upper steering shaft (56) is at the 12 o'clock position, wheels on vehicle should be straight ahead, then set ignition switch to "LOCK" position, to ensure no damage to coil assembly (3). (Refer to Figure 25)

17. Wave washer (4).

NOTICE: Coil assembly (3) will become uncentered if:

- 1) Steering column is separated from steering gear and is allowed to rotate, or
- 2) Centering spring is pushed down, letting hub rotate while coil is removed from column. (If this occurs, see Figure 12)

3F5B - 8 TILT STRG COL UNIT REP AIR (SIR, FLR SHFT)

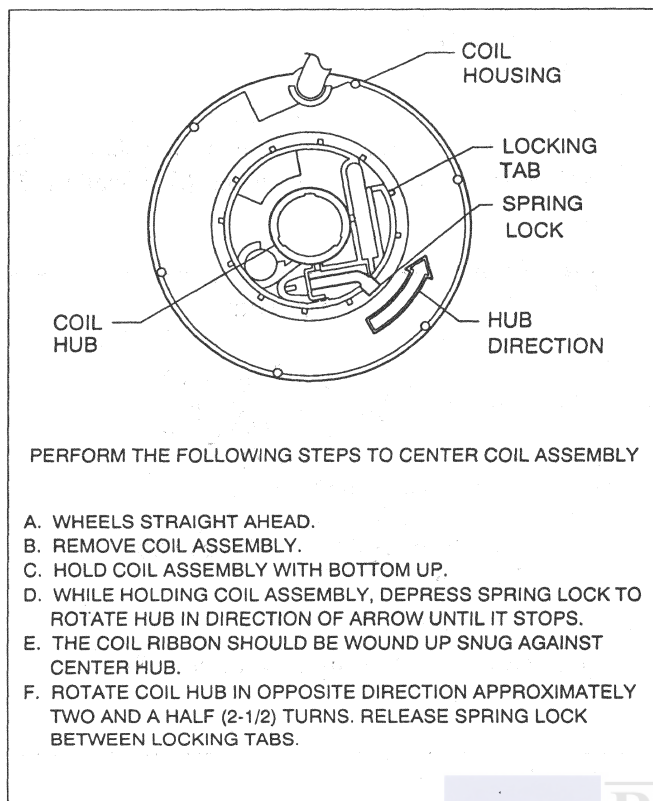


Figure 12 - Centering Coil Assembly

NOTICE: If a new coil assembly (3) is being installed, assemble pre-centered coil assembly (3) to steering column. Remove centering tab and dispose. (See Figure 12)

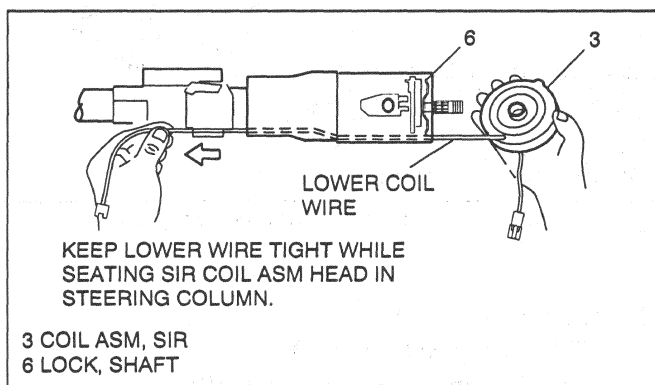


Figure 13 - Routing Coil Assembly Wire

NOTICE: SIR coil assembly wire must be kept tight with no slack while installing SIR coil assembly. Failure to do so may cause wire to be kinked near shaft lock area and cut when steering wheel is turned.

- Ensure coil assembly (3) hub is centered.
- Coil assembly (3).
 - Pull wire tight while positioning SIR coil to steering shaft. (See Figure 13)
 - Align opening in coil with horn tower and "Locating bump" between two tabs on housing cover. (See Figure 14)
 - Seat coil assembly into steering column.

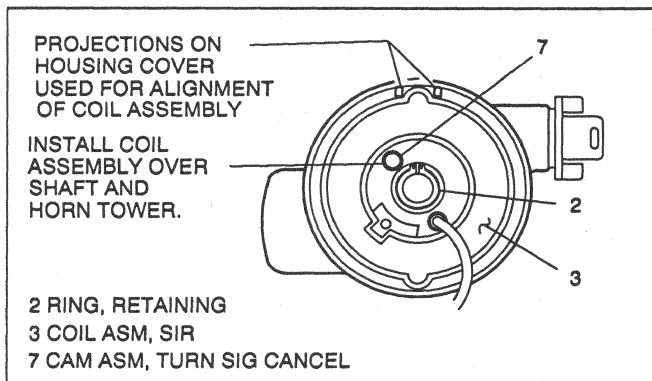


Figure 14 - Coil Assembly Installed

- Coil assembly retaining ring (2).
 - Ring (2) must be firmly seated in groove on shaft.

NOTICE: Gently pull lower coil assembly, turn signal, and pass key wires to remove any wire kinks that may be inside steering column assembly. Failure to do so may cause damage to wire harness.

- Wiring protector (26).
- Refer to Section 3F to complete remaining steering column assembly.
- Negative (-) battery cable.
- If all service operations are completed, enable the SIR system; refer to "Enabling SIR System" in this Section.

SUB SECTION B - HOUSING COVER*Figures 1, 2, 15 through 19***INCLUDES:**

**COL HSG COVER END CAP
LOCK HOUSING COVER ASSEMBLY
PIVOT & (PULSE) SWITCH ASSEMBLY
DIMMER SWITCH ROD ACTUATOR
TILT SPRING ASSEMBLY**

Tools Required:

J 23653-SIR Lock Plate Compressor

Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

Important

- Remove only those components necessary to do repairs.

Remove or Disconnect

- Do all steps, "Remove or Disconnect", Sub Section A.
- Column housing cover end cap (25).

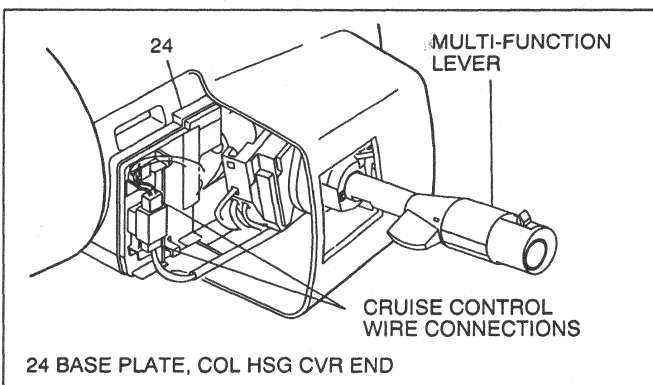


Figure 15 - Cruise Control Equipped Steering Columns

Important

- Remove cruise control and multifunction lever connectors from base plate (24) and disconnect.
- Remove multifunction lever. (See Section 3F)

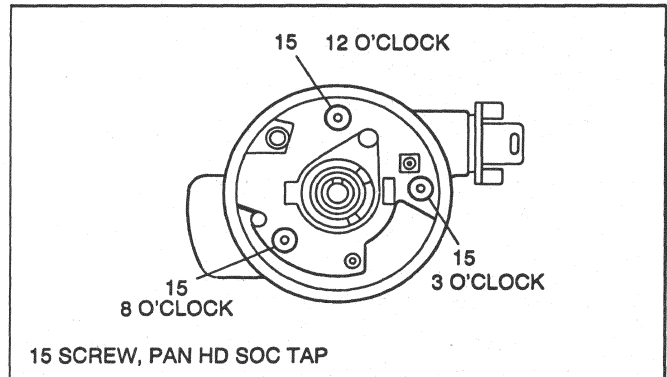


Figure 16 - Lock Housing Cover Screw Positions

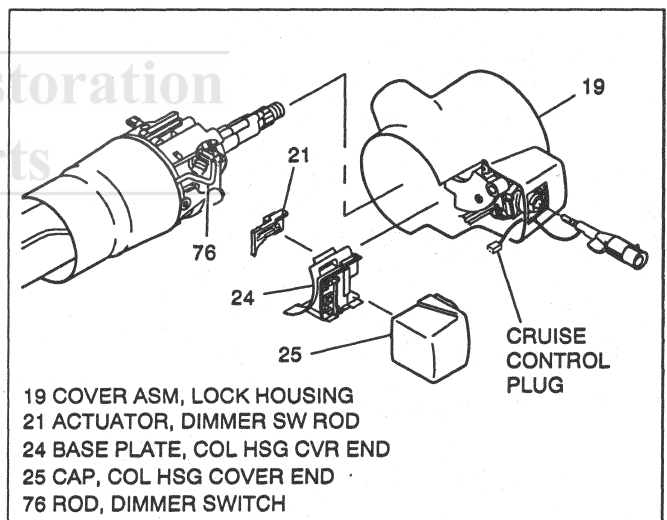


Figure 17 - Removing Lock Housing Cover

- Cover screws (15).
- Tilt lever. (See Section 3F)
- Lock housing cover assembly (19).
- Column housing cover end base plate (24) and dimmer switch rod actuator (21).
- Wire protector shield (36).

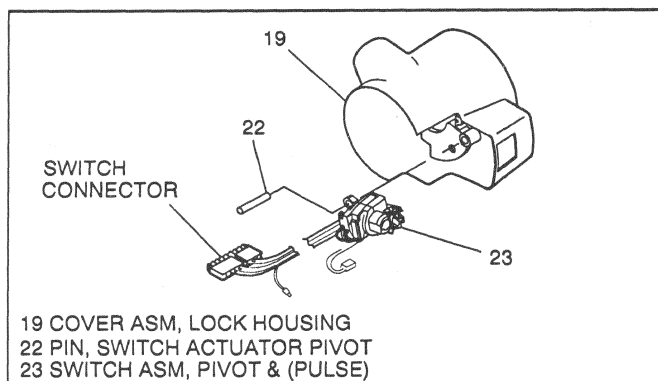


Figure 18 - Removing Pivot & (Pulse) Switch

8. Switch actuator pivot pin (22).
9. Pivot & (pulse) switch assembly (23).
 - Let switch hang freely if removal is not needed.
 - To remove switch (23):
 - A. Pivot & (pulse) switch connector from vehicle wire harness.
 - B. Gently pull wire harness through column.

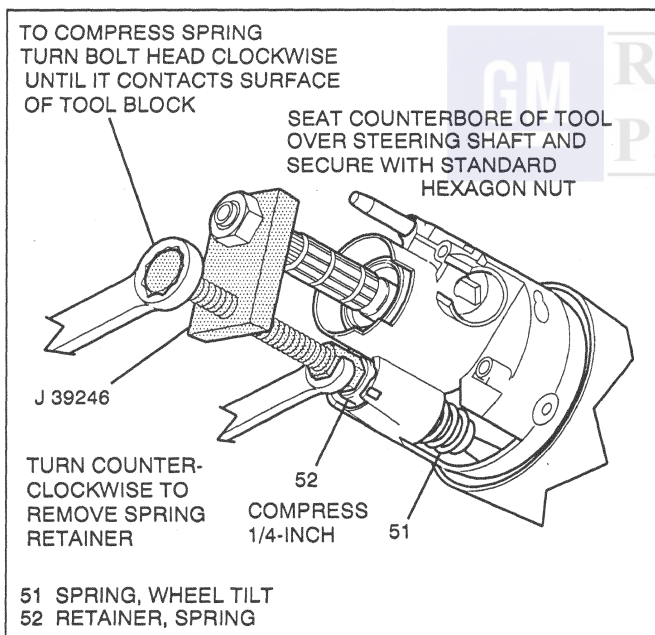


Figure 19 - Removing Tilt Spring Assembly

10. Seat counterbore of tool J 39246 over end of race & upper shaft assembly (56).
11. Thread and seat standard hexagon nut on shaft (56) to secure tool.

12. Align square extension on end of tool bolt with square hole in spring retainer (52) and seat.
13. Rotate tool bolt clockwise with wrench until it contacts surface of tool block.

Inspect

- Spring retainer (52) must be compressed approximately 1/4-inch into steering column housing (46).

Important

- Square hole in spring retainer (52) may become striped. Ensure spring retainer (52) is compressed at least 1/4-inch and is turned no more than 1/4 turn.

14. Rotate hexagon section on end of tool bolt counter clockwise approximately 1/4 turn.
15. Unscrew tool bolt until wheel tilt spring (51) and retainer (52) are loose and free of tool.
16. Remove retainer (52), spring (51), spring guide (50), and tool J 39246.

Install or Connect

NOTICE: See "Notice" on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

NOTICE: If new wheel tilt spring (51) is to be installed, grease spring (51) and spring guide (50).

1. Install spring (51), spring guide (50), and spring retainer (52) to steering column housing (46).
2. Align securing tabs on spring retainer (52) with slots in tilt spring hole.
3. Tool J 39246 to steering shaft (56) and retainer (52).
 - Do steps 10 through 13, **Inspect**, and **Important** to setup tool and compress spring (51).
4. Rotate hexagon section on end of tool bolt clockwise approximately 1/4 turn to lock retainer (52) into place.

5. Unscrew tool bolt and remove from shaft (56).
 - Spring (51) and retainer (52) must be locked into position in housing (46).

Inspect

- Tilt housing (46) to all positions to ensure smooth and proper operation of tilt spring.
6. Pivot & (pulse)switch assembly (23) to lock housing cover assembly (19).
 7. Switch actuator pivot pin (22) to switch (23) and cover (19).
 8. Pivot & (pulse)switch wire harness through steering column.
 - Switch connector to vehicle wire harness.
 - Wire protector shield (36).
 9. Dimmer switch rod actuator (21) to base plate (24).
 - Lubricate with lithium grease.
 10. Base plate (24) to lock housing cover assembly (19).
 - Bottom edge of dimmer switch rod actuator (21) must rest on bend in dimmer switch rod (76).
 11. Lock housing cover assembly (19).
 12. Screws (15). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 3 o'clock position third.

Tighten

- Tighten screws (15) in same order to 9.0 N·m (80 lb.in.).
13. Install multifunction lever and tilt lever. (See Section 3F)
 14. Plug multifunction lever and cruise control connectors together and mount on base plate (24).
 15. Column housing cover end cap (25).
 16. Do all steps, "Install or Connect", Sub Section A.

SUB SECTION C - MID COLUMN

INCLUDES:

STEERING COLUMN HOUSING ASM
STEERING WHEEL LOCK SHOE
SWITCH ACTUATOR SECTOR
SWITCH ACTUATOR RACK
BEARING ASSEMBLY
LOCK BOLT
STEERING COL HSG SUPPORT ASM
STEERING SHAFT ASSEMBLY

Tools Required:

J 23653-SIR Lock Plate Compressor
J 21854-01 Pivot Pin Remover
J 22635 Lock Shoe and Release Lever Pin Remover and Installer
J 8092 Driver Handle
J 38639 Strg Col Housing Bearing Installer

Important

- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. (Refer to "Disabling the SIR System" in this section and service procedures in Section 3F)

Remove or Disconnect

Figures 1,2,20 through 29,34 and 39

1. Disable the SIR system; refer to "Disabling the SIR System" in this section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

Inspect

- Steering column for accident damage.
(See Figure (33))

- Do all steps, "Remove or Disconnect", Sub Section B.

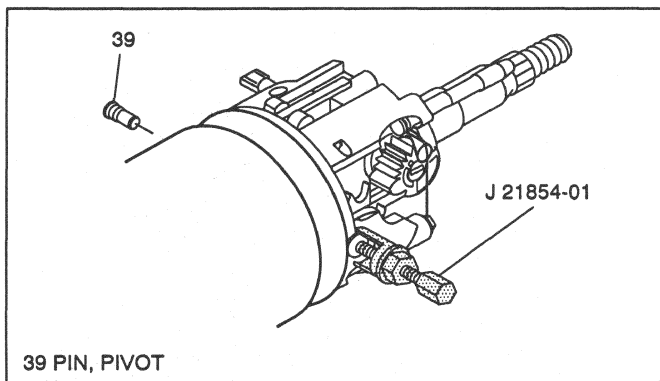


Figure 20 - Removing Pivot Pin

- Pivot pins (39) using J 21854-01.
 - Reinstall tilt lever. (See Section 3F)
- Steering column housing assembly (30).
 - Pull back on tilt lever and pull steering column housing assembly (30) down and away from column.

Important

- Remove only those components necessary to do repairs.

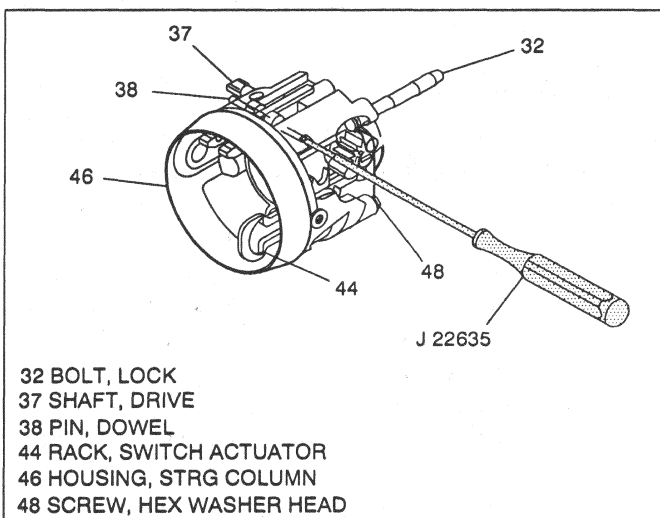


Figure 21 - Lock Housing Cover Components, Exterior

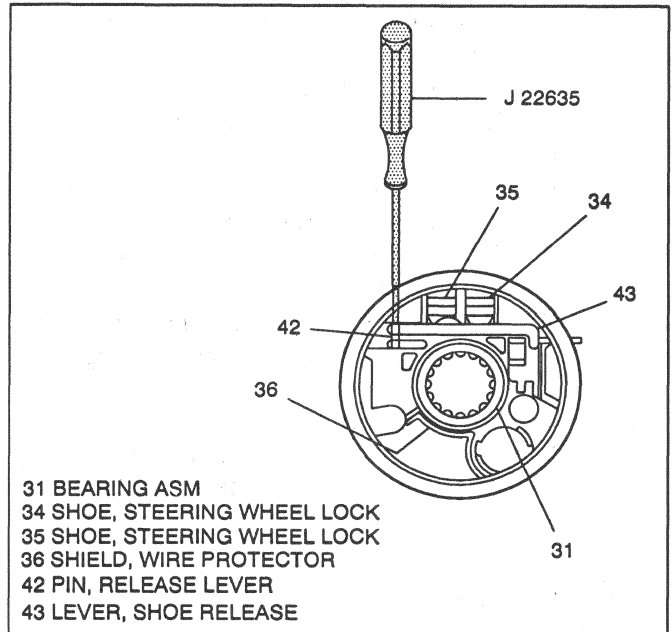


Figure 22 - Lock Housing Cover Components, Interior

Disassemble

Steering Column Housing Assembly

- Bearing assembly (31).
- Hexagon head screw (48).
- Lock bolt spring (33).
- Lock bolt (32).
- Switch actuator rack (44) and rack preload spring (45).
- Drive shaft (37).
- Switch actuator sector (47).
- Release lever pin (42) using J 22635.
(See Figure 22)
- Shoe release lever (43).
- Release lever spring (41).
- Dowel pin (38) using J 22635.
(See Figure 21)
- Lock shoes (34) and (35).
- Shoe springs (40).

Assemble

Steering Column Housing Assembly

- Shoe springs (40).
- Lock shoes (34) and (35).

- C. Dowel pin (38) using J 22635.
- D. Release lever spring (41).
- E. Shoe release lever (43).
- F. Release lever pin (42) using J 22635.
- G. Switch actuator sector (47).
- H. Drive shaft (37).
- I. Rack preload spring (45).
- J. Switch actuator rack (44) to actuator sector (47).
- K. Bearing assembly (31) lubricated with lithium grease to column housing (46) using J 38639 and J 8092.
- L. Lock bolt (32).
- M. Lock bolt spring (33). (Refer to Figure 29)
- N. Hexagon head screw (48).

Tighten

- Tighten screw (48) to 4.0 N·m (35 lb.in.).

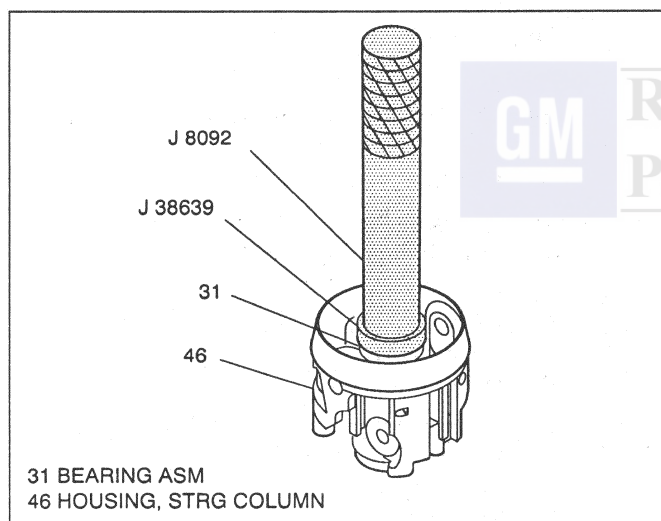


Figure 23 - Installing Bearings

- 7. Bearing adapter retainer (89).
- 8. Steering shaft bushing assembly (88).
- 9. Steering shaft assembly (55).

Inspect

- Steering shaft assembly (55) for accident damage. (See Figure 33)

Important

- Mark race & upper shaft assembly (56) and lower steering shaft asm (59) to ensure proper assembly. Failure to assemble properly will cause steering wheel to be turned 180 degrees. (See Figures 24 and 25)

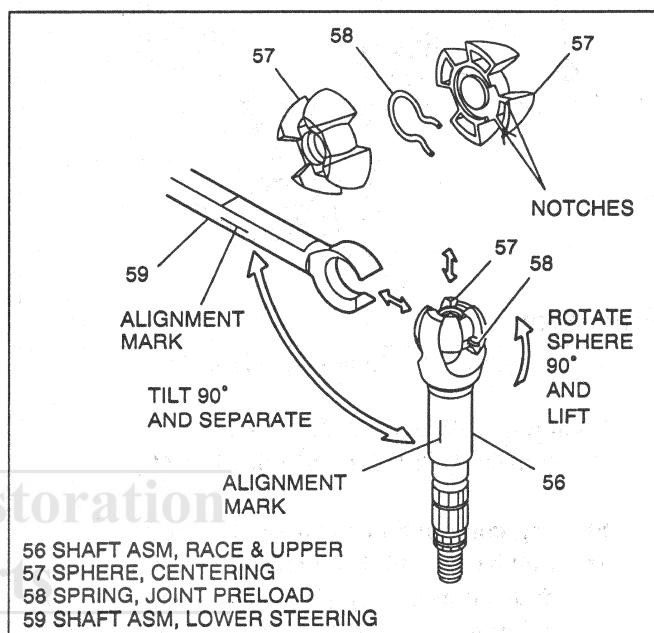


Figure 24 - Removing Steering Shaft Components

Important

- Remove only those components necessary to do repairs.

Disassemble

Steering Shaft Assembly

- A. Race & upper shaft assembly (56), lower steering shaft assembly (59).
 - Tilt 90 degrees to each other and disengage.
- B. Centering sphere (57) from upper shaft assembly (56).
 - Rotate sphere 90 degrees and slip out.
- C. Joint preload spring (58) from centering sphere (57).

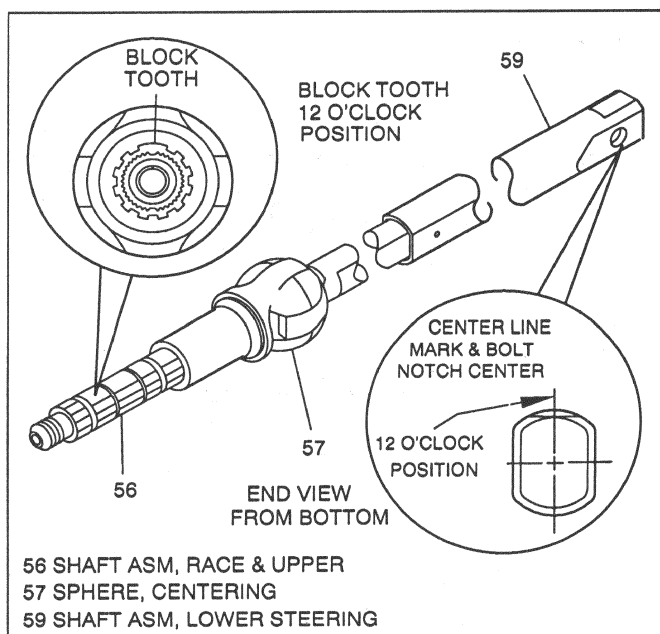


Figure 25 - Correct Upper to Lower Shaft Orientation

Assemble

Steering Shaft Assembly

- A. Joint preload spring (58) to two centering sphere (57).
- B. Centering sphere (57).
 - Lubricate with lithium grease, slip into upper shaft assembly (56), and rotate sphere 90 degrees.
- C. Race & upper shaft assembly (56) to lower steering shaft assembly (59).
 - Line up marks and tilt assemblies 90 degrees to each other.

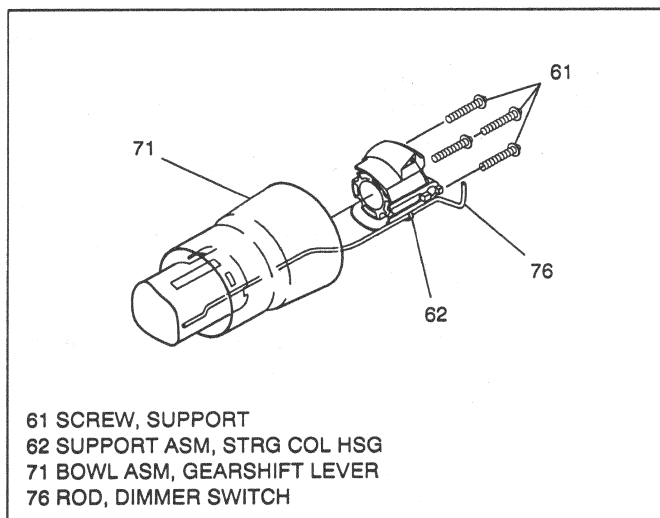


Figure 26 - Removing Column Housing Support

10. Hex washer head tapping screws (61).
 - Dispose of screws (61).
11. Column housing support assembly (62) with dimmer switch rod (76) from steering column jacket assembly (73).
 - Rod (76) from support (63).
12. Steering column housing shroud (71).

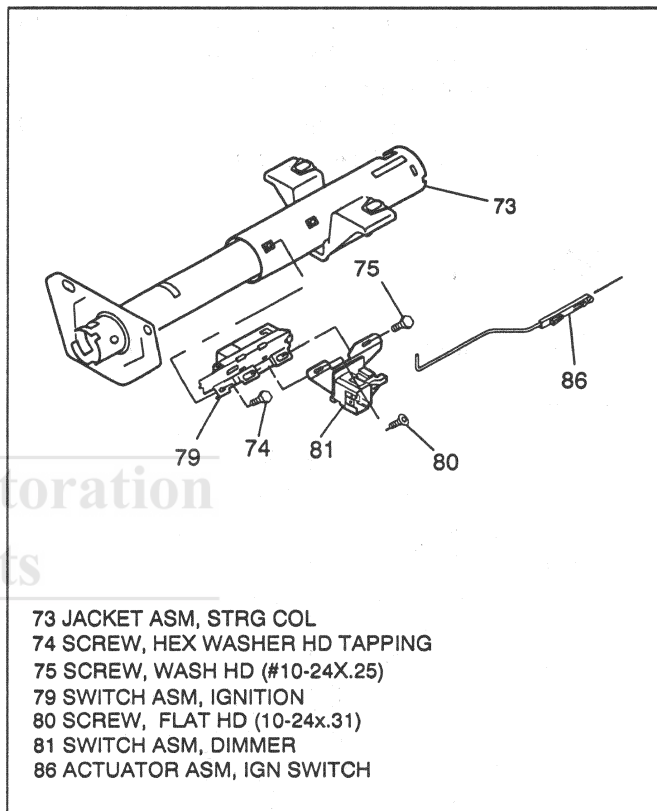


Figure 27 - Removing Ignition and Dimmer Switches

13. Washer head screw (75).
 - Dimmer switch assembly (81).
14. Flat head screw (#10-24x.31)(80).
15. Ignition switch assembly (79) from ignition switch actuator assembly (86).
16. Cable assembly with ignition switch actuator assembly (86).
 - Cable clip from upper location of steering column jacket assembly (73).

Install or Connect

Figures 1,2,28 through 31

NOTICE: See "Notice" on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Cable assembly with ignition switch actuator assembly (86).
 - A. Cable clip to upper location of jacket assembly (73).
 - B. Lubricate with grease at location where cable lug attaches to switch actuator.
 - C. Let lower cable hang freely.
2. Shroud (71) to jacket (73).

Tighten

- Tighten Hex washer head tapping screws (61) to 4.0 N·m (35 lb.in.).
3. Column shaft assembly (55) to jacket assembly (73).
 - Lubricate with lithium grease.
 4. Tilt lever. (See Section 3F)
 5. Steering column housing assembly (30) to column.
 - A. Position column housing (30) and align switch actuator rack (44) with pin on end of ignition switch actuator assembly (86).
 - B. Pull back on tilt lever, pushing column housing assembly (30) onto column housing support assembly (62).
 - C. Release tilt lever to lock shoes (34) and (35) onto dowel pins.
 - D. Remove tilt lever. (See Section 3F)
 6. Pivot pins (39).
 - Lubricate with lithium grease.
 - Press pin until firmly seated, two places.
 - Stake, three places.

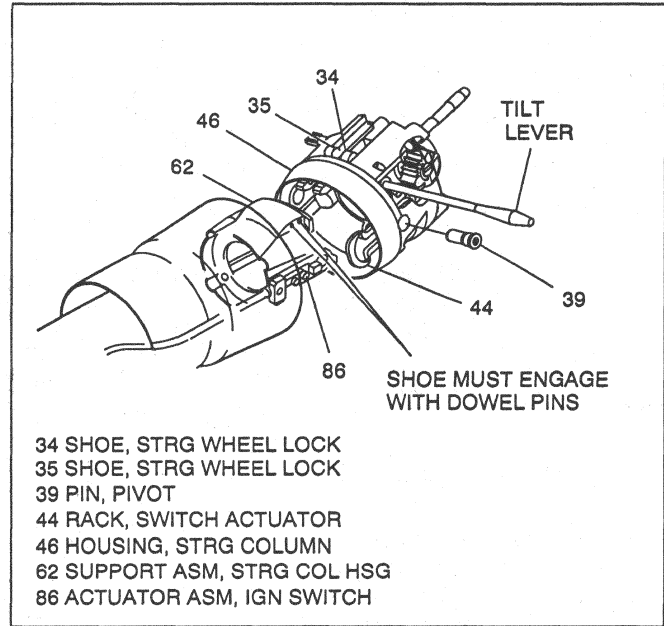


Figure 28- Installing Column Housing to Housing Support

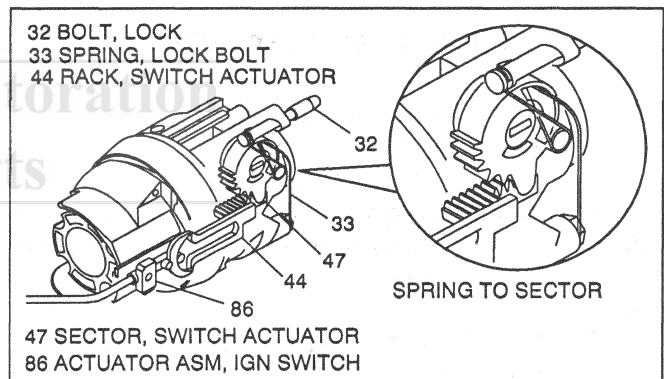


Figure 29 - Actuator Assembly to Actuator Rack Installed

7. Steering shaft bushing assembly (88) to jacket assembly (73).
 - Lubricate inner surface of bushing (88) with lithium grease.
8. Bearing adapter retainer (89).
9. Do steps 1 through 15, "Install or Connect", Sub Section B.
10. Do steps 1 through 21, "Install or Connect", Sub Section A.
11. Do all steps, "Install or Connect", **Ignition Switch Assembly**, Sub Section D.

SUB SECTION D - LOWER COLUMN INCLUDES:

**DIMMER SWITCH ASSEMBLY
DIMMER SWITCH ADJUSTMENT
IGNITION SWITCH ASSEMBLY
IGNITION SWITCH ADJUSTMENT
STEERING SHAFT BUSHING ASM**

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

 Inspect

- Steering column for accident damage.
(See Figure 33)

**Dimmer Switch Assembly
Dimmer Switch Adjustment**

 Remove or Disconnect

Figures 1,2 and 27

- Disable the SIR system; refer to **"Disabling the SIR System"** in this Section.
- Negative (-) battery cable.
- Vehicle wire harness from dimmer switch (81)
- Washer head screw (#10-24x.25)(75).
- Dimmer Switch assembly (81) from dimmer switch rod (76).

 Install or Connect

Figures 1,2,27, and 30

NOTICE: See "Notice" on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

- Dimmer Switch assembly (81) to dimmer switch rod (76) and flat head screw (80).
- Washer head screw (75).
 - Tighten finger tight.

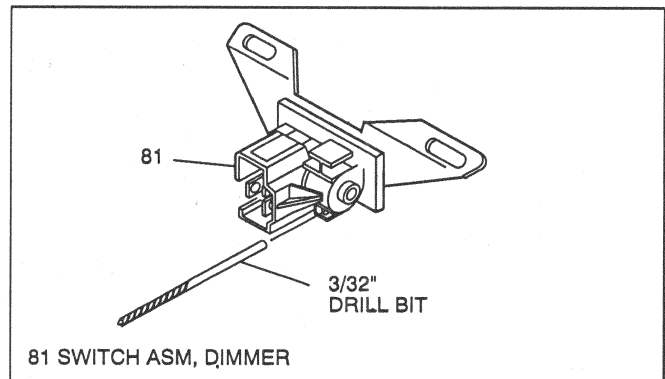


Figure 30 - Adjusting Dimmer Switch

 Adjust

- Dimmer switch (81). (See Figure 30)
 - Place 3/32-inch drill bit in hole on switch to limit travel.
 - Position switch on column and push against dimmer switch rod (76) to remove all lash.
 - Remove drill bit.

 Tighten

- Tighten washer head screw (#10-24x.25) (75) to 4.0 N·m (35lb.in.)
- Vehicle wire harness to dimmer switch (81).
- Negative (-) battery cable.
- If all service operations are completed, enable the SIR system; refer to **"Enabling the SIR System"** in this Section.

Ignition Switch Assembly Ignition Switch Adjustment

Remove or Disconnect

Figures 1,2 and 27

1. Disable the SIR system; refer to **“Disabling the SIR System”** in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Washer head screw (#10-24x.25) (75).
 - Dimmer switch assembly (81).
6. Flat head screw (#10-24x.31) (80).
 - Ignition switch assembly (79).
 - Ignition switch (79) from vehicle wire harness.

Install or Connect

Figures 1, 2,27 through 31

NOTICE: See “Notice” on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder (20) to “OFF-LOCK” position.

NOTICE: Install ignition switch assembly (79) with switch in “OFF-LOCK” position. (See Figure 31) New ignition switch will be pinned in “OFF-LOCK” position. Remove plastic pin after switch is assembled to column. Failure to do so may cause switch damage.

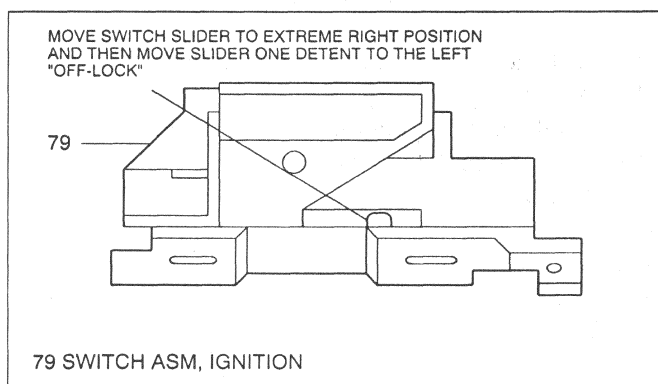


Figure 31 - Adjusting Ignition Switch

Adjust

- Ignition switch assembly (79). (See Figure 31)
 - A. Move switch slider to extreme right position.
 - B. Move switch slider one detent to left “OFF-LOCK” position.
 - C. Install 3/32 inch drill bit in hole on switch to limit travel.
- 2. Ignition switch assembly (79).
- 3. Flat head screw (#10-24x.31) (80).

Tighten

- Tighten flat head screw (80) to 4.0 N·m (35 lb.in.)
- 4. Remove drill bit from ignition switch (79).
- 5. Dimmer switch assembly (81) to dimmer switch rod (76) and flat head screw (80).
- 6. Washer head screw (75).
 - Tighten finger tight.

Adjust

- Dimmer switch asm (81). (See Figure 30)
 - A. Place 3/32-inch drill bit in hole on switch to limit travel.
 - B. Position Switch (81) on column and push to remove all lash.
 - C. Remove drill bit.

Tighten

- Tighten washer head screw (#10-24x.25) (75) to 4.0 N·m (35 lb.in.).
- 7. Steering column to vehicle. (See Section 3F)
- 9. Vehicle wire harness to ignition switch (79) and dimmer switch (81).
- 10. Negative (-) battery cable.
- 11. If all service operations are completed, enable the SIR system; refer to **“Enabling the SIR System”** in this Section.

Steering Shaft Bushing Asm

Remove or Disconnect

Figures 1,2, and 32

1. Disable the SIR system; refer to “**Disabling the SIR System**” in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Bearing adapter retainer (89).
5. Steering shaft bushing assembly (88).

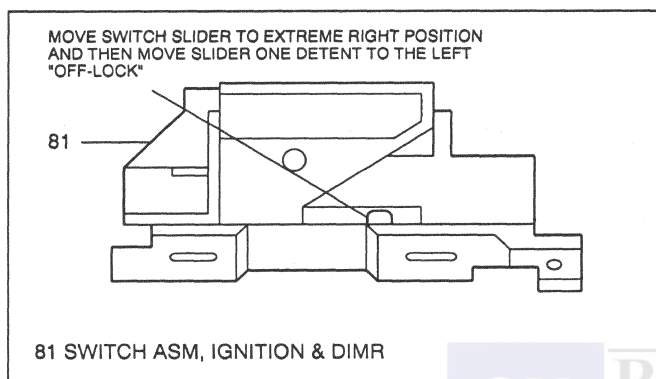


Figure 32 - Removing Steering Shaft Bushing

Install or Connect

Figures 1,2 and 32

NOTICE: See “**Notice**” on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Steering shaft bushing assembly (88) to jacket assembly (73).
 - Lubricate inner surface of bushing (88) with lithium grease.
2. Bearing adapter retainer (89).
3. Steering column to vehicle. (See Section 3F)
4. Negative (-) battery cable.
5. If all service operations are completed, enable the SIR system; refer to “**Enabling the SIR System**” in this Section.

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

NOTICE: Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, or where supplemental inflatable restraints systems deployed may also have a damaged or misaligned steering column.

CHECKING PROCEDURE**JACKET ASM, STEERING COLUMN**

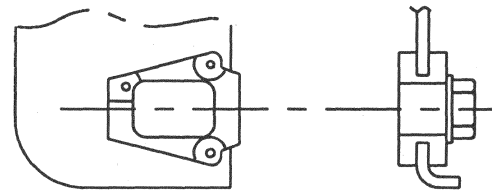
- Check capsules on steering column bracket assembly; all must be securely seated in bracket slots and checked for any loose conditions when pushed or pulled by hand (View A). If not, bracket should be replaced if bracket is bolted to the jacket assembly or the jacket assembly should be replaced if bracket is welded to jacket assembly.
- Check for jacket assembly collapse by measuring the distance from the lower edge of upper jacket to a defined point on the lower jacket (View C). If measured dimensions are not within specifications, a new jacket must be installed.

STEERING SHAFT ASM

- Visually inspect steering shaft for sheared injected plastic (View B). If steering shaft shows sheared plastic, a new steering shaft must be installed.

NOTICE: Inflatable restraint coil assembly must be removed from steering column and allowed to hang freely before shaft is rotated. Failure to do so could damage coil assembly.

- Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Using a dial indicator at lower end of steering shaft, have steering wheel rotated. Runout must not exceed 1.59mm.

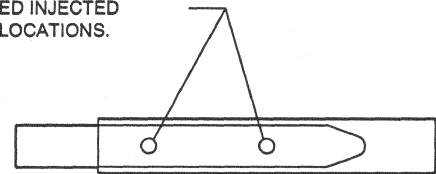


VIEW A
(CAPSULES)

CHECK FOR ANY LOOSE CONDITION WHEN PUSHED OR PULLED BY HAND.

CHECK FOR SHEARED INJECTED PLASTIC AT THESE LOCATIONS.

VIEW B
(STEERING SHAFT)



133.98 MM
+/- .50 MM

VIEW C (METHOD TO DETERMINE COLUMN COLLAPSE)
WITH LOWER BEARING REMOVED
MEASURE DISTANCE BETWEEN ARROWS.

Figure 33 - Checking for Accident Damage

SPECIFICATIONS**FASTENER TIGHTENING SPECIFICATIONS**

(1) Steering Wheel-to-Shaft Nut	41.0 N·m (30 lb.ft.)
(9) Turn Signal Switch Connecting Screws	3.4 N·m (30 lb.in.)
(10) Turn Signal Switch Arm Screw	2.3 N·m (20 lb.in.)
(15) Lock Housing Cover Screws	9.0 N·m (80 lb.in.)
(18) Lock Retaining Screw	2.5 N·m (22 lb.in.)
(48) Lock Bolt Spring Screw	4.0 N·m (35 lb.in.)
(61) Hex Washer Head Tapping Screw	8.8 N·m (78 lb.in.)
(75) Washer Head Screw (#10-24x.25)	4.0 N·m (35 lb.in.)
(80) Flat Head Screw (#10-24x.31)	4.0 N·m (35 lb.in.)

3F5B - 20 TILT STRG COL UNIT REP AIR (SIR, FLR SHFT)

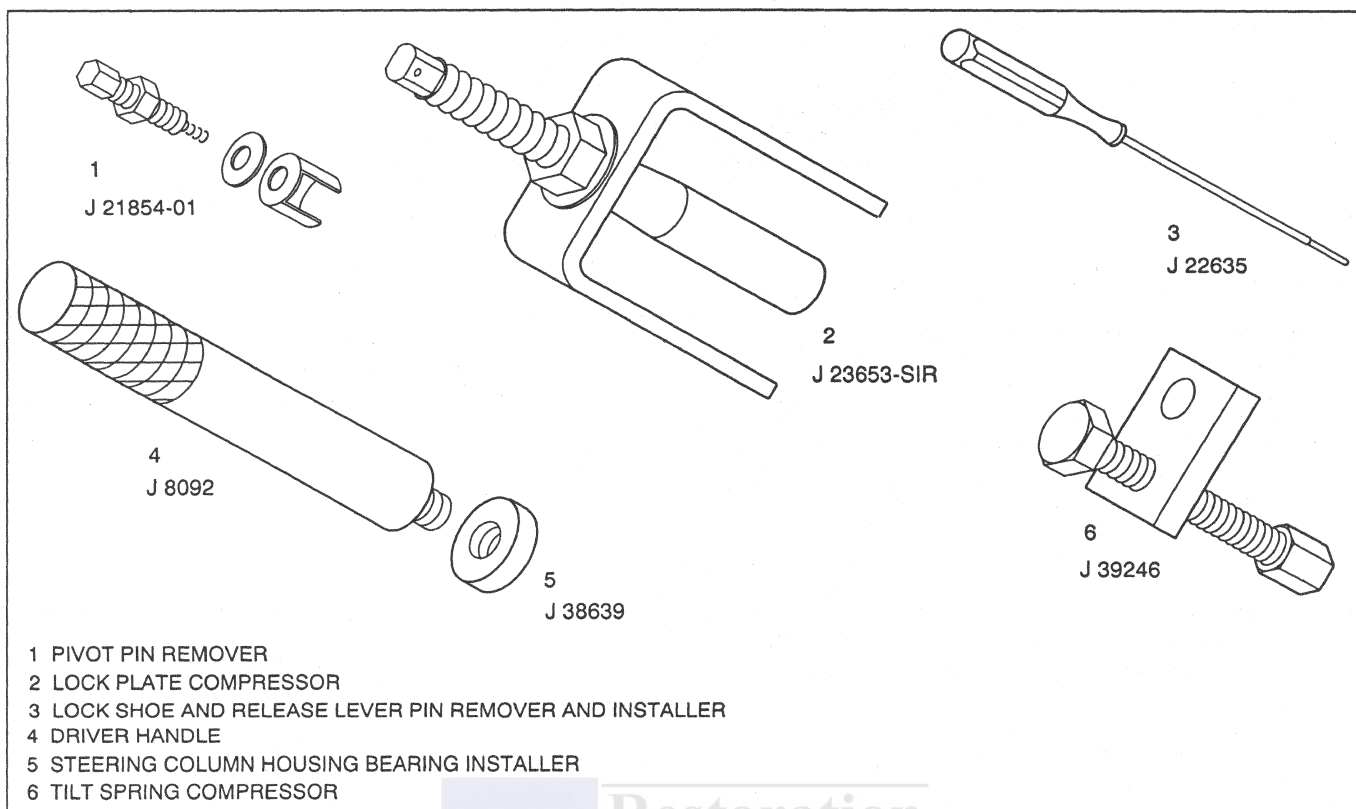


Figure 34 - Special Tools

SECTION 4A

PROPELLER SHAFT

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

PROPELLER SHAFT

Figure 1

Torque is transmitted from the transmission to the differential through the propeller shaft (5) and the universal joints. The shaft (5) is a one piece balanced tubular type.

A universal joint and splined propeller shaft slip yoke (1) are located at the transmission end of the shaft (5) where they are held in alignment by a bushing in the automatic transmission case extension. The slip yoke (1) permits fore-and-aft movement of the shaft (5) as the differential moves up and down. The spline is lubricated internally by the transmission lubricant. An oil seal in the automatic transmission case extension prevents fluid leakage and protects the slip yoke (1) from dust, dirt and other harmful material.

A second universal joint is used where the shaft (5) connects to the differential drive pinion gear yoke.

If a vehicle is to be undercoated, the shaft (5) must be kept completely free of undercoating material. Undercoating material or any other foreign material will upset the propeller shaft balance and produce a serious vibration.

UNIVERSAL JOINT

The universal joint is basically two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like a cross and the arms that extend from it are called trunnions. The spider allows the two yoke shafts to operate at an angle to each other. Factory installed universal joints are lubricated for life, but service universal joints have grease fittings and require periodic lubrication. For more information, refer to "Lubrication" in this section.

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the propeller shaft slip yoke rotates at a constant speed, the differential drive pinion gear yoke speeds up and slows down twice per revolution. This fluctuation of the pinion gear yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two yokes are 90 degrees apart provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the

4A-2 PROPELLER SHAFT

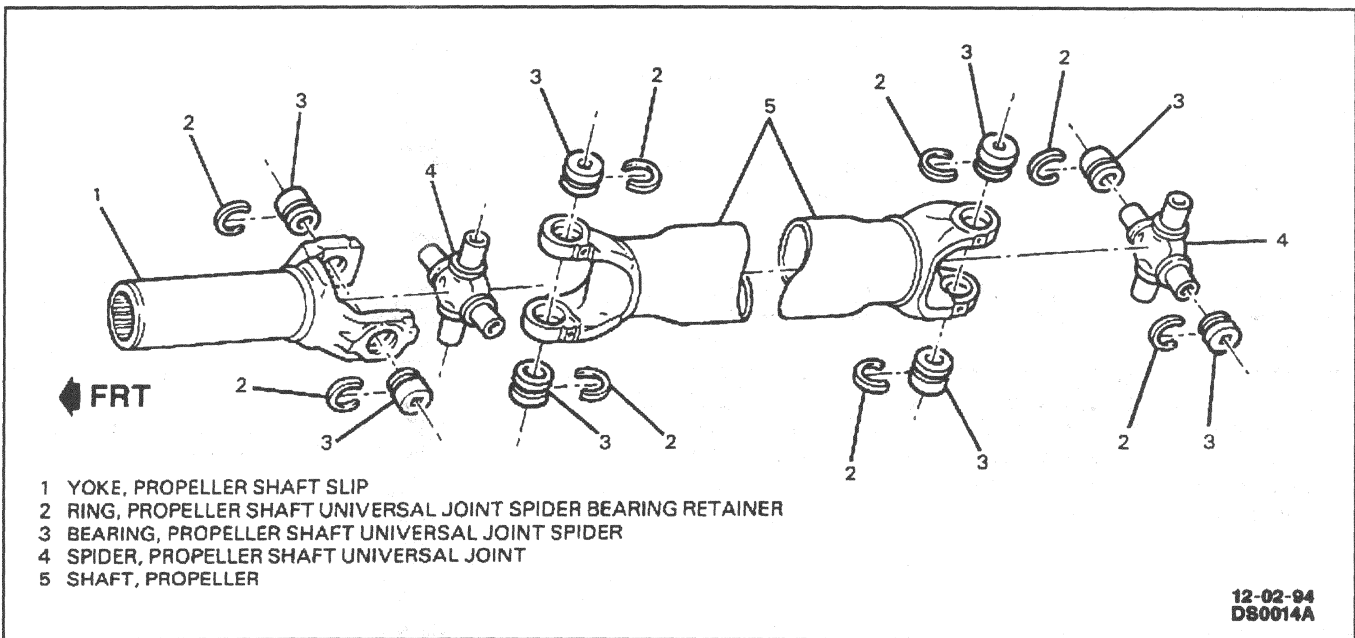


Figure 1 - Propeller Shaft Components

alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

Universal joints are designed to handle the effects of various loadings and rear axle windup during acceleration. Within the designed angle variations, the universal joint will operate efficiently and safely. When the design angle is changed or exceeded, the operational life of the universal joint may decrease.

The universal joint spider bearings used are the needle roller type. The needle roller bearings are held in place on the trunnions by round bearing caps. Production universal joint bearings are retained by nylon injected rings instead of conventional retainer (snap) rings. All service replacement universal joints use retainer (snap) rings.

If it becomes necessary to replace a universal joint, the entire propeller shaft must be removed from the vehicle. Care should be taken to avoid jamming or bending any parts of the propeller shaft.

DIAGNOSIS

The following major component groups are usually the cause of or are related to vibration.

- Engine and engine mounts.
- Transmission.
- Tire, wheel, brake drum and brake rotors.
- Propeller shafts and universal joints.

Before road testing a vehicle, check the following:

- All fasteners for tightness at universal joint, wheel nuts and engine mounts.
- Tire air pressure and condition.
- Load conditions.

ROAD TEST

Road test the vehicle to verify the complaint. Record the speed and rpm at which the greatest vibration occurs. The vibration is likely to be in the steering wheel or in the seat bottom. The road test can be helpful in locating the vibration source.

COAST TEST

NOTICE: When performing a "Coast Test" on a vehicle equipped with an automatic transmission, caution must be taken when returning automatic transmission control lever from "NEUTRAL" to "DRIVE" to avoid transmission damage.

When shifting from "NEUTRAL" to "DRIVE," remember to:

1. Maintain engine speed at 1500 rpm.
2. Brake to 40 km/h (25 mph).
3. Return automatic transmission control lever to "DRIVE."

Drive the vehicle past the vibration speed, shift into "NEUTRAL" and coast back through the vibration speed. During a coast test, two kinds of vibration normally occur: a shaking or a buzzing. A shaking vibration is usually a problem with the tire, wheel, brake drum or brake rotors. A buzzing vibration is usually a drive-line problem.

To determine whether the propeller shaft is causing the problem, drive the vehicle through the speed range and note at which speed (vehicle and/or engine) the problem is most pronounced. A tachometer may be used. Shift the transmission into a lower gear range and drive the vehicle at the same engine speed as when the problem was most pronounced in direct drive. Note the effect on the problem.

To determine the engine speed if a tachometer is not used, divide vehicle speed by the transmission gear ratio in which the problem occurs.

Example: When the HYDRA-MATIC 4L60 automatic transmission is in 2 range, divide by 1.63. If the problem is most pronounced in direct drive at 88 km/h (55 mph) the same engine speed would be produced in 2 range at 55 km/h (34 mph).

If the problem is still present at the same engine speed whether in direct drive or in the lower gear

range, the propeller shaft cannot be at fault since the propeller shaft speed varies. If the problem decreases or is eliminated in a different gear range at the same engine speed, the propeller shaft may be at fault. Refer to "Propeller Shaft Runout Measurement" under "On-Vehicle Service," "Diagnosis of Propeller Shaft and Universal Joint" and Figure 2.

DIAGNOSIS OF PROPELLER SHAFT AND UNIVERSAL JOINT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Leak at front propeller shaft slip yoke. (An occasional drop of lubricant leaking from slip yoke is normal and requires no attention.)	1. Rough outside surface on propeller shaft slip yoke. 2. Faulty rear automatic transmissions oil seal.	1. Replace transmission seal if cut by burrs on slip yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace slip yoke if outside surface is rough or burred badly. 2. Replace rear automatic transmission oil seal. Bring automatic transmission fluid up to proper level after correction.
Knock in driveline; clunking noise when vehicle is operated under float condition at 16 km/h (10 mph) in high gear or "NEUTRAL."	1. Worn or damaged universal joints. 2. Differential side gears worn.	1. Replace universal joints. 2. Replace differential side gears as required.
Ping, snap, or clicking noise in driveline.	1. Loose rear axle upper or lower control arm bolt/screw. 2. Worn or damaged universal joints.	1. Tighten bolt/screw to specified torque. 2. Replace universal joint.
Scraping noise	1. Slinger rubbing on the rear axle carrier. 2. Brake drum contacting backing plate.	1. Straighten the slinger to remove interference. 2. Replace brake drum or backing plate.

PROPELLER SHAFT DIAGNOSIS

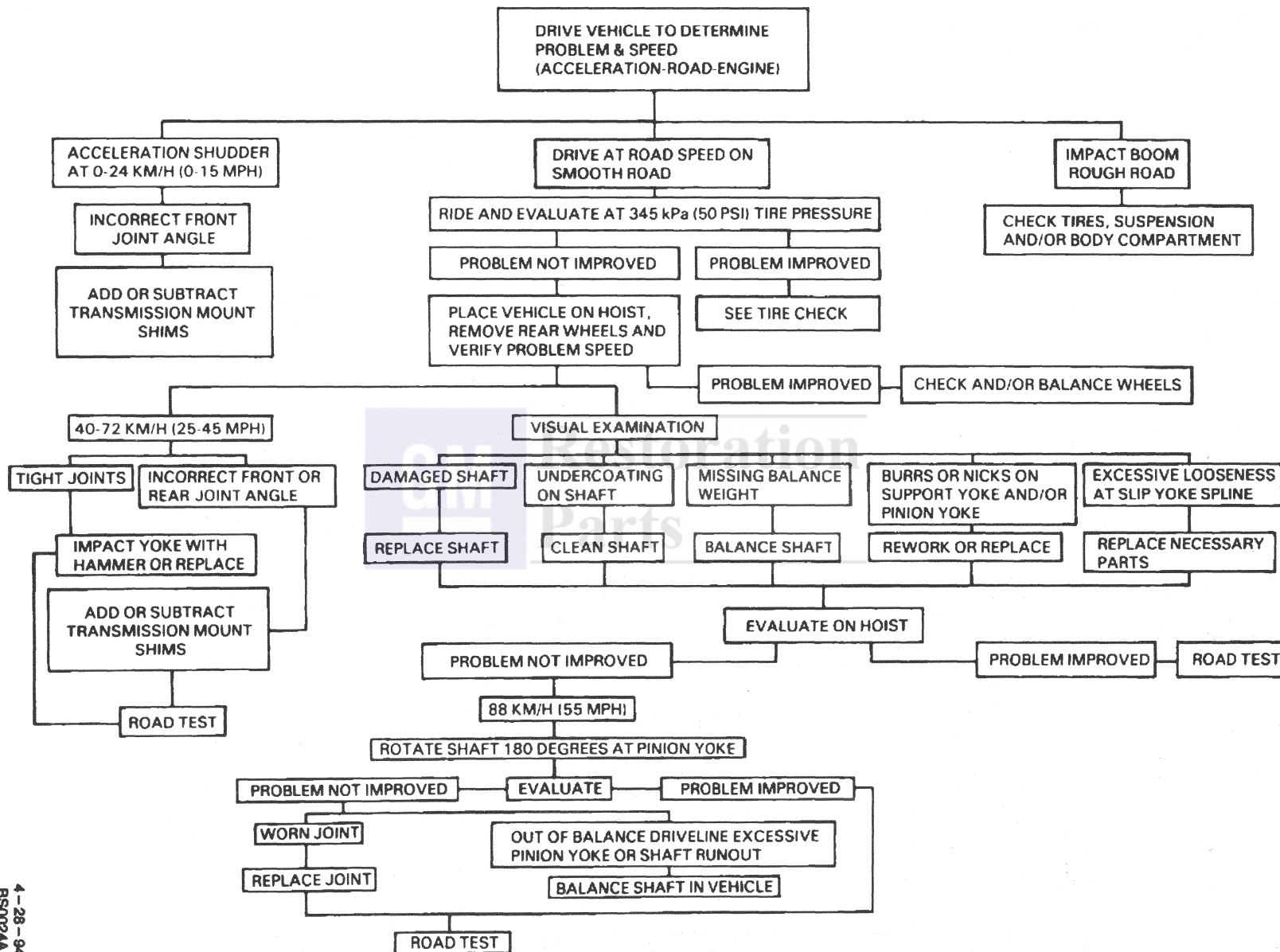


Figure 2 - Propeller Shaft Diagnostic Chart

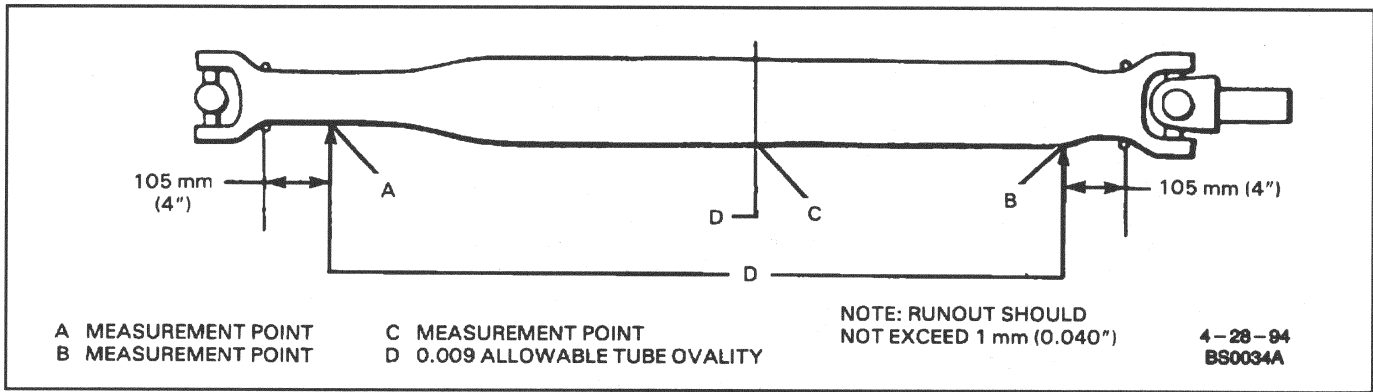


Figure 3 - Checking Propeller Shaft Runout

ON-VEHICLE SERVICE

PROPELLER SHAFT RUNOUT MEASUREMENT

Figure 3

Tool Required:

J 8001 Dial Indicator Set

Noise or vibration at high speed could be caused by a bent propeller shaft. The propeller shaft could have been damaged by rough handling or a collision. Check for propeller shaft straightness.

1. Place transmission in "NEUTRAL."
2. Raise vehicle on twin post hoist so rear is supported on rear axle housing and wheels can spin. Refer to SECTION 0A.
3. Mount J 8001 on a movable support that is high enough to permit contact of indicator button with propeller shaft, or mount J 8001 to magnetic base and attach it to smooth place on vehicle underbody. Readings are to be taken at points A, B and C.
4. Check for runout by turning rear wheels to rotate propeller shaft.
5. If runout exceeds specifications, disconnect propeller shaft at differential drive pinion gear yoke and rotate propeller shaft 180 degrees. Reinstall propeller shaft. Check runout again.
6. If runout is still over specifications at differential drive pinion gear yoke end, differential drive pinion gear yoke runout should be measured. Refer to "Differential Drive Pinion Gear Yoke Runout Measurement" below. If runout is still over specifications, replace propeller shaft, but only after checking for vibration or noise.
7. Lower vehicle.

DIFFERENTIAL DRIVE PINION GEAR YOE RUNOUT MEASUREMENT

Figure 4

Tools Required:

J 35819 Runout Gage

J 8001 Dial Indicator Set



Important

- The driveline components in this vehicle have been factory system balanced. System balance provides a smoother running driveline operation. However, it is essential that positions of all driveline components relative to propeller shaft and rear axle be observed and **ACCURATELY** REFERENCE MARKED PRIOR TO

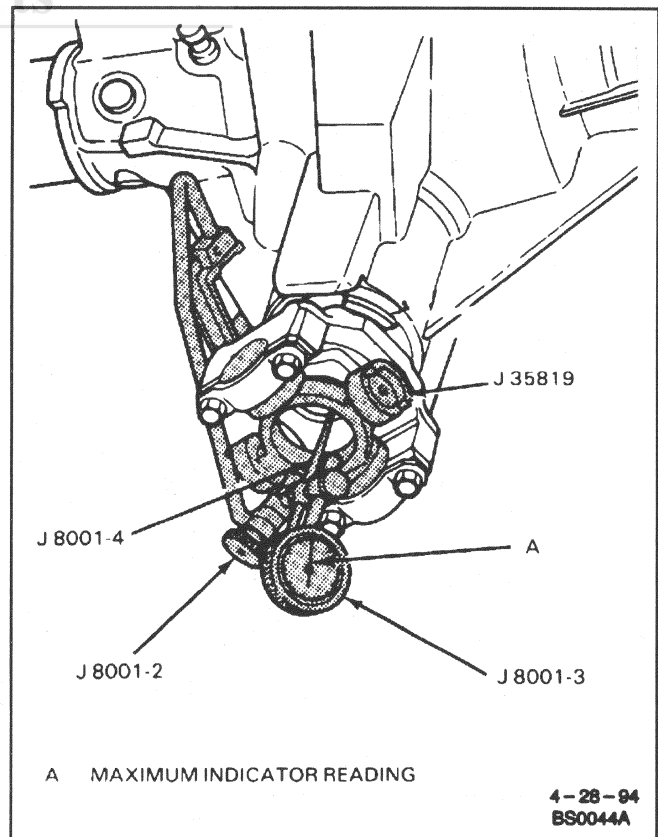


Figure 4 - Differential Drive Pinion Gear Yoke Runout

4A-6 PROPELLER SHAFT

DISASSEMBLY. These components include propeller shaft, rear axle assembly and differential drive pinion gear yoke. **ALL COMPONENTS MUST BE REASSEMBLED INTO THE EXACT RELATIONSHIP TO EACH OTHER AS THEY WERE WHEN REMOVED.**

Additionally, published specifications and torque values, as well as any measurements made prior to disassembly must be followed to maintain factory balance.

1. Raise vehicle on twin post hoist so rear is supported on rear axle housing and wheels can spin. Refer to SECTION 0A.
2. Measure pinion gear yoke runout using J 35819 and J 8001. Record runout and mark high and low points of pinion gear yoke.
3. If pinion gear yoke runout is 0.38 mm (0.015 inch) or less, no further action is required.
4. If pinion gear yoke runout is greater than 0.38 mm (0.015 inch), replace pinion gear yoke with a service pinion gear yoke. Refer to SECTION 4B.
 - Service replacement pinion gear yokes may be equipped with balance weights and weights **MUST NOT** be removed.
5. Lower vehicle.

UNIVERSAL JOINT ANGLE MEASUREMENT

Figure 5

The front universal joint angle is actually the angle between engine-transmission centerline and

propeller shaft centerline. This angle is determined by design of frame and may be altered by adding or removing shims between transmission and transmission mount. Refer to SECTION 7A.

Rear universal joint angle corrections of + or -1 degree can be made by loosening all of rear suspension control arm bolts and repositioning pinion nose up or down. This takes advantage of all bolt/screw hole tolerances in brackets. Refer to SECTION 3D.

Adding one shim at transmission mount will decrease transmission-universal joint angle by 1/2 degree and increase differential joint angle by 1/4 degree. If one shim is removed, transmission angle will increase 1/2 degree and decrease differential angle 1/4 degree. The production transmission mount bolt/screw is an M10-1.5 x 35 mm. When installing two or more shims, an M10-1.5 x 50 mm bolt/screw must be used.

All vehicles with propeller shaft vibration complaints should be checked for correct rear trim height measurements at curb weight. An incorrect trim height may cause some vibration. If any irregular roughness or vibration is detected in driveline, front and rear universal joint angles should be checked. If a vehicle is involved in a severe rear end collision, or if rear axle housing is replaced, rear universal joint angle should be checked and corrected if necessary.

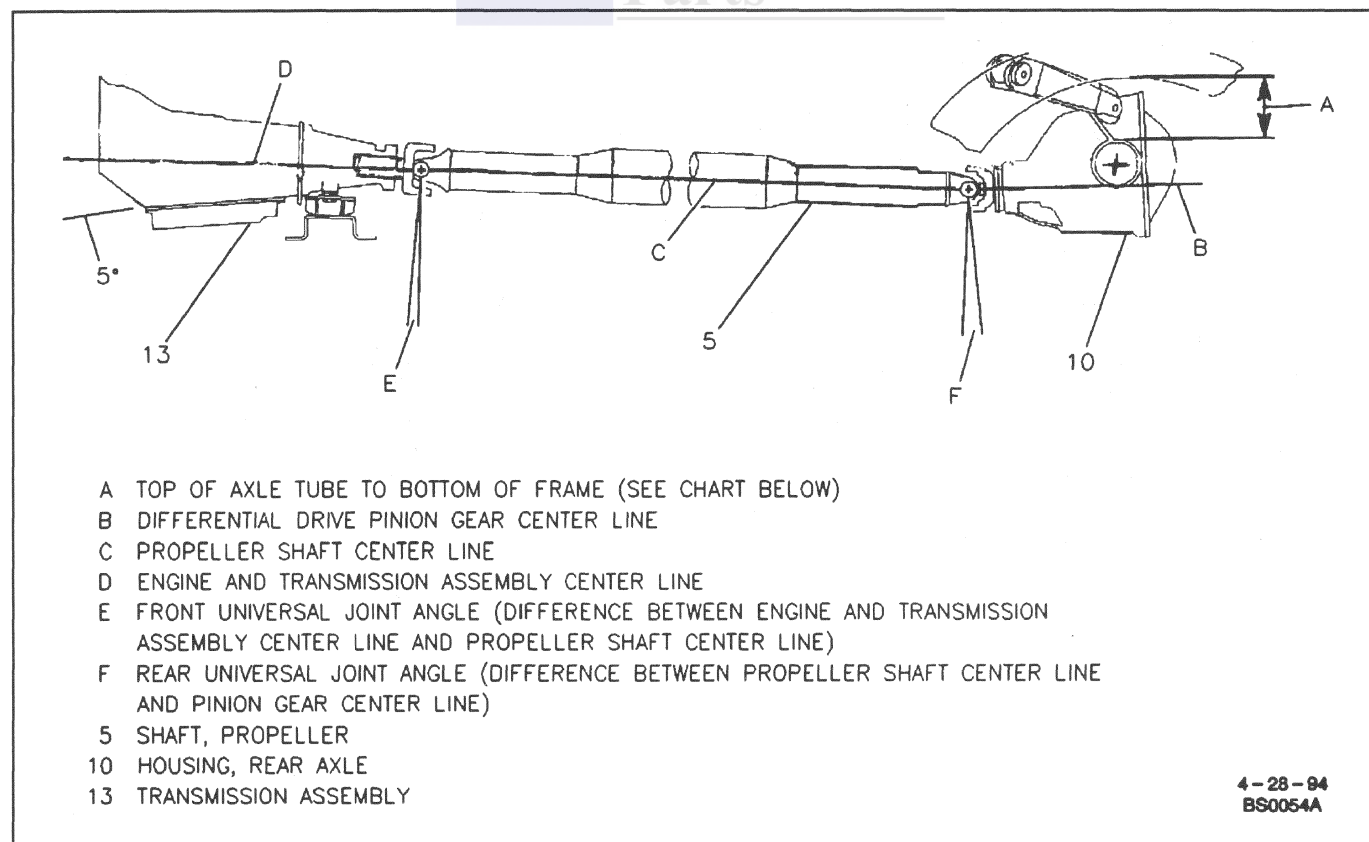


Figure 5 - Axle Tube-to-Frame Trim Height

Universal Joint Angle Specifications Chart

MODEL	AXLE	SUSPENSION	TIRE SIZE	TRIM HEIGHT* (+ or - 10mm (0.39 in.))	FRONT UNIVERSAL JOINT ANGLE (+ or - 0.3°)	REAR UNIVERSAL JOINT ANGLE (+ or - 0.3°)
Chevrolet Sedan	7 5/8	FE1	P215/75R15	142 mm (5.59 in.)	1.6°	2.6°
Chevrolet Sedan	8 1/2	FE1/FE2	P225/70R15	152 mm (5.98 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	FE2/F41	P225/70R15	140 mm (5.51 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	FE3	P235/70R15	133 mm (5.24 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	7B3	P215/75R15	150 mm (5.91 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	7B3	P225/70R15	153 mm (6.02 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	7B3	P235/70R15	145 mm (5.71 in.)	1.3°	2.6°
Chevrolet Sedan	8 1/2	FE4	P255/50R17	113 mm (4.45 in.)	1.3°	2.6°
Chevrolet Wagon	8 1/2	F40	P225/75R15	123 mm (4.84 in.)	1.4°	3.0°
Chevrolet Wagon	8 1/2	F40	P225/70R15	134 mm (5.28 in.)	1.4°	3.0°
Buick Sedan	8 1/2	FE2/F41	P225/70R15	123 mm (6.06 in.)	1.3°	2.6°
Buick Sedan	8 1/2	FE2	P225/70R15	152 mm (5.98 in.)	1.3°	2.6°
Buick Sedan	8 1/2	FE1	P235/70R15	147 mm (5.79 in.)	1.3°	2.6°
Buick Sedan	8 1/2	FE3	P235/70R15	147 mm (5.79 in.)	1.3°	2.6°
Buick Wagon	8 1/2	F40	P225/70R15	123 mm (4.84 in.)	1.4°	3.0°

* TOP OF AXLE TUBE TO BOTTOM OF FRAME TRIM HEIGHT SPECIFICATION

Inclinometer Method

Figure 5

This method can be used with vehicle over a pit or on a drive-on platform hoist as long as vehicle is at curb weight with a full tank of gasoline. Before universal joint angles can be checked, measurements specified for distance between top of axle tube and bottom of frame must be met. To ensure an accurate measurement, cut two 6-inch blocks of wood and place between axle tube and frame on both sides. Add weight to rear compartment until frame contacts the blocks of wood.

Readings should be taken at following locations in following manner:

ANGLE AT REAR UNIVERSAL JOINT

Figure 6

Tool Required
J 23498-A Driveshaft Inclinometer



Measure

1. Rotate propeller shaft until rear universal joint bearing cap pressed into propeller shaft is facing straight down.

4A-8 PROPELLER SHAFT

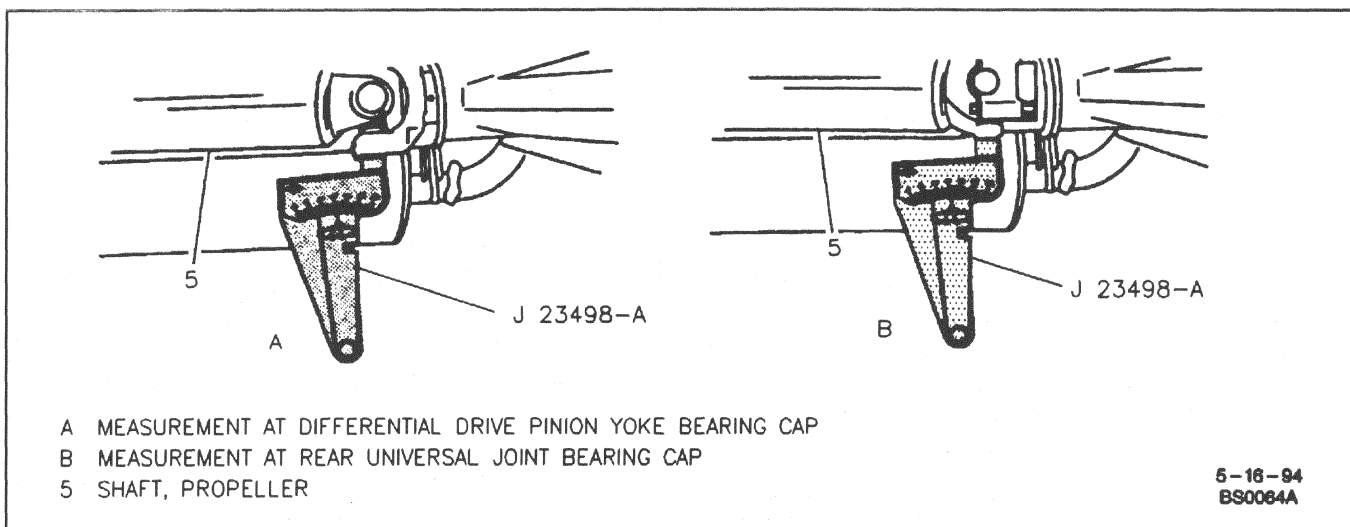


Figure 6 - Measuring Angle at Rear Universal Joint

2. Place inclinometer J 23498-A on rear universal joint bearing cap. Center bubble in sight glass and record measurement. Bearing cap must be straight up and down and free of dirt or other foreign material to obtain an accurate measurement.
3. Rotate propeller shaft 90 degrees and place inclinometer on differential drive pinion yoke bearing cap. Center bubble in sight glass and record measurement.
4. Subtract smaller figure from larger figure to obtain universal joint angle.
5. Compare with "Specifications" at the end of this section.

ANGLE AT FRONT UNIVERSAL JOINT

Figure 7

Tools Required:

J 23498-A Driveshaft Inclinometer

J 23498-20 Driveshaft Inclinometer Adapter



Measure

1. Rotate propeller shaft until front universal joint bearing cap pressed into propeller shaft is facing straight down.
2. Place inclinometer on front universal joint bearing cap. Center bubble in sight glass and record measurement.
3. Rotate propeller shaft 90 degrees and place inclinometer on propeller shaft slip yoke bearing cap. Center bubble in sight glass and record measurement.
4. Subtract smaller figure from larger figure to obtain front universal joint angle.
5. Compare with "Specifications" at the end of this section.

PROPELLER SHAFT BALANCE CHECK



Remove or Disconnect

NOTICE: Refer to "Notice" on page 4A-1 of this section.

1. Disable traction control system by pressing switch in instrument panel compartment.
2. Raise vehicle on twin post hoist so wheels can spin. Refer to SECTION 0A.
3. Tire and wheels. Refer to SECTION 3E.
4. Install wheel nuts with flat sides against rear brake drum.



Inspect

- Propeller shaft, universal joint, and attachments for mud, undercoating or loose fasteners.

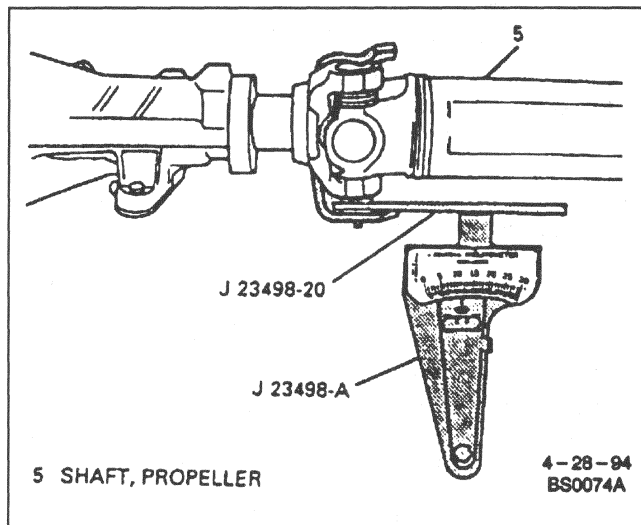


Figure 7 - Measuring Angle at Front Universal Joint



Clean

- Propeller shaft, universal joint, and attachments. Do not use solvents to clean propeller shaft.



Tighten

- Any loose attachments or fasteners to specifications. Refer to "Specifications" in this section.

CAUTION: Do not run vehicle faster than 88 km/h (55 mph). Stay clear of universal joint and balance weight areas to avoid possible personal injury. Do not run vehicle on hoist for extended periods due to danger of overheating transmission or engine.

- Run vehicle in gear at speed where disturbance peaks. Observe intensity of disturbance.

NOTICE: Allow driveline components to stop rotating transmission in "NEUTRAL" before placing transmission in "PARK" or parts may be damaged.

- Stop engine.

- Propeller shaft from pinion gear yoke only. Refer to "Propeller Shaft Replacement" in this section.
 - Rotate shaft 180 degrees from original position.



Install or Connect

- Propeller shaft to pinion gear yoke. Refer to "Propeller Shaft Replacement" in this section.
- Remove wheel nuts.
- Wheel and tires. Refer to SECTION 3E.
- Determine position that gives best driveline response by road testing vehicle for final check of propeller shaft balance.
- Cycle ignition to enable traction control system.
- If balance is unacceptable, refer to "Propeller Shaft Balancing" in this section.

PROPELLER SHAFT BALANCING

Hose Clamp Method

Figures 8 through 10

- Disable traction control system by pressing switch in instrument panel compartment.
- Place vehicle on twin post hoist so that rear of vehicle is supported on rear axle housing and rear wheels are free to rotate. Refer to SECTION 0A.
- Remove both rear tire and wheels. Refer to SECTION 3E. Install wheel nuts with flat sides next to rear brake drum.
- Mark and number shaft (5) at four points, 90 degrees apart, at rear of shaft (5) just forward of balance weight.

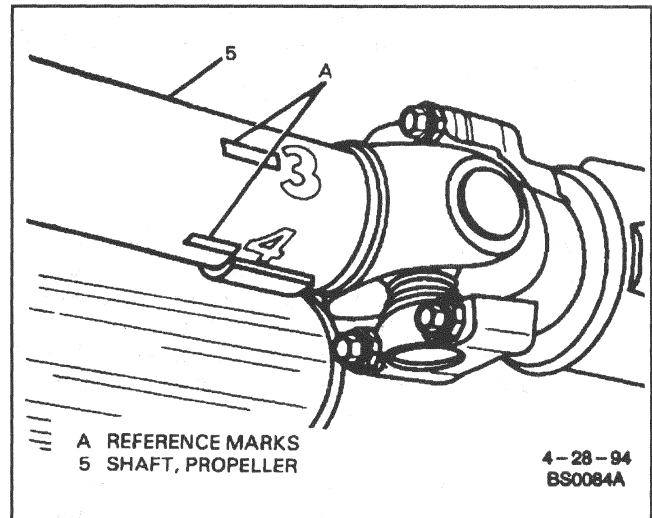


Figure 8 - Propeller Shaft Reference Marks

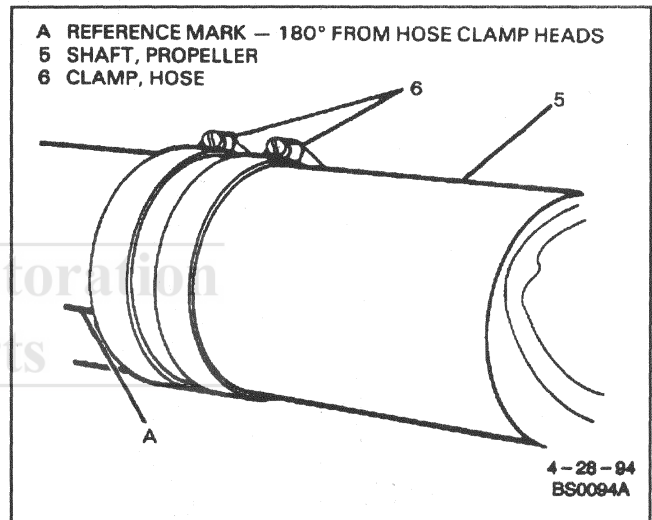


Figure 9 - Balance Hose Clamps

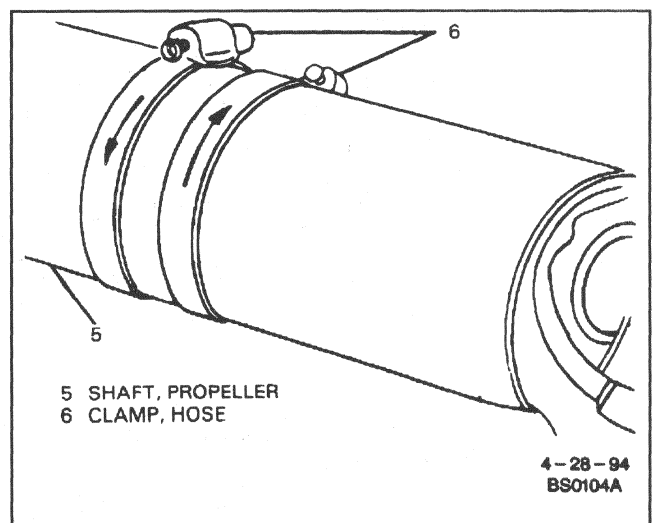


Figure 10 - Rotating Balance Hose Clamps

4A-10 PROPELLER SHAFT

5. Install two clamps (6) on rear of shaft (5) and slide them rearward until clamps (6) stop at nearest balance weight welded to tube.

- Align both clamps (6) at any one of four reference marks made on shaft (5) in step 4 and tighten.

CAUTION: Do not run vehicle faster than 88 km/h (55 mph). Stay clear of universal joint and balance weight areas to avoid possible personal injury. Do not run vehicle on hoist for extended periods due to danger of overheating transmission or engine.

6. Run vehicle through speed range to 81-88 km/h (50-55 mph). Note amount of imbalance felt at front of rear axle housing.
7. Loosen clamps (6) and rotate clamp heads 90 degrees to next mark on shaft (5). Tighten clamps (6) and repeat step 6.

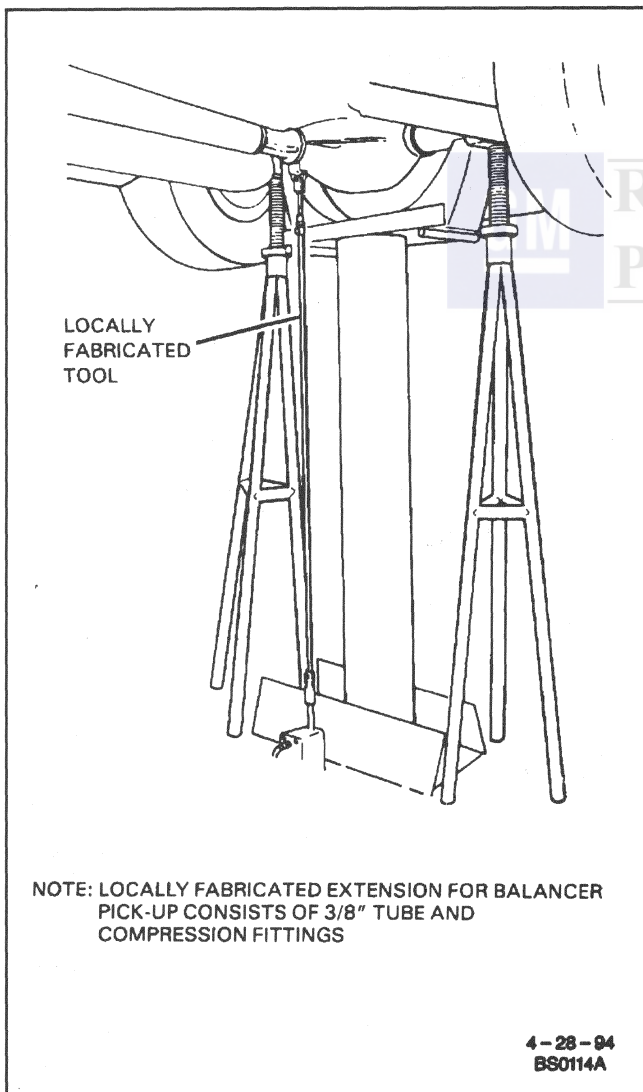


Figure 11 - Pick-Up Unit at Differential Drive Pinion Gear Yoke

8. Repeat step 7 until vehicle has been run with clamp heads located at all four marks on shaft (5).
9. Position clamps (6) at point of least imbalance. Rotate clamp heads away from each other 45 degrees, one on each side of position.

- A. Run vehicle and note if balance has improved.
- B. In some cases it may be necessary to use one clamp (6) or possibly three clamps (6) in order to obtain good balance.
- C. Replace shaft (5) if three clamps (6) do not improve balance.

10. Continue to rotate clamps (6) apart in smaller angular increments until imbalance is at its minimum.
11. Remove wheel nuts.
12. Install tire and wheels. Refer to SECTION 3E.
13. Lower vehicle.
14. Cycle ignition to enable traction control system.
15. Road test vehicle to check final balance.

- A small vibration felt while vehicle is on hoist may not be noticed on road test.

Strobe Light Method

Figures 8 through 12

If a strobe-light type wheel balancer is used, it will help in balancing of propeller shaft. The balance pick-up unit should be placed directly under nose of rear axle housing and as far forward as possible. Make up an extension for balance pick-up unit by using 3/8-inch tube and compression fittings (Figure 11).

1. Disable traction control system by pressing switch in instrument panel compartment.
2. Place vehicle on twin post hoist so rear of vehicle is supported on rear axle housing and rear wheels are free to rotate. Lower rear hoist and allow rear axle housing to rest on jackstands.
3. Remove both rear tire and wheels. Refer to SECTION 3E. Install wheel nuts with flat sides next to rear brake drums. System is now released and free to respond to shaft (5).
4. Mark and number shaft (5) at four points, 90 degrees apart, at rear of shaft (5) just forward of balance weights.
5. Place strobe light wheel balancer pick-up under pinion gear yoke in contact with rear axle housing and as far forward as possible.

CAUTION: Do not run vehicle faster than 88 km/h (55 mph). Stay clear of universal joint and balance weight areas to avoid possible personal injury. Do not run vehicle on hoist for extended periods due to danger of overheating transmission or engine.

6. Run vehicle in gear at speed where disturbance is at its peak.
7. Allow driveline to stabilize by holding at steady speed.

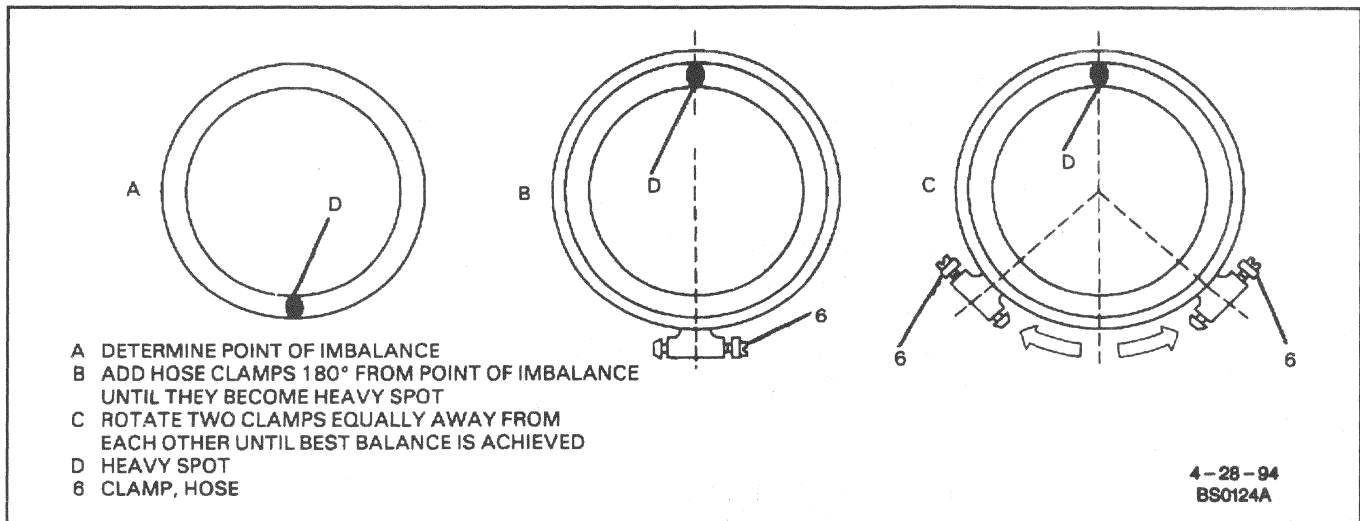


Figure 12 - Positioning Hose Clamps to Achieve Best Balance

8. Point strobe light up at spinning shaft (5) and note position of one of reference numbers.

NOTICE: Allow driveline components to stop rotating with transmission in “NEUTRAL” before placing transmission in “PARK” or parts may be damaged.

9. Shut off engine.
10. Position shaft (5) so reference numbers will be in same position as was noted while shaft (5) was rotating.
 - When strobe light flashed, heaviest point of shaft (5) was at bottom (6 o'clock). To balance shaft (5), it would be necessary to apply balancing weights (hose clamps) 180 degrees away from heaviest point or at top of shaft (5) (12 o'clock).
11. Install two screw-type clamps (6) on shaft (5) as close to rear as possible. Position both clamp heads 180 degrees from heaviest point of shaft (5) as indicated by strobe light. Tighten clamps (6).
12. Run vehicle through speed range 81-88 km/h (50-55 mph).
 - A. If disturbance is not gone and strobe light shows clamp heads at bottom (6 o'clock) of shaft (5), go to step 13.
 - B. If strobe light shows two clamp heads at top of shaft (5), add one more clamp (6) and check.
 - C. If strobe light shows clamp heads at top of shaft (5), remove shaft (5) and rotate 180 degrees on pinion gear yoke. Check again, without clamps (6).
 - D. Repeat balancing, starting with step 11.
 - E. If shaft (5) still needs more than three clamps (6) at same clock position, replace shaft (5).
 - F. If clamps (6) are also 180 degrees from their original position after rotating shaft (5) 180 degrees, pinion gear yoke is out of balance and must be replaced.

! Important

- Do not use more than three clamps (6) to balance shaft (5).
- G. If strobe light shows clamps (6) at bottom of shaft (5), but disturbance still exists, go to step 13.
 13. Rotate two of clamps (6) equally away from each other toward top (one on each side of position) in small increments until best balance is achieved. In some cases it may be necessary to use one clamp (6) or possibly three clamps (6) in order to obtain good balance. Replace shaft (5) if three clamps (6) do not correct problem.
 14. Remove wheel nuts.
 15. Install tire and wheels. Refer to SECTION 3E.
 16. Remove strobe light and lower vehicle.
 17. Cycle ignition to enable traction control system.
 18. Road test vehicle to check final balance.
 - A small vibration felt while vehicle is on hoist, may not be noticed on road test.

PROPELLER SHAFT REPLACEMENT

Figure 13

↔ Remove or Disconnect

NOTICE: Do not strike or drop propeller shaft, or allow universal joints to bend to extreme angles, as this might fracture a joint internally.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Mark relationship of shaft (5) to pinion gear yoke (9).
3. Four bolts/screws (7).
4. Two retainers (8).
5. Shaft (5) by withdrawing slip yoke (1) from transmission, moving shaft (5) rearward and passing it under axle housing (10).

4A-12 PROPELLER SHAFT

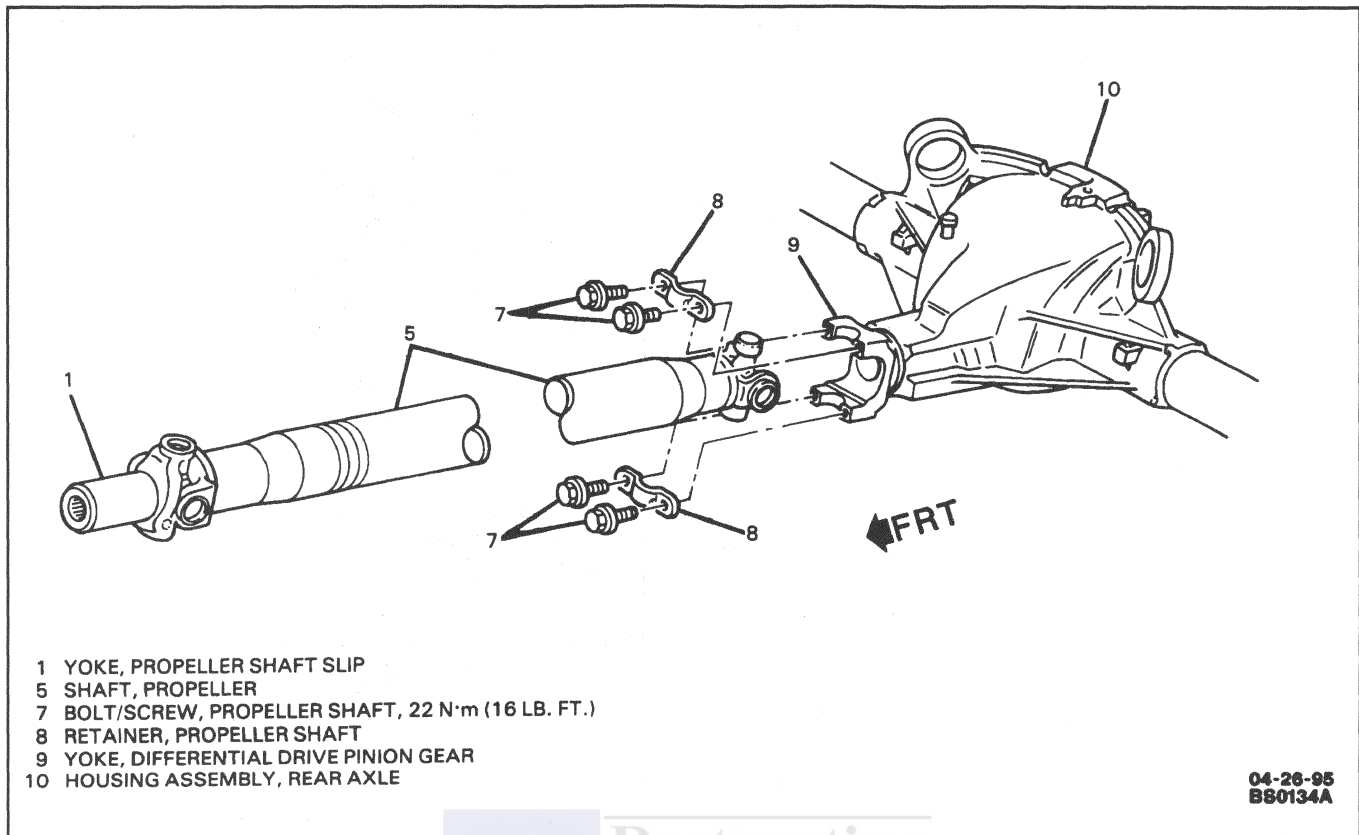


Figure 13 - Propeller Shaft

- On shaft (5), if bearing caps are loose, tape them together to prevent dropping and losing needle roller bearings.



Inspect

- Transmission rear seal for damage.
- Transmission output shaft splines for burrs.
- Outer diameter of slip yoke (1) for burrs.
- Splines of slip yoke (1) for damage, twisting or wear. They should agree in number and fit with transmission output shaft splines.
- Pinion gear yoke (9) for burrs or foreign material.



Install or Connect

NOTICE: Refer to “Notice” on page 4A-1 of this section.

NOTICE: The propeller shaft must be handled carefully to avoid jamming or bending any parts.

NOTICE: To prevent rear automatic transmission oil seal damage, do not place any tool between propeller shaft slip yoke and seal.

1. Slip yoke (1) onto transmission output shaft after lubricating spline with approximately 18 gm (0.6 ounce) of propeller shaft slip yoke lubricant GM P/N 1050169, or equivalent.



Important

- When making rear shaft connection, be sure to align mark on pinion gear yoke (9) with mark on shaft (5).
2. Propeller shaft (5) to pinion gear yoke (9).
 - On shaft (5), rear universal joint bearing caps must be fully seated in pinion gear yoke (9).
 3. Two retainers (8), if removed.
 4. Four bolts/screws (7).



Tighten

- Bolts/screws (7) evenly to 22 N·m (16 lb. ft.).
 - Bolts/screws (31) evenly to 95 N·m (70 lb. ft.).
5. Lower vehicle.



Adjust

- Transmission fluid level. Refer to SECTION 7A.

UNIT REPAIR

UNIVERSAL JOINTS

When taking apart a propeller shaft, two types of universal joints may be found: nylon injected ring and snap ring.

NOTICE: Never clamp propeller shaft tubing or slip yoke sealing surface in a vise, as they may be damaged. Always clamp on one of propeller shaft ends and support shaft horizontally. Mark slip joint and propeller shaft to ensure correct reassembly.

Nylon Injected Ring Type

Figures 14 through 16

Tools Required:

J 9522-3 U-Joint Bearing Separator

J 9522-5 U-Joint Bearing Spacer Remover



Disassemble

1. Support shaft in horizontal position in line with base plate of a press.
2. Place universal joint so that lower ear of yoke is supported on a 1 1/8-inch socket.
3. Lower bearing cap (12) out of yoke ear by placing J 9522-3 on open horizontal bearing caps (12) and pressing lower bearing cap (12) out of yoke ear. This shears nylon injected ring on lower bearing cap (12). If bearing cap (12) is not completely removed, lift J 9522-3 and insert J 9522-5 between seal and bearing cap (12).
4. Press bearing cap (12) out of yoke.
5. Rotate shaft. Shear opposite nylon injected ring.
6. Opposite bearing cap (12) out of yoke.
7. Spider (4) from yoke.

- If front universal joint is being replaced, remove pair of bearing caps (12) from propeller shaft slip yoke in same manner.

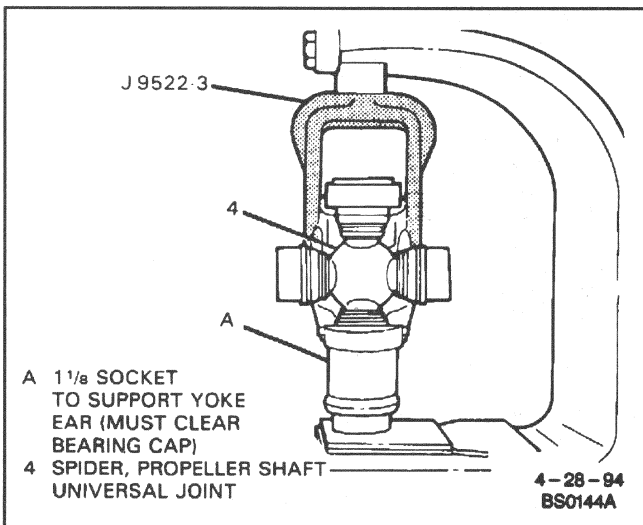


Figure 14 - Pressing Out Universal Joint Bearing

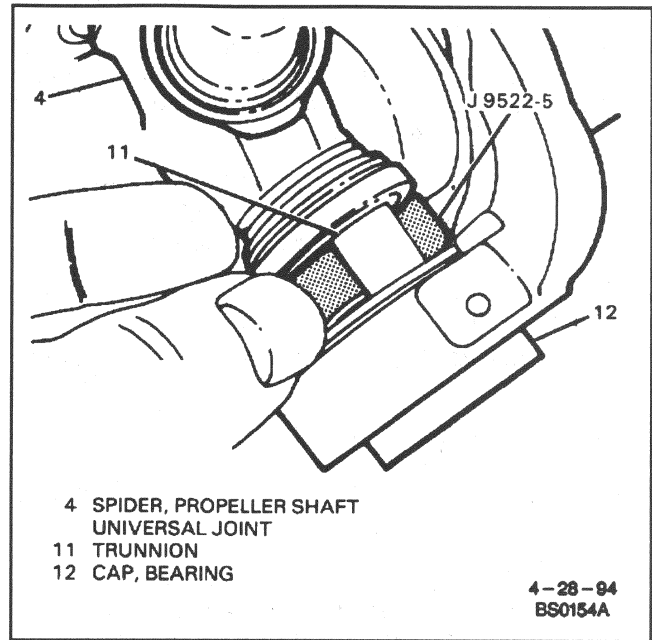


Figure 15 - Installing Universal Joint Bearing Spacer Remover

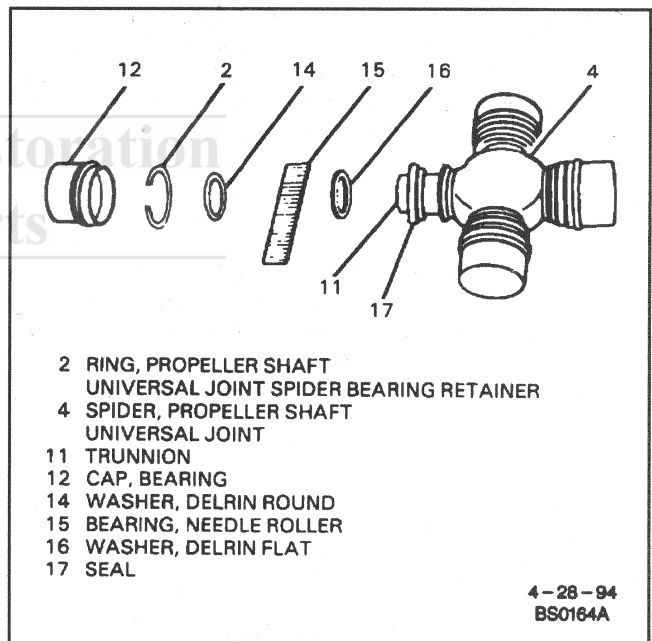


Figure 16 - Servicing Universal Joint



Clean

- Yoke in area locating retainer ring (2) to insure proper.
- All sheared nylon from universal joint cup bore.

NOTICE: Production universal joints of this type cannot be reassembled. Nylon injected ring types are replaced by external snap ring types.

4A-14 PROPELLER SHAFT

When reassembling a propeller shaft, always install a complete universal joint service kit. This kit includes one pregreased spider (4), four service bearing caps with seals (17), needle roller bearings (15), delrin round washers (14), delrin flat washers (16), grease and four retainer rings (2). Make sure that seals (17) are in place on service bearing caps (12) to hold needle roller bearings (15) in place during handling.



Assemble

For universal joint procedure, refer to "Snap Ring Type" in this section.

Snap Ring Type

Figures 14 through 19

Tools Required:

J 9522-3 U-Joint Bearing Separator

J 9522-5 U-Joint Bearing Spacer Remover

These universal joints are designed for extended life and do not require periodic inspections or lubrication. When these joints are taken apart, repack bearings and lubricant reservoir at end of trunnions with chassis lubricant GM P/N 1052356 or GM P/N 1052497 or equivalent. Use care not to loosen or damage dust seals. If dust seals are loose or damaged replace entire universal joint.



Disassemble

1. Retainer rings (2). If retainer ring (2) does not readily snap out of grooves, tap end of bearing cap (12) lightly to relieve pressure against retainer ring (2).
2. Support shaft in a horizontal position in line with base plate of a press.

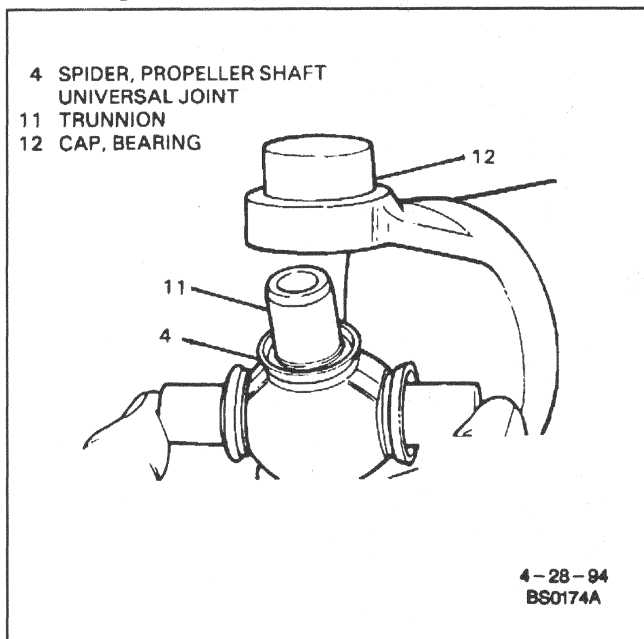


Figure 17 - Partially Inserted Bearing Cap

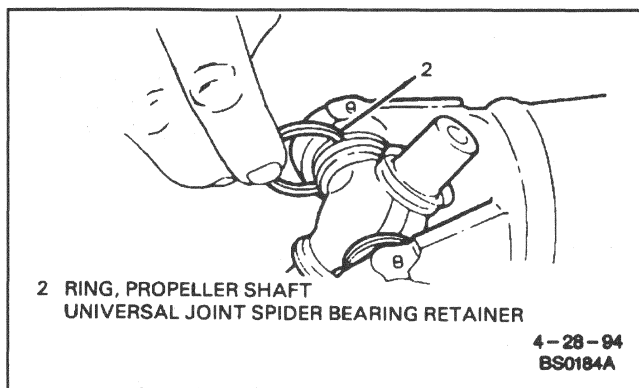


Figure 18 - Installing Propeller Shaft Universal Joint Spider Bearing Retainer Ring

3. Place universal joint so lower ear of yoke is supported on a 1 1/8-inch socket.
4. Lower bearing cap (12) out of yoke ear. Place J 9522-3 on open horizontal bearing cap (12). If bearing cap (12) is not completely removed, lift J 9522-3 and insert J 9522-5 between seal (17) and bearing cap (12) being removed. Complete removal of bearing cap (12) by pressing it out of yoke.
5. Rotate shaft and press opposite bearing cap (12) out of yoke.
6. Spider (4) from yoke.



Assemble

1. One bearing cap (12) part way into one side of yoke. Turn this yoke ear to bottom.
 - Insert J 9522-3 seating trunnion (11) in bearing cap (12).
2. Opposite bearing cap (12) part way.



Inspect

- Both trunnions (11) to ensure positioning is straight and true into bearing caps (12).
3. Press against opposite bearing caps (12), working spider (4) all of time to ensure free movement of trunnions (11) in bearings.

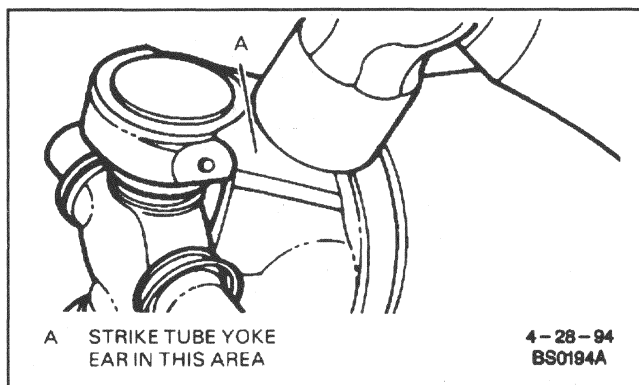


Figure 19 - Seating Propeller Shaft Universal Joint Spider Bearing Retainer Ring


Inspect

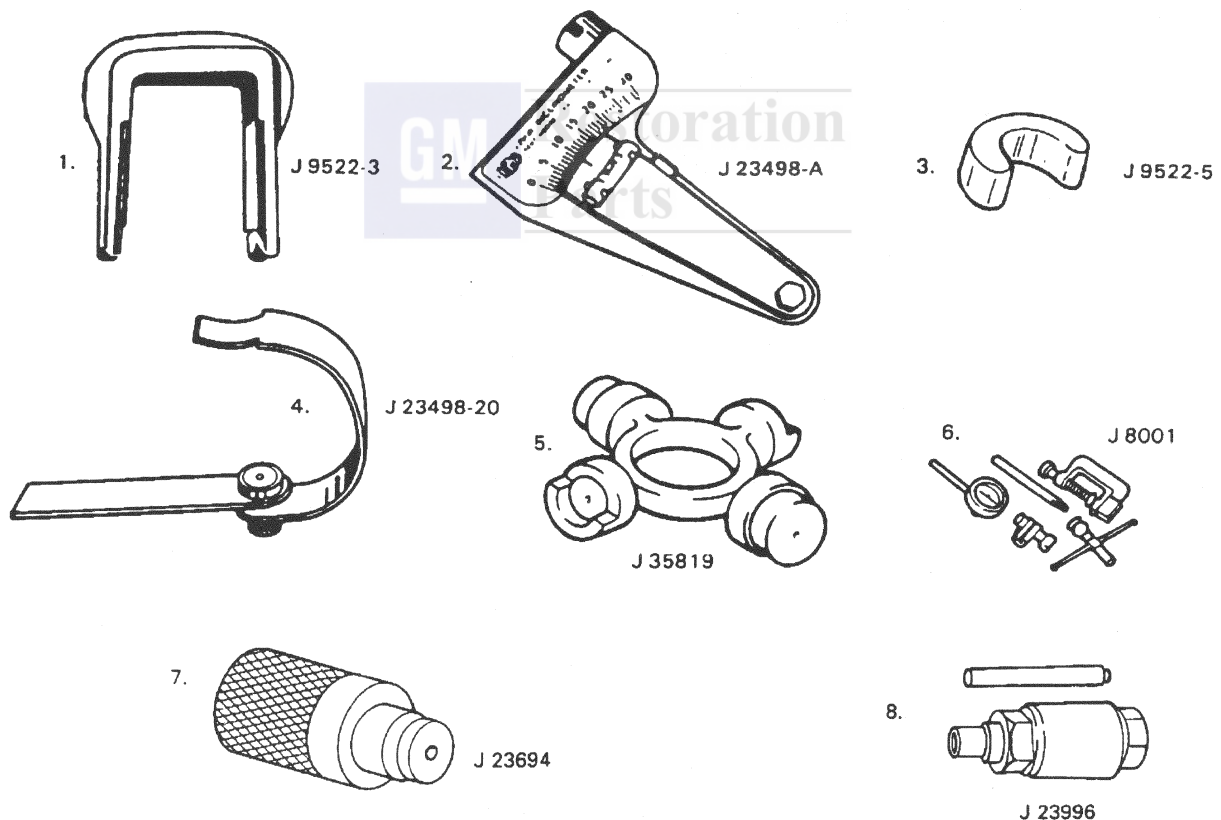
- Needle roller bearings (15) for binding. If binding, one or more needle roller bearings (15) has probably tipped under end of trunnion (11).
- 4. Stop pressing when one bearing retainer groove clears inside of yoke.
- 5. Retainer ring (2) by pressing into place.
 - Continue pressing until opposite side can be snapped into place. If needed, strike yoke firmly with hammer to aid in seating them. This springs yoke ears slightly.
- 6. Repeat steps 1 through 5 for other half of the universal joint.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Propeller Shaft Bolt/Screw 22 N-m (16 lb. ft.)

SPECIAL TOOLS



1. U-JOINT BEARING SEPARATOR
2. DRIVESHAFT INCLINOMETER
3. U-JOINT BEARING SPACER REMOVER
4. DRIVESHAFT INCLINOMETER ADAPTER
5. RUNOUT GAGE
6. DIAL INDICATOR SET
7. CONSTANT VELOCITY PROPELLER SHAFT SEAL INSTALLER
8. CONSTANT VELOCITY JOINT BALL REMOVER AND INSTALLER

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4A-16 PROPELLER SHAFT



SECTION 4B

REAR AXLE

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

REAR AXLE

Figures 1 and 2

The rear axle differential is a semi-floating type in which the vehicle weight is carried on the housing (37). The differential is designed for use with an open

driveline and coil springs. The differential has a hypoid type ring gear (3) with the centerline of drive pinion gear (16) below the centerline of ring gear (3).

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in housing (37). A removable steel cover (14) bolted to the rear of housing (37) permits service of the rear axle without removing it from the vehicle.

4B-2 REAR AXLE

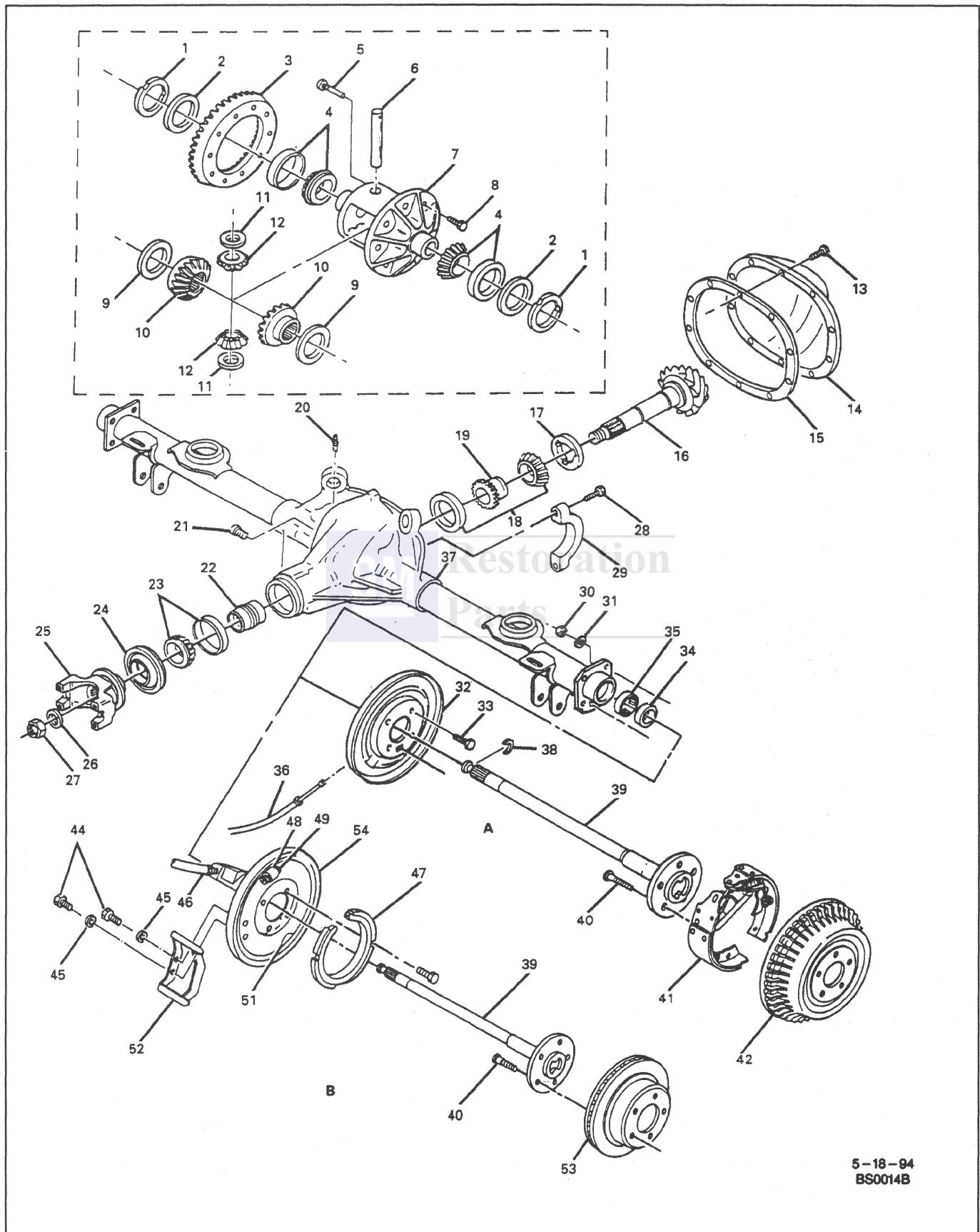


Figure 1 - Rear Axle

- | | |
|---|--|
| <p>A DRUM TYPE REAR BRAKE SYSTEM (TYPICAL)</p> <p>8 DISC TYPE REAR BRAKE SYSTEM (POLICE VEHICLES)</p> <p>1 SHIM, DIFFERENTIAL BEARING</p> <p>2 SPACER, DIFFERENTIAL BEARING</p> <p>3 GEAR, DIFFERENTIAL RING</p> <p>4 BEARING, DIFFERENTIAL</p> <p>5 BOLT/SCREW, DIFFERENTIAL PINION GEAR SHAFT LOCK, 36 N·m (27 LB. FT.)</p> <p>6 SHAFT, DIFFERENTIAL PINION GEAR</p> <p>7 CASE, DIFFERENTIAL</p> <p>8 BOLT/SCREW, DIFFERENTIAL RING GEAR, 120 N·m (89 LB. FT.) (LEFT-HAND THREAD)</p> <p>9 WASHER, DIFFERENTIAL SIDE GEAR THRUST</p> <p>10 GEAR, DIFFERENTIAL SIDE</p> <p>11 WASHER, DIFFERENTIAL PINION GEAR THRUST</p> <p>12 GEAR, DIFFERENTIAL PINION</p> <p>13 BOLT/SCREW, REAR AXLE HOUSING COVER, 30 N·m (22 LB. FT.)</p> <p>14 COVER, REAR AXLE HOUSING</p> <p>15 GASKET, REAR AXLE HOUSING COVER</p> <p>16 GEAR, DIFFERENTIAL DRIVE PINION</p> <p>17 SHIM, DIFFERENTIAL DRIVE PINION GEAR BEARING</p> <p>18 BEARING, DIFFERENTIAL DRIVE PINION GEAR INNER</p> <p>19 RING, REAR AXLE SPEED SENSOR</p> <p>20 VENT, REAR AXLE HOUSING</p> <p>21 PLUG, REAR AXLE HOUSING DRAIN, 35 N·m (26 LB. FT.)</p> <p>22 SPACER, DIFFERENTIAL DRIVE PINION GEAR BEARING</p> <p>23 BEARING, DIFFERENTIAL DRIVE PINION GEAR OUTER</p> <p>24 SEAL, DIFFERENTIAL DRIVE PINION GEAR</p> | <p>25 YOKE, DIFFERENTIAL DRIVE PINION GEAR</p> <p>26 WASHER, DIFFERENTIAL DRIVE PINION GEAR</p> <p>27 NUT, DIFFERENTIAL DRIVE PINION GEAR</p> <p>28 BOLT/SCREW, DIFFERENTIAL SIDE BEARING CAP, 75 N·m (55 LB. FT.)</p> <p>29 CAP, DIFFERENTIAL BEARING</p> <p>30 NUT, REAR BRAKE BACKING PLATE, 48 N·m (35 LB. FT.)</p> <p>31 WASHER, REAR BRAKE BACKING PLATE</p> <p>32 PLATE, REAR BRAKE BACKING</p> <p>33 BOLT/SCREW, REAR BRAKE BACKING PLATE</p> <p>34 SEAL, REAR AXLE SHAFT BEARING</p> <p>35 BEARING, REAR AXLE SHAFT</p> <p>36 CABLE, PARKING BRAKE REAR</p> <p>37 HOUSING, REAR AXLE</p> <p>38 LOCK, REAR AXLE SHAFT</p> <p>39 SHAFT, REAR AXLE</p> <p>40 WHEEL BOLT</p> <p>41 BRAKE, REAR</p> <p>42 DRUM, REAR BRAKE</p> <p>44 BOLT/SCREW, REAR BRAKE CALIPER ANCHOR BRACKET</p> <p>45 SPACER, REAR BRAKE CALIPER ANCHOR BRACKET</p> <p>46 CABLE, RIGHT PARKING BRAKE REAR</p> <p>47 BRAKE, REAR PARKING</p> <p>48 BOLT/SCREW, REAR ACTUATOR LEVER ADJUSTMENT</p> <p>49 ACTUATOR</p> <p>51 CLIP, REAR PARKING BRAKE</p> <p>52 BRACKET, REAR BRAKE CALIPER HOUSING</p> <p>53 ROTOR, REAR BRAKE</p> <p>54 MOUNTING PLATE, REAR BRAKE</p> |
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Figure 2 - Rear Axle - Legend

A universal joint connects the rear end of the propeller shaft to yoke (25), having a splined end which fits over and drives the drive pinion gear (16). Two preloaded tapered roller bearings support drive pinion gear (16) in housing (37). The race of inner bearing (18) and outer bearing (23) are a tight press fit in housing (37). Inner bearing (18) is a tight press fit onto drive pinion gear (16). Outer bearing (23) combines a light press fit with a close sliding fit on the yoke end of the differential drive pinion gear stem.

Located on the differential drive pinion gear shaft is the rear wheel speed sensor ring used by the Antilock Brake System (ABS) and Traction Control System (TCS) to transmit rear wheel speed information. The sensor ring is a press fit on the pinion shaft and is not reusable. For more information refer to SECTION 5E2.

Tightening nut (27) compresses a collapsible spacer (22) that bears against outer bearing (23) and inner bearing (18). This spacer (22) is used to enable automatic bearing preload adjustment and maintain a preload on both inner and outer bearings (18 and 23). Adjustment of the fore-and-aft position of drive pinion gear (16) is obtained by placing selective shims (17) between the head of drive pinion gear (16) and inner bearing (18).

Case (7) is one piece and is supported in housing (37) by two tapered roller bearings (4). These are preloaded by inserting shims (1) between bearings (4) and housing (37). Case (7) is positioned for proper differential ring gear to differential drive pinion gear backlash by varying the shim thickness from side to side. Ring gear (3) is bolted to case (7).

Two side gears (10) have splined bores for driving shafts (39). They are positioned to turn in counterbored cavities in case (7). The two pinion gears (12) have smooth bores and are held in position by a solid shaft (6), mounted and locked in case (7). All four gears are in mesh with each other. Pinion gears (12) turn freely on shaft (6), acting as idler gears when the rear wheels are turning at different speeds. Pinion gears (12) and side gears (10) are backed by steel thrust washers (9 and 11).

Operation

When the vehicle turns a corner, the differential allows the outer rear wheel to turn faster than the inner wheel. The inner wheel, turning slower with respect to the outer wheel, slows its rear differential side gear (as the shaft is splined to the differential side gear). The differential pinion gears roll around the slowed differential side gear, driving the other differential side gear and wheel faster.

LIMITED SLIP REAR AXLE

Limited slip rear axles have several definite operating characteristics. An understanding of these characteristics is necessary to aid diagnosis.

The energizing force comes from the thrust side of the gears. Consequently, a free spinning wheel may not have enough resistance to driving torque to apply the cones. If this occurs, applying the parking brake a few notches will provide enough resistance to energize the cones.

4B-4 REAR AXLE

Energizing the cones is independent of acceleration; therefore, a very slow application of the throttle on starting is recommended to provide maximum traction by preventing "break away" of either rear wheel.

All rear axle parts of vehicles with the limited slip rear axle are interchangeable with those equipped with the standard rear axle, except for the differential case. It is similar in all respects to the standard differential case, with the addition of cone clutches splined to each side gear. The Auburn limited slip differential case is non-serviceable and must be replaced.

REAR AXLE IDENTIFICATION

Figure 3

The axle identification code and manufacturer's code must be known before attempting to adjust or repair axle shafts or the differential. Rear axle ratio, differential type, manufacturer, and build date information is stamped on the right axle tube on the forward side, or is stamped on a metal tag on the housing cover. The service parts identification label also has RPO codes for the axle printed on it.

MAINTENANCE AND LUBRICATION

Figures 1 and 2

NOTICE: Refer to "Notice" on page 4B-1 of this section.

To check or add rear axle lubricant, hoist vehicle at suspension contact points. Refer to SECTION 0A. Keep vehicle level. Clean dirt or foreign material from around rear axle housing plug opening before removing plug (21). Maintain axle lubricant level from flush with bottom of opening to no lower than 15 mm (9/16 inch) below opening. Use GM P/N 1052271, or equivalent. Always replace plug (21).



Tighten

- Bolt/screw to 35 N.m (26 lb. ft.).

Limited slip differentials should have fluid drained and refilled at the first 12 500 km (7,500). Be sure to add limited slip additive GM P/N 1052358, or equivalent.

If the vehicle is used to pull a trailer, change rear axle lubricant every 12 500 km (7,500 miles) of trailer tow use.

DIAGNOSIS

Many noises reported as coming from the axle actually originate from other sources such as tires, road surfaces, wheel bearings, engine, transmission, muffler or body. A thorough and careful check should be made to determine the source of the noise before taking apart the axle. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the axle. Rear axle differential gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, observe the following:

1. Check rear axle lubricant to assure correct level, then drive vehicle far enough to thoroughly warm up rear axle lubricant.
2. Select a level asphalt road to reduce tire noise and body drumming.
3. Note speed at which noise occurs. Then stop vehicle and with automatic transmission control lever in "NEUTRAL," run engine slowly up and down through engine speeds, corresponding to vehicle speed at which noise was most pronounced, to determine if it is caused by exhaust, muffler roar, or other engine conditions.
4. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 345 kPa (50 psi) for test purposes only, will alter noise caused by the tires, but will not affect noise caused by the axle. Axle noise usually stops when coasting at speeds under 48 km/h (30 mph). Tire noise continues, but with

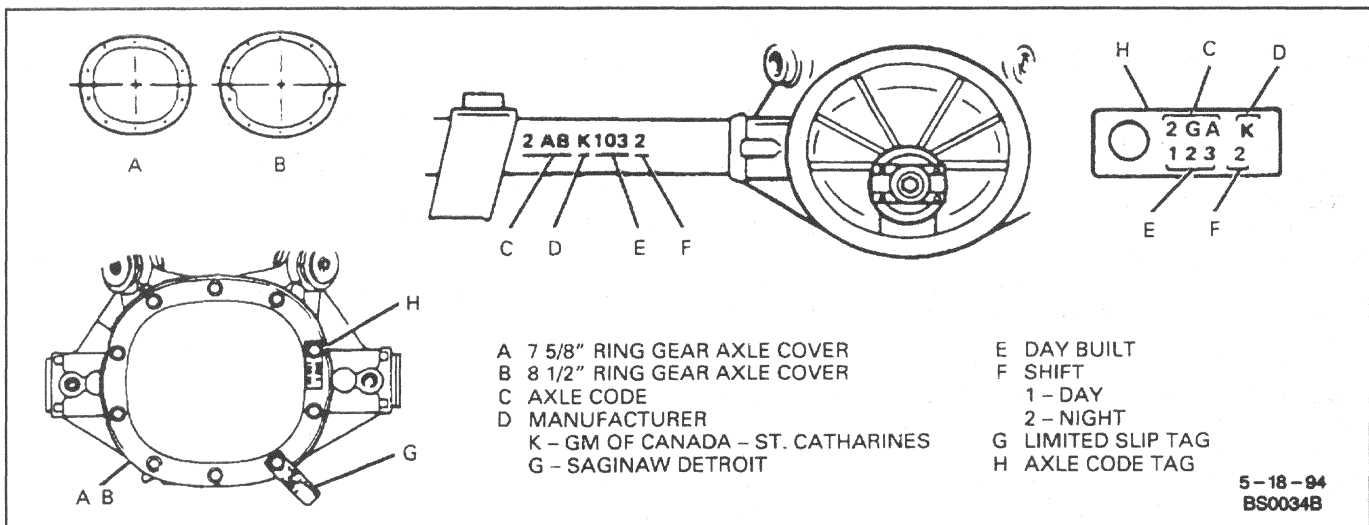


Figure 3 - Rear Axle Identification

a lower tone as vehicle speed is reduced. Axle noise usually changes when comparing drive and coast, but tire noise remains about the same.

- Distinguish between tire noise and axle noise by noting if noise varies with various speeds or sudden acceleration and deceleration. Exhaust and axle noises show variations under these conditions while tire noise remains constant and is more noticeable at speeds of 32 to 48 km/h (20 to 30 mph). Check for tire noise by driving vehicle over smooth pavement or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and appear again with changes in the road surface.
- 5. Loose or rough front wheel inner or outer bearings will cause a noise which may be confused with rear axle noise. Front wheel inner or outer bearing noise does not change when comparing drive and coast. Light application of the brake pedal while holding the vehicle speed steady will often cause front wheel inner or outer bearing noise to diminish, as this takes some weight off the bearing. Front wheel inner or outer bearings may be easily checked for noise by jacking up the wheels and spinning them or by shaking the wheels to determine if they are loose.
- 6. Rear suspension rubber bushings and spring insulators dampen out axle noise when correctly installed. Check that no metallic contact exists between the spring and spring opening in the frame or between upper and lower control arm bushings and frame or axle housing brackets. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by bushings.
- 7. Make sure that the floor of the body is not in metallic contact with the frame.

REAR AXLE NOISES

Gear Noise

After the noise has been determined as being in the axle, the type of noise should be established to help in making repairs if necessary.

Gear noise (whine) is audible from 32 to 89 km/h (20 to 55 mph) under four driving conditions:

1. Drive - Acceleration or heavy pull.
2. Road Load - Vehicle driving load or constant speed.
3. Float - Using enough throttle to keep the vehicle from driving the engine, the vehicle slows down gradually but the engine still pulls slightly.
4. Coast - Throttle closed and vehicle in gear. Gear noise most frequently has periods where noise is more noticeable, usually 48 km/h to 64 km/h (30 mph to 40 mph) and 80 km/h to 89 km/h (50 mph to 55 mph).

Bearing Noise

Bad bearings generally produce more of a rough growl or grating sound, rather than the whine typical of gear noise. Bearing noise frequently "wow-wows" at constant bearing rpm, indicating a faulty differential pinion or side bearing. This noise could easily be confused with rear axle shaft bearing noise. Inspect and replace as required.

Rear Axle Shaft Bearing Noise

A rough bearing produces a noise that continues with the vehicle coasting at low speed and automatic transmission control lever in "NEUTRAL." Noise may diminish with gentle braking. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough (noisy) bearing.

Knock at Low Speeds

Low-speed knock can be caused by a worn universal joint or a differential side gear hub counterbore in the differential case worn oversize. Inspect and replace universal joint or the differential case and differential side gear as required.

Backlash Clunk

Excessive clunk with acceleration and deceleration is caused by worn differential pinion gear shaft, worn differential case, excessive clearance between the axle shaft and differential side gear splines, excessive clearance between differential side gear hub and counterbore in case, worn differential pinion and side gear teeth, worn differential pinion gear thrust washers and excessive differential drive pinion gear-to-differential ring gear backlash. Remove worn parts and replace as required, selecting close fitting parts when possible. Adjust differential drive pinion gear-to-differential ring gear backlash. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" under "Unit Repair" in this section.

LIMITED SLIP REAR AXLE

Improper operation is generally indicated by cone slippage or grabbing. Sometimes this produces a chatter or whirring sound. These sounds are not always indicative of failure as they could be produced from lack of proper lubrication. For example, under certain conditions where one wheel is on a very slippery surface and the other is on dry pavement, wheel spin can occur if hard acceleration is attempted. Continued spinning may cause audible noise, such as a whirring sound, due to the cones lacking sufficient lubricant. This does not necessarily indicate a failure of the unit.

During regular operation (straight ahead driving) when both wheels rotate at equal speeds, there is an equal driving force delivered to each wheel. When cornering, the inside wheel requires extra driving force causing slippage in the clutch cone. Consequently, the operational life of the limited slip unit is dependant upon equal rotation of both wheels during straight ahead operation. If wheel rotation for both wheels is not equal during straight ahead operation, the limited slip unit will constantly be functioning as if the

4B-6 REAR AXLE

vehicle were cornering. This will impose constant slippage on the cone and will eventually lead to abnormal wear on the cone. It is important that there are no excessive differences in the rear wheel tire sizes, air pressures, or tire wear patterns. One indication of this condition is "swerving upon acceleration." If swerving upon acceleration is encountered, check the above items before replacing the limited slip differential.

Checking Limited Slip Operation

Figure 4

Tools Required:

J 2619-01 Slide Hammer with 1/2 x 13 Adapter

J 21579 Axle Shaft Remover

1. Place transmission control lever in "Park" position, parking brake lever released.
2. Raise both rear tires off the floor.
3. Remove hub cap or wheel disc and apply J 21579, the 1/2 x 13 adapter from J 2619-01 and a torque wrench.
4. Measure torque required to rotate one wheel. The torque should be between 169 and 305 N·m (125 and 225 lb. ft.).

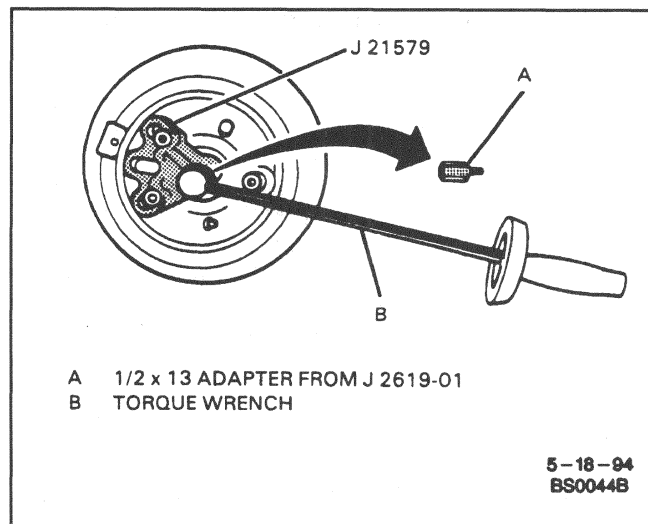


Figure 4 - Measuring Limited Slip Rotating Torque

5. Place transmission control lever in "Neutral" position and lower one rear tire to ground.
6. Measure torque required to rotate raised wheel. Torque should be between 60 and 136 N·m (44 and 100 lb. ft.).

The differential case must be replaced as an assembly if any of the above checks do not fall within specifications.

REAR AXLE STANDARD AND LIMITED SLIP DIAGNOSIS

CONDITION	CAUSE
Noise is the same in drive or coast.	• Road noise. • Tire noise. • Front wheel bearing noise. • Incorrect driveline angles.
Noise changes on a different type of road.	• Road noise. • Tire noise.
Noise tone lower as vehicle speed is lowered.	• Tire noise.
Noise is produced with vehicle standing and driving.	• Engine noise. • Automatic transmission noise.
Vibration.	• Rough rear axle shaft bearing. • Unbalanced or damaged propeller shaft. • Tire unbalance. • Worn universal joint in propeller shaft. • Incorrect driveline angles. • Mis-indexed propeller shaft at differential drive pinion gear yoke. • Differential drive pinion gear yoke runout too great.
A knock or click approximately every two revolutions of rear wheel.	• Rear axle shaft bearing.
Noise most pronounced on turns.	• Differential side gear and differential pinion gear noise.
A continuous low pitch whirring or scraping noise starting at relatively low speed.	• Differential drive pinion gear inner or outer bearing noise.
Drive noise, coast noise or float noise.	• Differential ring gear and drive pinion gear noise.

CONDITION	CAUSE
Clunk on acceleration or deceleration.	• Worn differential drive pinion gear shaft or differential side gear hub counterbore worn oversize. • Worn universal joint on propeller shaft. • Slip yoke lubrication insufficient.
Groan in forward or reverse.	• Wrong axle lubricant in axle.
Clunk or knock on rough road operation.	• Excessive end play of axle shafts.

INSPECTION AND DIAGNOSIS

A close examination of the differential prior to taking it apart will often reveal valuable information as to the extent and type of repairs or adjustments necessary. This information and the report of the malfunction provides a basis for determining the degree of tearing down required. Frequent causes of axle noise are improper backlash, differential drive pinion gear bearing preload, differential side bearing preload, or a combination of these items. A few simple adjustments may be all that are necessary to correct the problem.

Before removing the differential case from the housing, these items should be checked and the results recorded and analyzed: (1) backlash; (2) total differential preload; and (3) tooth contact pattern.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot, or sand, away from the rear axle to prevent the possibility of subsequent failure.

Differential Ring Gear Tooth Nomenclature

Figure 5

The side of the gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of the ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. The toe end of the tooth is smaller than the heel end.

Tooth Contact Pattern Test

Figures 1, 2, and 6

NOTICE: It is very important that tooth contact be tested before the differential is taken apart. Variations in the differential or drive pinion gear inner bearing may cause the drive pinion gear to be too far away from, or close to, the ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Clean all dirt from area of cover (14) before removing.

2. Remove housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.
3. Wipe axle lubricant out of housing (37) and carefully clean each tooth of ring gear (3).
4. Use gear marking compound GM P/N 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of differential drive pinion gear tooth contact will be visible when hand load is applied.



Tighten

- Bolts/screws (28) to 75 N.m (55 lb. ft.).
5. Apply parking brake lever until a torque of 54 to 70 N.m (40 to 52 lb. ft.) is required to turn drive pinion gear (16).
 - A test made without loading gears will not give a satisfactory pattern. Turn yoke (25) with a wrench so that ring gear (3) rotates one full revolution. Reverse rotation so that ring gear (3) rotates one revolution in opposite direction.
 6. Observe pattern on ring gear teeth and compare with Figure 6.
 7. Install housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

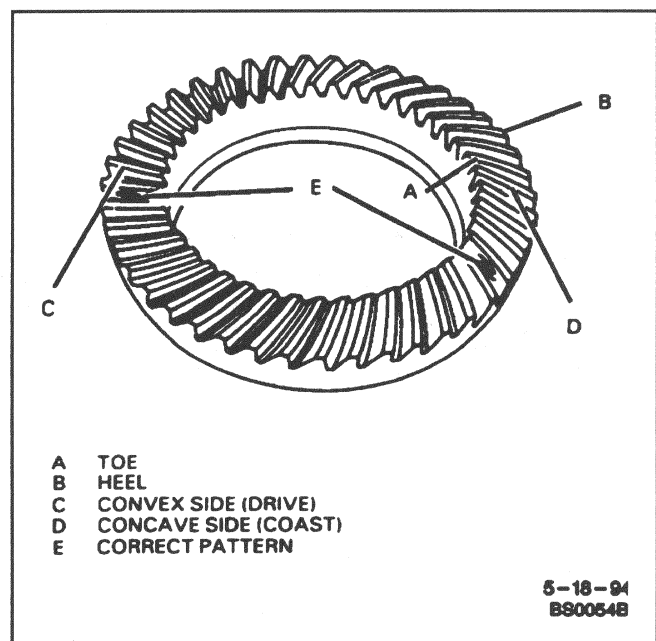
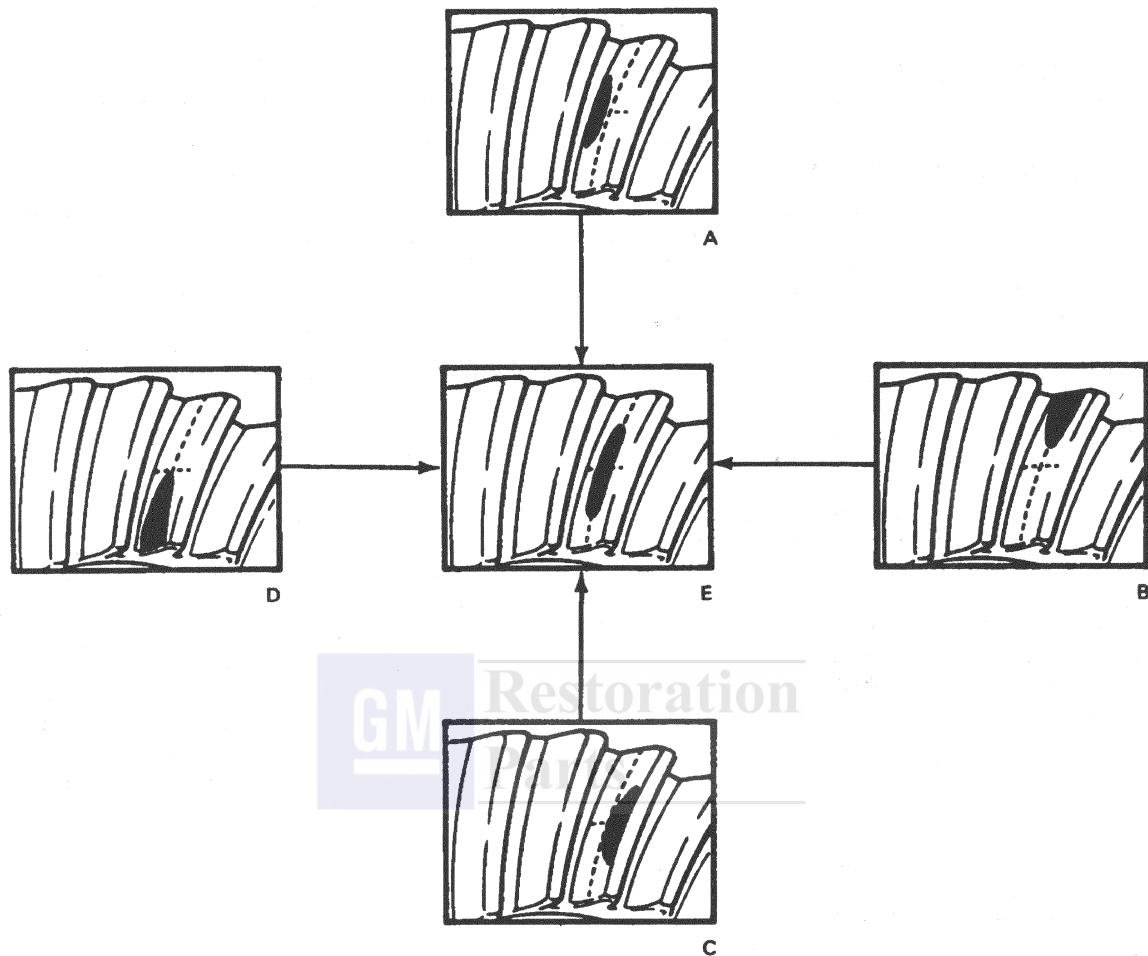


Figure 5 - Differential Ring Gear Tooth Nomenclature



- A LOW FLANK CONTACT: DECREASE DIFFERENTIAL DRIVE PINION GEAR BEARING SHIM THICKNESS — MOVES SMALLER DIAMETER OF DIFFERENTIAL DRIVE PINION GEAR OUT TOWARD DIFFERENTIAL RING GEAR CENTER LINE
- B HEEL CONTACT: DECREASE BACKLASH — MOVES AREA OF DIFFERENTIAL DRIVE PINION GEAR CONTACT TOWARD TOE
- C HIGH FACE CONTACT: INCREASE DIFFERENTIAL DRIVE PINION GEAR BEARING SHIM THICKNESS — MOVES LARGER DIAMETER OF DIFFERENTIAL DRIVE PINION GEAR IN TOWARD CENTER OF DIFFERENTIAL RING GEAR
- D TOE CONTACT: INCREASE BACKLASH — MOVES AREA OF DIFFERENTIAL DRIVE PINION GEAR CONTACT TOWARD HEEL
- E DESIRED PATTERN: IN CENTER OF DIFFERENTIAL RING GEAR TOOTH

Figure 6 - Differential Ring Gear Tooth Contact Pattern (Drive Side) Diagnosis Chart

Effects of Increasing Load on Tooth Contact Pattern

When the "load" on the ring gear and drive pinion gear is increased, such as when the vehicle is accelerated forward from stand still or from normal drive, the tooth contact will tend to spread out, and under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward the heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend only about halfway.

The important thing to note is that the contact pattern is centrally located up and down on the face of the differential ring gear teeth.

Insufficiently preloaded drive pinion gear and differential bearings will also cause a change in tooth contact pattern under load.

Adjustments Affecting Tooth Contact

Figure 7

Two adjustments can be made which will affect the tooth contact pattern: backlash and position of drive pinion gear (16) in the housing. The effects of bearing preloads are not readily apparent on hand-loaded tooth contact pattern tests.

Backlash is adjusted by means of shims (1). They move the entire differential closer to, or farther from, drive pinion gear (16). Shims (1) are also used to set differential bearing preload. If the thickness of the right shim (1) is increased, along with decreasing the left shim (1) thickness, backlash will increase. The backlash will decrease if the left shim (1) thickness is increased, along with a decrease in the right shim (1) thickness.

The position of drive pinion gear (16) is adjusted by increasing or decreasing the drive pinion gear bearing shim thickness between the drive pinion gear head and race of the drive pinion gear inner bearing. Shim (17) is used in the axle to compensate for manufacturing tolerances. Increasing thickness moves drive pinion gear (16) closer to the centerline of ring gear (3). Decreasing thickness moves drive pinion gear (16) farther away from the centerline of ring gear (3).

Effects of Differential Drive Pinion Gear Position on Tooth Pattern

Figure 8

When the drive pinion gear is too far away from the centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on the coast side. Moving the drive pinion gear closer to the centerline of the ring gear by decreasing backlash will cause the high heel contact on the drive side to lower and move toward the toe; the high toe contact on the coast side will lower and move toward the heel.

When the drive pinion gear is too close to the centerline of the ring gear, the pattern will be a low toe contact on the drive side, and a low heel contact on the coast side. Moving the drive pinion gear farther away from the ring gear by increasing backlash will cause low toe contact on the drive side to raise and move toward the heel; the low heel contact on the coast side will raise and move toward the toe.

ON-VEHICLE SERVICE

Before attempting any service procedures the technician must know what type rear axle is to be serviced. Refer to "Rear Axle Usage Chart" in this section to identify codes, differential ring gear size, and ratios. Also, refer to the service parts identification label on the vehicle.

Most axle service repairs can be made by supporting the vehicle by the frame with the housing supported and lowered to its lowest travel. On some vehicles it may be necessary to disconnect rear shock absorbers to obtain additional clearance. When doing this, do not allow the rear brake hose to become kinked or stretched.

Axle lubricant may be drained by removing all housing cover bolts/screws and breaking the cover loose at the bottom.

If the housing is removed for any reason, axle service can be performed on the bench.

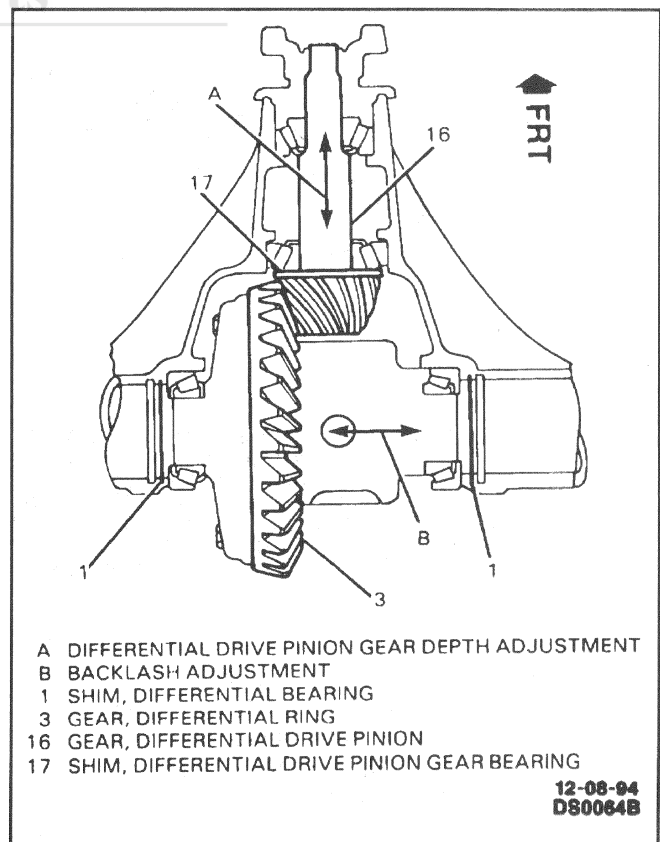


Figure 7 - Tooth Contact Adjustments

4B-10 REAR AXLE

When a new ring gear and drive pinion gear are installed, the owner should be advised not to accelerate rapidly or exceed 80 km/h (50 mph) for the first 80 km (50 miles) of driving.

REAR AXLE LUBRICANT FILL AND CHECK

Figures 1 and 2

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
 - Keep vehicle level.
2. Clean dirt or foreign material from around plug opening before removing plug (21).
3. Remove plug (21).
4. Maintain axle lubricant level from flush with the bottom of plug opening to no lower than 15 mm (9/16 inch) below plug opening.
5. Add or replace axle lubricant using GM P/N 1052271, or equivalent.
 - If limited slip differential, add rear axle friction modifier lubricant additive GM P/N 1052358, or equivalent.
6. Install plug (21) and tighten to 35 N.m (26 lb. ft.).
7. Lower vehicle.

REAR AXLE FLUSHING PROCEDURE

Figure 1

The rear axle flushing procedure should be performed if any small metal particles or chips are noticed in the rear axle lubricant or to remove varnish deposits on high mileage vehicles. If large metal particles are noticed, determine the cause and correct.

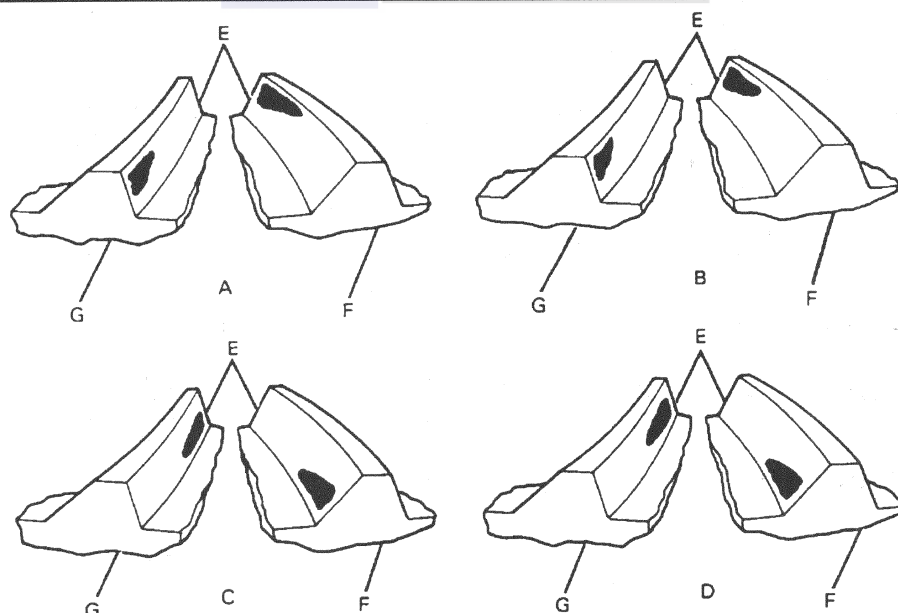
Remove or Disconnect

1. Rear axle housing cover and gasket. Refer to "Rear Axle Housing Cover and Gasket" in this section.
2. With vehicle in neutral, rotate propeller shaft until differential case window is facing down.



Clean

1. Using a medium size can of brake cleaner solvent and spray the following components:
 - Inside of rear axle housing.
 - Differential case.
 - Differential ring gear and drive pinion gear.
 - Differential side gears.
 - Differential pinion gears.
2. Continue to spray the above components while rotating the propeller shaft to ensure entire differential ring gear and drive pinion gear is sprayed with solvent.
3. Inside of rear axle housing cover.



- A DIFFERENTIAL DRIVE PINION GEAR TOO FAR AWAY FROM DIFFERENTIAL RING GEAR (INSUFFICIENT DIFFERENTIAL BEARING SHIM THICKNESS)
- B EFFECT ON PATTERN AS DIFFERENTIAL BEARING SHIM THICKNESS IS INCREASED
- C DIFFERENTIAL DRIVE PINION GEAR TOO CLOSE TO DIFFERENTIAL RING GEAR (EXCESSIVE DIFFERENTIAL BEARING SHIM THICKNESS)
- D EFFECT ON PATTERN AS DIFFERENTIAL BEARING SHIM THICKNESS IS DECREASED

- E TOE
- F HEEL, COAST SIDE (CONCAVE)
- G HEEL, DRIVE SIDE (CONVEX)

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Figure 8 - Differential Bearing Shim Thickness Effect On Tooth Pattern

4. Remove rear wheel speed sensor. Clean any foreign matter from sensor face. If sensor body or tip shows any evidence of damage, replace it. Refer to SECTION 5E1.

Install or Connect

- Rear axle housing cover and gasket. Refer to "Rear Axle Housing Cover and Gasket" in this section.

REAR AXLE HOUSING COVER AND GASKET

Figures 1 and 2

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (13) and pry cover (14) loose.

Clean

- All dirt from area of cover (14).
3. Cover (14).
 4. Drain axle lubricant.
 5. Gasket (15).
 - Clean both gasket sealing surfaces.

Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Cover (14) and new gasket (15).
2. Bolts/screws (13).

Tighten

- Bolts/screws (13) in a crosswise pattern to 30 N.m (22 lb. ft.).
3. Add axle lubricant. Refer to "Rear Axle Lubricant Fill and Check" in this section.
 4. Lower vehicle.

REAR AXLE SHAFT

Figures 1, 2, and 9

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Rear tire and wheels. Refer to SECTION 3E.
3. Rear brake drums, on vehicles equipped with rear drum brake systems. Refer to SECTION 5C2.
4. Rotor and rear parking brake shoe lining, on vehicles equipped with rear disc brake systems. Refer to SECTION 5B2.
5. Housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

6. Bolt/screw (5) from case (7).
7. Pinion gear shaft (6) from case (7).
8. Shaft lock (38).
- Access by pushing the flanged end of shaft (39) into housing (37).
9. Axle Shaft (39) from housing (37), being careful not to damage seal (34) or sensor (49) and sensor ring.
- Hold a shop towel under axle shaft (39) while pulling out to prevent axle lubricant from contaminating brake shoes and linings.

Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Shaft (39) into place taking care that splines on the end of shaft (39) do not damage seal (34) and that they engage with the splines of side gear (10).
- The 30-spline, 8 1/2-inch ring gear rear axle shaft is not interchangeable with any pre-1989 shaft.
2. Shaft lock (38).
- Push axle shaft (39) outward so that shaft lock (38) seats in counterbore of side gear (10).

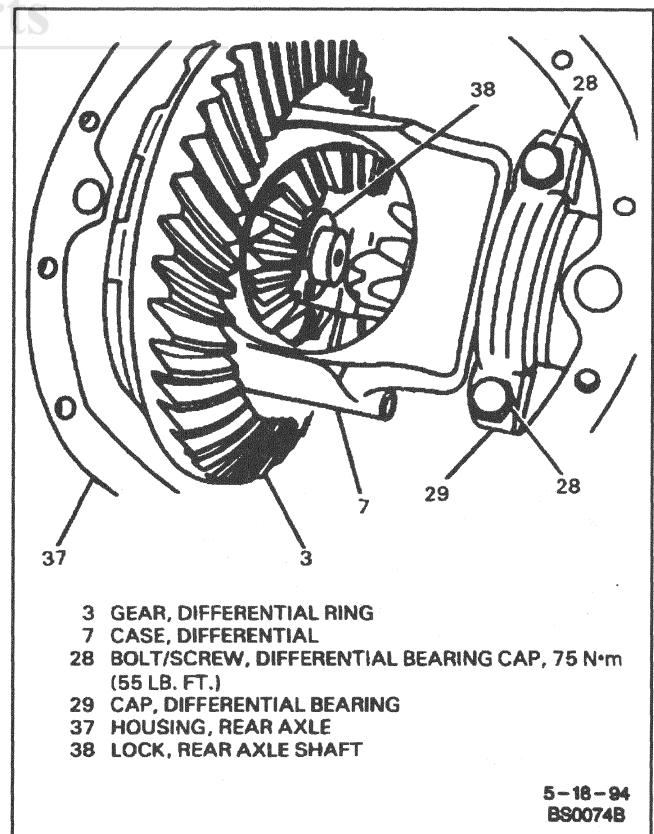


Figure 9 - Internal View of Rear Axle Housing (Non-Limited Slip)

4B-12 REAR AXLE

3. Pinion gear shaft (6) through case (7), thrust washers (11) and pinion gears (12), aligning the hole in shaft (6) with the shaft lock bolt/screw hole.
4. Bolt/screw (5).
 - Coat threads with Loctite® 242 (GM P/N 12345382) or equivalent.



Tighten

- Bolt/screw (5) to 36 N.m (27 lb. ft.).
5. Housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.
 6. Rear brake drum. Refer to SECTION 5C2.
 7. Rotor and rear parking brake shoe and linings, if removed. Refer to SECTION 5B2.
 8. Rear tire and wheels. Refer to SECTION 3E.
 9. Lower vehicle.

REAR AXLE SHAFT BEARING AND/OR BEARING SEAL

Figures 10 through 13

Tools Required:

- J 2619-01 Slide Hammer with 1/2 x 13 Adapter
- J 8092 Driver Handle
- J 22813-01 Axle Shaft Bearing Remover, 7 5/8 & 8 1/2-Inch Ring Gear (B Sedans)
- J 23689 Axle Shaft Bearing Remover, 8 1/2-Inch Ring Gear (B Wagons)

- J 23765 Axle Shaft Bearing Installer, 7 5/8 & 8 1/2-Inch Ring Gear (B Sedans)
- J 23690 Axle Shaft Bearing Installer, 8 1/2-Inch Ring Gear (B Wagons)
- J 23771 Axle Oil Seal Installer, 7 5/8 & 8 1/2-Inch Ring Gear (B Sedans)
- J 21128 Axle Oil Seal Installer, 8 1/2-Inch Ring Gear (B Wagons)



Remove or Disconnect

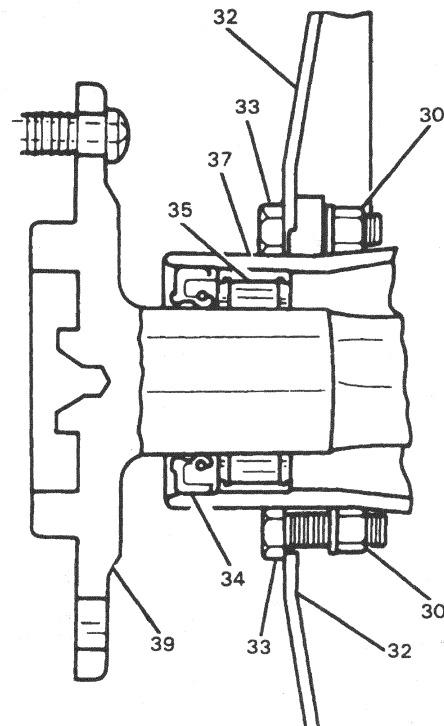
1. Rear axle shaft. Refer to "Rear Axle Shaft" in this section.
2. Rear brake backing plate (32), on vehicles equipped with rear drum brake system. Refer to SECTION 5C2.
3. Rear brake mounting plate, on vehicles equipped with rear disc brake system. Refer to SECTION 5B2.
4. Seal (34) from housing (37) with a pry bar behind steel case of seal (34), being careful not to damage housing (37).
5. Insert J 22813-01 or J 23689 into bore and position it behind bearing (35) so tangs on tool engage rear axle shaft bearing outer race.
6. Bearing (35), using J 2619-01.



Install or Connect

1. Lubricate new bearing (35) with gear lubricant. Use GM P/N 1052271, or equivalent.

- 30 NUT, REAR BRAKE BACKING PLATE, 48 N•m (35 LB. FT.)
- 32 PLATE, REAR BRAKE BACKING
- 33 BOLT/SCREW, REAR BRAKE BACKING PLATE
- 34 SEAL, REAR AXLE SHAFT BEARING
- 35 BEARING, REAR AXLE SHAFT
- 37 HOUSING, REAR AXLE
- 39 SHAFT, REAR AXLE



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Figure 10 - Rear Axle Shaft

2. Bearing (35) so that tool bottoms against shoulder in housing (37), using J 23765 or J 23690 and J 8092.
3. Lubricate sealing lips with gear lubricant. Use GM P/N 1052271, or equivalent.
4. Position seal (34) on J 23771 or J 21128 and direct seal (34) into housing bore.
5. Seal (34) into place, flush with the axle tube.
6. Rear disc brake mounting plate, if removed. Refer to SECTION 5B2.
7. Rear drum brake backing plate, if removed. Refer to SECTION 5C2.
8. Rear Axle shaft. Refer to "Rear Axle Shaft" in this section.

DIFFERENTIAL DRIVE PINION GEAR YOE AND SEAL

Figures 1, 2, and 14 through 17

Tools Required:

- J 8614-01 Pinion Flange Remover Set
- J 23911 Pinion Oil Seal Installer, 7 5/8-Inch Ring Gear
- J 22388 Pinion Oil Seal Installer, 8 1/2-Inch Ring Gear

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Both rear tire and wheels. Refer to SECTION 3E.
3. Rear brake drums, on vehicles equipped with rear drum brake systems. Refer to SECTION 5C2.
4. Rotor and rear parking brake shoe and lining, on vehicles equipped with rear disc brake system. Refer to SECTION 5B2.
5. Mark propeller shaft and yoke (25) so they can be assembled in same position.
6. Propeller shaft from yoke (25).
 - A. Remove four propeller shaft bolts/screws and two propeller shaft retainers attaching propeller shaft to yoke (25).

- B. Support propeller shaft up in body tunnel by wiring propeller shaft to the exhaust muffler.
 - If universal joint bearings are not retained by a retainer strap, use a piece of tape to hold universal joint bearings on their journals.
7. Mark position of yoke (25), drive pinion gear (16) and nut (27) so proper drive pinion gear inner and outer bearing preload can be maintained.
8. Check preload with a pound-inch torque wrench and record. This will give combined drive pinion gear inner and outer bearing, axle shaft bearing and differential bearing preload.
9. Nut (27), washer (26), and yoke (25) using J 8614-01.
 - Use a suitable container to hold any lubricant that may drain from axle.
10. Seal (24) by driving it out of housing (37) with a blunt chisel. Do not damage housing (37).

Inspect

- Differential drive pinion gear seal surface of yoke (25) for tool marks, nicks, or damage, such as a groove worn by seal (24). If damaged, replace yoke (25).

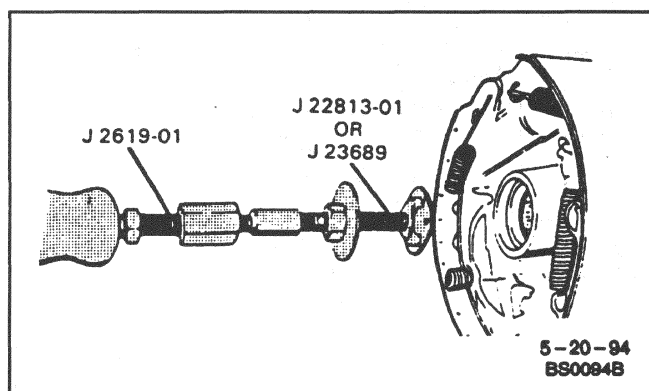


Figure 11 - Removing Rear Axle Shaft Bearing

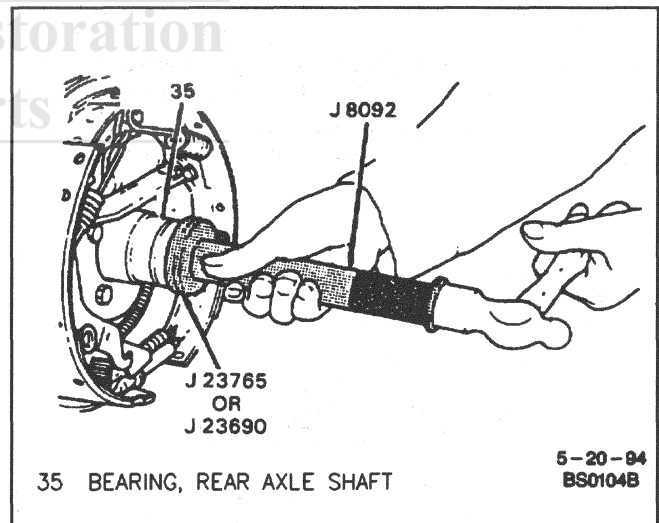


Figure 12 - Installing Rear Axle Shaft Bearing

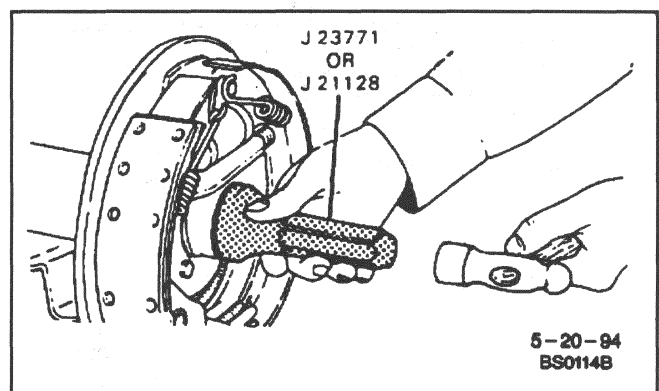


Figure 13 - Installing Rear Axle Shaft Bearing Seal

4B-14 REAR AXLE

- Housing bore and remove any burrs that might cause leaks around the outer diameter (OD) of seal (24).

Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Seal (24), using J 23911 or J 22388.
2. Apply seal lubricant, GM P/N 1050169 or equivalent, to OD of yoke (25) and sealing lip of new seal (24).
3. Yoke (25).
4. Washer (26) and nut (27) finger tight.
5. While holding yoke (25), using J 8614-01, tighten nut (27) gradually and turn drive pinion gear (16) several revolutions after each tightening to set

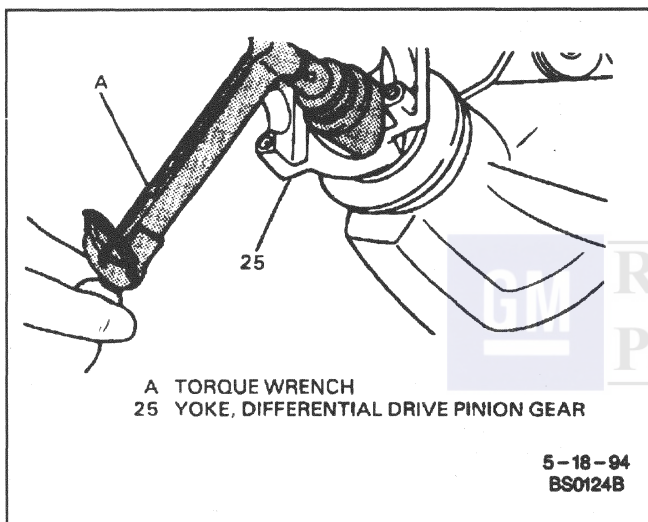


Figure 14 - Checking Differential Drive Pinion Gear Preload

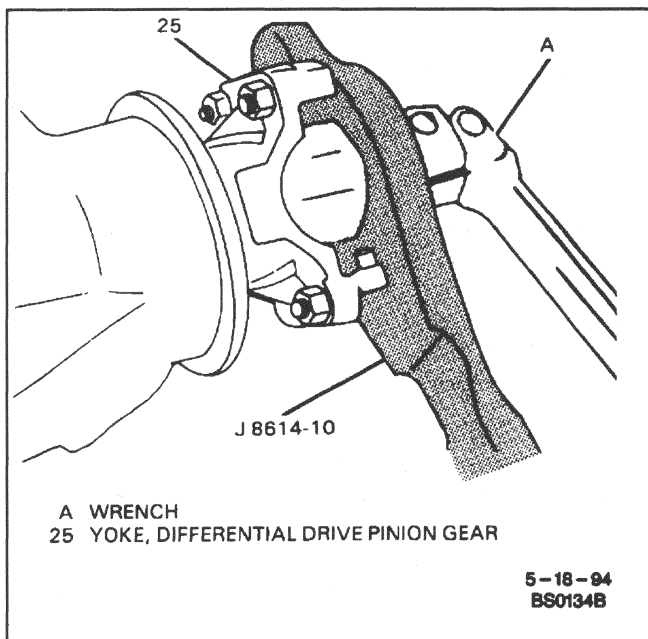


Figure 15 - Removing Differential Drive Pinion Gear Nut

bearings. Check preload of bearings each time with a pound-inch torque wrench until preload is 0.3 N.m to 0.6 N.m (3 lb. in. to 5 lb. in.) more than reading obtained in removal procedure.

6. Propeller shaft to yoke (25).

- Install two propeller shaft retainers and four propeller shaft bolts/screws attaching propeller shaft to yoke (25).

Tighten

- Propeller shaft bolts/screws to 22 N.m (16 lb. ft.).
7. Rear brake drums, if removed. Refer to SECTION 5C2.
 8. Rotor and rear parking brake shoe and lining, if removed. Refer to SECTION 5B2.
 9. Tire and wheels. Refer to SECTION 3E.
 10. Lubricant. Refer to "Rear Axle Lubricant Fill and Check" in this section.
 11. Lower vehicle.

Inspect

- Operation of axle.

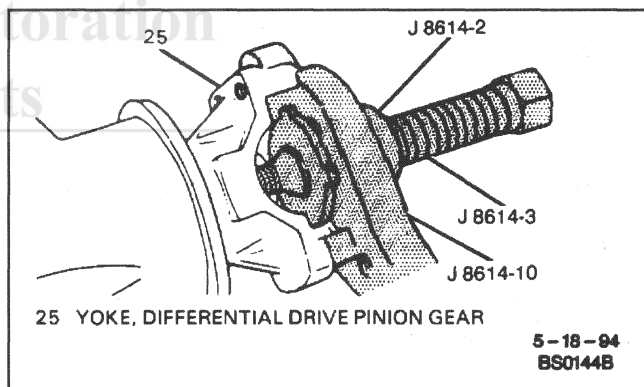


Figure 16 - Removing Differential Drive Pinion Gear Yoke

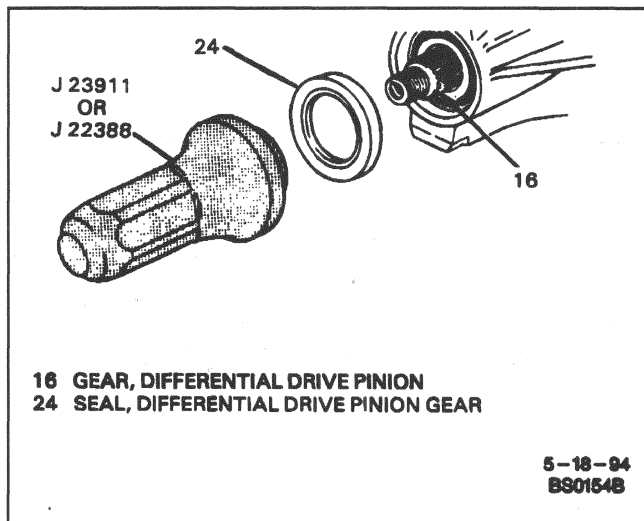


Figure 17 - Installing Differential Drive Pinion Gear Seal

REAR AXLE HOUSING REPLACEMENT

Figures 1 and 2

It is not necessary to remove the rear axle housing for any normal repairs. However, if the rear axle housing is damaged, it may be removed and installed using the following procedure.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support front end of vehicle with an adjustable lifting device.
3. Support housing (37) with an adjustable lifting device.
4. Rear wheel speed sensor. Refer to SECTION 5E1.
5. Automatic level control sensor link, if equipped. Refer to SECTION 5E1.
6. Propeller shaft. Refer to SECTION 4A.
7. Rear wheels and tires. Refer to SECTION 3E.
8. Rear brake pipes from rear brake hose fitting.
 - Be careful not to bend brake pipes.
 - Plug brake pipes and brake hose fittings to prevent loss of fluid and entrance of dirt.
9. Parking brake cables from equalizer and frame. Refer to SECTION 5F.
10. Bolt/screw attaching rear brake hose fitting to housing (37).
11. Rear brake pipe hose fitting from housing (37).
12. Rear brake pipe fittings from rear wheel cylinders on vehicles equipped with rear drum brake systems, if replacing housing (37).
13. Rear brake pipe fittings from rear brake hoses on vehicles equipped with rear disc brake systems, if replacing housing.
 - Plug brake pipe and brake hoses to prevent loss of brake fluid and entrance of dirt.
14. Rear brake pipes from housing (37), if replacing housing (37).
 - Disengage brake pipes from clips.
15. Rear springs. Refer to SECTION 3D.
16. Upper and lower control arms from rear axle housing. Refer to SECTION 3D.
 - Use a helper to stabilize housing (37).
17. Rear axle from hoist, with the aid of a helper.
18. Rear brake drums on vehicles equipped with rear drum brake systems, if replacing rear axle housing. Refer to SECTION 5C2.
19. Rotor and rear parking brake shoe and lining on vehicles equipped with rear disc brake systems, if replacing rear axle housing. Refer to SECTION 5B2.

20. Rear axle shaft, if replacing rear axle housing. Refer to SECTION 5C2.
21. Rear brake backing plate with parking brake cables attached on vehicles with rear drum brake systems, if replacing rear axle housing. Refer to SECTION 5C2.
22. Rear brake mounting plate on vehicles equipped with rear disc brake system, if replacing rear axle housing. Refer to SECTION 5B2.
23. Differential drive pinion gear, if replacing rear axle housing. Refer to "Differential Drive Pinion Gear" in this section.

Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Determine differential side bearing preload. Refer to "Differential Side Bearing Preload Adjustment" under "Unit Repair" in this section.
2. Drive pinion gear (16), if removed.
3. Rear brake mounting plate, if removed. Refer to SECTION 5B2.
4. Rear brake backing plate with parking brake cables attached, if removed. Refer to SECTION 5C2.
5. Rear axle shaft, if removed. Refer to "Rear Axle Shaft" in this section.
6. Rear brake drums, if removed. Refer to SECTION 5C2.
7. Rotor and rear parking brake shoe and lining, if removed. Refer to SECTION 5B2.
8. Rear axle to hoist, with the aid of a helper.
9. Lower and upper control arms. Refer to SECTION 3D.
10. Rear springs. Refer to SECTION 3D.
11. Rear brake pipes to housing (37), if housing (37) was replaced.
 - Engage brake pipes into clips or install straps.
12. Rear brake pipe fittings to rear brake hoses, if removed.

Tighten

- Rear brake pipe-to-rear brake hose fittings to 24 N·m (18 lb. ft.).
13. Rear brake pipe fittings to 24 N·m (18 lb. ft.).

Tighten

- Rear brake pipe fittings to 24 N·m (18 lb. ft.).
14. Rear brake hose fitting to housing (37).
 15. Bolt/screw to 27 N·m (20 lb. ft.).

Tighten

- Bolt/screw to 27 N·m (20 lb. ft.).
16. Parking brake cables to frame and equalizer. Refer to SECTION 5F.

4B-16 REAR AXLE

17. Rear brake pipes to rear brake hose fitting.
 - Unplug brake pipes and brake hose fittings.



Tighten

- Rear brake pipe-to-rear brake hose fitting to 24 N.m (18 lb. ft.).
18. Rear wheels and tires. Refer to SECTION 3E.
 19. Propeller shaft. Refer to SECTION 4A.
 20. Automatic level control sensor link, if equipped. Refer to SECTION 3D1.
 21. Rear wheel speed sensor. Refer to SECTION 5E1.
 22. Remove support from housing (37).
 23. Remove support from front end of vehicle.
 24. Bleed brake hydraulic system. Refer to SECTION 5.
 25. Adjust parking brake cable, if necessary. Refer to SECTION 5F.
 26. Lower vehicle.

WHEEL BOLT

Figures 1, 2, 18 and 19

Tool Required:

J 6627-A Wheel Stud Remover

When replacing rear wheel bolts (hub studs), use the following guide:

- Stripped bolt(s) - Replace the bolt(s) involved.
- One loose bolt - Replace all bolts.
- One broken bolt - Replace all bolts.
- Wheel bolt hole elongated - Replace rear axle shaft.



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Rear tire and wheel. Refer to SECTION 3E.
3. Mark relationship of drum (42) or rotor (53) to axle shaft flange.
4. Rear brake drum on vehicles equipped with rear drum brake system. Refer to SECTION 5C2.
5. Rotor and rear parking brake shoe and lining, on vehicles equipped with rear disc brake system. Refer to SECTION 5B2.
6. Wheel bolt (40) from rear axle shaft flange using J 6627-A.



Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Wheel bolt (40), four washers and wheel nut (43) to rear axle shaft flange.
2. Wheel nut (43) until wheel bolt (40) is completely seated against rear axle shaft flange.
3. Remove wheel nut (43) and four washers.

4. Rotor and rear parking brake shoe and lining, if removed. Refer to SECTION 5B2.
5. Rear brake drum, if removed. Refer to SECTION 5C2.
6. Rear tire and wheel. Refer to SECTION 3E.
7. Lower vehicle.

UNIT REPAIR



Important

- The driveline components in this vehicle have been factory system balanced. System balance provides a smoother running driveline operation. However, it is essential that the positions of all driveline components relative to the propeller shaft and rear axle be observed and **ACCURATELY REFERENCE MARKED PRIOR TO DISASSEMBLY**. These components include the propeller shafts, rear axles, differential drive pinion gear yoke, output shaft, etc. **ALL COMPONENTS MUST BE REASSEMBLED IN THE EXACT RELATIONSHIP TO EACH**

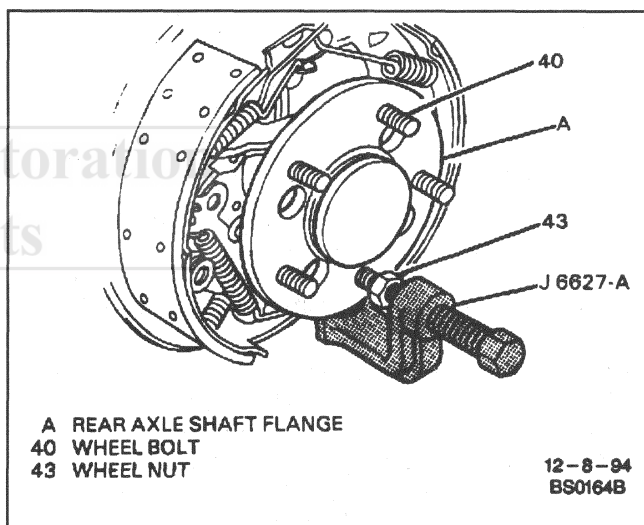


Figure 18 - Removing Wheel Bolt

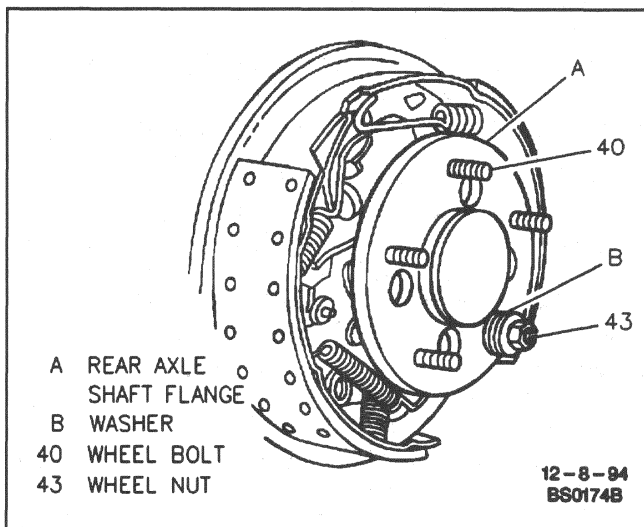


Figure 19 - Installing Wheel Bolt

OTHER AS THEY WERE WHEN REMOVED.

Additionally, the published specifications and torque values, as well as any measurements made prior to disassembly must be followed to maintain the factory balance.

When a new ring gear and drive pinion gear is installed, the original drive pinion gear yoke should be replaced with a service drive pinion gear yoke. The owner should be advised not to accelerate rapidly or exceed 80 km/h (50 mph) for the first 80 km (50 miles) of driving.

Any time the differential is taken apart for service, the following cleaning and inspecting procedures should be followed:



Clean

- All differential bearings thoroughly in clean solvent.



Inspect

- Bearings visually and by feel. Bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible. Minute scratches and pits that appear on rollers and races at low mileage are due to the initial preload, and bearings having these marks should not be replaced.
- Sealing surface of drive pinion gear yoke for nicks, burrs, or rough tool marks which would cause damage to the drive pinion gear seal and result in an axle lubricant leak. Replace if damaged.
- Housing bore and remove any burrs that might cause leaks around the OD of the drive pinion gear seal.
- Ring gear and drive pinion gear teeth for excessive wear and scoring. If any of these conditions exist, replacement of the gears as a set will be required.
- Differential pinion gear shaft for unusual wear. Also, check the differential pinion and side gears and differential pinion gear thrust washers.
- Press fit of the differential bearing inner race on the differential case hub by prying against the shoulder at the puller recess in the case. Differential bearings must be press fit on the hub.
- Rear axle failures such as chipped bearings, loose (lapped-in) bearings, chipped gears, etc. are indications that foreign material is present. The housing must be cleaned.

DIFFERENTIAL CASE

Figures 1, 2, and 20 through 25

Tools Required:

- J 8092 Driver Handle
- J 25588 Side Bearing Shim Installer
- J 21465-13 Driver Handle Extension
- J 22888-20A Differential Side Bearing Remover
- J 8107-2 Differential Side Bearing Remover Plug, 7 5/8-Inch Ring Gear
- J 8107-4 Differential Side Bearing Remover Plug, 8 1/2-Inch Ring Gear
- J 22761 Differential Side Bearing Installer, 8 1/2-Inch Ring Gear
- J 25299 Differential Side Bearing Installer, 7 5/8-Inch Ring Gear

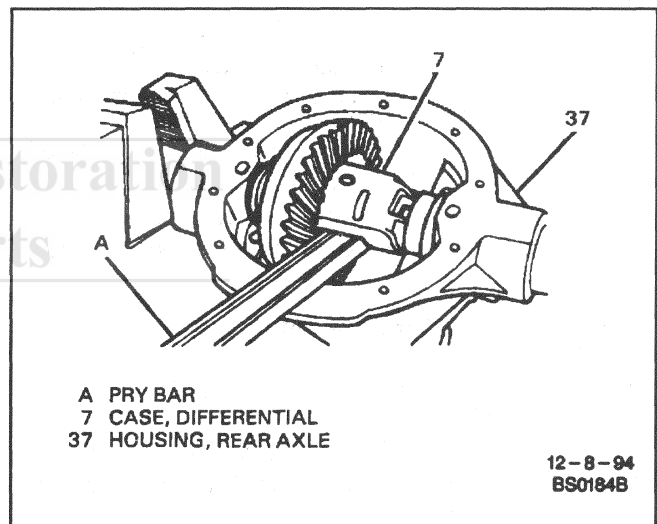


Figure 20 - Removing Differential Case

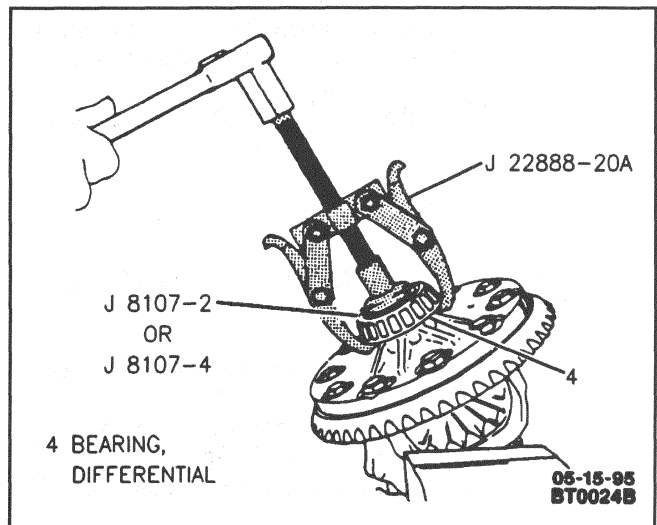


Figure 21 - Removing Differential Bearing

4B-18 REAR AXLE

Remove or Disconnect

Important

- Before removing case (7) from housing (37), differential ring gear-to-differential drive pinion gear backlash must be checked. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" in this section. This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining the cause of rear axle noise.

1. Axle shafts. Refer to "Rear Axle Shaft" in this section.
2. Bolts/screws (28).

Important

- Bearing caps (29) should be marked "R" and "L" to make sure they will be assembled in their original location.
 - Place right and left bearing outer races of bearings (4) and shims (1) in sets with marked caps (29) so that they can be reinstalled in their original positions.
3. Shims (1).

NOTICE: Exercise caution in prying on housing so cover gasket sealing surface is not damaged.

4. Case (7) from housing (37).

Disassemble

Figures 1, 2 and 21

1. Bearing (4) from case (7), if replacing, using J 22888-20 and J 8107-4 or J 8107-2.
2. Pinion gears (12), thrust washers (11), side gears (10) and thrust washers (9) from case (7).
 - Mark side gears (10) and case (7) so side gears (10) can be reinstalled in their original position.
3. All bolts/screws (8) from case (7), if replacing ring gear (3).
 - Bolts/screws (8) are left-hand thread type.
 - Discard bolts/screws (8).
4. Ring gear (3) from case (7).
 - Do not pry between ring gear (3) and case (7), if ring gear (3) is on tight.
 - Drive ring gear (3) from case (7) using a brass drift and hammer.

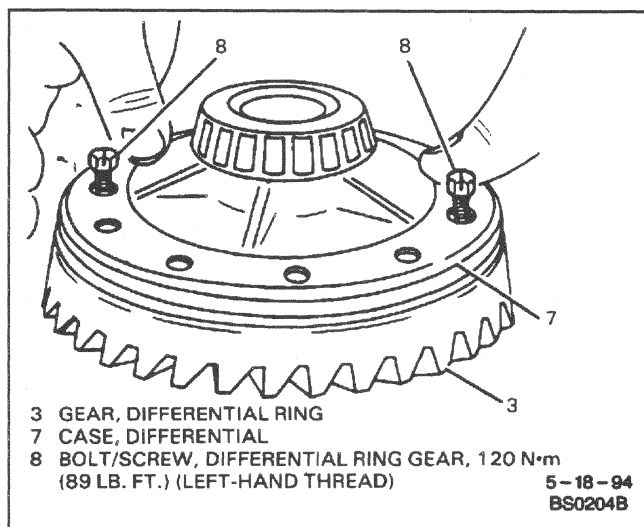


Figure 22 - Differential Ring Gear-to-Differential Case

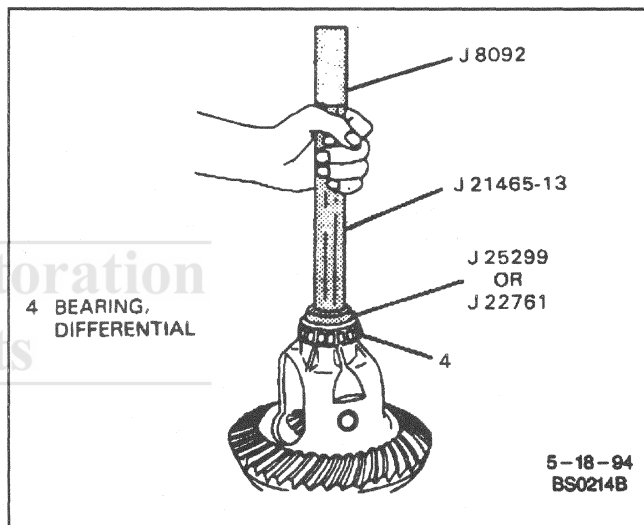


Figure 23 - Installing Differential Bearing

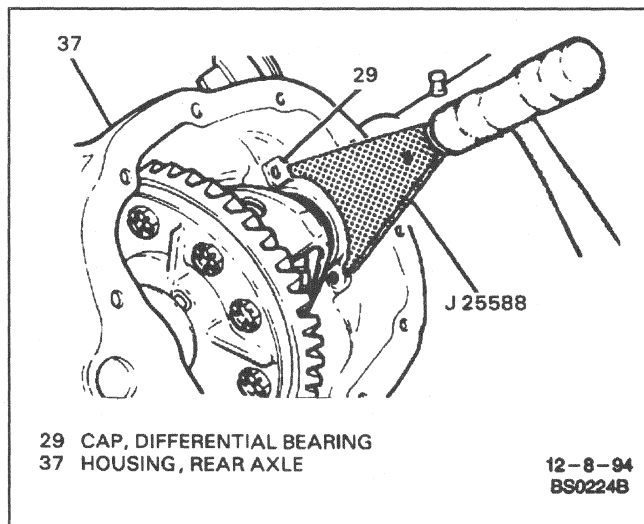


Figure 24 - Installing Differential Bearing Shim



Assemble

Figures 1, 2, and 26

NOTICE: Refer to "Notice" on page 4B-1 of this section.



Important

- Before assembling the differential, lubricate all parts with axle lubricant GM P/N 1052271, or equivalent.



Clean

- Connecting surfaces of ring gear (3) and case (7), if replacing ring gear (3).



Adjust

- Differential bearing preload adjustment. Refer to "Differential Bearing Preload Adjustment" in this section.

1. Ring gear (3) to case (7), if removed.
2. Two new bolts/screws (8) into opposite sides of ring gear (3) on case (7). If converting to an Auburn type limited slip rear axle, skip step 3.
 - Install remaining new bolts/screws (8) to case (7) until just snug.



Tighten

- New bolts/screws (8) alternately in progressive stages to 120 N·m (89 lb. ft.).
3. Thrust washers (9), side gears (10), pinion gears (12) and thrust washers (11) into case (7).
 - A. Thrust washers (9) over gear hubs and install side gears (10) in case (7). If same parts are reused, install in original sides. If side gears (10) are replaced, pre-1989 gears are not interchangeable.
 - B. Position one pinion gear (12) (without washer) between side gears (10) and rotate side gears (10) until pinion gear (12) is directly opposite loading opening in case (7). Place other pinion gear (12) between side gears (10) so that pinion gear shaft holes are in line; then rotate gears, lining up holes in pinion gears (12) with holes in case (7).
 - C. Rotate pinion gears (12) back toward loading opening just enough to permit sliding in thrust washers (11).
 4. Bearings (4) to case (7), if removed, using J 8092 and J 22761 or J 25299.



Install or Connect

Figures 1, 2 and 24

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. Case (7) into housing (37).

2. Shims (1) as determined during differential bearing preload adjustment.

- It will be necessary to drive the right differential bearing shim into position using J 25588.



Important

- Do not attempt to reinstall the production shims (1) as they may break when tapped into place.
- If service shims were previously installed, they can be reused, but whether using new or old bearings, adhere to the following procedure in all cases. If bearings are used again, they must have original outer races in place. Refer to "Differential Side Bearing Preload Adjustment" in this section.
- Keep ship packs in their respective position, right or left side.
- Select a shim 0.10 mm (0.004 inch) thicker than the one removed from the left side, then insert left side shim pack between the spacer and the left bearing race.
- Loosely install bearing cap (29).
- Select a shim 0.10 mm (0.004 inch) thicker than the one removed from the right side and insert between the spacer and the right bearing race.
- It will be necessary to drive the right shim into position using J 25588.

3. Bolts/screws (28).



Tighten

- Bolts/screws (28) to 75 N·m (55 lb. ft.).
4. Check backlash and correct if necessary. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" in this section.
 5. Rear axle shafts. Refer to "Rear Axle Shaft" in this section.

DIFFERENTIAL RING GEAR-TO-DIFFERENTIAL DRIVE PINION GEAR BACKLASH

Figures 1, 2 and 25

Tool Required:
J 8001 Dial Indicator Set



Remove or Disconnect

- Housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.



Measure

1. Rotate case (7) several times to seat bearings. Mount J 8001.
 - Use small button on indicator stem so that contact can be made near heel end of tooth.
 - Set J 8001 so that stem is in line with gear rotation and perpendicular to tooth angle for accurate backlash reading.

4B-20 REAR AXLE

2. Check backlash at three or four points around ring gear (3).

- Lash must not vary over 0.05 mm (0.002 in.) around ring gear (3).
- Drive pinion gear must be held stationary when checking backlash.

! Important

- If variation is over 0.05 mm (0.002 in.), check for burrs, uneven bolting conditions or distorted differential case flange and make corrections as necessary.

🔑 Adjust

1. Backlash at point of minimum lash should be between 0.13 mm and 0.20 mm (0.005 in. and 0.008 in.) for all new gears.
2. Backlash by increasing thickness of one shim (1) and decreasing thickness of other shim (1) the same amount.
 - For each 0.03 mm (0.001 in.) change in backlash desired, transfer 0.05 mm (0.002 in.) in differential bearing shim thickness.
 - To decrease backlash 0.03 mm (0.001 in.), decrease thickness of right shim (1) 0.05 mm (0.002 in.) and increase thickness of left shim (1) 0.05 mm (0.002 in.). To increase backlash 0.05 mm (0.002 in.), increase thickness of right shim (1) 0.10 mm (0.004 in.) and decrease thickness of left shim (1) 0.10 mm (0.004 in.).
 - Refer to "Differential Bearing Preload Adjustment" in this section for further information.

↔ Install or Connect

- Housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

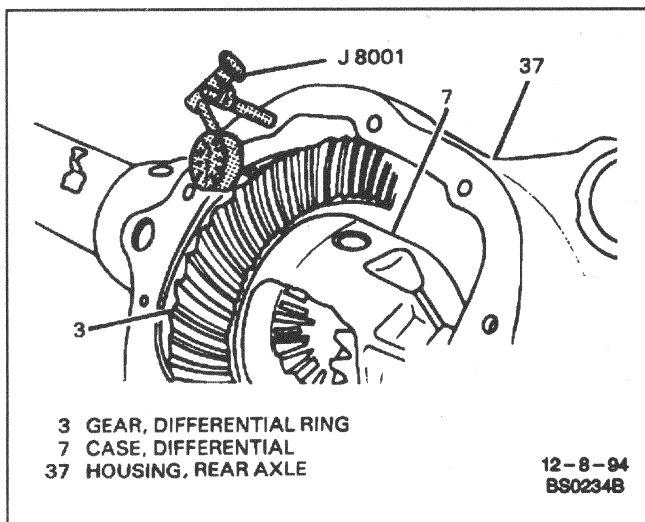


Figure 25 - Checking Differential Ring Gear-to-Differential Drive Pinion Gear Backlash

DIFFERENTIAL SIDE BEARING PRELOAD ADJUSTMENT

Figures 1 and 2

The differential bearing preload adjustment is to be made before installing drive pinion gear (16). If drive pinion gear (16) is installed, remove ring gear (3). Refer to "Differential Case" in this section.

Differential bearing preload is adjusted by changing the thickness of both the right and left shims (1) by an equal amount.

By changing the thickness of both shims (1) equally, the original backlash will be maintained.

Production shims (1) are cast iron and vary in thickness from 5.33 mm to 6.91 mm (0.210 in. to 0.272 in.) in increments of 0.05 mm (0.002 in.).

Standard service spacers (2) are 4.32 mm (0.170 in.) thick and steel service differential bearing shims (1) are available from 1.02 mm to 2.08 mm (0.040 in. to 0.082 in.) in increments of 0.05 mm (0.002 in.).

! Important

- If service shims (1) were previously installed, they can be reused, but whether using new or old bearings (4), adhere to the following procedure in all cases. If bearings (4), are used again, they must have original outer races in place.
1. Determine the approximate thickness of shims (1) needed by measuring each production shim (1) or each service spacer (2) and differential bearing shim pack.
 - In addition to service spacer (2), service shims (1) will be needed. Select a starting point in service differential bearing shim thickness.
 2. Place case (7) with differential bearing outer races in position in housing (37).
 3. Slip spacer (2) between each differential bearing race and housing (37) with chamfered edge against housing (37).

NOTICE: Install the left differential bearing cap loosely so that the differential case may be moved while checking adjustments. Another differential bearing cap bolt/screw can be added in the lower right differential bearing cap hole. This will prevent the differential case from dropping while making differential bearing shim adjustments.

4. Select one or two shims (1) totaling the amount shown in right-hand column of Figure 29 and position between the right differential bearing race and spacer (2).
 - Be sure the left differential bearing race and spacer (2) are against left side of housing (37).
5. Rotate case (7) while using feeler gage to assure an even reading.
 - The original light drag is caused by weight of case (7) against housing (37) while additional drag is caused by differential bearing preload.

- By starting with a thin feeler gage, a sense of "feel" is obtained so the beginning of preload can be recognized to obtain zero clearance.
 - It will be necessary to work case (7) in and out and to the left in order to insert feeler gage.
6. Remove left cap (29) and shim (1) from housing (37).
 7. The total differential bearing shim pack needed (with no preload on differential bearings) is the feeler gage reading found in step 5 plus the thickness of differential bearing shims installed in step 4.
 8. Select two shims (1) of approximately equal size whose total thickness is equal to the value obtained in step 7.
 - These shims (1) will be installed between each differential bearing race and service spacer (2) when case (7) is installed in housing (37).
 - The preload will not be added until case (7) is installed.
 9. If drive pinion gear (16) is in position, install ring gear (3). Refer to "Differential Case" in this section.

4.32 mm (0.170") SERVICE DIFFERENTIAL BEARING SPACER	
TOTAL THICKNESS OF BOTH PRODUCTION DIFFERENTIAL BEARING SHIMS REMOVED	TOTAL THICKNESS OF SERVICE DIFFERENTIAL BEARING SHIMS TO BE USED AS A STARTING POINT
10.57 mm (0.416")	1.52 mm (0.060")
10.92 mm (0.430")	1.78 mm (0.070")
11.18 mm (0.440")	2.03 mm (0.080")
11.43 mm (0.450")	2.29 mm (0.090")
11.68 mm (0.460")	2.54 mm (0.100")
11.94 mm (0.470")	2.79 mm (0.110")
12.19 mm (0.480")	3.05 mm (0.120")
12.45 mm (0.490")	3.30 mm (0.130")
12.70 mm (0.500")	3.56 mm (0.140")
12.95 mm (0.510")	3.81 mm (0.150")
13.21 mm (0.520")	4.06 mm (0.160")
13.46 mm (0.530")	4.32 mm (0.170")
13.97 mm (0.550")	4.83 mm (0.190")

T5607

DIFFERENTIAL DRIVE PINION GEAR

Figures 1 and 2

Tool Required:
Deadblow hammer or weighted rubber mallet.

Remove or Disconnect

1. Differential case. Refer to "Differential Case" in this section.
2. Check differential drive pinion gear inner and outer bearing preload. If there is no preload reading, check for looseness of drive pinion gear (16) by shaking. Looseness could be caused by

defective bearings or worn yoke (25). If the rear axle was operated for an extended period with very loose differential drive pinion gear inner and outer bearings, ring gear (3) and drive pinion gear (16) will also require replacement.

3. Differential drive pinion gear yoke. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
4. Drive pinion gear (16) from front pinion bearing and housing, using deadblow hammer or weighted mallet. Apply heavy hand pressure on pinion remover toward housing (37) to keep outer bearing (23) seated to avoid damage to outer race.

Install or Connect

1. If installing new differential ring gear and differential drive pinion gear, measure differential drive pinion gear depth. Refer to "Differential Drive Pinion Gear Depth" in this section.
2. Drive pinion gear (16) into housing (37).
3. Differential drive pinion gear yoke. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
 - A. Hold yoke (25).
 - B. While intermittently rotating drive pinion gear (16) to seat inner and outer bearings (18 and 23), tighten nut (27) until end play begins to be taken up.

Important

- When no further end play is detectable and when holder will no longer pivot freely as drive pinion gear (16) is rotated, preload specifications are being approached.
 - No further tightening should be attempted until the preload has been checked.
 - After preload has been checked, final tightening should be done very carefully.
 - Additional tightening of nut (27) can add many additional pound-inches of torque.
 - Nut (27) should be further tightened only slightly and the preload should be checked after each tightening.
 - Exceeding preload specifications will compress the collapsible spacer (22) too far and require the installation of a new spacer (22).
4. Set preload at 1.7 N·m to 3.4 N·m (15 lb. in. to 30 lb. in.) for 7 5/8 inch ring gear on new bearings or 2.0 N·m to 4.1 N·m (18 lb. in. to 36 lb. in.) for 8 1/2 inch ring gear on new inner and outer bearings (18 and 23) or 1.1 N·m to 1.7 N·m (10 lb. in. to 15 lb. in.) on used ones.
 5. Rotate drive pinion gear (16) several times to assure that inner and outer bearings (18 and 23) have been seated.
 - A. Check preload again.
 - B. If preload has been reduced by rotating drive pinion gear (16), reset preload to specifications.
 6. Differential case. Refer to "Differential Case" in this section.

4B-22 REAR AXLE

Differential Drive Pinion Gear Outer Bearing

Figures 1, 2 and 26

Tools Required:

- J 8092 Driver Handle
- J 7817 Front Pinion Bearing Cup Installer,
7 5/8 Inch Ring Gear
- J 8611-01 Front Pinion Bearing Cup Installer,
8 1/2 Inch Ring Gear



Remove or Disconnect

1. Differential drive pinion gear from rear axle housing. Refer to "Differential Drive Pinion Gear" in this section.
2. Differential drive pinion gear seal from rear axle housing. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
3. Outer bearing (23) from housing (37).
4. Outer bearing race from housing (37), if replacing outer bearing (23).
 - Drive race from housing (37), using a punch in slots provided for this purpose.



Install or Connect

1. Outer bearing race into housing (37), if removed, using J 8092 and J 8611-01 or J 7817.
2. Outer bearing (23) into housing (37).
3. Differential drive pinion gear seal. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
4. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

Rear Axle Speed Sensor Ring

Refer to "Differential Drive Pinion Gear Inner Bearing" below, for removal and installation procedures.

Differential Drive Pinion Gear Inner Bearing

Figures 1, 2 and 27 through 31

Tools Required:

- J 8092 Driver Handle
- J 22912-01 Universal Bearing Puller
- J 21493-B Rear Pinion Bearing Cone Remover, 7 5/8 Inch Ring Gear
- J 8612-B Rear Pinion Bearing Cone Remover, 8 1/2 Inch Ring Gear
- J 5590 Rear Pinion Bearing Cone Installer, 7 5/8 Inch Ring Gear
- J 35512 Rear Pinion Bearing Cone Installer, 8 1/2 Inch Ring Gear
- J 29609 Rear Pinion Bearing Cup Installer, 7 5/8 Inch Ring Gear
- J 8608 Rear Pinion Bearing Cup Installer, 8 1/2 Inch Rear Axle

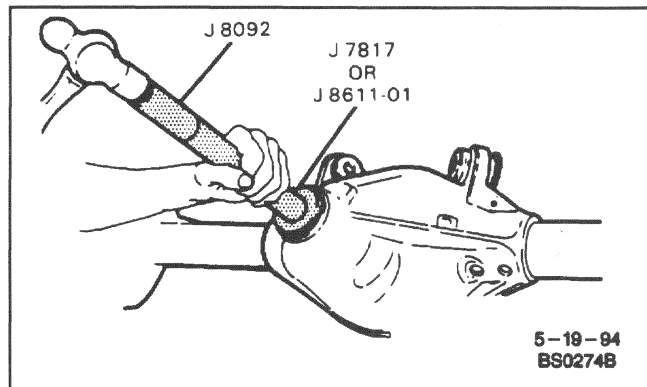


Figure 26 - Installing Differential Drive Pinion Gear Outer Bearing Race

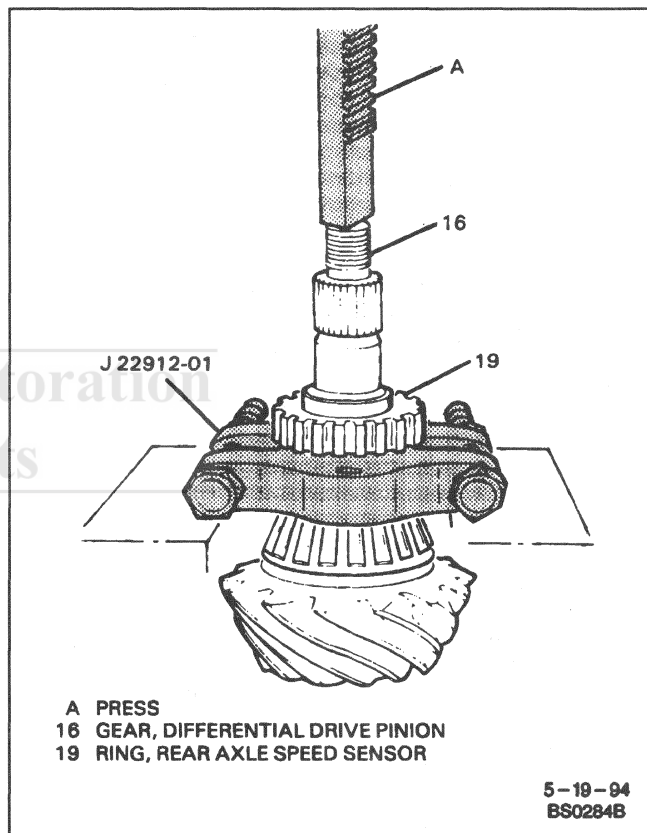


Figure 27 - Removing Rear Axle Speed Sensor Ring



Remove or Disconnect

1. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.
2. Spacer (22) from drive pinion gear (16).
 - Discard spacer (22).
3. Sensor ring (19) from drive pinion gear (16).
 - A. Use flat side of J 22912-01 facing sensor ring (19).
 - B. Discard sensor ring (19).
4. Drive pinion gear inner bearing race from housing (37), if replacing inner bearing (18).
 - Drive race from housing (37) using a punch in slots provided for this purpose.
5. Separate inner pinion bearing (18) from drive pinion gear (16).

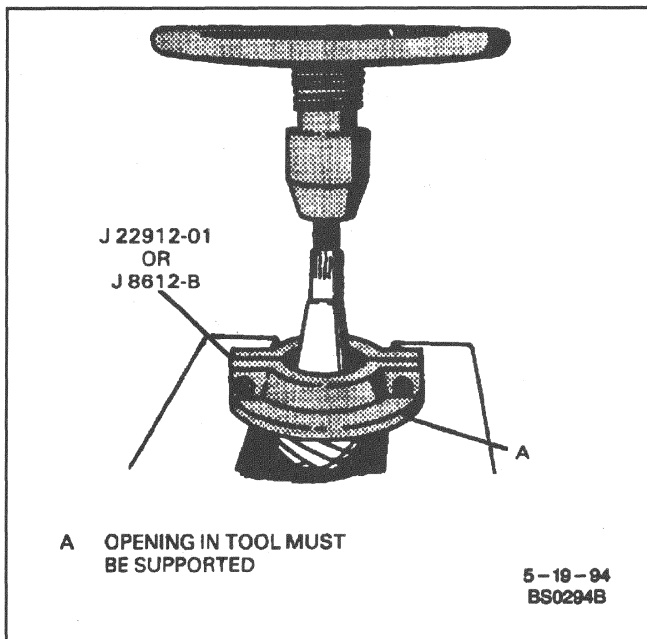


Figure 28 - Removing Differential Drive Pinion Gear Inner Bearing

- Use J 22912-01 (Universal) or J 8612-B (8 1/2 inch ring gear) or J 21493-B (7 5/8 inch ring gear).

Install or Connect

1. Inner bearing (18) onto drive pinion gear (16).
 - Use J 35512 or J 5590.
2. Inner bearing race into housing (37), if inner bearing (18) was replaced.
 - Use J 8092 and J 8608 or J 29609.

CAUTION: Once the rear wheel speed sensor ring has been removed from the differential drive pinion gear, a new rear speed sensor ring must be installed. The press fit may be lost if the rear speed sensor is used more than once. This would allow the rear speed sensor ring to rotate freely on the differential drive pinion gear shaft causing a significant reduction in performance of the antilock brake system, which could result in bodily injury.

3. New sensor ring (19) onto drive pinion gear (16).
 - Flat side of J 22912-01 faces sensor ring (19).
4. New spacer (22) onto drive pinion gear (16).
5. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

DIFFERENTIAL DRIVE PINION GEAR DEPTH

Figures 1, 2, 32 and 33

Tools Required (7 5/8-Inch Ring Gear):

- J 8001 Dial Indicator Set
- J 23597-1 Pinion Setting Gage - Arbor
- J 21777-42 Pinion Setting Gage - Front Pilot Washer
- J 21777-40 Pinion Setting Gage - Rear Pilot Washer
- J 23597-11 Pinion Setting Gage - Gage Plate
- J 23597-12 Pinion Setting Gage - Rear Pilot Washer
- J 21777-43 Pinion Setting Gage - Stud Assembly - Bolt
- J 21777-45 Pinion Setting Gage - Side Bearing Disc - 2 Req'd

Tools Required (8 1/2-Inch Ring Gear):

- J 8001 Dial Indicator Gage Set
- J 21777-1 Pinion Setting Gage - Arbor
- J 21777-29 Pinion Setting Gage - Gage Plate
- J 21777-35 Pinion Setting Gage - Rear Pilot Washer
- J 21777-42 Pinion Setting Gage - Front Pilot Washer
- J 21777-43 Pinion Setting Gage - Stud Assembly-Bolt
- J 21777-45 Pinion Setting Gage - Side Bearing Discs

Differential drive pinion gear depth is measured with a pinion setting gage. The gage provides a "nominal" or "zero" pinion as a gaging reference.

Disassemble

- Differential case. Refer to "Differential Case" in this section.

Remove or Disconnect

- Differential drive pinion gear inner bearing. Refer to "Differential Drive Pinion Gear Inner Bearing" in this section.

Clean

1. All parts of gage.
2. Differential bearing bore.
3. Differential drive pinion gear inner and outer bearing cups.
4. Lubricate outer bearing (23) and inner bearing (18) with axle lubricant. Use GM P/N 1052271, or equivalent.

Install or Connect

NOTICE: Refer to "Notice" on page 4B-1 of this section.

1. J 21777-43 through J 21777-35 or J 21777-40.

4B-24 REAR AXLE

2. J 23597-11 or J 21777-29.
3. J 21777-42 or J 21777-42 and nut in housing (37).

Tighten

- Nut to 2.3 N.m (20 lb. in.).
4. Rotate J 21777-29 or J 23597-11 to seat the bearings.
 5. Mount J 8001 on J 23597-1 or J 21777-1 and preload indicator against plunger about 1.27 mm (0.050 in.).
 6. J 21777-45 on J 23597-1 or J 21777-1 and position unit in housing (37).
 7. Bearing caps (29) and bolts/screws (28).

Tighten

- Bolts/screws (28) to 75 N.m (55 lb. ft.).

Adjust

- Differential drive pinion gear depth.
 - A. Rotate J 23597-1 or J 21777-1 slowly back and forth until J 8001 reads the greatest deflection (the point where the needle changes direction). At that point, set J 8001 to zero. Repeat rocking action to verify the zero setting.
 - B. After zero setting is obtained, rotate J 23597-1 or J 21777-1 just until the plunger no longer touches J 23597-11 or J 21777-29. This provides the gaging reference of a "zero" or "nominal" drive pinion gear (16).
 - C. Record J 8001 reading at pointer position. This indicates the proper shim (17) to use. Example: if pointer moved counterclockwise 1.70 mm (0.067 in.) to a dial reading of 0.84 mm (0.033 in.), this indicates a shim thickness of 0.84 mm (0.033 in.).
 - D. Required shim thickness is EQUAL to J 8001 reading.
 - E. Shims (17) are available in 0.03 mm to 0.94 mm (0.001 inch to 0.037 inch). Shim thickness is etched on the flat surface for easy identification.

Install or Connect

1. Loosen J 21777-43 and remove special tools and both bearings (4) from housing (37).
2. Correct shim (17) on drive pinion gear (16).

Important

- Proper differential drive pinion gear depth setting is a two-step procedure.
 - A. The set-up dimension arrived at using J 8001 is to be considered a starting point.

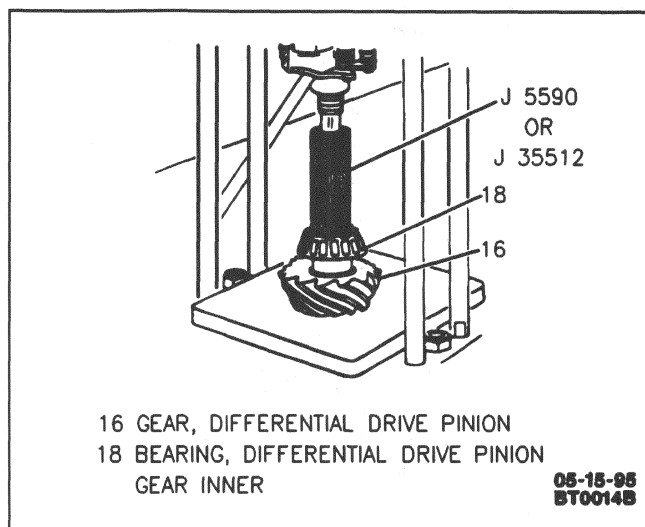


Figure 29 - Installing Differential Drive Pinion Gear Inner Bearing

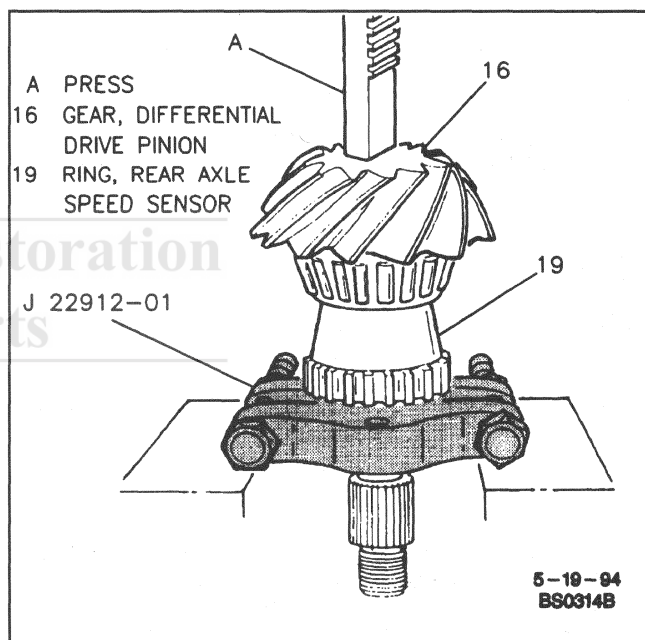


Figure 30 - Installing Rear Axle Speed Sensor Ring

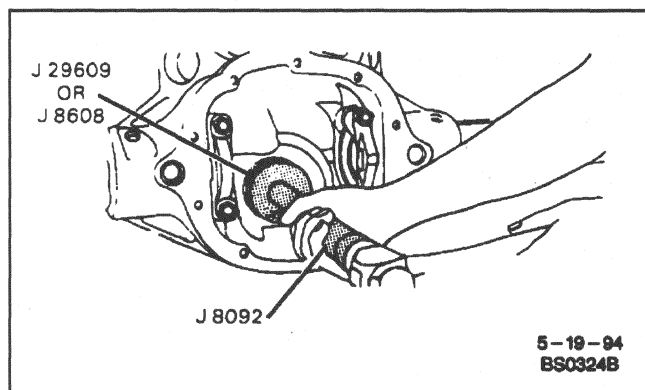


Figure 31 - Installing Differential Drive Pinion Gear Inner Bearing Race

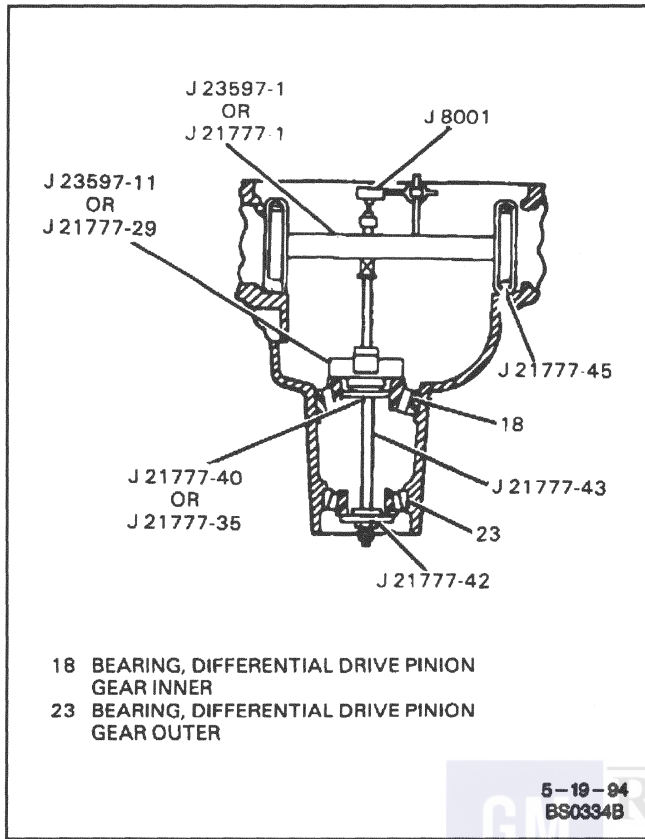


Figure 32 - Pinion Gage Plate Installed in Rear Axle Housing

B. A differential ring gear tooth pattern check is necessary to fine tune the differential drive pinion gear depth and may indicate additional shim (17) changes to the differential drive pinion gear stem. Refer to "Tooth Contact Pattern Test" in this section.

- Both procedures must be performed to insure proper rear axle performance.

3. Differential drive pinion gear inner bearing. Refer to "Differential Drive Pinion Gear Inner Bearing" in this section.



Assemble

- Differential case. Refer to "Differential Case" in this section.



Measure

- Preload of the total at nut (27). With new inner and outer bearings (18 and 23), preload is 4.0 to 4.5 N.m (25 to 40 lb. in.) rotating torque with a new seal (24). With used inner and outer bearings (18 and 23), preload is 2.3 to 2.8 N.m (10 to 25 lb. in.) rotating torque with a new seal (24).

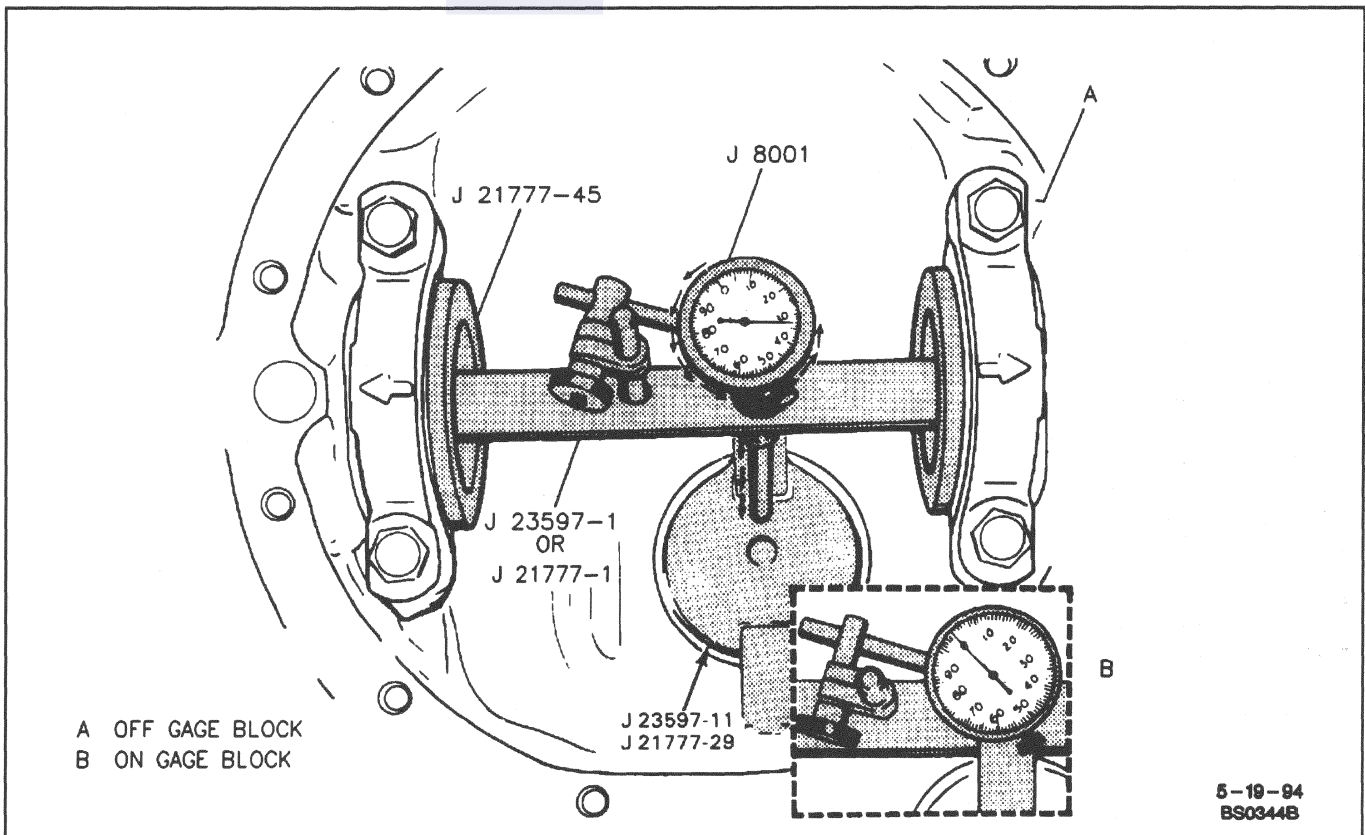


Figure 33 - Checking Differential Drive Pinion Gear Depth

4B-26 REAR AXLE

DIFFERENTIAL CASE (LIMITED SLIP)

Figure 34

The Auburn limited slip differential case is non-serviceable and must be replaced as an assembly. Removal and replacement of the differential case and service on the side bearings and ring gear is the same as for the standard rear axle.

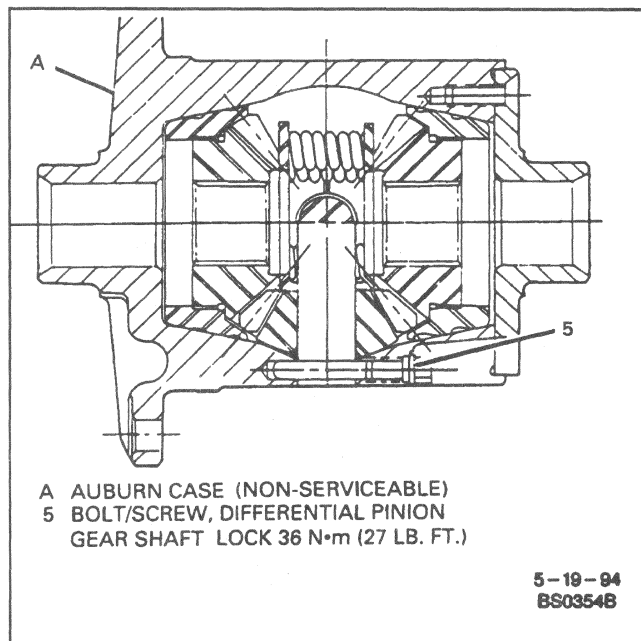


Figure 34 - Limited Slip Rear Axle - Auburn Type

SPECIFICATIONS

GENERAL SPECIFICATIONS

Rear Axle Type.....	Semi-Floating Hypoid
Drive and Torque.....	Through 4 Arms
Rear Axle Lubricant Capacity	
7 5/8-Inch Ring Gear.....	1.7 Liters (3.50 Pints)
8 1/2-Inch Ring Gear.....	2.03 Liters (4.20 Pints)
Limited Slip Additive.....	120 Milliliters (4 Fluid Ounces)
Differential Ring Gear and Differential Drive Pinion Gear Set Type.....	Hypoid
Differential Lubricant.....	GM P/N 1052271 or equivalent
Limited Slip Differential Additive Lubricant.....	GM P/N 1052358 or equivalent
Differential Drive Pinion Gear Seal Lubricant.....	GM P/N 9985092 or equivalent
Gear Marking Compound.....	GM P/N 1382262 or equivalent

FASTENER TIGHTENING SPECIFICATIONS

Differential Bearing Cap Bolt/Screw.....	75 N•m (55 lb. ft.)
Differential Drive Pinion Gear Setting Gage Nut.....	2.3 N•m (20 lb. in.)
Differential Pinion Gear Shaft Lock Bolt/Screw*.....	36 N•m (27 lb. ft.)
Differential Ring Gear Bolt/Screw (Left-Hand Thread).....	120 N•m (89 lb. ft.)
Propeller Shaft Bolt/Screw.....	22 N•m (16 lb. ft.)
Rear Axle Housing Cover Bolt/Screw.....	30 N•m (22 lb. ft.)
Rear Axle Housing Drain Plug.....	35 N•m (26 lb. ft.)
Rear Axle Lower Control Arm Bolt/Screw.....	155 N•m (114 lb. ft.)
Rear Axle Lower Control Arm Nut.....	121 N•m (89 lb. ft.)
Rear Axle Upper Control Arm Bolt/Screw.....	113 N•m (83 lb. ft.)
Rear Axle Upper Control Arm Nut.....	100 N•m (74 lb. ft.)
Rear Brake Backing Plate Nut.....	48 N•m (35 lb. ft.)
Rear Brake Hose Fitting Bolt/Screw.....	27 N•m (20 lb. ft.)
Rear Brake Rear Pipe-to-Rear Brake Hose.....	24 N•m (18 lb. ft.)
Rear Brake Rear Pipe-to-Rear Wheel Cylinder.....	24 N•m (18 lb. ft.)
Rear Shock Absorber Nut.....	68 N•m (50 lb. ft.)
Wheel Nut.....	140 N•m (100 lb. ft.)
Wheel Speed Sensor Bolt/Screw.....	8 N•m (71 lb. in.)

*Threads must first be coated with Loctite®242 (GM P/N 12345382) or equivalent.

LIMITS FOR FITTING AND ADJUSTING

Differential Drive Pinion Gear Inner and Outer Bearings Preload (Measured at Differential Drive Pinion Gear Yoke Nut)

New Bearings
(Rotating Torque with New Seal)

7 5/8-Inch Ring Gear 1.7 to 3.4 N.m (15 to 30 lb. in.)

8 1/2-Inch Ring Gear 2.0 N.m to 4.1 N.m (18 to 36 lb. in.)

Used Bearings 1.1 to 1.7 N.m (10 to 15 lb. in.)

Total Preload
(Measured at Drive Pinion Gear Yoke Nut)

New Bearings..... 4.0 to 4.5 N.m (35 to 40 lb. in.) Rotating Torque with New Seal

Used Bearings..... 2.3 to 2.8 N.m (20 to 25 lb. in.) Rotating Torque with New Seal

Ring Gear-to-Drive Pinion Gear Backlash..... 0.13 to 0.23 mm (0.005 to 0.009 in.)

REAR AXLE USAGE CHART

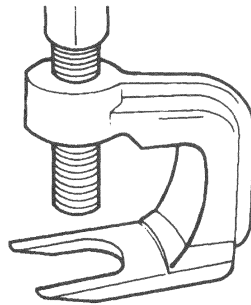
VEHICLE MODEL	RING GEAR DIA.	STAN. AXLE CODE	LIMITED SLIP AXLE CODE	AXLE GEAR RATIO	REAR BRAKE	TEETH RING GEAR: PINION	AXLE RPO	AXLE WIDTH (MM)
CHEV. SEDAN	7 5/8"	2GF*		2.93	9.5" DRUM	41:15	GW9	1598.0
CHEV. SEDAN	7 5/8"	2GG*		2.93	9.5" DRUM	41:15	GW9	1598.0
CHEV. SEDAN	8 1/2"	4ZB TAXI		2.93	11.0" DRUM	41:15	GW9	1566.0
CHEV. SEDAN	8 1/2"		2LQ	2.93	11.0" DRUM	41:14	GW9	1598.0
CHEV. SEDAN	8 1/2"		2LU	3.23	9.5" DRUM	42:13	GU5	1598.0
CHEV. SEDAN	8 1/2"	2LT	2LS	3.23	11.0" DRUM	42:13	GU5	1566.0
CHEV. SEDAN	8 1/2"		2GU TAXI	3.23	11.0" DRUM	42:13	GU5	1566.0
CHEV. SEDAN	8 1/2"	2LY POLICE	2LZ POLICE	3.23	DISC	42:13	GU5	1566.0
CHEV. SEDAN	8 1/2"	2LW POLICE	2LX POLICE	3.08	DISC	40:13	GU4	1566.0
CHEV. SEDAN	8 1/2"		2LL IMPALA SS	3.08	DISC	40:13	GU4	1598.0
CHEV. AND BUICK WAGON	8 1/2"	2YN		2.56	11.0" DRUM	41:16	GM8	1642.5
CHEV. AND BUICK WAGON	8 1/2"	2YF	2YG	2.93	11.0" DRUM	41:14	GW9	1642.5
BUICK SEDAN	8 1/2"	2GC	2GQ	2.56	11.0" DRUM	41:16	GM8	1566.0
BUICK SEDAN	8 1/2"		2NS	2.93	11.0" DRUM	41:14	GW9	1566.0

* Axle code 2GF is equipped with soft-mount housing bushings. Axle code "2GG" is equipped with firm-mount housing bushings.

SPECIAL TOOLS

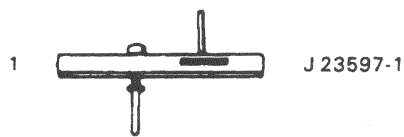
1 WHEEL STUD REMOVER

1



J 6627-A

5-19-94
BS0374B



J 23597-1



J 23597-11

7 5/8" RING GEAR

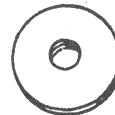
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- 2 PINION SETTING GAGE — GAGE PLATE
- 3 PINION SETTING GAGE — REAR PILOT WASHER
- 4 PINION SETTING GAGE — FRONT PILOT WASHER
- 5 PINION SETTING GAGE — STUD ASM-BOLT
- 6 PINION SETTING GAGE — SIDE BEARING DISCS

3



J 21777-40

4



J 21777-42

5



J 21777-43

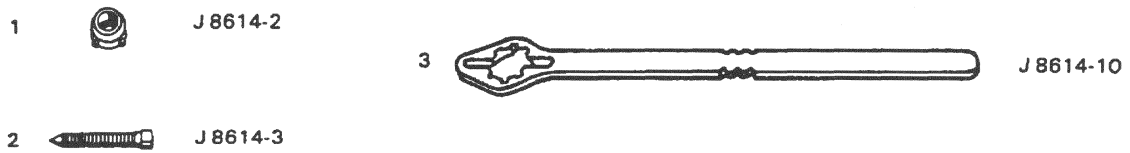
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J 21777-45

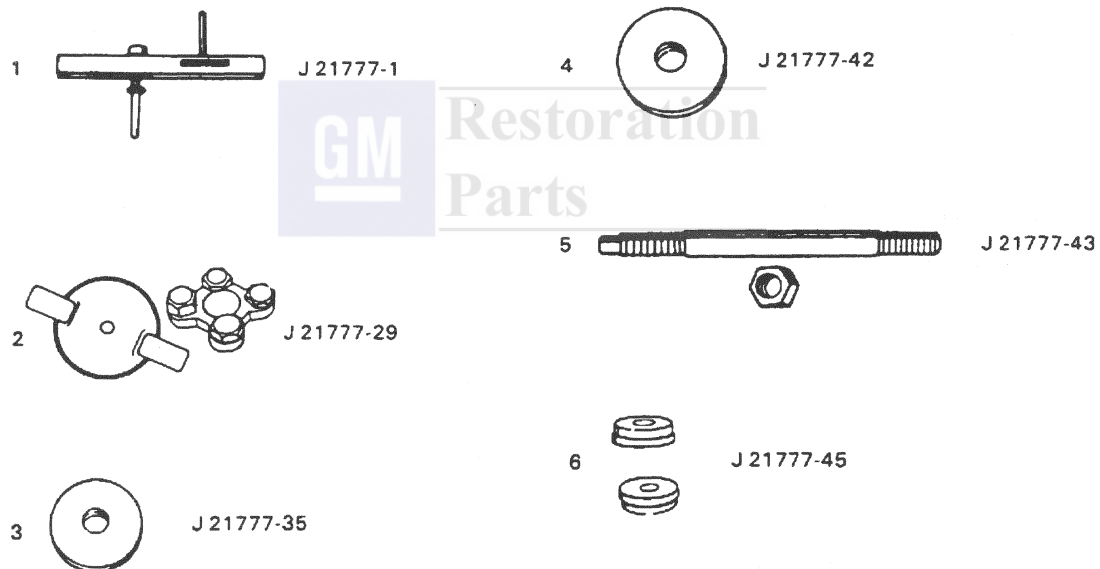
5-19-94
BS0384B

J 8614-01 SET



J 8614-01 SET, 7 5/8" AND 8 1/2" RING GEAR

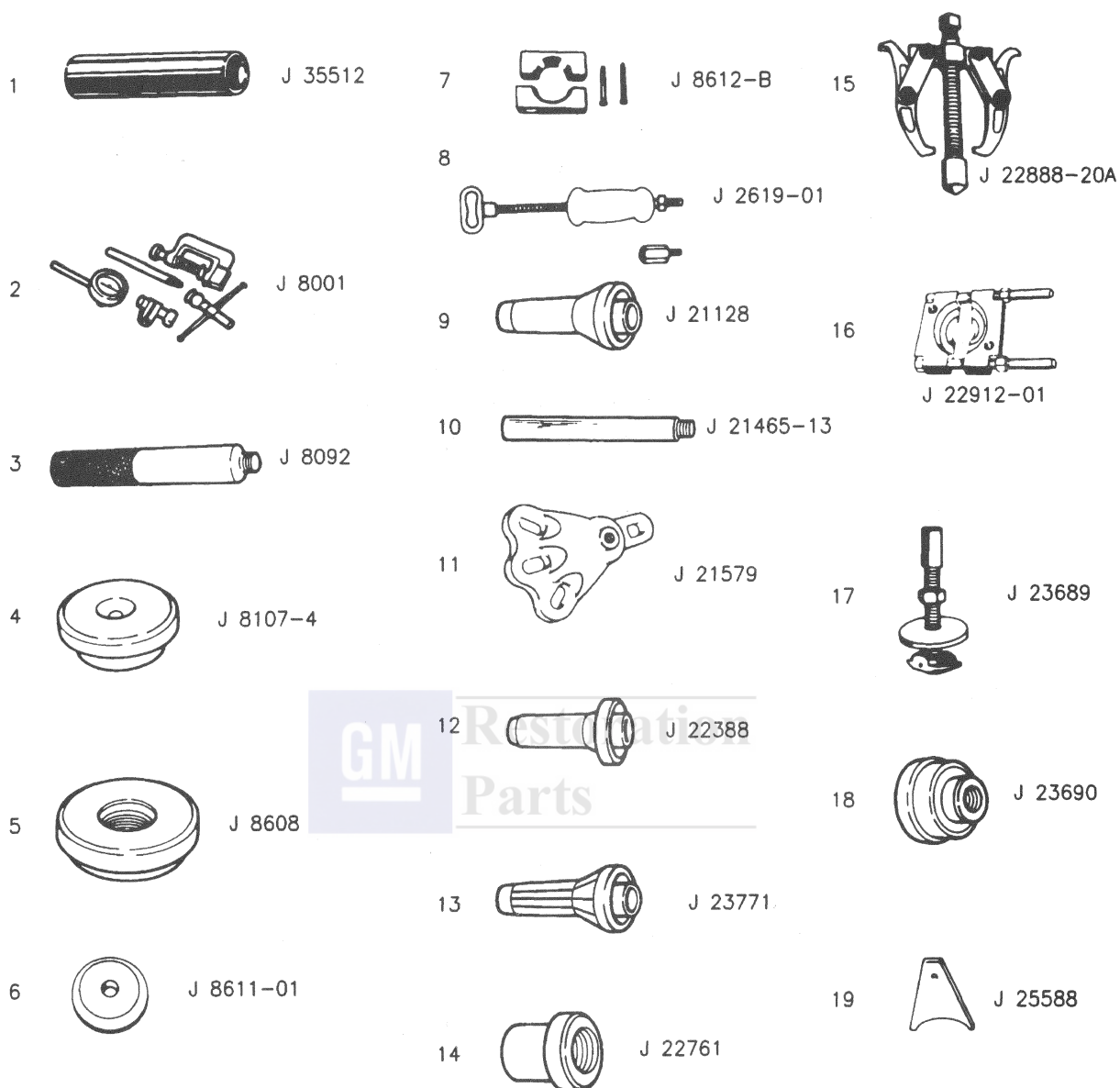
- 1 PINION FLANGE REMOVER ADAPTER
- 2 PINION FLANGE REMOVER SCREW
- 3 PINION FLANGE REMOVER



8 1/2" RING GEAR

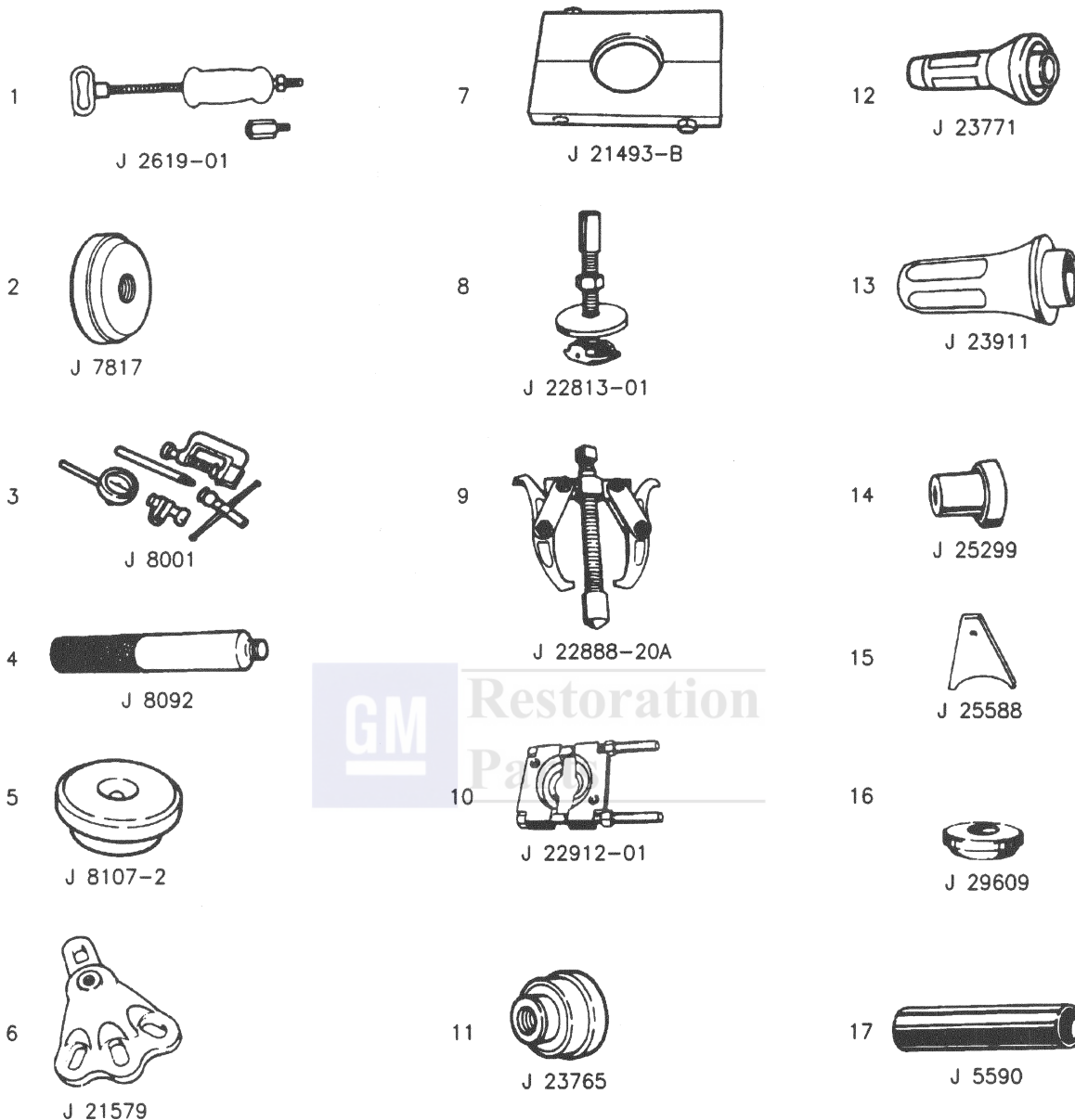
- 1 PINION SETTING GAGE — ARBOR
- 2 PINION SETTING GAGE — GAGE PLATE
- 3 PINION SETTING GAGE — REAR PILOT WASHER
- 4 PINION SETTING GAGE — FRONT PILOT WASHER
- 5 PINION SETTING GAGE — STUD ASSEMBLY BOLT
- 6 PINION SETTING GAGE — SIDE BEARING DISCS

4B-30 REAR AXLE



8 1/2" RING GEAR REAR AXLE

- | | |
|--|--|
| 1 REAR PINION BEARING CONE INSTALLER | 11 AXLE SHAFT REMOVER |
| 2 DIAL INDICATOR SET | 12 PINION OIL SEAL INSTALLER |
| 3 DRIVER HANDLE | 13 AXLE SEAL INSTALLER (SEDANS) |
| 4 DIFFERENTIAL SIDE BEARING REMOVER PLUG | 14 DIFFERENTIAL SIDE BEARING INSTALLER |
| 5 REAR PINION BEARING CUP INSTALLER | 15 DIFFERENTIAL SIDE BEARING REMOVER |
| 6 FRONT PINION BEARING CUP INSTALLER | 16 REAR PINION BEARING REMOVER |
| 7 REAR PINION BEARING CONE REMOVER | 17 AXLE SHAFT BEARING REMOVER |
| 8 SLIDE HAMMER WITH 1/2 X 13 ADAPTER | 18 AXLE SHAFT BEARING INSTALLER |
| 9 AXLE SEAL INSTALLER (WAGON) | 19 SIDE BEARING SHIM INSTALLER |
| 10 DRIVER HANDLE EXTENSION | |



7 1/2" RING GEAR REAR AXLE

- 1 SLIDE HAMMER WITH 1/2 x 13 ADAPTER
- 2 FRONT PINION BEARING CUP INSTALLER
- 3 DIAL INDICATOR SET
- 4 DRIVER HANDLE
- 5 DIFFERENTIAL SLIDE BEARING REMOVER PLUG
- 6 AXLE SHAFT REMOVER
- 7 REAR PINION BEARING CONE REMOVER
- 8 AXLE BEARING REMOVER

- 9 DIFFERENTIAL SIDE BEARING REMOVER
- 10 REAR PINION BEARING REMOVER
- 11 AXLE BEARING INSTALLER
- 12 AXLE OIL SEAL INSTALLER
- 13 PINION OIL SEAL INSTALLER
- 14 DIFFERENTIAL SIDE BEARING INSTALLER
- 15 SIDE BEARING SHIM INSTALLER
- 16 REAR PINION BEARING CUP INSTALLER
- 17 REAR PINION BEARING CONE INSTALLER



SECTION 5

BRAKES WITH ANTI-LOCK BRAKING SYSTEM (ABS)

CONTENTS

General Brakes	Section 5	Duo-Servo Drum Brakes	Section 5C2
Master Cylinder	Section 5A	Vacuum Booster System	Section 5D1
Front Disc Brakes	Section 5B1	Antilock Brake System (ABS)	Section 5E1
Rear Disc Brakes	Section 5B2	Parking Brake	Section 5F

SECTION 5

GENERAL BRAKES

CAUTION: Certain components in the Antilock Brake System (ABS) are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures in Sections 5 and 5E1 should be serviced.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System may lead to functional problems requiring major overhaul. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake pipe or hose assembly disconnected, it may be necessary to bleed all or part of the brake hydraulic system. The torque values specified are for dry, unlubricated fasteners.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

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GENERAL DESCRIPTION

BRAKE FLUID AND FLUID HANDLING

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact** - rinse thoroughly with water.
- **Skin contact** - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.



Important

- Do not re-use fluid accumulated during brake hydraulic system bleeding.
- Always store fluid in a closed container. Reseal fluid containers immediately after use.
- Do not use fluid left in an open or improperly sealed container as it absorbs moisture or can become contaminated.

Substandard or Contaminated Brake Fluid

Use only hydraulic brake fluid GM P/N 1052535 or an equivalent DOT-3 fluid. DO NOT use power steering fluid, automatic transmission fluid or DOT-5

silicone hydraulic brake fluid. Use of an improper fluid or one contaminated with mineral oil or water may cause the fluid to boil or the rubber components in the brake hydraulic system to deteriorate.

Flushing Brake Hydraulic System

The entire brake hydraulic system should be flushed thoroughly with clean brake fluid whenever new parts are installed or if there is any doubt about the grade of the fluid in the system or if a fluid has been used which contains the slightest trace of mineral oil. Approximately 0.95L (1 quart) of fluid is required to flush the brake hydraulic system.

COMBINATION VALVE

The non-serviceable brake combination valve is located under the hood, mounted to a bracket below the brake master cylinder. The brake combination valve incorporates the following functions into a single component.

Metering Valve

The purpose of the metering valve is to limit or hold off hydraulic pressure to the front brake calipers until the rear brakes are activated. Rear brake line pressure must be sufficient to overcome the rear brake shoe return spring tension and the lining-to-drum clearance before the rear brakes are applied. The front brake calipers then may apply. When the brake pedal is not applied, brake fluid may flow freely through the metering valve. This allows normal fluid expansion and contraction.

Brake Pressure Differential Indicator Switch

The brake pressure differential indicator switch monitors the front and rear brake systems to measure any difference in hydraulic pressure between the two systems. If a sufficient pressure differential exists between the systems, an electrical ground is made energizing the red "BRAKE" indicator lamp if the ignition is in "RUN." The brake combination valve and brake pressure differential indicator switch are so designed that the indicator switch will latch in the warning position once a malfunction has occurred. The "BRAKE" lamp will turn off only after the malfunction is repaired and a pedal force sufficient to develop approximately 3 100 kPa (450 psi) hydraulic brake pressure is applied.

Brake Master Cylinder Proportioning Valve

The rear brake master cylinder proportion valve improves front-to-rear brake balance under severe brake application. Severe brake application transfers part of the vehicle rear weight to the front wheels. The resulting decrease in weight at the rear wheels can cause reduced braking efficiency. The brake master cylinder proportion valve limits the pressure to the rear brakes to reduce the tendency for decreased brake efficiency. The proportioning valve also has a bypass feature which assures full system pressure to the rear brakes in the event of a front brake system failure. Full front pressure is retained in the event of rear brake system malfunction.

WARNING LAMP OPERATION

Brake

The brake hydraulic system uses a single red "BRAKE" indicator lamp located in the instrument cluster. When the ignition switch is in the "START" position, the "BRAKE" indicator lamp should come on. It should go off when the ignition switch returns to the "RUN" position. The following conditions will activate the "BRAKE" indicator lamp:

1. Parking brake applied. The lamp should be on when the parking brake is applied and the ignition switch is "RUN."
2. Brake pressure differential warning switch detects a failure. Refer to "Brake Pressure Differential Warning Switch" in this section.
3. During engine cranking the "BRAKE" indicator lamp should remain on. This notifies the driver that the warning circuit is operating properly.

Antilock

The antilock brake system (ABS) uses two indicator lamps: a red "BRAKE" indicator lamp and an amber "ANTILOCK" indicator lamp, both located in the instrument cluster. Under normal conditions, these lamps should operate as follows:

1. When ignition is turned to the "RUN" position, prior to starting the engine, the amber "ANTILOCK" lamp should turn on.

2. As the engine is cranked, both the red "BRAKE" indicator lamp and the amber "ANTILOCK" indicator lamp should come on.
3. When the engine is started, both lamps should go out. The operation of these two indicator lamps is an important part of the antilock brake system (ABS) diagnosis. If the indicator lamps turn on while driving the vehicle, this indicates a malfunction. For further information regarding warning lamp operation for the antilock brake system (ABS), refer to SECTION 5E1.

DIAGNOSIS

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be affected if the roadway is crowned, which would throw the weight of the vehicle toward the wheels on one side. If the roadway is too rough, the wheels will tend to bounce. Test brakes at different vehicle speeds with both light and heavy brake pedal pressure.

EXTERNAL CONDITIONS THAT AFFECT BRAKE PERFORMANCE

Tires

Tires having unequal contact and grip on the road will cause unequal braking. Tires must be equally inflated, and the tread pattern of right and left tires must be approximately equal.

Vehicle Loading

A heavily loaded vehicle requires more braking effort. When a vehicle has unequal loading, the most heavily loaded wheels require more braking power than others.

Wheel Alignment

Misalignment of the wheels, particularly excessive camber and caster, will cause the vehicle to pull to one side.

BRAKE SYSTEM

For diagnosis of the brake hydraulic system, refer to the diagnostic chart.

BRAKE PEDAL TRAVEL

Most low brake pedal problems are caused by air in the brake hydraulic system or mis-adjusted rear brakes. Bleed the system until air is purged and check rear brake adjustment. Refer to "Bleeding Brake Hydraulic System" in this section. Other less frequent causes of excessive brake pedal travel are incorrect power brake booster power piston pushrod length,

5-4 GENERAL BRAKES

improperly adjusted parking brake cable, rear brake shoe adjusters not operating, linings excessively worn, and brake hydraulic system leakage.

Tool Required:

J 28662 Brake Pedal Effort Gage



Measure

1. With engine off and key off, pump pedal until all reserve is exhausted from the power brake booster. A definite change in brake pedal feel will occur.
2. Install J 28662 onto pedal.
3. Hook end of tape measure over top edge of pedal and measure the distance to the rim of the steering wheel.
4. Apply pedal with 445 N (100 lb.) force and remeasure. The difference between both readings is the actual pedal travel and should not exceed 57.00 mm (2.250 inch).
5. If pedal travel is more than specifications, remove the brake master cylinder and check power brake booster pushrod length. Refer to SECTION 5D1. If power brake booster pushrod length is within specified range, repair or replace brake master cylinder. Refer to SECTION 5A.

BRAKE FLUID LEAKS

With engine running at idle and the shift lever in "NEUTRAL," depress the brake pedal and hold a constant foot pressure. If the pedal gradually falls away with the constant pressure, the brake hydraulic system may be leaking. Perform a visual check to confirm any suspected leak. Check the master cylinder fluid levels. While a slight drop in master cylinder reservoir level does result from normal lining wear, an abnormally low level in either master cylinder reservoir indicates a leak in the system. The brake hydraulic system may be leaking either internally or externally. Refer to SECTION 5A. Also, the system may appear to pass this test but still have slight leakage.

Check for possible fluid leaks at the brake pipe and brake hose connections. If any signs of leakage are found, replace the brake pipe or hose. Also, inspect the connecting brake component to determine if it is damaged and should be rebuilt or replaced. Check the front brake caliper boots and rear wheel cylinder boots for leaks. If any fluid appears to be leaking, rebuild or replace the caliper or rear wheel cylinder. Refer to SECTION 5B1, 5B2, or SECTION 5C2.

When checking the fluid levels, the master cylinder rear reservoir may be as low as 0.254 mm (1 inch) from the top if the front linings are worn. This is not abnormal.

Brake Hose and Pipe Inspection



Inspect

- Flexible hydraulic brake hoses, which transmit hydraulic pressure from the steel brake pipes on the body to the rear drum brakes and to the front

brake calipers, at least twice a year when the vehicle is on a lift for lubrication.

- Hoses for road hazard damage, cracks, and chafing of the outer cover, and for leaks and blisters.

— A light and mirror may be needed for an adequate inspection.

— If any of the above conditions are observed on a brake hose, it will be necessary to replace it.

BRAKE FLUID

NOTICE: Improper brake fluid, mineral oil or water in the fluid may cause rubber components in the brake hydraulic system to deteriorate. If master cylinder primary or secondary piston seals are swollen, the rubber parts have deteriorated. This deterioration may also be seen by swollen brake master cylinder reservoir diaphragm, rear wheel cylinder piston boots or front brake caliper piston boots. If rubber deterioration is evident, disassemble all hydraulic parts and wash with alcohol. Dry parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including brake hoses. Also replace the combination valve, since it has rubber components inside which are not serviceable. Check for brake fluid on the linings. If excessive fluid is found, replace the linings. The entire brake system must be flushed if there is any doubt as to the grade of fluid in the system or if a fluid has been used which contains the slightest trace of petroleum or mineral oil based fluids. All rubber parts, including the brake hoses, that have been subjected to a contaminated fluid must be replaced.

ON-VEHICLE SERVICE

BRAKE PEDAL

Figures 1 and 2



Remove or Disconnect

1. Left-hand instrument panel sound insulator. Refer to SECTION 8C.
2. Retainer (57) from brake pedal pin.
3. Outer washer (59), pushrod (54) and inner washer (58) from brake pedal pin.
4. Bolt/screw (55).
5. Four nuts (56) attaching pedal (2) to booster (40).
6. Daytime running lamp diode electrical connector, if equipped.
7. Pedal (2).
8. Bolt/screw (71), if equipped.
9. Diode (70) from pedal (2), if equipped.

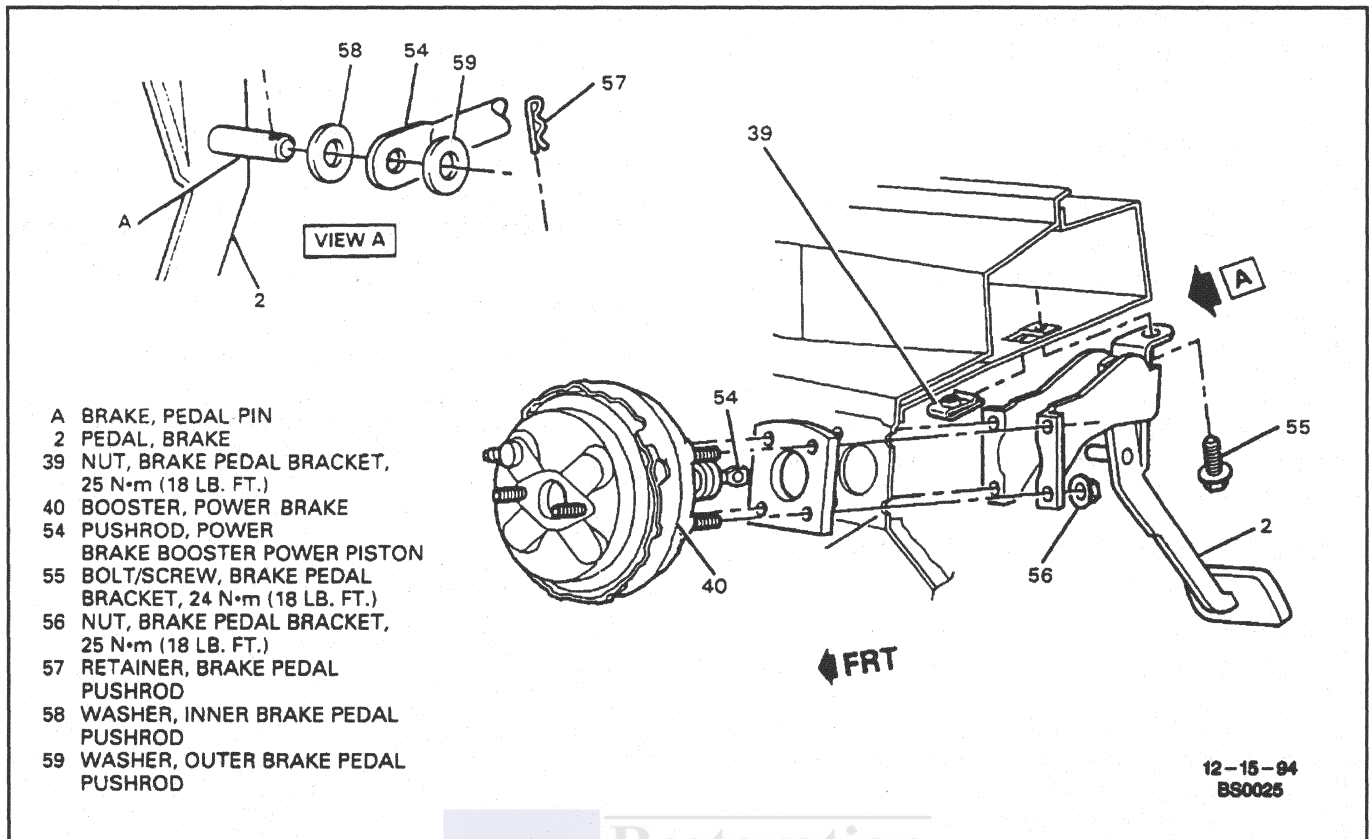


Figure 1 - Brake Pedal

Install or Connect

NOTICE: Refer to "Notice" on page 5-1 of this section.

1. Diode (70) to pedal (2), if removed.
2. Bolt/screw (71), if removed.

Tighten

- Bolt/screw (71) to 1.9 N·m (17 lb. in.).
3. Pedal (2).
 4. Daytime running lamp diode electrical connector, if disconnected.
 5. Four nuts (56) attaching pedal (2) to booster (40).

Tighten

- Nuts (56) to 27 N·m (20 lb. ft.).
6. Bolt/screw (55).

Tighten

- Bolt/screw (55) to 24 N·m (18 lb. ft.).
7. Inner washer (58), pushrod (54) and outer washer (59) onto brake pedal pin.
 - Lubricate brake pedal pin before installing inner washer (58).
 8. Retainer (57) to brake pedal pin.
 9. Left-hand instrument panel sound insulator. Refer to SECTION 8C.

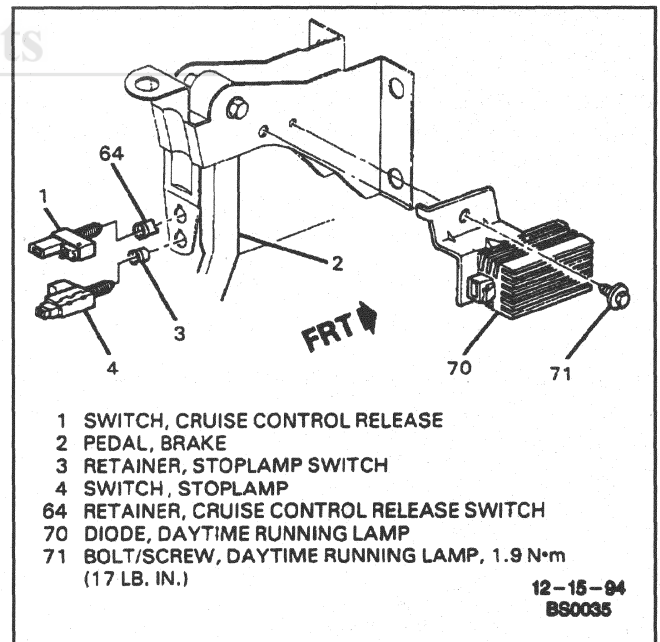


Figure 2 - Stoplamp Switch

STOPLAMP SWITCH

Figure 2

Remove or Disconnect

1. Left hand instrument panel sound insulator if Buick. Refer to SECTION 8C.

5-6 GENERAL BRAKES

2. Electrical connectors from switch (4).
3. Switch (4) from retainer (3).
4. Retainer (3) from pedal (2).

Install or Connect

1. Retainer (3) into pedal (2).
2. Switch (4) into retainer (3).
3. Electrical connectors to switch (4).

Adjust

- Stoplamp switch. Refer to "Stoplamp Switch Adjustment" below.
- 4. Left Hand instrument panel sound insulator, if Buick. Refer to SECTION 8C.

STOPLAMP SWITCH ADJUSTMENT

Figure 3

Adjust

With pedal (2) in fully released position, the stoplamp switch plunger should be fully depressed against the brake pedal shank. Adjust switch (4) by moving it in or out as necessary.

1. Insert switch (4) into tubular retainer (3) until stoplamp switch body seats on the tubular retainer (3).
 2. Pull pedal (2) to the rear, against switch (4) until brake pedal contacts its stop. The switch (4) will move in the tubular retainer (3) giving the proper adjustment.
- When no clicks are heard when the pedal (2) is pulled up, and the brake lamps do not stay on without the brakes being applied, the proper stoplamp switch adjustment is obtained.
 - For diagnosis of the taillamps, refer to SECTION 8A-110.

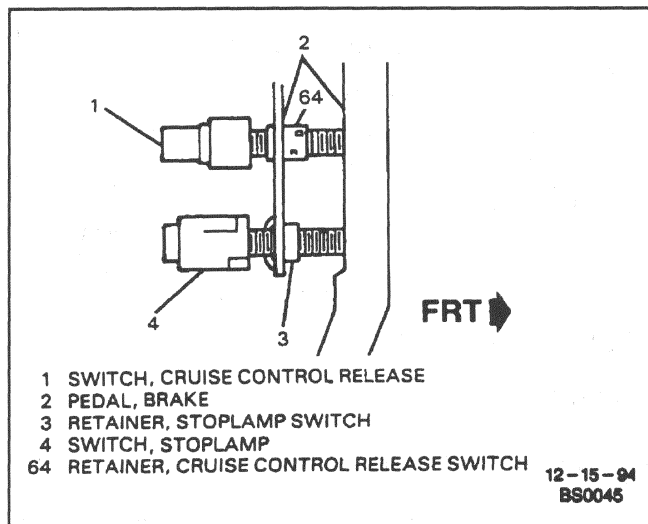


Figure 3 - Stoplamp Switch Adjustment

BRAKE PIPES

CAUTION: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake system and cause brake system failure.

Refer to Figures 4 through 7 for brake pipe routing and replacement. For brake pipe fitting torque specifications, refer to "Specifications" in this section. For information on the brake pressure modulator valve, refer to SECTION 5E1.

Double Lap Flare

Figures 6 and 8 through 11

Double lap flares are used for the rear brake rear pipe connection to rear wheel cylinders only (Figure 6). All other brake pipes use ISO flares.

Tool Required:

J 23530 Brake Line Flaring Tool
(45° Single and Double)

1. Obtain recommended tubing and steel fitting nuts of correct size.
 - Outside diameter of tubing is used to specify size.
2. Cut tubing to length.
 - Correct length may be determined by measuring old pipe using a string and adding 3 mm (1/8 inch) for each double flare.
3. Cut end square and chamfer inside and outside diameter of tubing with de-burring tool.
 - Remove all traces of lubricant from tubing.

NOTICE: Do not use single lap flaring tools. Double lap flaring tools must be used to produce a flare strong enough to hold the system pressure. Using single-lap flaring tools could cause system damage. A single-lap flare will split the tubing while a double-lap flare produces a well-formed, unbroken, reinforced double-walled flare.

4. Double lap flare tubing ends using J 23530.
 - A. Make sure fittings are installed before starting flare.
 - B. Unscrew compression screw until swivel cone is at its highest point.
 - Swing strap to one side.
 - C. Open lever handle so it is at right angle to rest of tool and revolve hexagonal tube lights to accommodate tubing (selection of six sizes).
 - D. Be sure fitting nut is properly placed on tubing. Insert end of tube between two blocks until level with top of gage.

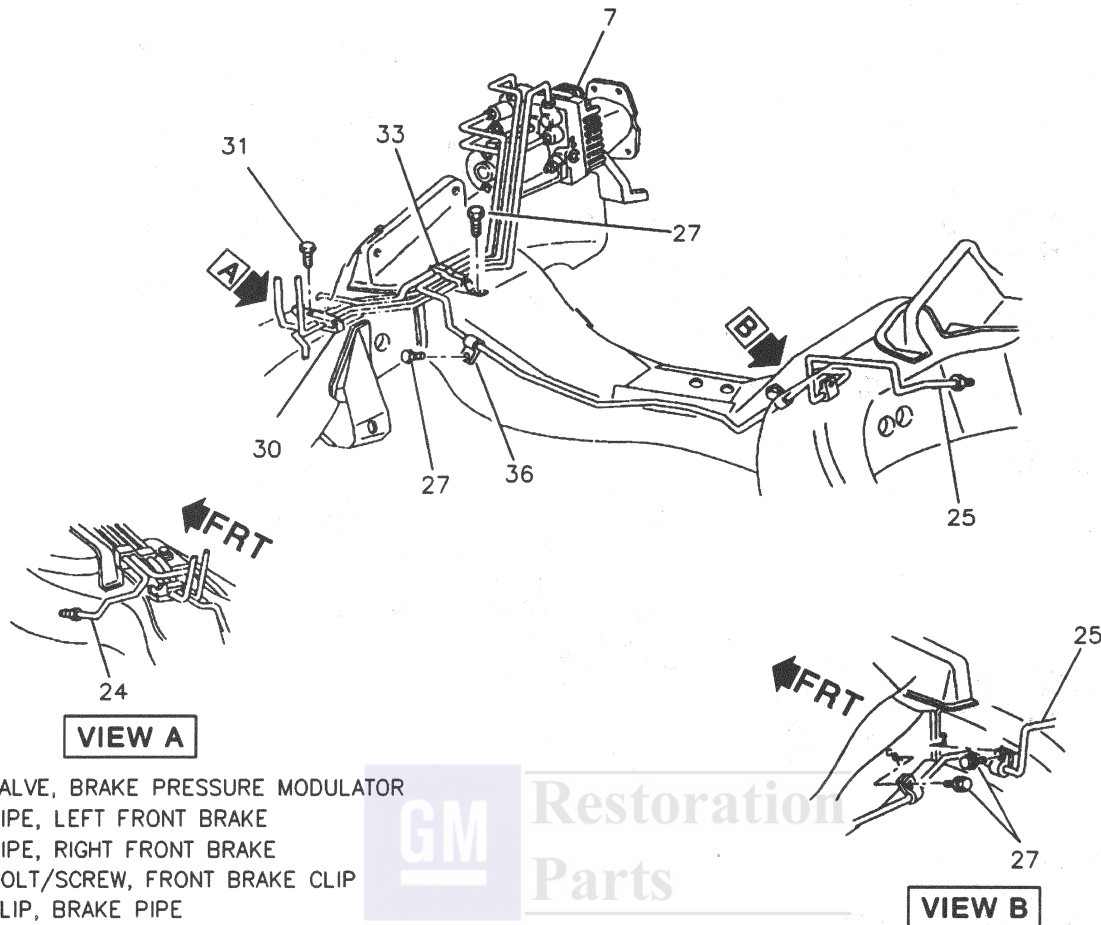
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Figure 4 - Front Brake Pipe Routing

- E. Insert proper pin of gage into tubing and swing strap back in closed position. Tighten compression screw until gage bottoms on tool, then unscrew compression screw and swing strap to one side. Remove gage.
- F. Swing strap back in closed position, then tighten compression screw to flare cone downward to complete double lap flare.
- G. Unscrew compression screw and open smaller lever handle to remove pipe.
- H. Inspect flared ends for splits, cracks, pits or excessive out-of-round which may cause leaks.
- I. Blow pipe out with dry compressed air to remove any foreign objects.
5. Bend new pipe to match old using a tubing bender.

! Important

- Minimum clearance of 19 mm (3/4 inch) must be maintained to all moving components, 13 mm (1/2 inch) to all vibrating components and 7 mm (1/4 inch) to any shielded line, unless clipped to component.

ISO Flare

Figures 12 through 14

ISO flares are NOT to be used for rear brake rear pipe connection to rear wheel cylinders.

Tool Required:

J 29803-A ISO Flaring Kit

1. Obtain recommended tubing and steel fitting nuts of correct size.
 - Outside diameter of tubing is used to specify size.
2. Cut tubing to length.
 - Correct length may be determined by measuring old pipe using a string and adding 3 mm (1/8 inch) for each ISO flare.
3. Cut end square and chamfer inside and outside diameter of tubing with de-burring tool.
 - Remove all traces of lubricant from tubing.
4. ISO flare tubing ends using J 29803-A.
 - A. Make sure fittings are installed on tubing before starting flare.
 - B. Clamp flaring tool body in vise.

5-8 GENERAL BRAKES

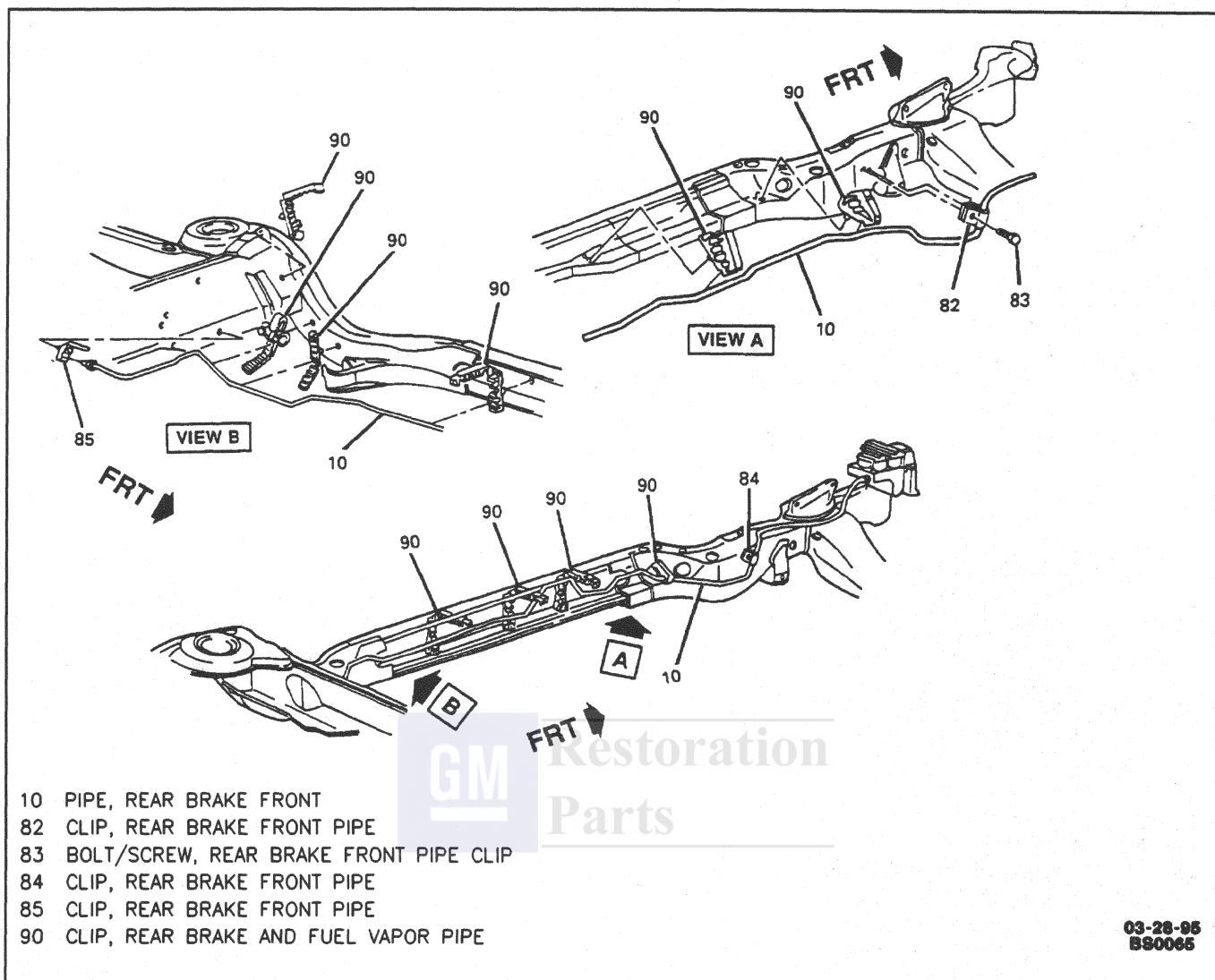


Figure 5 - Frame Brake Pipe Routing

- C. Select correct size collet and forming mandrel for tube size used.
- D. Insert proper forming mandrel into tool body. While holding mandrel in place with your finger, thread in forcing screw until it makes contact and begins to move forming mandrel. When contact is made, turn forcing screw back one complete turn.
- E. Slide clamping nut over tubing into correct collet. Leave approximately 19 mm (3/4 inch) of tubing extending out of collet. Insert into tool body. Tube end must contact face of forming mandrel.
- F. Tighten clamping nut into tool body very tight or tube may push out.
- G. Wrench tighten forcing screw in until it bottoms. Do not tighten forcing screw further or flare may become over-sized.
- H. Back clamping nut out of tool body and disassemble clamping nut and collet. Flare is now ready for use.

5. Bend new pipe to match old using tube bender.

- Minimum clearance of 19 mm (3/4 inch) must be maintained to all moving components, 13 mm (1/2 inch) to all vibrating components and 7 mm (1/4 inch) to any shielded lines, unless clipped to component.

COMBINATION VALVE

Figures 15 and 16

Remove or Disconnect

1. Electrical connector from brake pressure differential warning switch.
 - Squeeze sides of connector to release tabs and pull up.
2. Pipes (8, 9, 41, and 43).
 - Plug open brake pipes (8, 9, 41, and 43) to prevent loss of brake fluid and entrance of dirt.
3. Two nuts (42) attaching valve (6) to booster (40).
4. Valve (6).

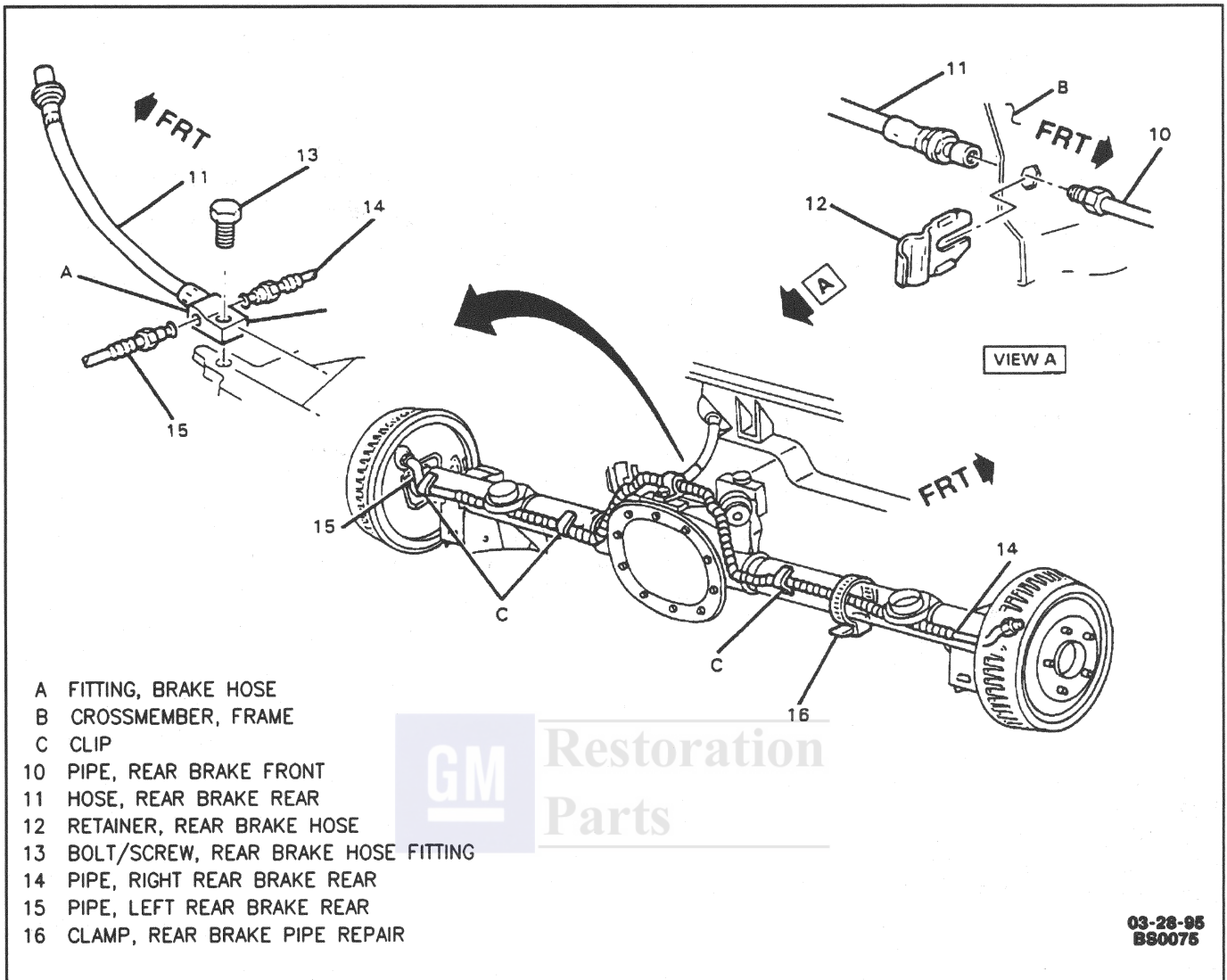


Figure 6 - Rear Drum Brake Pipe Routing

Install or Connect

NOTICE: Refer to "Notice" on page 5-1 of this section.

1. Valve (6).
2. Two nuts (42) attaching valve (6) to booster (40).

Tighten

- Nuts (42) to 25 N·m (18 lb. ft.).

3. Pipes (43, 41, 9, and 8).

Tighten

- Pipes (8, 9, 41, and 43) to 15 N·m (11 lb. ft.).
4. Electrical connector to brake pressure differential warning switch.
 5. Bleed brake hydraulic system. Refer to "Bleeding Brake Hydraulic System" in this section.

BRAKE HOSES

Front Brake Hose

Figure 17

Remove or Disconnect

1. Tire and wheel. Refer to SECTION 3E.

Clean

- Dirt and foreign material from hose (21) and fitting (22).
2. Brake pipe from hose (21).
 - Use a backup wrench on hose fitting.
 - Be careful not to bend bracket (17) or brake pipe.
 3. Retainer (19) from female fitting at bracket (17).
 4. Hose (21) from bracket (17).
 5. Place drain pan under brake caliper (20).

5-10 GENERAL BRAKES

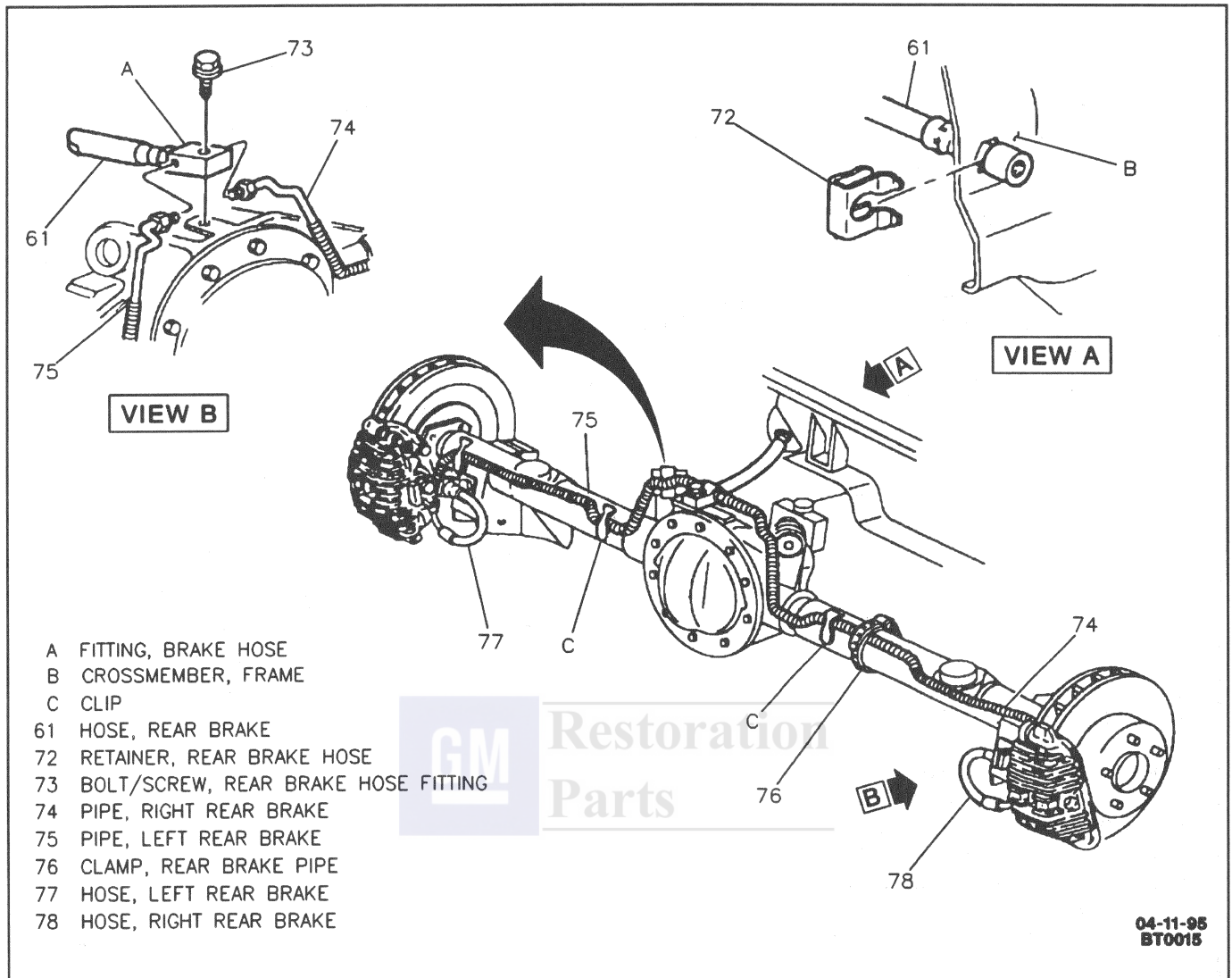


Figure 7 - Rear Disc Brake Pipe Routing

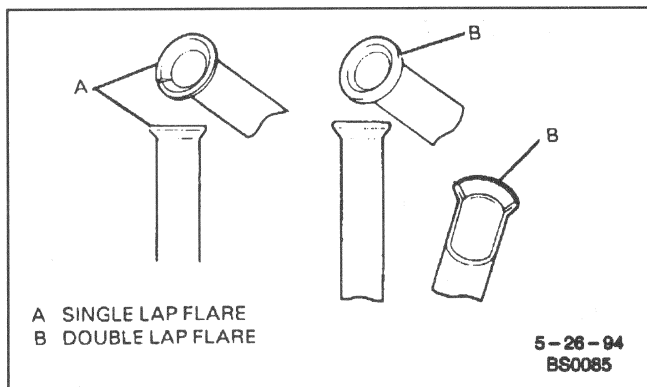


Figure 8 - Single Lap vs. Double Lap Flares

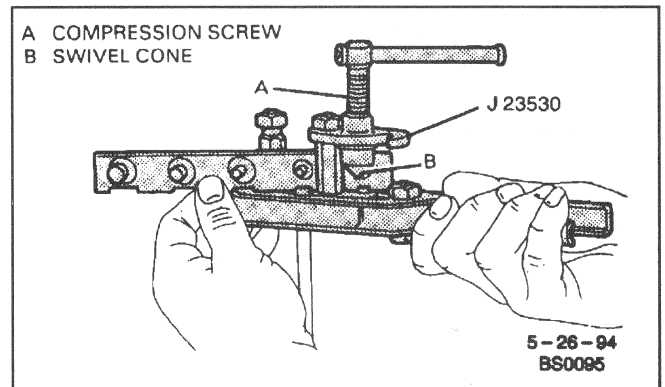


Figure 9 - Placing Tubing in Tool

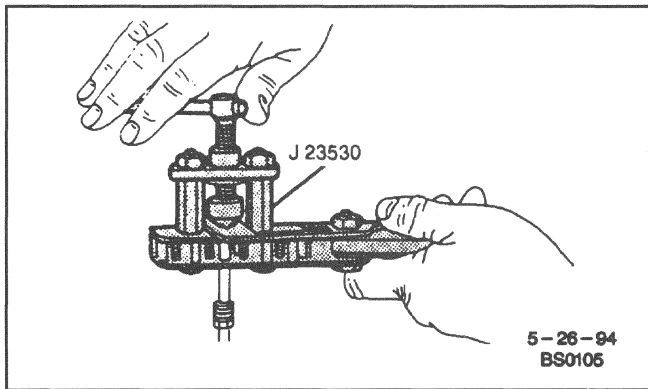


Figure 10 - Preparing for Double Lap Flare

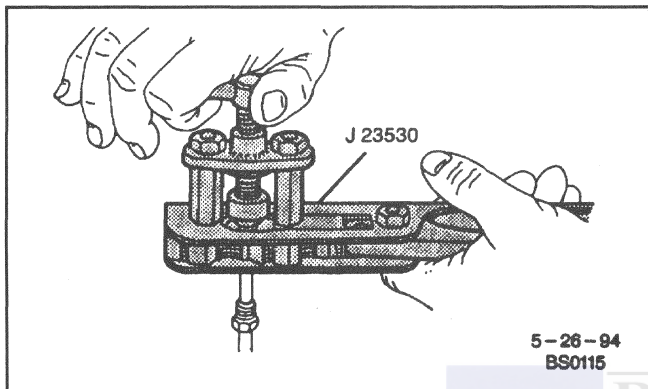


Figure 11 - Completing Double Lap Flare

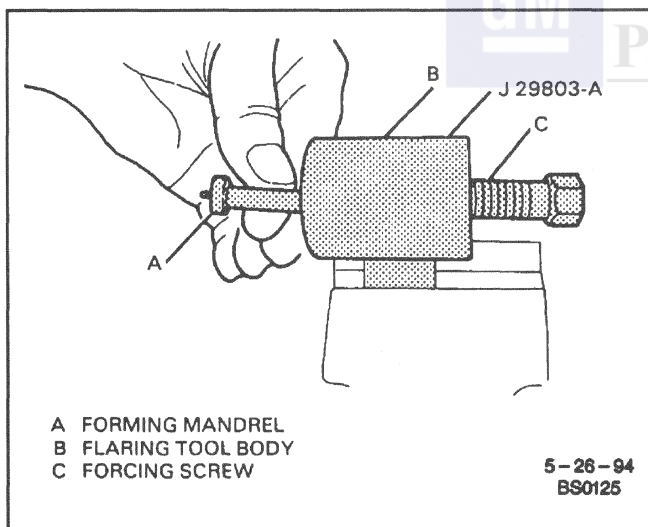


Figure 12 - Forming Mandrel and Forcing Screw

6. Fitting (22), hose (21), and two copper fitting gaskets (23) from front brake caliper (20).
 - Discard two copper gaskets (23).

Install or Connect

NOTICE: Refer to "Notice" on page 5-1 of this section.

1. Fitting (22), hose (21), and two new copper gaskets (23) to caliper (20).
 - Lubricate front brake hose fitting threads with brake fluid.

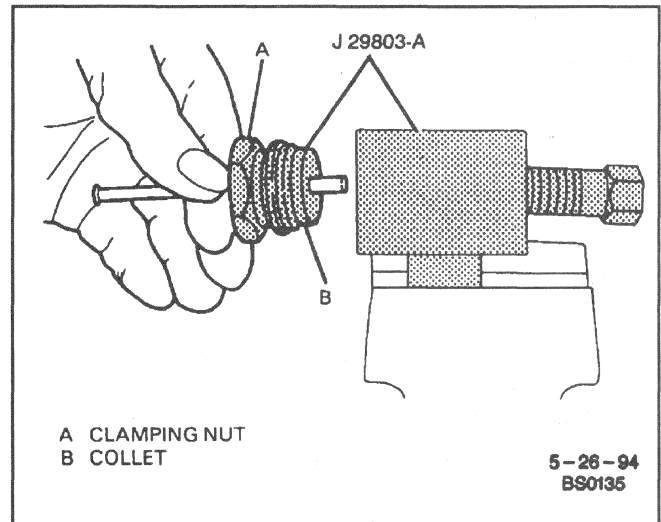


Figure 13 - Clamping Nut and Collet

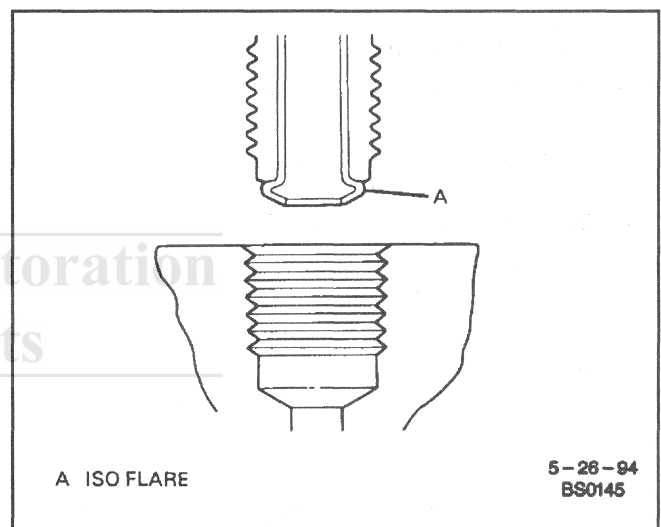


Figure 14 - ISO Flare

- Front brake hose fitting flange must engage front brake caliper orientation ledge.



Tighten

- Fitting (22) to 44 N.m (32 lb. ft.).
2. Hose (21) into bracket (17).
 - There should be no kinks or twists in hose (21).
 3. Retainer (19) at bracket (17).
 4. Brake pipe to hose (21).
 - Use backup wrench on hose fitting.
 - Make sure that hose (21) does not make contact with any part of suspension. Check in extreme right and extreme left turn conditions.



Tighten

- Front brake pipe to 15 N.m (11 lb. ft.).
5. Bleed brake hydraulic system. Refer to "Bleeding Brake Hydraulic System" in this section.
 6. Tire and wheel. Refer to SECTION 3E.

5-12 GENERAL BRAKES

Rear Brake Hose

Figure 6

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Clean

- Dirt and foreign material from hose (11) and brake pipe fittings.
2. Pipe (10) from hose (11) at frame crossmember.
 - Use a backup wrench on rear brake hose fitting.
 - Be careful not to bend pipe (10).
 3. Retainer (12) from frame crossmember and hose (11).
 4. Hose (11) from frame crossmember.
 5. Left rear pipe (15) and right rear pipe (14) from hose (11).
 - Be careful not to bend left rear pipe (15) or right rear pipe (14).
 6. Bolt/screw (13) and hose (11) from rear axle.
 - Note position of hose (11) for proper location during installation.

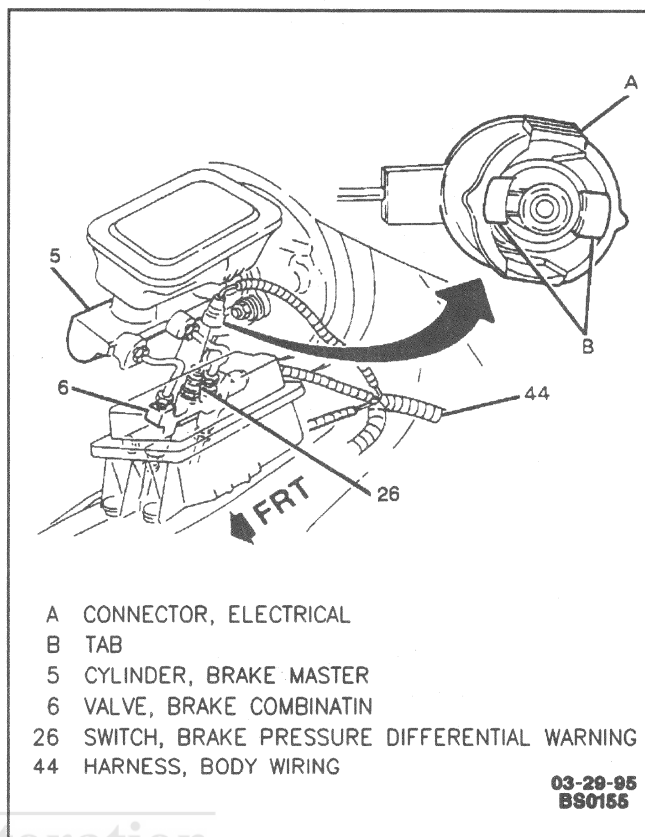


Figure 15 - Brake Pressure Differential Warning Switch

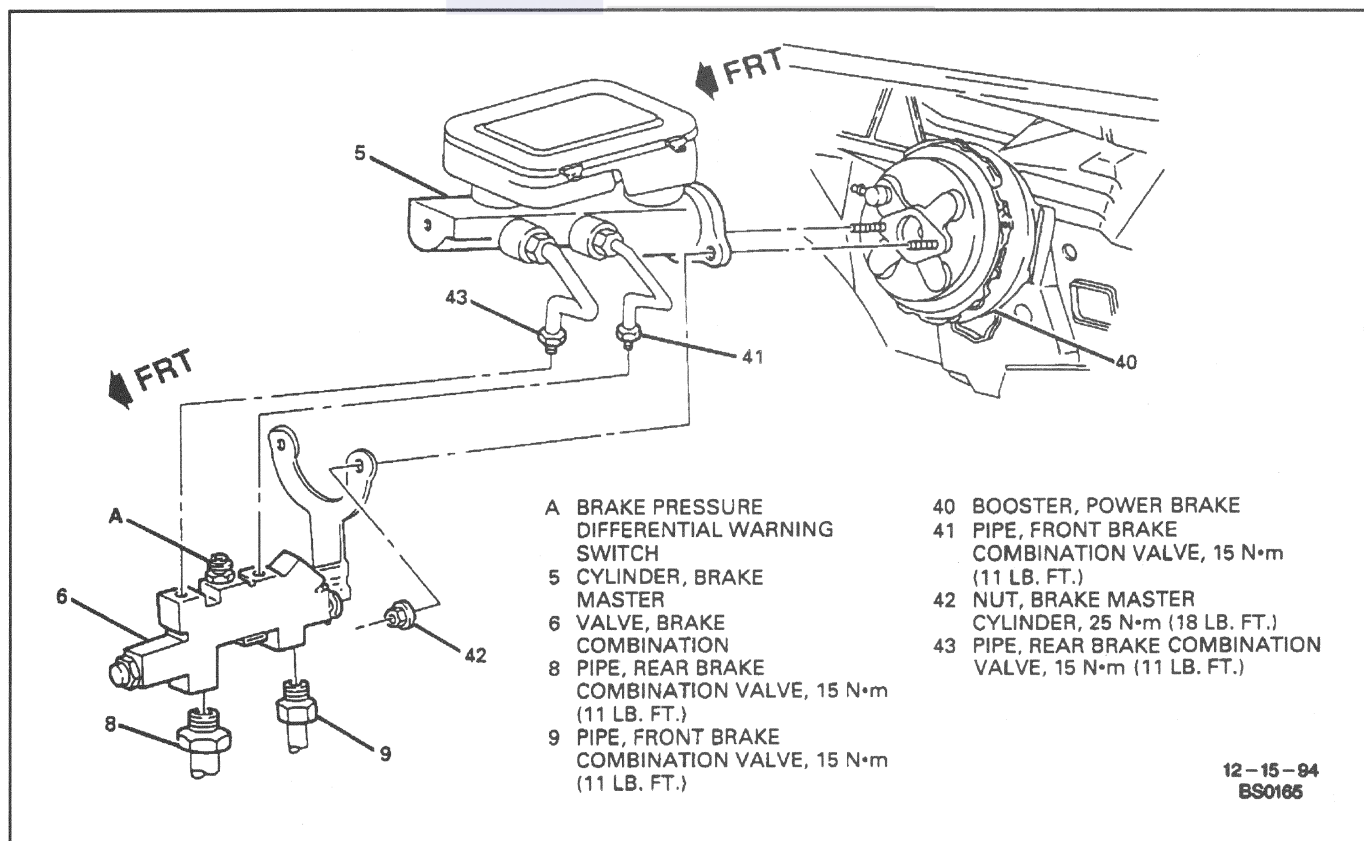


Figure 16 - Brake Combination Valve

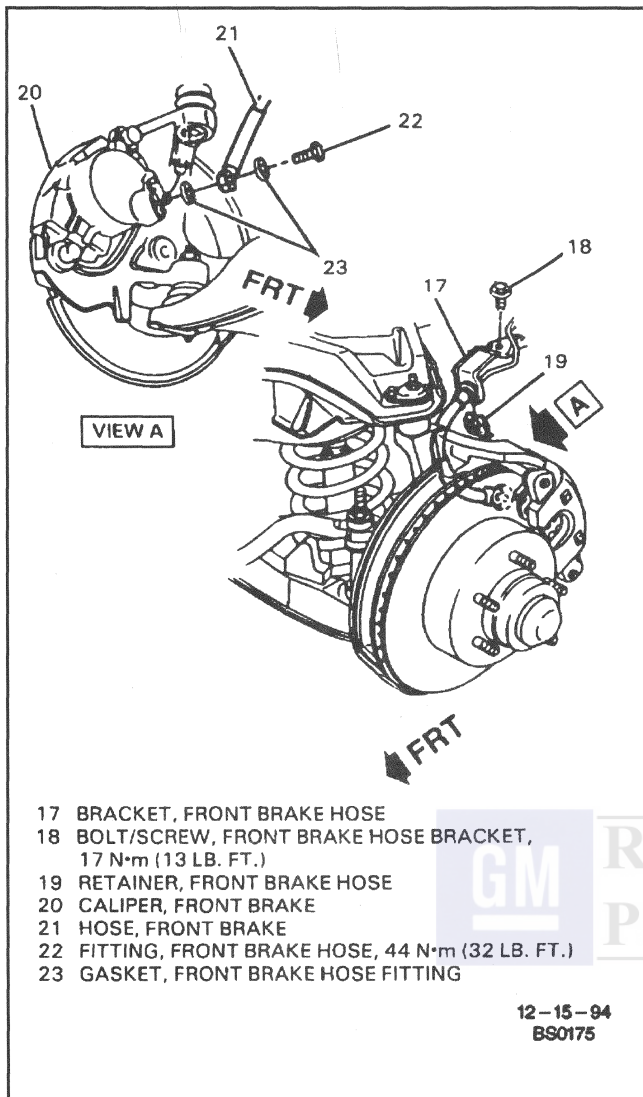


Figure 17 - Front Brake Hose

Install or Connect

NOTICE: Refer to "Notice" on page 5-1 of this section.

- Hose (11) and bolt/screw (13) to rear axle.

Tighten

- Bolt/screw (13) to 27 N·m (20 lb. ft.).
- Left rear pipe (15) and right rear pipe (14) into hose (11).

Tighten

- Left rear pipe (15) and right rear pipe (14) at hose (11) to 15 N·m (11 lb. ft.).
- Hose (11) into frame crossmember.
 - Be sure hose (11) is not twisted.
 - Retainers (12) on frame crossmember and hose (11).

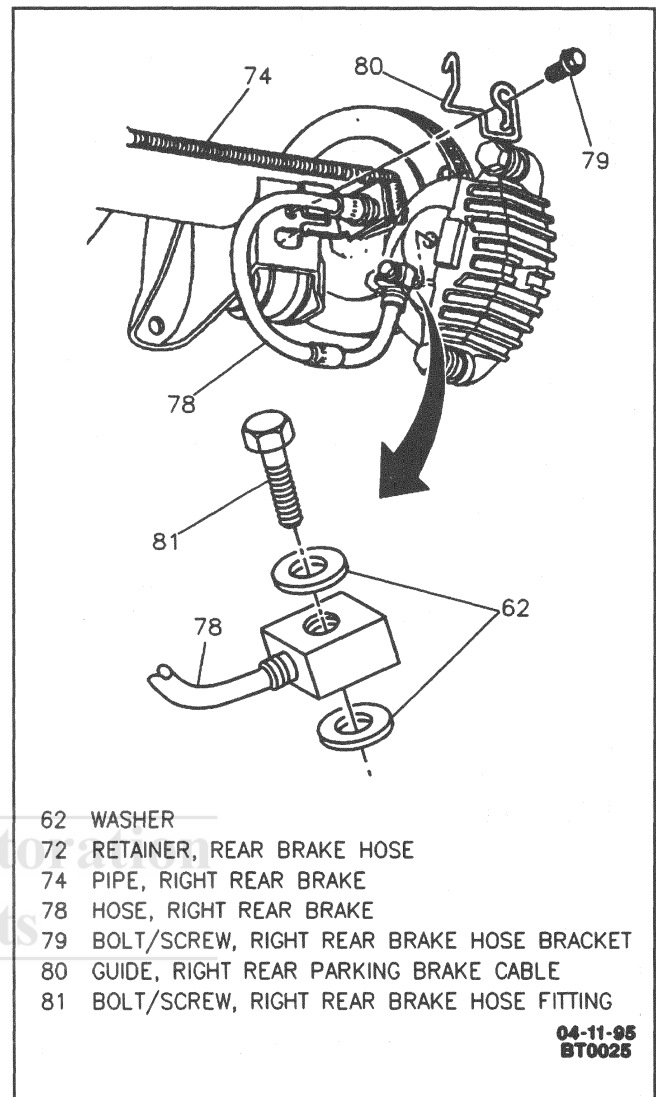


Figure 18 - Rear Brake Hose

- Pipe (10) to hose (11) at frame crossmember.

Tighten

- Pipe (10) to hose (11) to 15 N·m (11 lb. ft.).
- Bleed brake hydraulic system. Refer to "Bleeding Brake Hydraulic System" in this section.
 - Lower vehicle.

Rear Brake Caliper Hoses - Rear Disc Brakes

Figure 18

Remove or Disconnect

- Raise and suitably support vehicle. Refer to SECTION 0A.

Clean

- Dirt and foreign material from hose (11) and brake pipe fittings.

5-14 GENERAL BRAKES

- Pipe (74) from hose (78) at bracket.
 - Be careful not to bend pipe (74).
- Bolt/screw (81) and hose (78) from caliper housing.
- Bolt/screw (79), hose (78), and retainer from rear axle.
 - Note position of hose (78) for proper location during installation.

↔ Install or Connect

NOTICE: Refer to “Notice” on page 5-1 of this section.

- Bolt/Screw (79), hose (78), and retainer to rear axle.

⌚ Tighten

- Bolt/Screw (79) to 10 N.m (89 lb. in.).
- Bolt/Screw (81) and hose (78) to caliper housing.

⌚ Tighten

- Bolt/Screw (81) to 40 N.m (29 lb. ft.).
- Pipe (74) to hose (78) at bracket.

⌚ Tighten

- Pipe (74) at caliper hose fitting to 15 N.m (11 lb. ft.).
- Bleed brake hydraulic system. Refer to “Bleeding Brake Hydraulic System” in this section.
- Lower vehicle.

BLEEDING BRAKE HYDRAULIC SYSTEM

CAUTION: Do not move the vehicle until a firm brake pedal feel is obtained. Air in the brake system can cause loss of brakes and could result in personal injury.

A bleeding operation is necessary to remove air from the hydraulic brake system whenever it is introduced into the hydraulic system. It may be necessary to perform an “Auto Bleed Procedure” if air has been introduced through a low fluid level condition or by disconnecting brake pipes at the master cylinder or brake pressure modulator valve. If a pipe is disconnected at one wheel, and the master cylinder did not lose all of its fluid (air was not introduced into the system), then that rear wheel cylinder or front brake caliper only needs to be bled. If pipes are disconnected at any fitting located between the brake pressure modulator valve and front or rear brakes, then the brake system served by the disconnected pipe must be bled.

Auto Bleed Procedure

The “Auto Bleed Procedure” is used to provide a complete brake system bleed on Bosch 5 equipped vehicles. The procedure cycles the system valves and

runs the pump to purge air from secondary circuits normally closed during a non-ABS/TCS mode operation and normal bleeding. It is to be used when it is suspected that air has been ingested into the brake system secondary circuits, or when the brake pressure modulator valve has been replaced with a new unit. Refer to SECTION 5E1 for procedure.

Manual Bleeding

Figure 19

Tool Required:

J 21472 Brake Bleeder Wrench

NOTICE: Refer to “Notice” on page 5-1 of this section.

Remove the vacuum reserve by applying the brakes several times, with the engine off.

- Fill the master cylinder reservoir with brake fluid and keep at least half full during the bleeding operation.
- If the master cylinder is known or suspected to have air in the bore, bleed it before bleeding any rear wheel cylinder or front brake caliper in the following manner:
 - Disconnect the front brake combination valve pipe fitting at the master cylinder.
 - Allow fluid to fill the master cylinder body bore until it begins to flow from the front brake combination valve pipe fitting port.
 - Connect the front brake combination valve pipe to the master cylinder and tighten.
 - Have a helper depress the brake pedal slowly one time and hold. Loosen the front brake combination valve pipe fitting at the master cylinder body to purge air from the bore. Tighten the fitting and then have a helper release the brake pedal slowly. Wait 15 seconds. Repeat the sequence, including the 15 second wait, until all air is removed from the brake master cylinder body bore. Care must be taken to prevent fluid from contacting any painted surface.

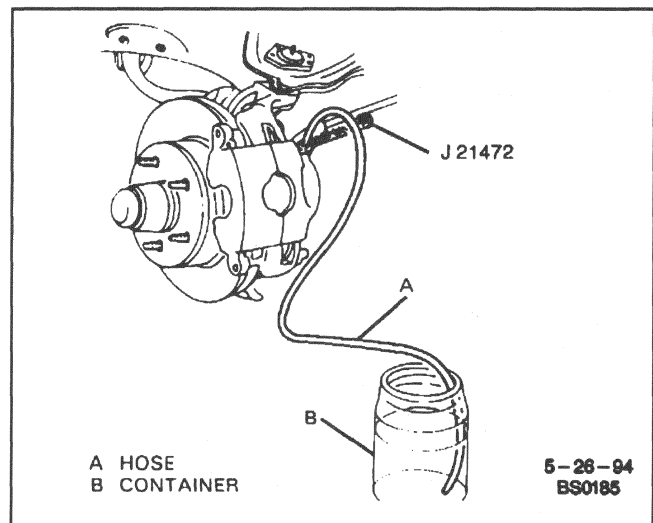


Figure 19 - Bleeding Brakes

**Tighten**

- Front brake combination valve pipe fitting at master cylinder to 32 N·m (24 lb. ft.).
- E. After all air has been removed at the front brake combination valve pipe fitting, repeat procedure outlined above to bleed the master cylinder at the rear brake combination valve fitting.

**Tighten**

- Rear brake combination valve pipe fitting at master cylinder to 32 N·m (24 lb. ft.).
3. Bleed individual rear brake calipers or wheel cylinders, or front brake calipers only after all air is removed from the brake master cylinder.
 4. If it is necessary to bleed all of the rear wheel brake calipers or cylinders, and front brake calipers, follow this sequence:
 - A. Right rear.
 - B. Left rear.
 - C. Right front.
 - D. Left front.
 5. Raise and suitably support vehicle. Refer to SECTION 0A.
 - A. Place a proper size box end wrench or J 21472 over the bleeder valve.
 - B. Attach a clear tube over front or rear brake caliper, or rear brake wheel cylinder bleeder valve, and allow tube to hang submerged in a clear container partially filled with brake fluid.
 - C. Have a helper depress the brake pedal slowly one time and hold. Loosen the bleeder valve to purge the air from the front caliper or wheel cylinder. Tighten brake caliper or rear brake wheel cylinder bleeder valve and slowly release brake pedal. Wait 15 seconds. Repeat the sequence, including the 15 second wait until all air is removed.

**Tighten**

- Front brake caliper bleeder valve to 13 N·m (115 lb. in.).
 - Rear brake caliper bleeder valve to 11 N·m (97 lb. in.).
 - Rear brake wheel cylinder bleeder valve to 7 N·m (62 lb. in.).
 - It may be necessary to repeat the sequence ten or more times to remove all the air.
- D. Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the master cylinder body bore in a way that makes it difficult to bleed the rear side of the system.
 6. Lower vehicle.
 7. Fill master cylinder reservoir to proper level. Refer to SECTION 5A.
 8. Check the brake pedal for “sponginess” and the red “BRAKE” indicator lamp for indication of unbalanced pressure.
 - Repeat entire bleeding procedure to correct either of these two conditions.

Pressure Bleeding**Figure 20****Tools Required:**

- J 29532 Diaphragm Type Brake Bleeder
- J 29567 Brake Bleeder Adapter
- J 21472 Brake Bleeder Wrench
- J 39177 Combination Valve Pressure Bleeding Tool

NOTICE: Refer to “Notice” on page 5-1 of this section.

NOTICE: Pressure bleeding equipment must be the diaphragm type and must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system.

1. Install J 29567 to the cylinder (5).
2. Charge J 29532 to 140-172 kPa (20-25 psi).
3. Connect line to adapter.
 - Open line valve and depress bleed-off valve on top of adapter until a few drops of fluid appear.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Bleed the brakes in the following sequence:
 - A. Right rear.
 - B. Left rear.
 - C. Right front.
 - D. Left front.
6. Place a proper size box end wrench or J 21472 over the brake caliper or rear brake wheel cylinder bleeder valve.
7. Attach a clear tube over bleeder valve and allow tube to hang submerged in a clear container partially filled with brake fluid.
8. Open brake bleeder valve and allow fluid to flow until no air is seen in the fluid.

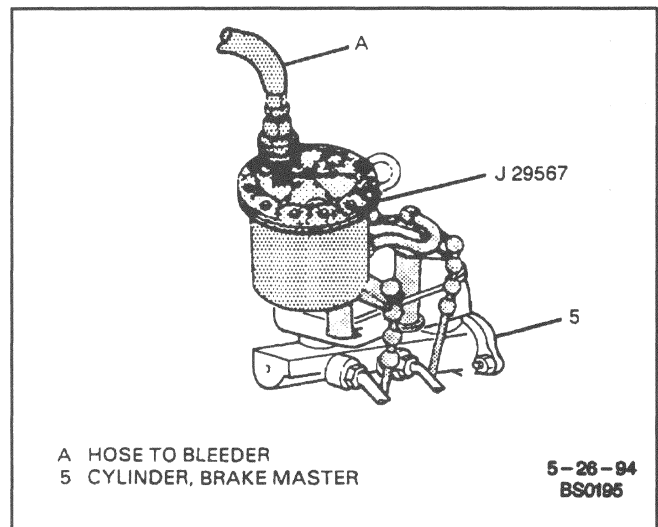


Figure 20 - Pressure Bleeding Adapter

5-16 GENERAL BRAKES

9. Close bleeder valve.

- Be sure it seals.



Tighten

- Front brake caliper bleeder valve to 13 N.m (115 lb. in.).
 - Rear brake wheel cylinder bleeder valve to 7 N.m (62 lb. in.).
 - Rear brake caliper bleeder valve to 11 N.m (97 lb. in.).
10. Repeat steps 7 through 10 until all calipers and/or wheel cylinders have been bled.
11. Lower vehicle.
12. Check the brake pedal for “sponginess” and the red “BRAKE” indicator lamp for indication of unbalanced pressure.
- Repeat entire bleeding procedure to correct either of these two conditions.
13. Remove brake bleeding equipment from master cylinder (5).
14. Fill master cylinder reservoir to the proper level. Refer to SECTION 5A.

FLUSHING BRAKE HYDRAULIC SYSTEM

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is contaminated with water. Do not use DOT 5 silicone brake fluid. Improper brake fluid, mineral oil or water in the fluid may cause the fluid to boil or the rubber components to deteriorate. Keep all fluid containers capped to prevent contamination.

The complete hydraulic system should be flushed thoroughly with clean brake fluid whenever new parts are installed in the hydraulic system. The system must be flushed if there is any doubt about the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil. Approximately 0.95 L (1 quart) of brake fluid is required to flush the brake hydraulic system. All rubber parts, including brake hoses that have been subjected to a contaminated fluid must be replaced.



SPECIFICATIONS

GENERAL SPECIFICATIONS

BRAKE PEDAL TRAVEL (NOMINAL).....	57.00 mm (2.250 inch)
• Brake pedal travel maximum with 445 N (100 lbs.) force applied to pedal with ignition switch "OFF" and vacuum assist depleted.	
HYDRAULIC BRAKE (GLYCOL) FLUID.....	GM P/N 1052535 or equivalent DOT-3 fluid
BRAKE PIPE CLEARANCE (MINIMUM)	
A. Moving Components	19 mm (3/4 inch)
B. Vibrating Components	13 mm (1/2 inch)
C. Shielded Line.....	7mm (1/4 inch)

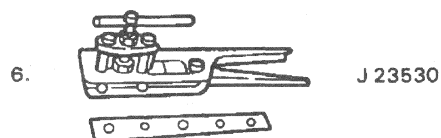
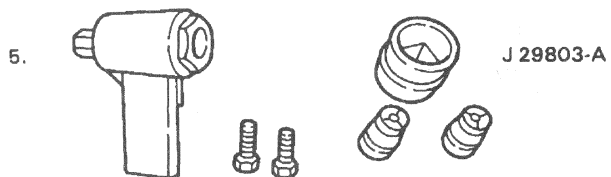
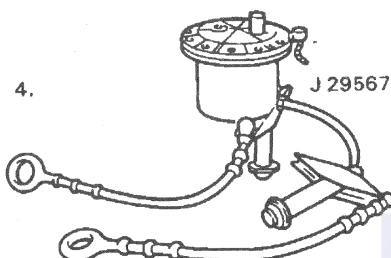
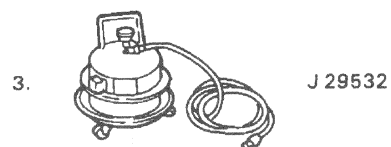
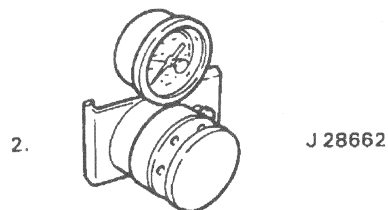
BRAKE PIPE TIGHTENING SPECIFICATIONS

All Brake Pipes-to-Brake Combination Valve.....	15 N.m (11 lb. ft.)
All Brake Pipes-to-Brake Master Cylinder	32 N.m (24 lb. ft.)
All Brake Pipes-to-Brake Pressure Modulator Valve.....	15 N.m (11 lb. ft.)
All Brake Front Pipes-to-Rear Brake Hose Tee	15 N.m (11 lb. ft.)
Front Brake Pipes-to-Front Brake Hoses.....	15 N.m (11 lb. ft.)
Rear Drum Brake Rear Pipes to Rear Brake Hose Tee.....	15 N.m (11 lb. ft.)
Rear Drum Brake Rear Pipes-to-Wheel Cylinders	23 N.m (17 lb. ft.)
Rear Disc Brake Rear Pipes to Brake Hose Tee.....	15 N.m (11 lb. ft.)
Rear Disc Brake Rear Pipes to Caliper Hose.....	15 N.m (11 lb. ft.)
Rear Disc Brake Hose to Caliper.....	40 N.m (30 lb. ft.)
Rear Disc Caliper Hose Bracket Bolt	10 N.m (89 lb. in.)

FASTENER TIGHTENING SPECIFICATIONS

Brake Master Cylinder Nut.....	27 N.m (20 lb. ft.)
Brake Pedal Bracket Bolt/Screw.....	24 N.m (18 lb. ft.)
Brake Pedal Brake Nut	25 N.m (18 lb. ft.)
Brake Combination Valve Pipe Clip Bolt/Screw	10 N.m (89 lb. in.)
Brake Pipe Clip Bolt/Screw	10 N.m (89 lb. in.)
Daytime Running Lamp Bolt/Screw.....	1.9 N.m (17 lb. in.)
Front Brake Caliper Bleeder Valve.....	13 N.m (115 lb. in.)
Front Brake Combination Valve Pipe at Brake Combination Valve.....	15 N.m (11 lb. ft.)
Front Brake Combination Valve Pipe at Brake Master Cylinder	32 N.m (24 lb. ft.)
Front Brake Hose Bracket Bolt/Screw	17 N.m (13 lb. ft.)
Front Brake Hose Fitting	44 N.m (32 lb. ft.)
Front Brake Pipe	15 N.m (11 lb. ft.)
Front Brake Pipe Clip Bolt/Screw.....	10 N.m (89 lb. in.)
Rear Brake Caliper Bleeder Valve.....	11 N.m (97 lb. in.)
Rear Brake Combination Valve Pipe at Brake Combination Valve.....	15 N.m (11 lb. ft.)
Rear Brake Combination Valve Pipe at Brake Master Cylinder	32 N.m (24 lb. ft.)
Rear Brake Front Pipe	15 N.m (11 lb. ft.)
Rear Brake Front Pipe Clip Bolt/Screw.....	10 N.m (89 lb. in.)
Rear Brake Hose	15 N.m (11 lb. ft.)
Rear Brake Hose Fitting Bolt/Screw	27 N.m (20 lb. ft.)
Rear Brake Rear Pipe.....	24 N.m (18 lb. ft.)
Rear Brake Wheel Cylinder Bleeder Valve	7 N.m (62 lb. in.)

SPECIAL TOOLS



- 1 BRAKE BLEEDER WRENCH
- 2 BRAKE PEDAL EFFORT GAGE
- 3 DIAPHRAGM TYPE BRAKE BLEEDER
- 4 BRAKE BLEEDER ADAPTER
- 5 ISO FLARING KIT
- 6 BRAKE LINE FLARING TOOL (45° SINGLE AND DOUBLE)

GM

Restoration
Parts

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SECTION 5A

MASTER CYLINDER

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

MASTER CYLINDER

This brake master cylinder is a composite design (plastic reservoir and aluminum body) incorporating a conventional front to rear brake system split. The master cylinder primary piston provides the fluid pressure to the front disc brakes, while the master cylinder secondary piston provides the fluid pressure to the rear brake systems. If pressure is lost from either system, the remaining system will function to stop the vehicle.

A quick take-up feature provides a large volume of fluid to the brakes at low pressure with initial brake application. The low pressure fluid quickly provides the displacement requirements created by the seal retraction of the front (and rear if equipped) brake caliper pistons into the brake calipers and the retraction of rear brake primary and secondary shoes.

The secondary piston includes a centering valve that improves the performance of the master cylinder

under low pressure brake application when the antilock brake system (ABS) is engaged. This valve is not serviceable.

MASTER CYLINDER RESERVOIR

Figure 1

Since this vehicle does not use a low fluid level indicator for the brake system, the brake master cylinder reservoir has two windows, which allow the brake fluid level to be checked without removal of the brake master cylinder reservoir cover.

BRAKE PRESSURE DIFFERENTIAL WARNING SWITCH

The brake pressure differential warning switch constantly compares brake pressure in both parts of the system. The switch will activate the red "BRAKE" indicator lamp in the instrument cluster in the event of a failure in either part. The brake combination valve is designed so the switch will stay

5A-2 MASTER CYLINDER

in the warning position once a failure has occurred. The lamp can only be turned off by repairing the failure and applying a brake pedal force as required to develop up to 3 100 kPa (450 psi) line pressure.

For diagnosis of the brake pressure differential warning switch, refer to SECTION 8A. For replacement of the brake combination valve refer to SECTION 5.

BRAKE FLUID AND FLUID HANDLING

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any is spilled on the vehicle, flush the area with water to lessen the damage.

! Important

- Do not re-use brake fluid accumulated during brake hydraulic system bleeding.
- Always store fluid in a closed container. Reseal containers immediately after use. Do not use fluid left in an open or improperly sealed container as it absorbs moisture or may be contaminated.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Use only brake fluid GM P/N 1052535 or an equivalent DOT-3 fluid. DO NOT use power steering fluid, automatic transmission fluid, or DOT-5 silicone hydraulic brake fluid. Use of an improper fluid or one contaminated with mineral oil or water may cause the brake fluid to boil or the rubber components in the brake hydraulic system to deteriorate. This deterioration may be seen by a swollen brake master cylinder reservoir diaphragm or swollen brake master

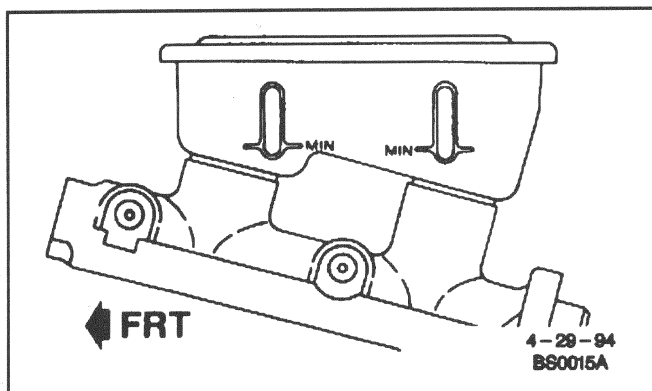


Figure 1 - Brake Master Cylinder Reservoir Windows

cylinder primary or secondary seals. If rubber deterioration is evident, the entire brake system must be flushed and all rubber components replaced. Refer to SECTION 5.

DIAGNOSIS

MASTER CYLINDER CHECK

1. Check for a cracked master cylinder body or brake fluid around the master cylinder.
 - Leaks are indicated only if there is at least a drop of fluid.
 - A damp condition is not abnormal.
2. Check for a binding brake pedal linkage and incorrect power brake booster power piston pushrod length.
 - A. If both of these are satisfactory, disassemble the master cylinder and check for swollen or elongated primary or secondary piston seal(s).
 - B. If swollen primary or secondary seals are found, substandard or contaminated brake fluid should be suspected.
 - C. If contaminated, all components should be disassembled and cleaned; all rubber components should be replaced and all brake pipes flushed.

For diagnostic information of master cylinder malfunctions, refer to SECTION 5.

ON-VEHICLE SERVICE

! Important

- Replace all components included in repair kits used to service this brake master cylinder.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake hydraulic system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

FILLING MASTER CYLINDER RESERVOIRS

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the brake hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, the reservoirs must not be overfilled. Thoroughly clean master cylinder reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and reservoir diaphragm.

NOTICE: Use only DOT-3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is wet with water. Do not use DOT-5 silicone brake fluid. Improper brake fluid, mineral oil or water in the brake fluid may cause it to boil or the rubber components to deteriorate. Keep all containers capped to prevent contamination.

Add brake fluid GM P/N 1052535 or equivalent as required to bring level between the high and low fill mark on the inner rear side of the reservoir. Normal fill is 10.5 mm to 15.5 mm (0.413 to 0.610 inch) below the top of the reservoir.

MASTER CYLINDER

Figure 2

Remove or Disconnect

1. Brake fluid from master cylinder reservoir.
 - Discard old fluid.
2. Pipes (11 and 16) from cylinder (9).
 - Plug open pipes (11 and 16) to prevent brake fluid from contacting painted surfaces and contamination.
3. Two nuts (12) attaching valve (15) to booster (10).
4. Valve (15) and reposition.
5. Cylinder (9).

Install or Connect

NOTICE: Refer to "Notice" on page 5A-1 of this section.

1. Cylinder (9).
2. Valve (15) and reposition.
3. Two nuts (12) attaching valve (15) to booster (10).

Tighten

- Nuts (12) to 29 N·m (21 lb. ft.).
4. Pipes (11 and 16) to cylinder (9).

Tighten

- Pipes (11 and 16) to 32 N·m (24 lb. ft.).
5. Bleed brake hydraulic system. Refer to SECTION 5.

UNIT REPAIR

MASTER CYLINDER

Figure 3

Important

- Reservoir cover (1) and diaphragm (2) can be inspected and/or serviced without removing the master cylinder from the vehicle.

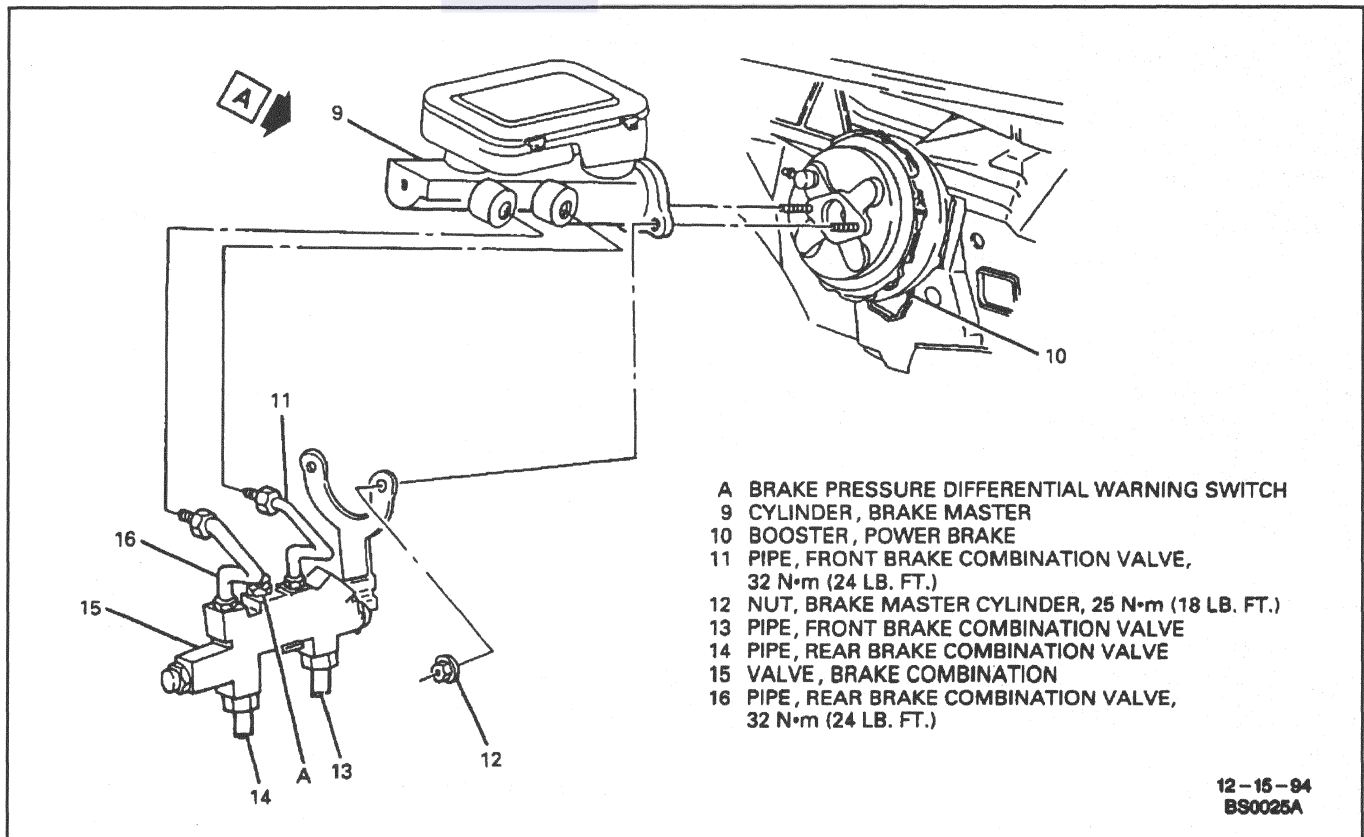


Figure 2 - Brake Master Cylinder

5A-4 MASTER CYLINDER

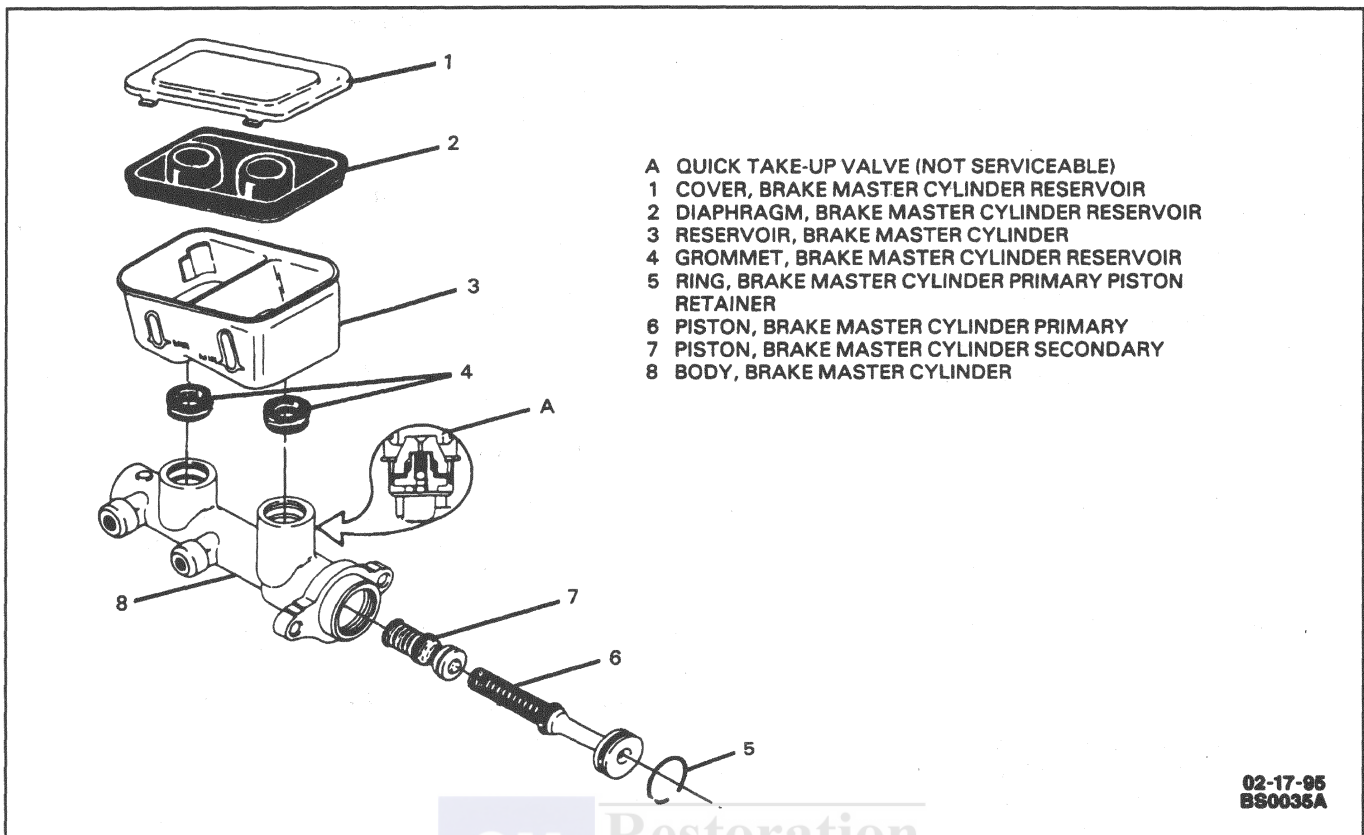


Figure 3 - Brake Master Cylinder Components

- Do not remove the quick take-up valve from the master cylinder body (8). This valve cannot be serviced.

- Abrasives should not be used in brake master cylinder body bore.

Disassemble

1. Cover (1) and diaphragm (2) from reservoir (3).
 - Wipe cover (1) clean before removing.
 2. Empty brake fluid from reservoir (3).
- NOTICE:** Take care not to damage the piston bore or retainer groove during primary piston retainer ring removal.
3. Ring (5) while depressing primary piston (6).
 4. Primary piston (6) and secondary piston (7).
 - To remove parts, apply low pressure dry compressed air into the outlet port near the closed end of the bore with the other outlet port plugged.

Inspect

- Cover (1) and diaphragm (2) for cuts, cracks, nicks and deformation.
- Brake master cylinder body bore for scoring or corrosion. If noted, replace body (8).
- Replace damaged parts.

Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate rubber parts with clean brake fluid to ease assembly.
2. Lubricated secondary piston (7) into brake master cylinder body bore.
3. Lubricated primary piston (6) into brake master cylinder body bore.
4. Ring (5) while depressing primary piston (6).
5. Diaphragm (2) into cover (1).
6. Diaphragm (2) and cover (1) onto reservoir (3).

MASTER CYLINDER RESERVOIR

Figures 4 and 5

Disassemble

1. Master cylinder. Refer to "Master Cylinder" in preceding procedure.

NOTICE: Do not clamp housing area of body in vise or the part may be damaged.

2. Clamp the flange of the body (8) in a vise.
3. Reservoir (3) from grommets (4), using a pry bar.
4. Grommets (4) from body (8).

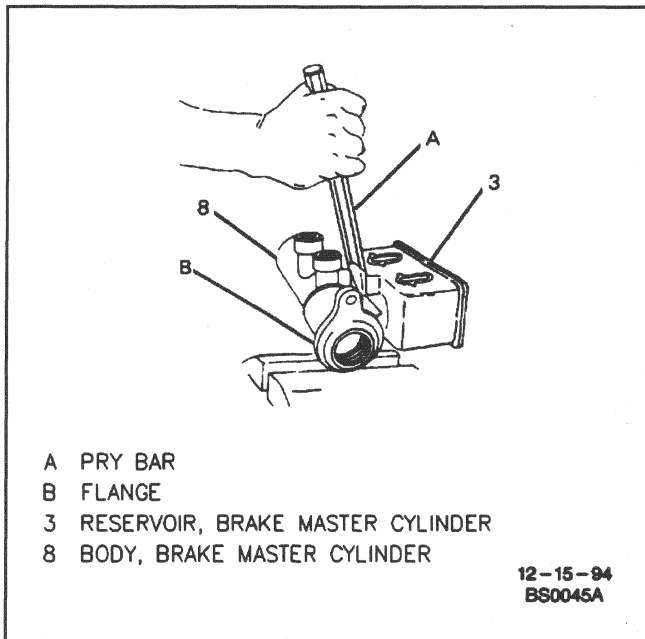


Figure 4 - Removing Brake Master Cylinder Reservoir

Inspect

- Reservoir (3) for cracks or deformation. Replace reservoir (3) if any damage is found.
- Grommets (4) for deterioration. Replace reservoir grommets (4), if necessary.

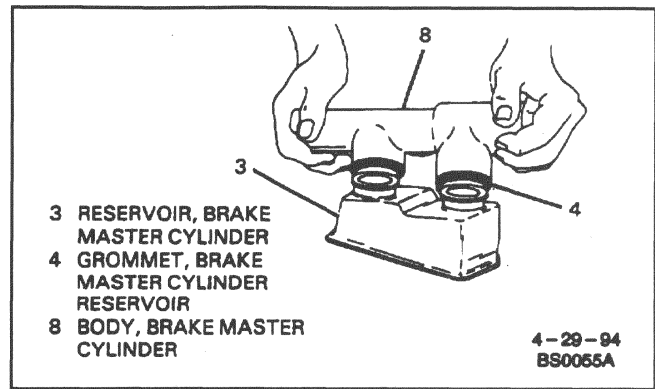


Figure 5 - Installing Brake Master Cylinder Reservoir

Clean

- Reservoir (3) with clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate new grommets (4) and reservoir flanges with clean brake fluid.
2. Lubricated grommets (4) into body (8).
 - Make sure grommets (4) are properly seated.
3. Reservoir (3) into body (8) and grommets (4), using a rocking motion.
4. Master cylinder. Refer to "Master Cylinder" in preceding procedure.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Brake Master Cylinder Body Bore Diameter.....	28.60 mm (1.125")
Sedan and Wagon.....	28.60 mm (1.125")
Police With 4 Wheel Disc Brakes	31.80 mm (1.251")
Hydraulic Brake (Glycol) Fluid	GM P/N 1052535 or equivalent DOT-3 fluid
Fill brake master cylinder reservoir to 10.5-15.5 mm (0.413"-0.610") below top.	

FASTENER TIGHTENING SPECIFICATIONS

Brake Master Cylinder Nut.....	29 N.m (21 lb. ft.)
Front Brake Combination Valve Pipe.....	32 N.m (24 lb. ft.)
Rear Brake Combination Valve Pipe.....	32 N.m (24 lb. ft.)



SECTION 5B1

FRONT DISC BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Brake parts may contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious injury.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

FRONT BRAKE ROTOR

The brake rotor is a highly machined, cast iron finned type. It is mounted to the steering knuckle spindle and also acts as the hub for the front wheels.

FRONT BRAKE CALIPER

The full floating caliper has a single bore and is mounted to the steering knuckle with two bolts/screws. When the brakes are applied, fluid pressure behind the piston increases. Pressure is exerted equally against the bottom of the piston and also against the bottom of the caliper housing bore. The pressure applied to the

5B1-2 FRONT DISC BRAKES

piston is transmitted to the inner pad, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the caliper housing bore forces the caliper to slide on the caliper bolts/screws toward the center of the vehicle. This movement causes the outer section of the caliper to apply pressure against the back of the outer pad, forcing the lining against the outer rotor surface. As line pressure builds, the inner and outer pads are pressed against the rotor surfaces with increased force, bringing the vehicle to a stop. When the brake pedal is released, line pressure is released and the piston seal and groove cause the piston to be slightly retracted, resulting in less drag on the rotor by the inner and outer pads.

Outward movement of the piston and inward movement of the caliper automatically compensate for lining wear. As the linings wear, the increased area behind the piston is filled with brake fluid from the brake master cylinder reservoir.

DIAGNOSIS

FRONT DISC BRAKE INNER AND OUTER PADS INSPECTION

Figure 1

Inspect

- Inner and outer pads at least twice a year when the wheels are removed (tire rotation, etc).

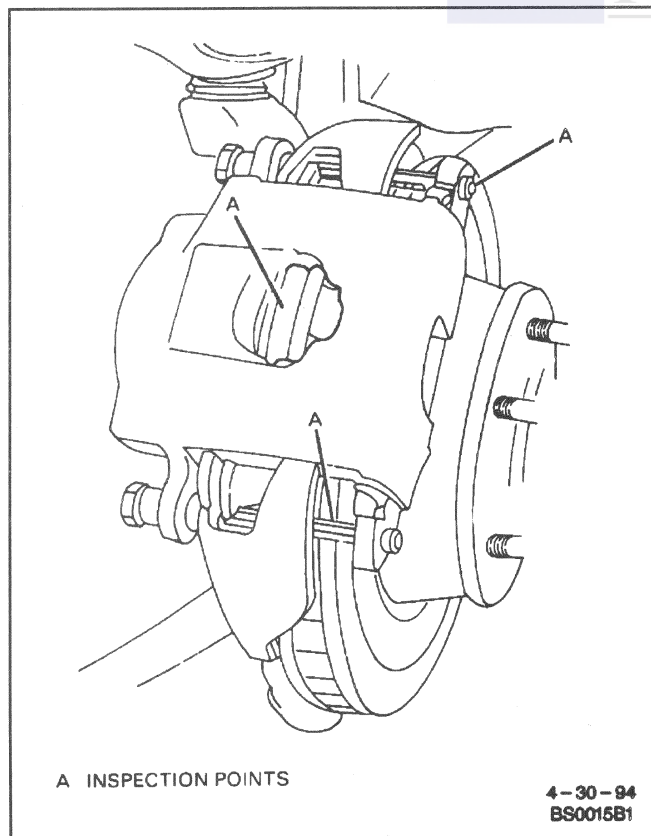


Figure 1 - Front Disc Brake Inner and Outer Pads Inspection

When inspecting front disc brakes, check both ends of the outer pad by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. Also, check the lining thickness of the inner pad to make sure that it has not worn prematurely. Look through the hole in the top of the caliper to view the inner pad. Inner and outer pads should be replaced when the thickness of any lining is worn to within 0.76 mm (0.030 inch) of the shoe or rivet. All inner and outer pads should be replaced in axle sets.

All front disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required. The wear indicator is an integral part of the inner pad. When the lining is worn, the clip indicator contacts the rotor and produces a warning noise.

Check the flatness of linings. Place inner and outer pad surfaces together and check for gap between surfaces. If more than 0.13 mm (0.005 inch) gap is measured midway between attaching lugs, inner and outer pads must be replaced.

FRONT BRAKE ROTOR INSPECTION

Front Brake Rotor Tolerance and Surface Finish

In manufacturing the rotor, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. A new rotor falls into this surface finish range, as will a rotor that is refinished exactly as directed in "Refinishing Front Brake Rotor" under "Unit Repair" in this section. The control of the braking surface finish is necessary to avoid problems of hard pedal-apply, excessive brake fade, pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.060 inch) in depth, which may result from normal use, will not affect brake operation.

Thickness Variation Check

Thickness variation can be checked by measuring the thickness of the front brake rotor at four or more points around its circumference. All measurements must be made at the same distance in from the edge of the rotor. A rotor that varies by more than 0.013 mm (0.0005 inch) can cause brake pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

Lateral Runout Check

Figure 2

Tool Required:

J 8001 Dial Indicator Set

Lateral runout is the movement of the rotor from side to side as it rotates on the steering knuckle spindle. This could be described as "rotor

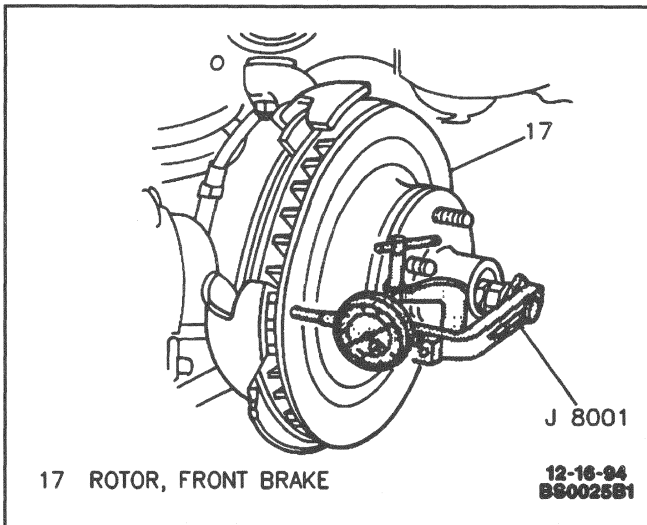


Figure 2 - Checking Lateral Runout

wobble.” The movement of the rotor from side to side in the lateral plane knocks the pads away from the rotor, causing the piston to be knocked back into its bore. This results in additional pedal travel required and a vibration during the braking action.

Measure

1. Remove front brake caliper. Refer to “Front Brake Caliper” under “On-Vehicle Service” in this section.
2. Adjust front wheel bearings until zero play is obtained (for measuring purposes only). Refer to SECTION 3C.
3. Fasten J 8001 to the steering knuckle so that the indicator button contacts the rotor surface about 13 mm (0.5 inch) from the edge.
4. Zero J 8001.
5. Move rotor (17) one complete revolution, and observe total indicated runout (TIR).
 - Total indicated runout (TIR) should not be more than 0.10 mm (0.004 inch).
 - A front brake rotor (17) that does not meet the lateral runout specification should be resurfaced or replaced as necessary.
6. Install front brake caliper. Refer to “Front Brake Caliper” under “On-Vehicle Service” in this section.

FRONT BRAKE CALIPER INSPECTION

The front brake caliper must be disassembled for inspection. Refer to “Front Brake Caliper” under “Unit Repair” in this section.

ON-VEHICLE SERVICE

Important

- Replace all components included in repair kits used to service this front brake caliper.
- Lubricate rubber parts with clean brake fluid to ease installation.

- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace front disc brake inner and outer pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

FRONT BRAKE CALIPER

Figures 3 through 7

Remove or Disconnect

1. Two-thirds of the brake fluid from the brake master cylinder.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Tire and wheel. Refer to SECTION 3E.
4. Bottom piston (10) into caliper housing bore to provide clearance between linings and rotor (17).
 - A. Position C-clamp on housing (13) and against outer pad.
 - B. Tighten clamp slowly to press piston (10) into caliper housing bore.

Important

- If removing caliper only to access other brake parts, skip step 6.
 - If fitting (14) is disconnected, caliper must be bled after installation.
5. Fitting (14), copper gaskets (15), and hose (16) from housing (13), if removing the caliper entirely from the vehicle.
 - A. Plug the openings in the hose (16) and housing (13) to prevent brake fluid loss and contamination.
 - B. Discard gaskets (15).
 6. Front brake caliper bolts/screws (1) and sleeves (2).
 7. Caliper from rotor (17) and knuckle (18).
 - If the caliper is not being removed from the vehicle for unit repair, suspend it from the frame using a locally fabricated wire hook.

Inspect

- Bolts/screws (1) and sleeves (2) for corrosion.
 - If corrosion is found, use new parts, including inner or outer bushings (3 and 4) when installing caliper.
 - Do not attempt to polish away corrosion.

5B1-4 FRONT DISC BRAKES

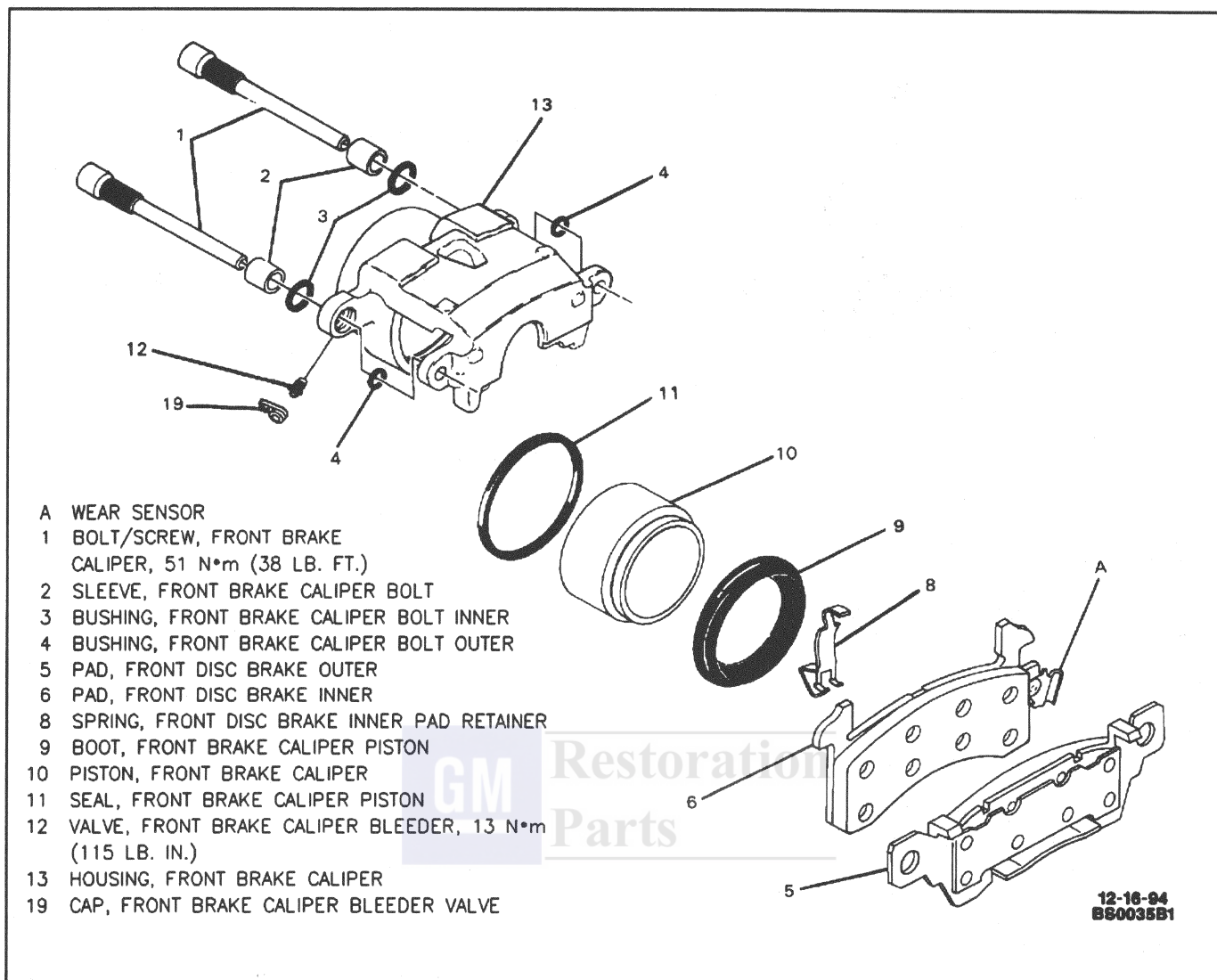


Figure 3 - Front Brake Caliper Components

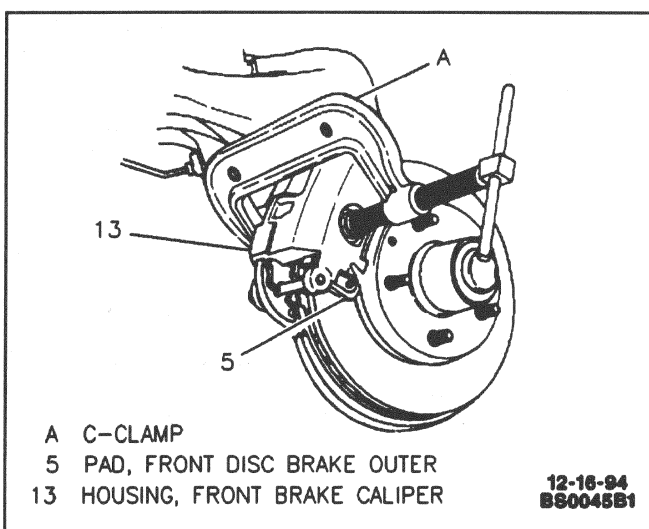


Figure 4 - Compressing Front Brake Caliper Piston

- Fitting (14) and hose (16).
 — If nicks or burrs are noticed on fitting (14) or cuts or deterioration on hose (16), replace fitting and hose.

Install or Connect

NOTICE: Refer to “ Notice” on page 5B1-1 of this section.

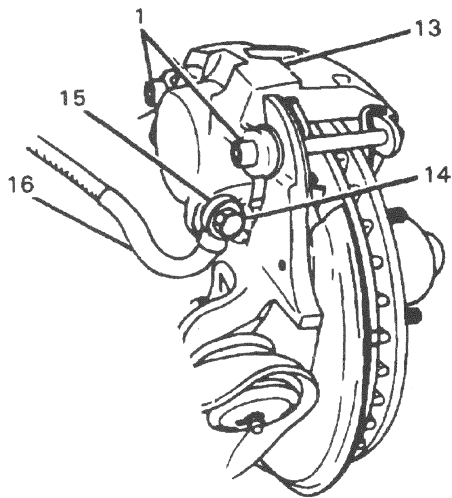
1. Lubricate sleeves (2) and inner and outer bushings (3 and 4) with silicone grease GM P/N 12345579 or equivalent.
2. Sleeves (2) into housing (13).
3. Caliper onto rotor (17) and knuckle (18).
4. Bolts/screws (1).

Tighten

- Bolts/screws (1) to 51 N•m (38 lb. ft.).

Measure

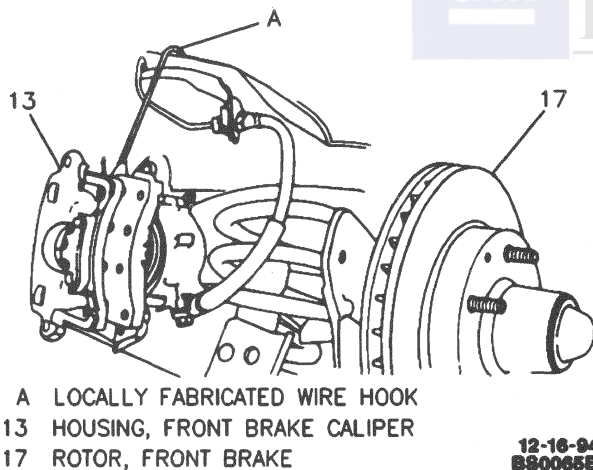
- Clearance between the housing (13) and the stops on knuckle (18). Clearance should be 0.13 to 0.30 mm (0.005 to 0.012 inch).
- If necessary, remove caliper and file ends of the stops on knuckle (18) to provide proper clearance.



- 1 BOLT/SCREW, FRONT BRAKE CALIPER,
51 N•m (38 LB. FT.)
- 13 HOUSING, FRONT BRAKE CALIPER
- 14 FITTING, FRONT BRAKE HOSE,
44 N•m (32 LB. FT.)
- 15 GASKET, FRONT BRAKE HOSE FITTING
- 16 HOSE, FRONT BRAKE

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Figure 5 - Front Brake Caliper Attachment



- A LOCALLY FABRICATED WIRE HOOK
- 13 HOUSING, FRONT BRAKE CALIPER
- 17 ROTOR, FRONT BRAKE

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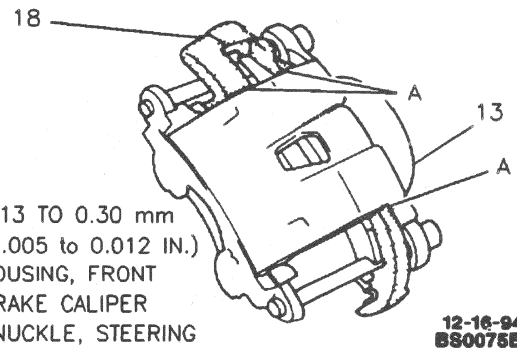
Figure 6 - Suspending Front Brake Caliper

- 5. Fitting (14) and new copper gaskets (15) to housing (13) if removed.



Tighten

- Fitting (14) to 44 N•m (32 lb. ft.).
- 6. Fill the brake master cylinder reservoir to the proper level. Refer to SECTION 5A.
- 7. If hose (16) was removed, bleed caliper. Refer to SECTION 5.
- 8. Tire and wheel. Refer to SECTION 3E.
- 9. Lower vehicle.



- A 0.13 TO 0.30 mm
(0.005 to 0.012 IN.)
- 13 HOUSING, FRONT
BRAKE CALIPER
- 18 KNUCKLE, STEERING

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Figure 7 - Front Brake Caliper Housing to Steering Knuckle Clearance

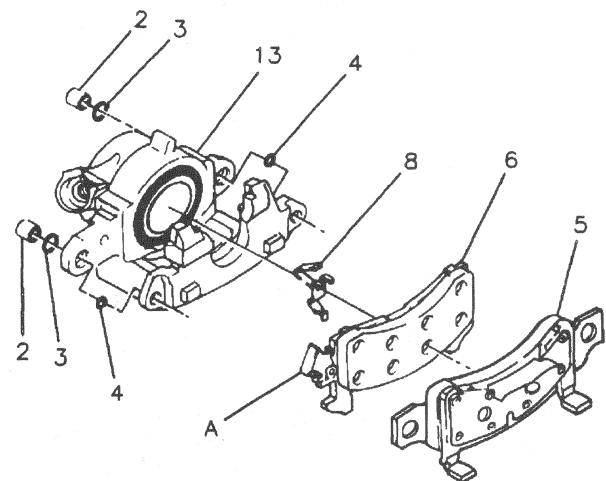
FRONT DISC BRAKE INNER AND OUTER PADS

Figures 3, 6, and 8 through 14



Remove or Disconnect

- 1. Front brake caliper. Refer to "Front Brake Caliper" under "On-Vehicle Service" in this section.
- 2. Outer pad (5).
- 3. Inner pad (6).
- 4. Inner and outer bushings (3 and 4) and sleeves (2) from the grooves in housing (13).
- 5. Spring (8) from inner pad (6).



- A WEAR SENSOR
- 2 SLEEVE, FRONT BRAKE CALIPER BOLT
- 3 BUSHING, FRONT BRAKE CALIPER BOLT INNER
- 4 BUSHING, FRONT BRAKE CALIPER BOLT OUTER
- 5 PAD, FRONT DISC BRAKE OUTER
- 6 PAD, FRONT DISC BRAKE INNER
- 8 SPRING, FRONT DISC BRAKE INNER PAD RETAINER
- 13 HOUSING, FRONT BRAKE CALIPER

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Figure 8 - Front Disc Brake Inner and Outer Pads

5B1-6 FRONT DISC BRAKES

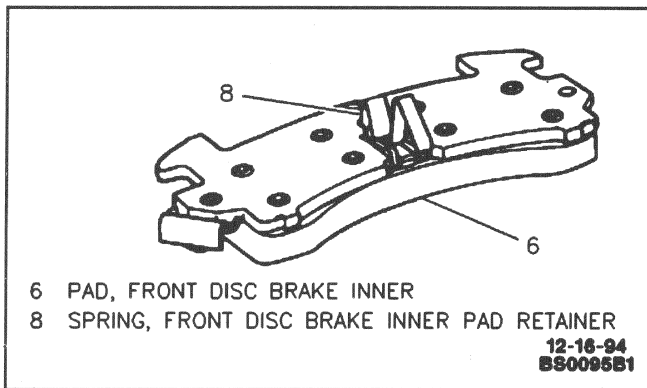


Figure 9 - Front Disc Brake Inner Pad Retainer Spring

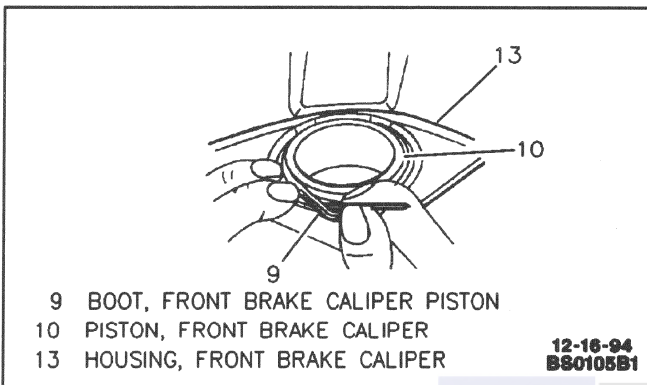


Figure 10 - Lifting Front Brake Caliper Piston Boot

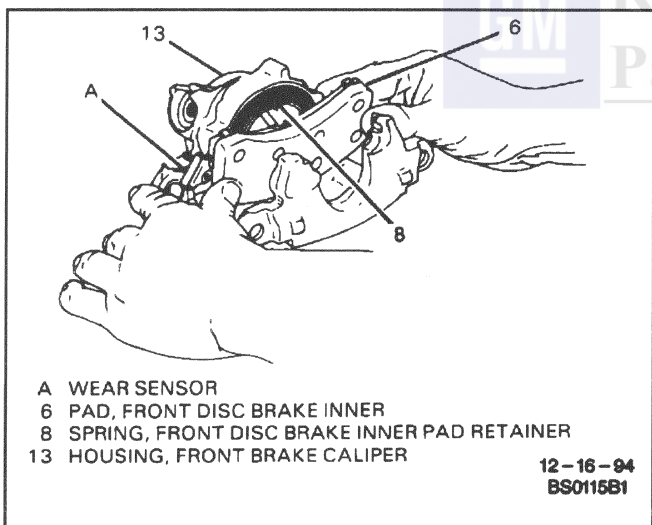


Figure 11 - Installing Front Disc Brake Inner Pad



Clean

- Wipe outside surface of boot (9).
- Use denatured alcohol.



Tighten

- Bottom piston (10) into caliper housing bore using a large C-clamp positioned on housing (13) and inside piston well.
- Tighten clamp slowly to press piston (10) into caliper housing bore.

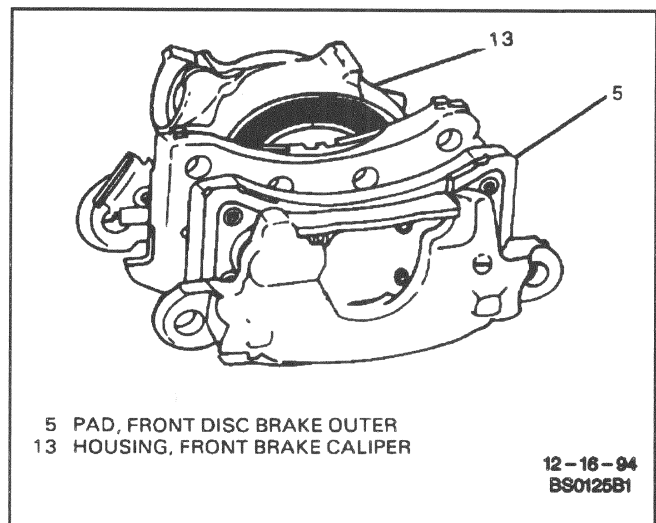


Figure 12 - Installing Front Disc Brake Outer Pad

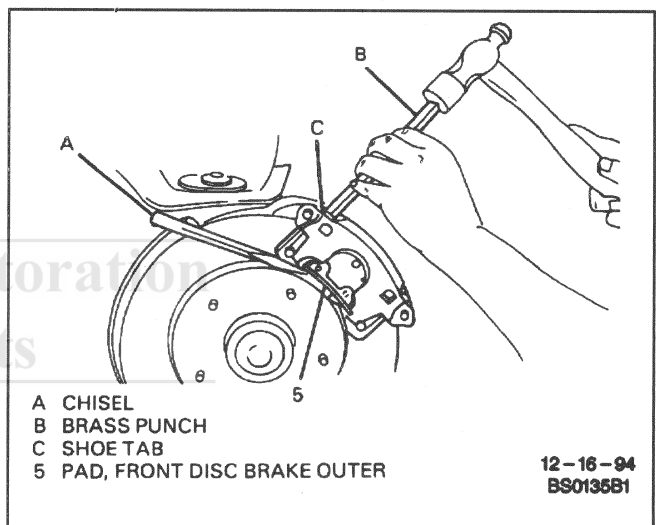


Figure 13 - Clinching Procedure

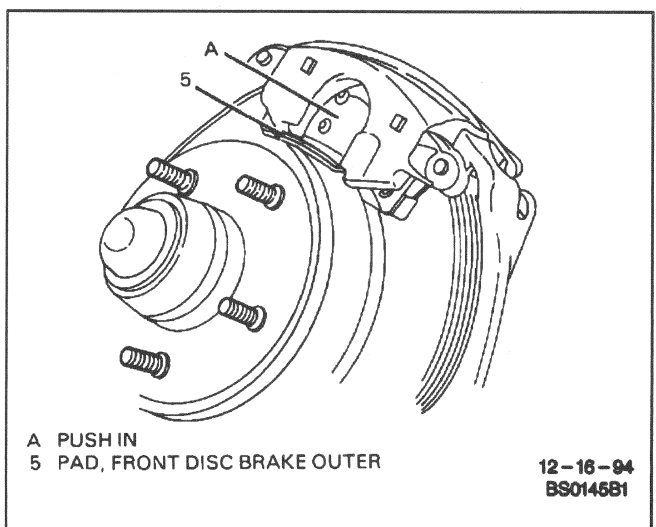


Figure 14 - Checking Front Disc Brake Outer Pad Clench

- A. With piston (10) bottomed in housing bore, lift inner edge of boot (9) next to front piston (10) and press out any trapped air.
- B. Boot (9) must lay flat.

**Install or Connect**

NOTICE: Refer to “Notice” on page 5B1-1 of this section.

1. Lubricate new inner and outer bushings (3 and 4) and sleeves (2) with silicone grease GM P/N 12345579 or equivalent.
2. Inner and outer bushings (3 and 4) and sleeves (2) into the grooves in housing (13).
3. Spring (8) on inner pad (6).
4. Inner pad (6).
 - A. Snap spring (8) into piston (10).
 - B. The wear sensor should be at the leading edge of inner pad (6) during forward wheel rotation. If not, inner pad (6) is on wrong side of vehicle.
 - C. The inner pad (6) must lay flat against the piston (10).
 - D. Check that boot (9) and inner pad (6) are not touching. If there is contact, remove inner pad (6) and remove any trapped air in boot (9).
5. Outer pad (5).
 - The back of outer pad (5) must lay flat against housing (13).
6. Front brake caliper. Refer to “Front Brake Caliper” under “On-Vehicle Service” in this section.
7. Clinch shoe tabs.
 - A. Do upper tab first by positioning a metal chisel or other suitable wedge between outer pad (5) and rotor (17).
 - B. Secure chisel so that there is maximum clearance between shoe tab and caliper casting ear.
 - Prevents outer pad (5) from moving.
 - C. Position brass punch against shoe tab. Strike punch with hammer to drive the shoe tab down against the front brake caliper casting ear.
 - D. Repeat until shoe tab is securely clinched on front brake caliper casting ear.
 - Repeat procedure for lower tab.

**Inspect**

- A. Pull caliper out to get clearance between rotor (17) and outer pad (5).
- B. Push on back of outer pad (5) with thumb to insure clinch is tight. There should be no movement of outer pad (5).
8. Apply approximately 778 N (175 lb.) of force to the brake pedal three times to seat the linings.
9. Burnish front brake rotors. Refer to “Burnishing Front Brake Rotors” in this section.

**Important**

- GM replacement brake lining material is recommended for all GM vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for purposes of both stopping distance and controllability over the full range of operating conditions. Installation of front or rear brake lining material with performance different from that of the GM replacement parts recommended for this vehicle can change the intended brake balance of this vehicle.

UNIT REPAIR**REFINISHING FRONT BRAKE ROTOR**

NOTICE: Whenever a front brake rotor is removed, check the ABS wheel speed sensor and sensor ring for dirt or debris. A dirty sensor may cause intermittent ABS wheel speed sensor fault. Wipe using a clean cloth. Do not use chemicals or the sensor may be damaged.

**Important**

- DO NOT refinish front brake rotors when performing routine brake maintenance such as replacing worn front disc brake inner and outer pads. Refinish a front brake rotor **ONLY** under the following circumstances:
 1. There is a complaint of brake pulsation.
 2. There is scoring greater than 1.5 mm (0.060 inch).

All rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. The minimum refinish dimension is greater than the discard dimension. Do not use a brake rotor that, after refinishing, will not meet specifications shown on the rotor. Always replace it with a new rotor.

Since accurate control of the rotor tolerances is necessary for proper performance of the front disc brakes, the rotor should be machined only with precision equipment. Equipment should be serviced on a regular basis following the manufacturer's recommended maintenance procedure.

When refinishing rotors, the attaching adapters, tool holders, vibration dampeners and tool bits must be in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish. Make sure these adapters are clean and free of nicks.

5B1-8 FRONT DISC BRAKES

On-Vehicle

Tool Required:

J 37704 On Vehicle Disc Brake Lathe

In cases where rotors are being refinished to correct a problem with brake pulsation, it is recommended that J 37704 be used to achieve the best results. Follow the manufacturer's recommended specifications and procedures.

Off-Vehicle

Following are two recommended procedures for front brake rotor machining that achieve adequate results using two different off-car drum/disc brake lathes. (If any other lathe is used, follow that lathe's instructions and recommendations).

AMMCO® BRAKE LATHE (TWO-CUT REFINISHING PROCEDURE)

	ROUGH CUT	FINISH CUT
Spindle Speed	150 rpm	150 rpm
Depth of Cut (per side)	0.15 to 0.6 mm (0.006 to 0.025 in.)	0.10 to 0.15 mm (0.004 to 0.006 in.)
Cross Feed (per rev.)	0.25 mm (0.010 in.)	0.05 mm (0.002 in.)
Vibration Dampener	Yes	Yes
Sand Front Brake Rotor (Swirl Pattern)	No	Yes

ACCUTURN® BRAKE LATHE (ONE-CUT REFINISHING PROCEDURE)

Locate the deepest score and turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out the tool bit (repeat for opposite side of rotor). Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face. Adjust the micrometer knobs for approximately 0.13 mm (0.005 in.) more than the first reading. This will ensure resurfacing the rotor in one cut.

	SINGLE CUT
Spindle Speed	105 rpm
Depth of Cut	As necessary
Cross Feed (per rev.)	0.08 mm (0.003 in.)
Sand Front Brake Rotor (Swirl Pattern)	Yes
Vibration Dampener	Yes

NON-DIRECTIONAL FINISHING

It is very important that the rotor surface be made nondirectional by dressing the surfaces with a sanding disc tool such as Ammco® 8750 Safe Swirl

Disc Rotor Grinder, Accuturn® 433179 Non-Directional Swirl Finisher, or equivalent, using 120 grit aluminum oxide sandpaper. Sand each rotor surface with moderate pressure for a minimum of 60 seconds.

If the brake lathe is not equipped with an adequate non-directional finishing tool, an alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure.

After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner. The finished rotor surface should be as close to that of a new front brake rotor as possible. Failure to obtain the best possible finish may affect braking performance.



Important

- Rotors should always be replaced if turning will result in a rotor that does not meet manufacturer specifications for minimum thickness.

BURNISHING FRONT BRAKE ROTORS

After inner and outer pads have been replaced and/or rotors have been refinished, it is recommended that the new braking surface be broken in, or burnished. This can be accomplished by making 20 stops from 48 km/h (30 mph), using medium to firm brake pedal pressure. Take care to avoid overheating the brakes.

FRONT BRAKE CALIPER

Figures 15 through 19

Tool Required:

J 22904 Dust Boot Seal Installer



Disassemble

CAUTION: Do not place fingers in front of the front brake caliper piston in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious injury.

NOTICE: Do not use a metal tool to remove the piston seal from the caliper housing bore. Using a metal tool may damage the caliper bore or seal groove.

NOTICE: Use clean shop towels to pad the interior of the housing during caliper piston removal. Use just enough air to ease the piston out of the bore. If the piston is blown out, even with the padding provided, it may be damaged.

1. Piston (10) from housing (13).

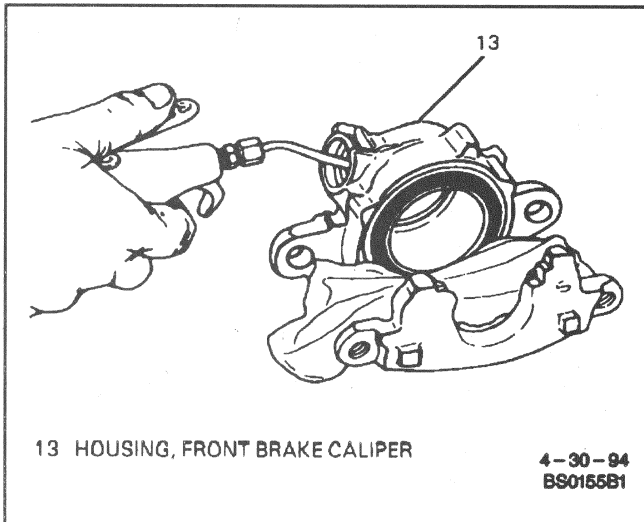


Figure 15 - Removing Front Brake Caliper Piston

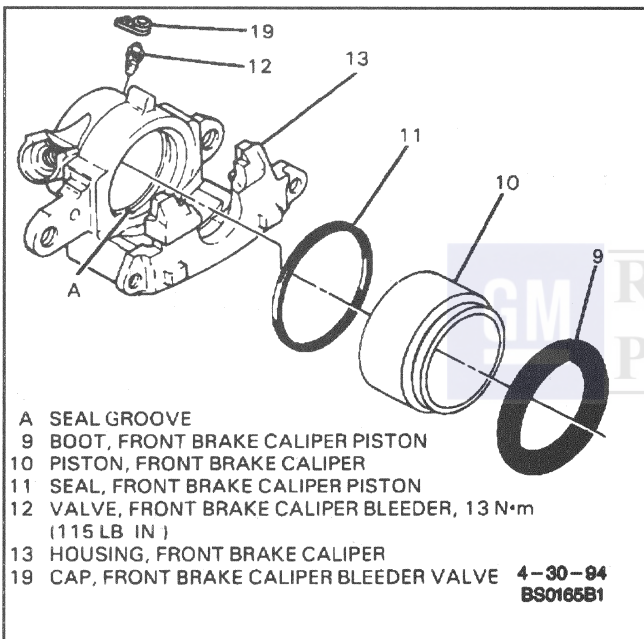


Figure 16 - Front Brake Caliper Components

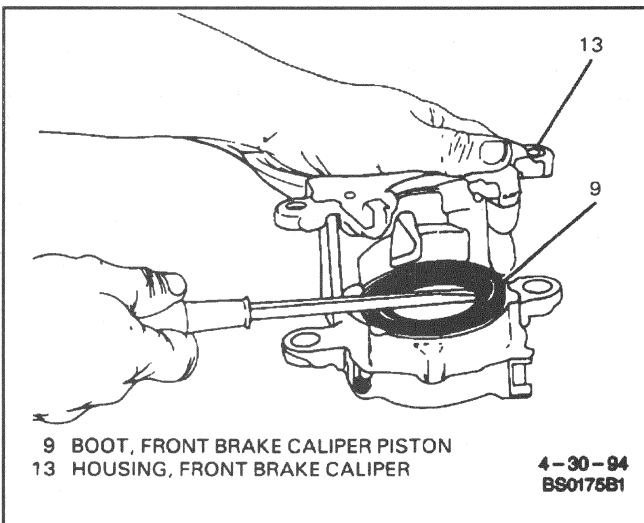


Figure 17 - Removing Front Brake Caliper Piston Boot

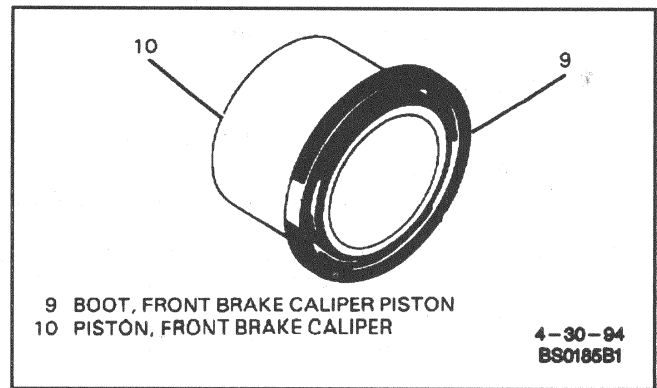


Figure 18 - Installing Front Brake Caliper Piston Boot

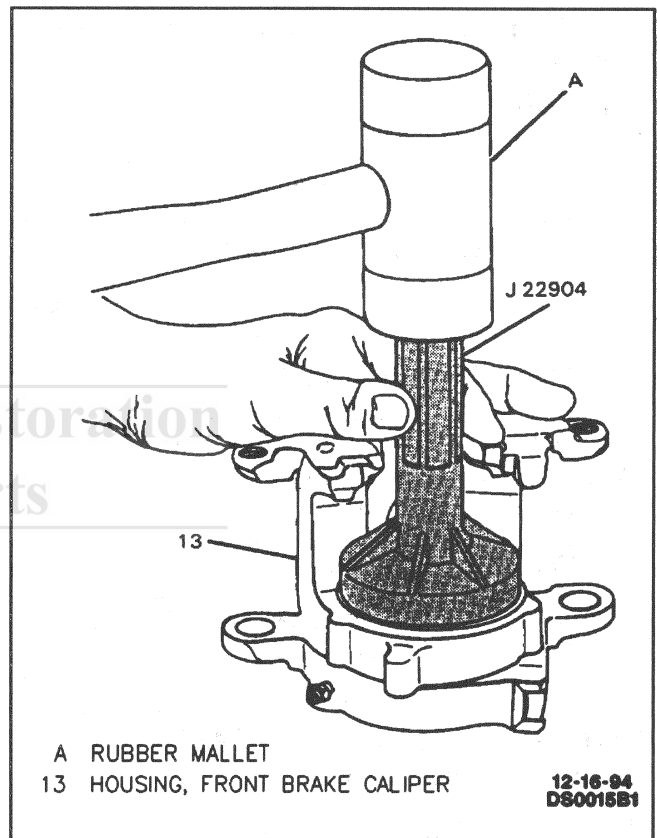


Figure 19 - Seating Front Brake Caliper Piston Boot

- Apply compressed air to the caliper housing inlet hole.



Inspect

- Piston (10) for scoring, nicks, corrosion, and worn or damaged chrome plating.
- Replace piston (10) if any of the above are found.

2. Boot (9) from housing (13).

NOTICE: Do not use a metal tool to remove the front brake caliper piston seal from the front brake caliper housing bore. Using a metal tool may damage the front brake caliper housing bore or seal groove.

3. Seal (11) from the housing (13).

5B1-10 FRONT DISC BRAKES

- Use a small wood or plastic tool.



Inspect

- Caliper housing bore and seal groove for scoring, nicks, corrosion, and wear.
 - A. Use crocus cloth to polish out light corrosion.
 - B. Replace housing (13) if corrosion in and around seal groove will not clean up with crocus cloth.

4. Valve (12) and cap (19) from housing (13).



Assemble

NOTICE: Refer to "Notice" on page 5B1-1 of this section.



Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.
- Blow out all passages in housing (13) and valve (12) with compressed air.

1. Lubricate all rubber parts with clean brake fluid.
2. Valve (12) into housing (13).



Tighten

- Valve (12) to 13 N·m (115 lb. in.).
3. Replace cap (19).
 4. Seal (11) into the bore groove of housing (13).
 - Make sure seal (11) is not twisted.
 5. Boot (9) onto piston (10).
 6. Piston (10) with assembled boot (9) into the bore of housing (13).
 - Push piston (10) to the bottom of the caliper housing bore.
 7. Seat boot (9) into the counterbore of housing (13) using J 22904.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Front Brake Caliper Housing Bore Diameter.....	75.00 mm (2.952 inch)
Front Brake Caliper-to-Steering Knuckle and Hub Clearance	0.13 mm to 0.30 mm (0.005 to 0.012 inch)

FRONT BRAKE ROTOR

Diameter (Nominal).....	305.00 mm (12.000 inch)
Lateral Runout	0.10 mm (0.004 inch)
Thickness Variation.....	0.013 mm (0.0005 inch)
Thickness (New).....	26.50 mm (1.043 inch)
Minimum Thickness after Refinish.....	24.89 mm (0.980 inch)
Discard Thickness.....	24.51 mm (0.965 inch)

- All front brake rotors have a discard dimension cast in them. This is a wear dimension and not a refinish dimension. Any front brake rotor which does not meet the specification should be replaced.

ROTOR REFINISHING SPECIFICATIONS

AMMCO® BRAKE LATHE

Rough Cut

Spindle Speed.....	150 rpm
Depth of Cut (per side).....	0.15 mm to 0.64 mm (0.006 to 0.025 inch)
Tool Crossfeed (per revolution).....	0.25 mm (0.010 inch)
Vibration Dampener.....	Yes
Sand Front Brake Rotor (Swirl Pattern).....	No

Finish Cut

Spindle Speed.....	150 rpm
Depth of Cut.....	0.10 mm to 0.15 mm (0.004 to 0.006 inch)
Tool Crossfeed (per revolution).....	0.05 mm (0.002 inch)
Vibration Dampener.....	Yes
Sand Front Brake Rotor (Swirl Pattern).....	Yes

ACCUTURN® BRAKE LATHE

Single Cut

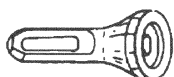
Spindle Speed.....	105 rpm
Depth of Cut.....	As necessary
Tool Crossfeed (per revolution).....	0.08 mm (0.003 inch)
Vibration Dampener.....	Yes
Sand Front Brake Rotor (Swirl Pattern).....	Yes

FASTENER TIGHTENING SPECIFICATIONS

Front Brake Caliper Bleeder Valve.....	13 N.m (115 lb. in.)
Front Brake Caliper Bolt/Screw.....	51 N.m (38 lb. ft.)
Front Brake Hose Fitting	44 N.m (32 lb. ft.)

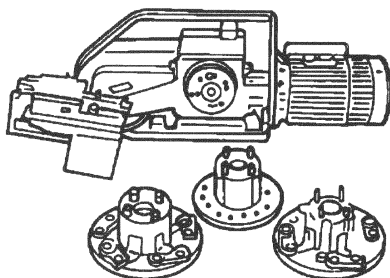
SPECIAL TOOLS

1



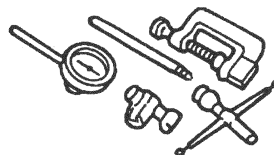
J 22904

2



J 37704

3



J 8001

- 1 DUST BOOT SEAL INSTALLER
- 2 ON-VEHICLE DISC BRAKE LATHE
- 3 DIAL INDICATOR SET

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5B1-12 FRONT DISC BRAKES



SECTION 5B2

REAR DISC BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The rear disc brake caliper has a single piston in an aluminum housing which is suspended in the anchor bracket on two guide pins. Hydraulic pressure, created by applying force to the brake pedal, acts equally against the piston and the bottom of the

caliper bore to move the piston outward and to slide the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle. Parking brake application is completely independent of the hydraulic braking system. Refer to SECTION 5F for more information.

DIAGNOSIS

REAR DISC BRAKE INNER AND OUTER PAD INSPECTION

Figure 1



Inspect

- Inner and outer pads at least twice a year when the wheels are removed (tire rotation, etc.). When inspecting rear disc brakes, check both ends of the outer pad by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. Also, check the lining thickness of the inner pad to make sure that it has not worn prematurely. Look through the hole in the top of the caliper to view the inner pad. Inner and outer pads should be replaced when the thickness of any lining is worn to within 0.76 mm (0.030 inch) of the shoe. All inner and outer pads should be replaced in axle sets.



Measure

- Flatness of inner and outer pad linings. Place inner and outer pad surfaces together and check for gap between surfaces. If more than 0.13 mm (0.005 inch) gap is measured midway between attaching lugs, inner and outer pad assemblies must be replaced.

REAR BRAKE ROTOR INSPECTION

Rear Brake Rotor Tolerance and Surface Finish

In manufacturing the rotor, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are held very close. The maintenance of close tolerances on the braking surfaces is necessary to prevent brake roughness.

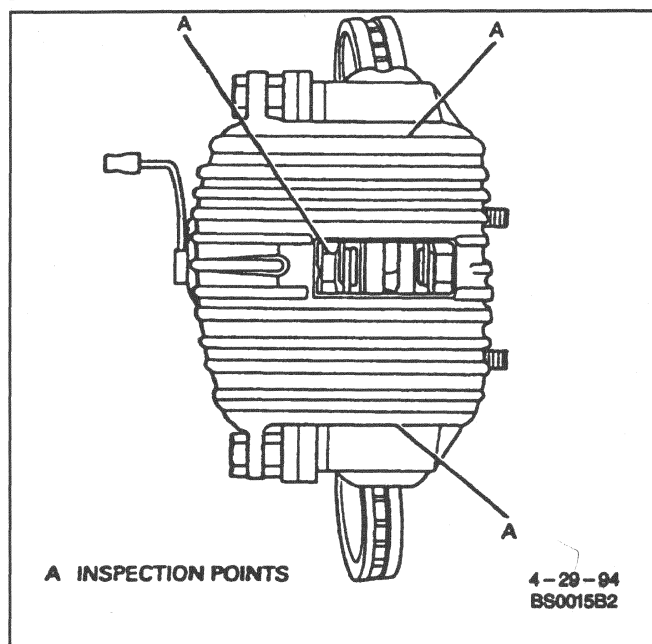


Figure 1 - Rear Disc Brake Inner and Outer Pad Inspection

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.06 inch) in depth, which may result from normal use, will not affect brake operation.

Thickness Variation Check

Thickness variation can be checked by measuring the thickness of the rear brake rotor at four or more points around its circumference. All measurements must be made at the same distance in from the edge of the rotor. A rotor that varies by more than 0.013 mm (0.0005 inch) can cause brake pedal pulsation and/or rear end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

Lateral Runout Check

Figure 2

Tool Required:

J 8001 Dial Indicator Set

1. Remove tire and wheel. Refer to SECTION 3E.
2. Remove rear brake caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.
3. Install wheel nuts snugly so rotor is held tight against the rear axle.
4. Fasten J 8001 to rear brake caliper housing so that indicator button contacts rotor surface about 13 mm (0.5 inch) from rotor edge.
5. Set J 8001 to zero.
 - Push in rear axle while setting J 8001 to eliminate endplay.
6. Turn rotor (39) one complete revolution, and observe Total Indicated Runout (TIR).
 - Push in rear axle while turning rotor assembly to eliminate endplay.
 - Total Indicated Runout (TIR) should not be more than 0.10 mm (0.004 inch).
7. In some cases, excessive lateral runout of rotor (39) on-vehicle condition can be improved by indexing rotor (39).
 - Move rotor (39) on hub one or two wheel bolt positions from original position.
8. If lateral runout of rotor (39) still exceeds 0.10 mm (0.004 inch), check rear axle shaft flange for excessive lateral runout or looseness.

NOTICE: Whenever the rotor has been separated from the axle flange, clean any rust or foreign material from the mating surface of the axle flange and brake rotor. Failure to do this may result in increased lateral runout of the rotor and brake pulsation.

- A. Remove rear brake rotor. Refer to "Rear Brake Rotor" in this section.
- B. Reposition J 8001 so button contacts surface of axle shaft flange.
- C. Push axle shaft flange inward while turning the axle shaft flange one full revolution.

- D. Continue pushing in axle shaft flange while setting J 8001 to zero.
- E. While maintaining inward pressure, rotate axle shaft flange and note lateral runout.
- F. If axle shaft flange lateral runout exceeds 0.05 mm (0.002 inch), replace rear axle shaft. Refer to SECTION 4B.

- 9. If axle shaft flange lateral runout is within specifications, refinish or replace rotor as necessary. Refer to "Refinishing Rear Brake Rotors" under "Unit Repair" in this section.

REAR BRAKE CALIPER INSPECTION

The rear brake caliper must be disassembled for inspection. Refer to "Rear Brake Caliper" under "Unit Repair" in this section.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated compressed air on brake parts as damage to rubber components may result.

! Important

- Replace all components included in repair kits used to service this caliper assembly.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake hydraulic system.
- Replace pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

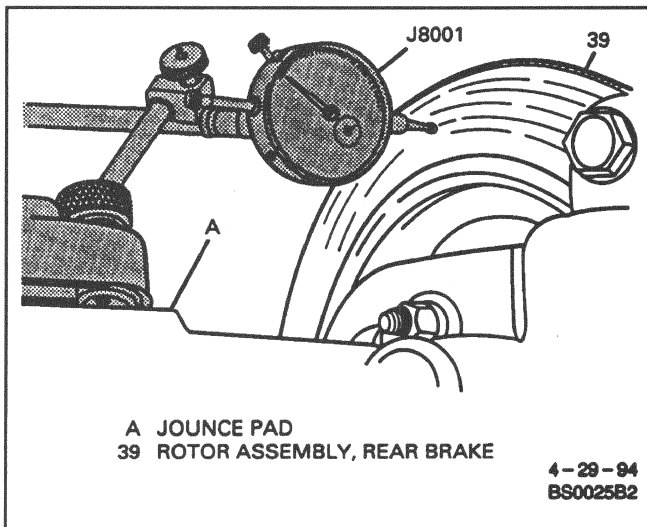


Figure 2 - Checking Lateral Runout

REAR BRAKE CALIPER

Figures 3 through 6

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
 - Install wheel nuts to retain rotor.
3. Brake hose fitting bolt/screw (32), brake hose fitting (33) and two gaskets (34) only if caliper is being removed for overhaul.
 - A. Discard old gaskets (34).
 - B. Plug hole in caliper housing (14) and brake hose fitting (33).
4. Upper caliper guide pin bolt/screw (13) and discard.
5. Lower caliper guide pin bolt/screw (52) and discard, only if removing caliper from vehicle.
6. Caliper housing (14) from rotor (39) and anchor bracket (17).
 - If caliper overhaul or replacement is not required, hang caliper housing (14) from suspension to avoid damage to brake hose.
7. Inner and outer pads (29 and 30) only if they are being replaced or if anchor bracket (17) is being removed.

🔍 Inspect

- A. Guide pins (15) for free movement in anchor bracket (17). Replace guide pins (15) or guide pin boots (16) if corroded, worn or damaged.
- B. Inner and outer pads (29 and 30) for wear and maximum taper of 0.15 mm (0.006 inch).
 - Replace with new inner and outer pad sets (29 and 30) if they are tapered beyond specification.
- C. Brake hose fitting bolt/screw (32).
 - If through-hole in brake hose fitting bolt/screw (32) is blocked, remove blockage or replace brake hose fitting bolt/screw (32).

→→ Install or Connect

NOTICE: Refer to "Notice" on page 5B2-1 of this section.

1. Inner and outer pads (29 and 30), if removed.
 - Outer pad (30) with insulator is installed toward caliper housing (14). Inner pad (29) is installed nearest to piston (19).
2. Caliper housing (14) over rotor (39) and into anchor bracket (17).
3. New upper caliper guide pin bolt/screw (13).

🔧 Tighten

- Bolt/screw (13) to 31 N.m (23 lb. ft.).

5B2-4 REAR DISC BRAKES

4. New lower caliper guide pin bolt/screw (52), if removed.



Tighten

- Bolt/screw (52) to 31 N.m (23 lb. ft.).
5. Brake hose fitting (33), two new gaskets (34) and brake hose fitting bolt/screw (32), if removed.
-
- ### Tighten
- Brake hose fitting bolt/screw (32) to 27 N.m (20 lb. ft.).
6. Bleed brake hydraulic system, if brake hose fitting was removed. Refer to SECTION 5.
 7. Tire and wheel. Refer to SECTION 3E.
 - Remove wheel nuts securing rotor (39).
 8. Lower vehicle.
 9. With engine running, pump brake pedal slowly and firmly three times to seat inner and outer pads (29 and 30).
 10. Check brake hydraulic system for leaks.

REAR DISC BRAKE INNER AND OUTER PADS

Figures 3, 5, and 6



Remove or Disconnect

1. Two-thirds of brake fluid from master cylinder reservoir.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Tire and wheel. Refer to SECTION 3E.
 - Install wheel nuts to retain rotor.
4. Position a C-clamp and tighten until piston (19) bottoms in base of caliper housing (14).
 - Make sure one end of C-clamp rests on brake hose fitting bolt/screw (32) and other end against outer pad (30).
5. Upper caliper guide pin bolt/screw (13).
 - Discard upper caliper guide pin bolt/screw (13).
6. Inner and outer pads (29 and 30).

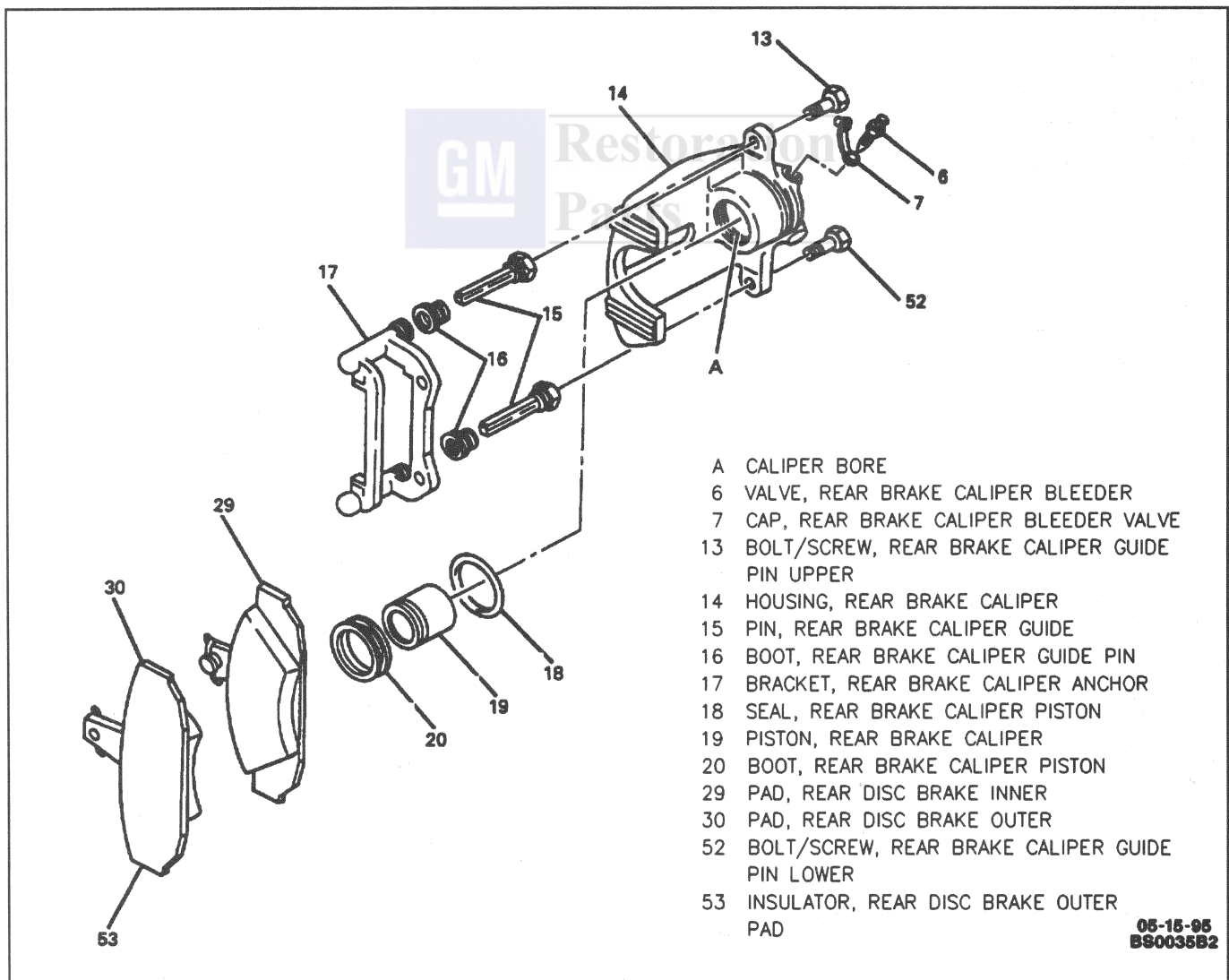


Figure 3 - Rear Brake Caliper Components

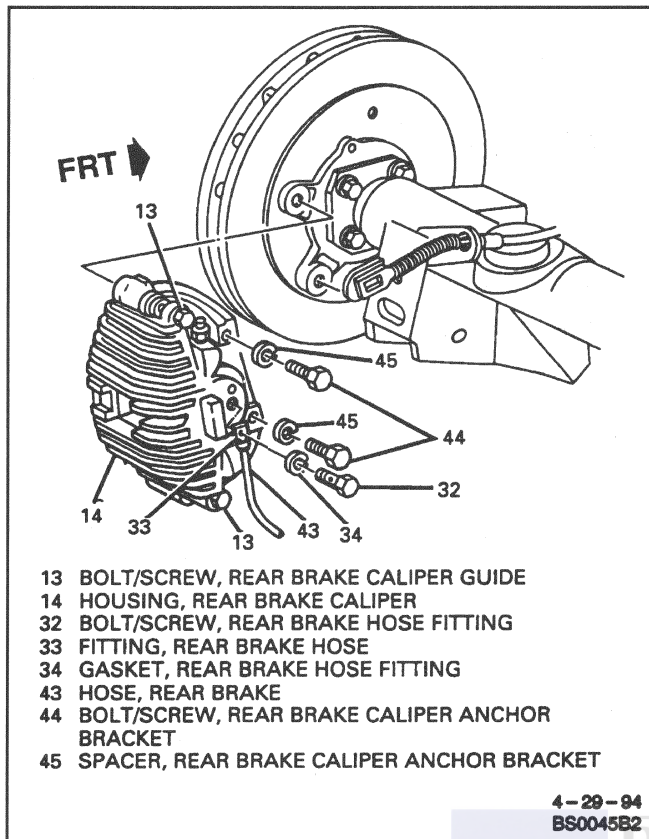


Figure 4 - Removing Rear Brake Hose Fitting

- A. Rotate caliper housing (14) about lower caliper guide pin bolt/screw (52) and guide pin (15). Be careful not to strain hose or cable conduit.
- B. Lift out inner and outer pads (29 and 30).
7. Rear brake pad spring shim.



Clean

- All residue from shoe guide surfaces on anchor bracket (17) and caliper housing (14).



Inspect

- Guide pins (15) for free movement in anchor bracket (17).
— Replace guide pins (15) or guide pin boots (16) if corroded or damaged. Refer to "Rear Brake Caliper" in this section.



Install or Connect

NOTICE: Refer to "Notice" on page 5B2-1 of this section.

1. Rear brake pad spring shim.
 - Spring must lay flat within groove at caliper. (14).
2. New inner and outer pads (29 and 30).
 - Outer pad (30) with insulator is installed toward caliper housing (14). Inner pad (29) is installed nearest the piston (19).
 - Replace inner and outer pads (29 and 30) in axle sets only.

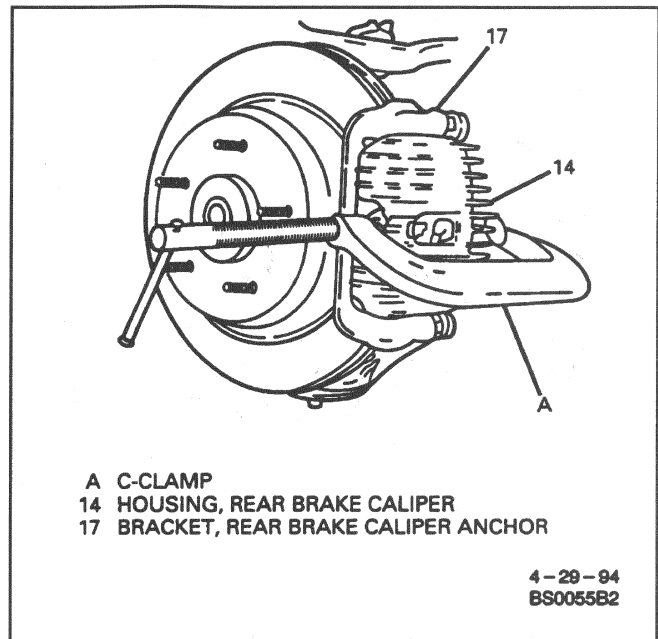


Figure 5 - Compressing Rear Brake Caliper Piston

3. Rotate caliper housing (14) into its operating position.
 - Springs on inner and outer pads (29 and 30) must not stick through inspection hole in caliper housing (14). If springs are sticking through inspection hole in caliper housing (14), lift caliper housing (14) and reposition springs.
4. New upper caliper guide pin bolt/screw (13).



Tighten

- Upper caliper guide pin bolt/screw (13) to 31 N·m (23 lb. ft.).
- 5. With engine running, pump brake pedal slowly and firmly to seat inner and outer pads (29 and 30).
- 6. Tire and wheel. Refer to SECTION 3E.
 - Remove wheel nuts securing rotor (39).
- 7. Lower vehicle.
- 8. Fill master cylinder reservoir. Refer to SECTION 5A.
- 9. Pump the brake pedal until a firm pedal feel is obtained.
- 10. Burnish the rear brake rotors. Refer to "Burnishing the Rear Brake Rotors" in this section.

REAR BRAKE CALIPER ANCHOR BRACKET AND MOUNTING PLATE

Figure 7

1. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.



Important

- Remove anchor bracket (17) only if it is damaged or if rotor (39) is being removed for refinishing or other service operations.

5B2-6 REAR DISC BRAKES

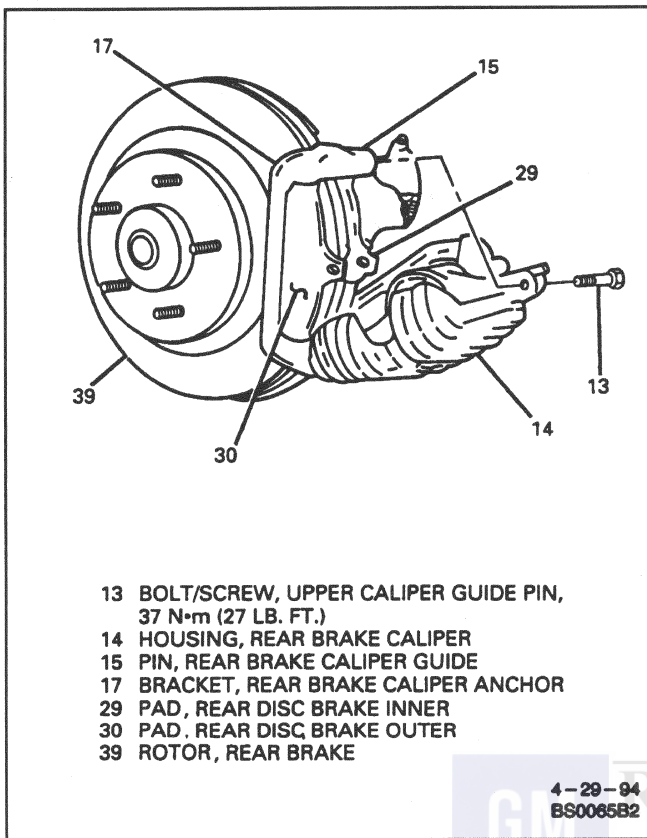


Figure 6 - Rear Disc Brake Inner and Outer Pad Replacement

2. Anchor bracket bolts/screws (44).
3. Anchor bracket (17) from mounting plate (38).
4. Parking brake rear cable. Refer to SECTION 5F.
5. Rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining" in this section.
6. Rear axle shaft. Refer to SECTION 4B.
7. Bolts/screws (54), nuts (55), and washers (56).
8. Mounting plate (38) from axle housing.



Install or Connect

NOTICE: Refer to "Notice" on page 5B2-1 of this section.

1. Position mounting plate (38) to axle housing.
2. Bolts/screws (54), nuts (55), and washers (56).



Tighten

- Mounting plate nuts (55) to 48 N·m (35 lb. ft.).
3. Rear axle shaft. Refer to SECTION 4B.
 4. Rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining" in this section.
 5. Parking brake rear cable. Refer to SECTION 5F.
 6. Anchor bracket (17) to mounting plate (38).
 7. Anchor bracket bolts/screws (44).

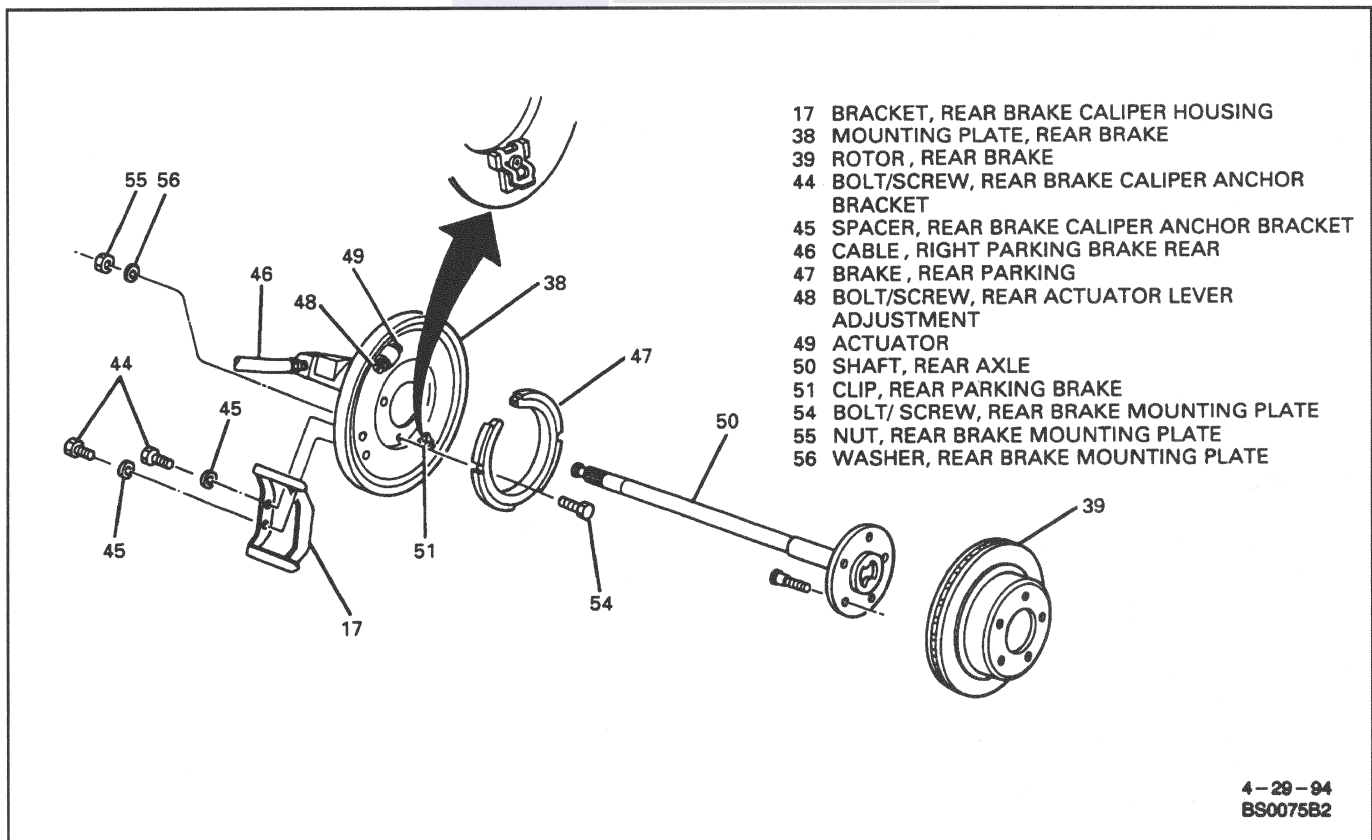


Figure 7 - Rear Brake Rotor, Caliper Anchor Bracket, and Mounting Plate



Tighten

- Anchor bracket bolts/screws (44) to 100 N.m (74 lb. ft.).
8. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.

REAR BRAKE ROTOR

Figure 7

Rear brake rotor can be removed without removal of caliper from anchor bracket.



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Anchor bracket bolts/screws (44).
4. Anchor bracket (17) with assembled caliper from mounting plate (38) and suspend them from rear suspension out of the way using locally fabricated wire hook.
5. Rotor (39).
 - Slowly turn rotor (39) while pulling away from axle.

NOTICE: Refer to "Notice" on page 5B2-1 of this section.

NOTICE: Whenever the rotor has been separated from the axle flange, clean any rust or foreign material from the mating surface of the axle flange and brake rotor. Failure to do this may result in increased lateral runout of the rotor and brake pulsation.

1. Rotor (39).
2. Anchor bracket (17) with assembled caliper to mounting plate (38).
3. Anchor bracket bolts/screws (44).



Tighten

- Anchor bracket bolts/screws (44) to 100 N.m (74 lb. ft.).
4. Tire and wheel. Refer to SECTION 3E.
 5. Lower vehicle.
 6. Burnish rear brake rotors, if replaced. Refer to "Burnishing the Rear Brake Rotors" in this section.

REAR PARKING BRAKE SHOE AND LINING

Figure 7 and 8



Remove or Disconnect

1. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.
2. Rotor. Refer to "Rear Brake Rotor" under "On-Vehicle Service" in this section.

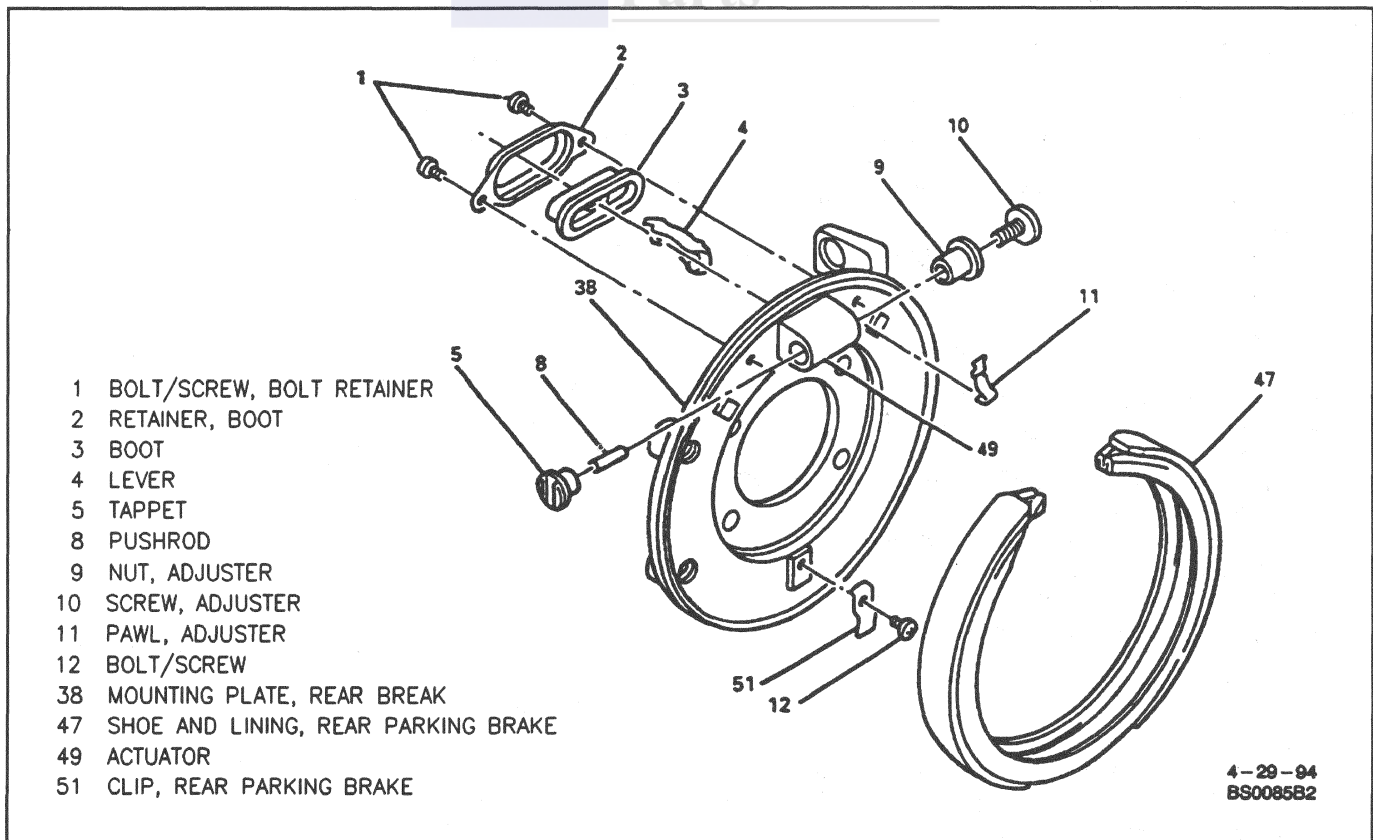


Figure 8 - Rear Parking Brake Components

5B2-8 REAR DISC BRAKES

3. Slide shoe and lining (47) downward from actuator (49).

Install or Connect

1. Open end of shoe and lining (47) through rear axle shaft (50).
2. Slide shoe and lining (47) upward into actuator (49).

Important

- Make sure shoe and lining (47) engages clip (51).

Adjust

- Rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining Adjustment" in this section.
3. Rotor. Refer to "Rear Brake Rotor" under "On-Vehicle Service" in this section.
 4. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.

REAR PARKING BRAKE SHOE AND LINING ADJUSTMENT

Figure 8

Tool Required:
J 21177-A Drum-to-Brake Shoe Clearance Gage

Remove or Disconnect

1. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.
2. Rotor.
 - Slowly turn rotor while pulling away from axle.
3. Loosen parking brake cable adjusting nut until lever (4) is at its "at rest" position.

Adjust

1. Rear parking brake shoe and lining (47).
 - A. Set J 21177-A so that it contacts inside diameter of rotor.
 - B. Position J 21177-A over shoe and lining (47) at its widest point.
 - C. Turn adjuster nut (9) until shoe and lining (47) just contacts J 21177-A.
 - D. Repeat procedure for opposite side.
2. Rear parking brake cable. Refer to SECTION 5F.

Install or Connect

1. Rotor.
 - Slowly turn rotor while sliding onto axle.
2. Caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.

UNIT REPAIR

REFINISHING REAR BRAKE ROTORS

Important

- DO NOT refinish rotors when performing routine brake maintenance such as replacing worn rear disc brake inner and outer pads. Refinish a rotor ONLY under the following circumstances:
 - There is a complaint of brake pulsation.
 - There is scoring greater than 1.5 mm (0.060 inch).

All rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. The minimum refinish dimension is greater than the discard dimension. Do not use a rotor that will not meet specifications. A rotor that has been refinished too thin will not have proper heat transfer capabilities. Replace with a new rotor. Refer to "Specifications" in this section.

Since accurate control of the rotor tolerances is necessary for proper performance of the rear disc brakes, the rotor should be machined only with precision equipment. Equipment should be serviced on a regular basis following the manufacturer's recommended maintenance procedure. When refinishing rotors, the attaching adapters, tool holders, vibration dampeners and tool bits must be in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance and possibly cause brake chatter while machining. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments help eliminate tool chatter and will result in better surface finish. Make sure these adapters are clean and free of nicks.

On-Vehicle

Tools Required:

J 37704 On-Vehicle Brake Lathe or equivalent

In the cases where rotors are being refinished to correct a problem with brake pulsation, it is recommended that an on-vehicle brake lathe be used to achieve best results. Follow the equipment manufacturer's recommended specifications and procedure.

Off-Vehicle

Figure 9

Tool Required:

J 39144 Brake Rotor Mounting Adapter

Important

- Remove rust and scale from rotor and rear axle shaft flange mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor is mounted on the brake lathe, or when the rotor is reinstalled on the rear axle shaft flange.



Assemble

1. Brake rotor to J 39144 brake rotor adapter.
 - A. Install spacer to adapter first.
 - B. Set brake rotor top of adapter and spacer.
 - C. Install 1 1/2 inch long, 1/2 NC bolts/screws with washers through rotor, spacer and into adapter.



Important

- Do not use the bolts/screws supplied with J 39144. They are too short, and are likely to strip out when torque is applied. Obtain correct length bolts/screws from a local hardware store.



Tighten

- Rotor-to-adapter bolts screws to 140 N.m (100 lb. ft.).

Following are two recommended procedures that achieve adequate results using two different off-vehicle drum/disc brake lathes. (If any other lathe is used, follow that lathe's instructions and recommendations).

Accuturn Brake Lathe, GM Dealer Equipment

(One-cut refinishing procedure)

Locate the deepest score and turn the tool bit micrometer knob until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out

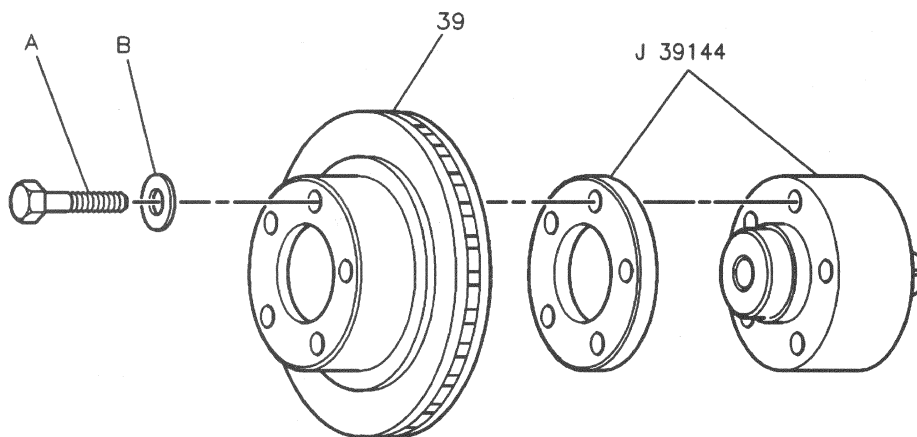
the tool bit (repeat for opposite side of rotor). Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face. Adjust the micrometer knobs for approximately 0.13 mm (0.005 inch) more than the first reading. This will ensure resurfacing the rotor in one cut.

- Spindle Speed 105 rpm
- Depth of Cut As necessary
- Tool Cross Feed 0.08 mm (0.003 inch) per rev.
- Tool Bit Nose Radius 1/64
- Vibration Dampener Yes
- Non-Directional Finishing Yes

Ammco Brake Lathe

(Two-cut refinishing procedure)

1. Rough cut.
 - Spindle Speed 150 rpm
 - Depth of Cut (per side) 0.15 - 0.64 mm (0.006 - 0.025 in.)
 - Tool Cross Feed (Per Revolution) 0.25 mm (0.010 in.)
 - Vibration Dampener Yes
 - Sand Rear Brake Rotor (Swirl Pattern) No
2. Finish Cut.
 - Spindle Speed 150 rpm
 - Depth of Cut (Per Side) .. 0.010 - 0.015 mm (0.004 - 0.006 in.)
 - Tool Cross Feed (Per Rev.) 0.05 mm (0.002 in.)
 - Sand Brake Rotor (Swirl Pattern) Yes



- A BOLT/SCREW, 1 1/2 INCH LONG, 1/2 NC
- B WASHER
- 39 ROTOR, REAR BRAKE

05-13-95
BT0115B2

Figure 9 - Mounting Rear Brake Rotor on Adapter

5B2-10 REAR DISC BRAKES

Non-Directional Finishing

It is very important that the rotor surface be made non-directional by dressing the rotor surfaces with a sanding disc tool such as Accuturn 433179 Non-Directional Swirl Finisher, Ammco 8750 Safe Swirl Disc Rotor Grinder, or equivalent, using 120 grit aluminum oxide sandpaper. Sand each rotor surface with moderate pressure for a minimum of 60 seconds. If the brake lathe is not equipped with an adequate non-directional finishing tool, an alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure. After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner. The finished rotor surface should be as close to that of a new rear brake rotor as possible. Failure to obtain the best possible finish may affect braking performance.

Important

- Rear brake rotors should always be replaced if turning will result in a rear brake rotor that does not meet manufacturer specifications for minimum thickness. When installing new brake rotors, do not refinish the surfaces of these parts. New brake rotors have the correct level of surface finish.

Burnishing Rear Brake Rotors

After rear brake pads have been replaced and/or rotors have been refinished, it is very important that the new braking surface be broken in, or burnished. This can be accomplished by making 20 stops from 48 km/h (30 mph), using medium to firm brake pedal pressure. Take care to avoid overheating the brakes.

Refinishing Rear Brake Rotor Parking Brake Surface

The rear brake rotor parking brake contact surface should not be refinished. If the parking brake system cannot effectively hold the vehicle and all other parking brake components are functioning properly, replace the rotor.

REAR PARKING BRAKE ACTUATOR

Figure 8

Disassemble

1. Remove rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining" in this section.
2. Remove parking brake cable from lever (4).
 - Loosen equalizer enough to provide adequate clearance.
3. Bolts/screws (1).
4. Retainer (2) and boot (3).
5. Adjuster screw (10) and nut (9).

6. Tappet (5).
7. Pushrod (8).
 - Use a magnet to remove pushrod (8) from actuator (49).
8. Lever (4).



Clean

- All parts with a clean dry shop cloth.



Inspect

- All parts for excessive wear, cracks or other changes. Replace parts as needed.



Assemble

1. Lubricate all moving parts with Lubriplate® P/N 1050109.
2. Lever (4).
3. Pushrod (8).
 - Fully seat pushrod (8) into actuator (49).
4. Tappet (5).
5. Adjuster screw (10) and nut (9).
6. Boot (3) and retainer (2).
7. Bolts/screws (1).
 - Tighten snugly.
8. Install rear parking brake cable to lever (4).
9. Install rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining" in this section.



Adjust

- A. Rear parking brake shoe and lining. Refer to "Rear Parking Brake Shoe and Lining Adjustment" in this section.
- B. Rear parking brake cable. Refer to SECTION 5F.

REAR BRAKE CALIPER

Figures 3 and 9



Disassemble

1. Remove caliper. Refer to "Rear Brake Caliper" under "On-Vehicle Service" in this section.

CAUTION: Do not place fingers in front of the piston in an attempt to catch or protect it when applying compressed air. The piston can fly out with force and could result in serious injury.



Important

- Use clean shop towels to pad the inside of the caliper housing (14) during rear brake caliper piston removal.

NOTICE: To prevent damage, be careful when handling rear brake caliper piston.

2. Piston (19) by directing dry, filtered compressed air into brake hose port of caliper housing (14).



Clean

- Piston (19) for scoring, nicks, corrosion and wear.
- Replace piston (19) if necessary.

NOTICE: Do not use a metal tool to remove piston seal. Metal tools may damage the caliper housing bore or the piston seal groove.

3. Piston seal (18).
 - Use small wood or plastic tool.
4. Bleeder valve cap (7) and bleeder valve (6).
 - Discard bleeder valve cap (7).



Clean

- Pad contact area on anchor bracket (17).
5. Two guide pins (15) and guide pin boots (16) from anchor bracket (17).



Inspect

- All parts for excessive wear, cracks or other changes. Replace parts as needed.



Clean

- A. All parts not included in repair kit in denatured alcohol.
- B. Use dry, filtered compressed air to dry parts.
- C. Blow out all passages in caliper housing (14) and bleeder valve (6).



Inspect

- Caliper housing bore for scoring and corrosion. Replace caliper housing (14) if badly scored or corroded around seal area.

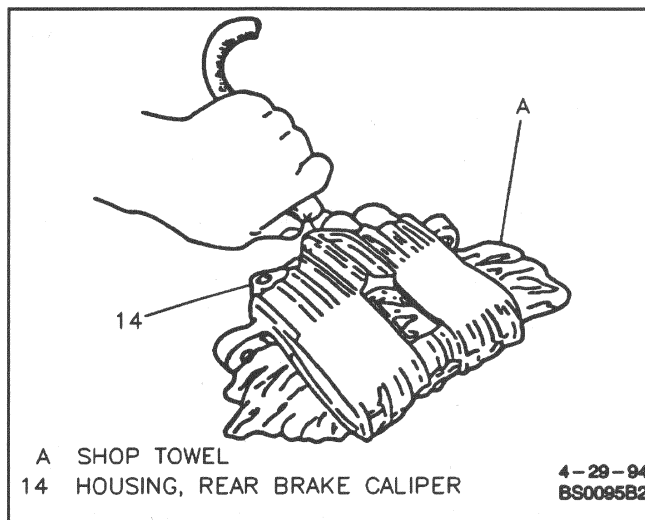


Figure 10 - Removing Rear Brake Caliper Piston



Assemble

NOTICE: Refer to “Notice” on page 5B2-1 of this section.

1. Lubricate new piston seal (18) and caliper housing bore seal groove with silicone grease or clean brake fluid.
2. New piston seal (18) into caliper housing seal groove.
 - Make sure piston seal (18) is not twisted.
3. Lubricate bore of caliper housing (14) and piston (19) with clean brake fluid.
4. Piston (19) into bore of caliper housing (14).
 - Work lip of piston seal (18) over piston (19) using a small wood or plastic tool.
 - Push down by hand to bottom of bore.

SPECIFICATIONS

GENERAL SPECIFICATIONS

- Rear Brake Caliper Housing Bore Diameter.....54mm (2.126 inch)
- Rear Brake Rotor
 - Rotor Diameter (Nominal) 295 mm (11.614 inch)
 - Lateral Runout:
 - A. Rear Brake Rotor (On-Vehicle)..... 0.10 mm (0.004 inch)
 - B. Rear Axle Shaft Flange 0.05 mm (0.002 inch)
 - Thickness Variation..... 0.013 mm (0.0005 inch)
 - Rotor Thickness (Maximum) 20.00 mm (0.787 inch)
 - A. Minimum Thickness After Refinish..... 19.64 mm (0.735 inch)
 - B. Discard Thickness 18.50 mm (0.728 inch)

All rear brake rotors have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any rear brake rotor which does not meet this specification should be replaced.

ROTOR REFINISHING SPECIFICATIONS

Ammco Brake Lathe

1. Rough Cut
 - Spindle Speed150 rpm
 - Depth of Cut (Per Side)..... 0.15 mm to 0.64 mm (0.006 to 0.025 inch)
 - Tool Crossfeed (Per Rev.)..... 0.25 mm (0.010 inch)
 - Vibration Dampener..... Yes
 - Sand Brake Rotor (Swirl Pattern)No
2. Finish Cut
 - Spindle Speed150 rpm
 - Depth of Cut (Per Side)..... 0.10 mm to 0.15 mm (0.004 to 0.006 inch)
 - Tool Crossfeed (Per Rev.)..... 0.05 mm (0.002 inch)
 - Vibration Dampener..... Yes
 - Sand Brake Rotor (Swirl Pattern) Yes

Accuturn Brake Lathe

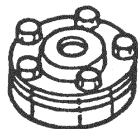
1. Single Cut Refinishing
 - Spindle Speed105 rpm
 - Depth of Cut..... As necessary
 - Tool Crossfeed (Per Rev.)..... 0.08 mm (0.003 inch)
 - Vibration Dampener..... Yes

FASTENER TIGHTENING SPECIFICATIONS

- Lower Caliper Guide Pin Bolt/Screw 31 N.m (23 lb. ft.)
- Rear Brake Caliper Anchor Bracket Bolt/Screw..... 100 N.m (74 lb. ft.)
- Rear Brake Caliper Bleeder Valve..... 11 N.m (97 lb. in.)
- Rear Brake Hose Fitting Bolt/Screw 27 N.m (20 lb. ft.)
- Rear Brake Mounting Brake Nut..... 48 N.m (35 lb. ft.)
- Rear Parking Brake Lever Pivot Pin Nut 22 N.m (16 lb. ft.)
- Upper Caliper Guide Pin Bolt/Screw 31 N.m (23 lb. ft.)

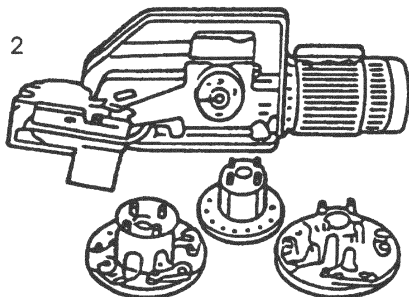
SPECIAL TOOLS

1



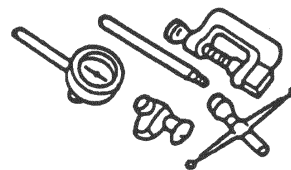
J 39144

2



J 39144

3



J 8001

4



J 21177-A

- 1 BRAKE ROTOR MOUNTING ADAPTER
- 2 ON DISC BRAKE LATHE
- 3 DIAL INDICATOR SET
- 4 DRUM-TO-BRAKE SHOE CLEARANCE GAGE

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5B2-14 REAR DISC BRAKES



SECTION 5C2

DUO-SERVO DRUM BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The rear brake system is a duo-servo design. In the duo-servo brake, the force which the rear wheel cylinder applies to the rear brake primary shoe is multiplied by the primary lining friction to provide a

very large force, which is applied to the rear brake secondary shoe. Torque from the brake shoes is transferred to the anchor pin, through the rear brake backing plate and to the axle flange. Adjustment for both the rear brake primary and secondary shoe and linings is automatic during reverse brake applications.

DIAGNOSIS

PRIMARY AND SECONDARY SHOES INSPECTION

When the thickness of any lining is worn within 0.76 mm (0.030 inch) of the primary or secondary shoe rivets, the primary and secondary shoes must be replaced. Replace shoes in axle sets only.

REAR BRAKE DRUM INSPECTION

Pulsation in the brake pedal is usually corrected by servicing the front brakes. Service the rear brakes only if the problem persists. To determine if the front or rear brakes are at fault, drive the vehicle in an area away from people and moving traffic (such as in a large parking lot), and at a slow speed, apply the parking brake and feel for the pulsation. If the pulsation is not noticed, the fault is probably in the front brakes.

When drums are removed, thoroughly clean and inspect them for cracks, scores, deep grooves, out-of-round and taper.

Surface Finish

Normal light scoring of the drum surfaces not exceeding 0.51 mm (0.020 inch) in depth will not affect brake operation.

Inside Diameter Check

The nominal inside diameter of the drum is 279.00 mm (11.000 inches). Refer to "Specifications" for maximum refinish diameter and discard diameter.

Out-of-Round or Taper Check

An out-of-round or tapered drum makes accurate primary or secondary shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the drum exceeds the specification limits in taper and/or out-of-round, refinish drum to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper, and wear, take measurements at the open and closed edges of machined surface and at right angles (90 degrees) to each other.

Runout Check

Runout for drums is not to exceed 0.15 mm (0.006 inch).

Balance

During manufacture, weights are used to balance drums. These weights must not be removed. After drums have been refinished or if difficulty is experienced in maintaining proper wheel balance, drums should be checked for balance. Drums may be checked for balance on most off-the-vehicle wheel balancers.

ON-VEHICLE SERVICE



Important

- Replace all components included in repair kits used to service this rear brake system.
- Lubricate parts as specified.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnects, it may be necessary to bleed all or part of the brake hydraulic system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

REAR BRAKE DRUM

Figure 1



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Drum.
 - Mark the relationship of the drum to the axle flange.
 - If you have trouble removing the rear brake drum, try the following:
 - A. Make sure the parking brake is released.
 - B. Back off the parking brake cable adjustment. Refer to SECTION 5F.
 - C. Remove the adjusting hole plug or knockout from the plate (29) and back off the adjusting screw using a screwdriver and a brake adjusting tool.
 - D. Use a rubber mallet to tap gently on the outer rim of the drum and/or around the inner drum diameter by the spindle. Take care not to deform the drum by excessive use of force.



Install or Connect



Adjust

- Rear brake. Refer to "Rear Brake Adjustment" in this section.
1. Drum.
 - Align locating marks on drum and axle flange.
 - If the knockout in plate (29) was removed, an adjusting hole cover, GM P/N 5464803, must be installed.
 2. Tire and wheel. Refer to SECTION 3E.



Adjust

- Parking brake rear cable. Refer to SECTION 5F.

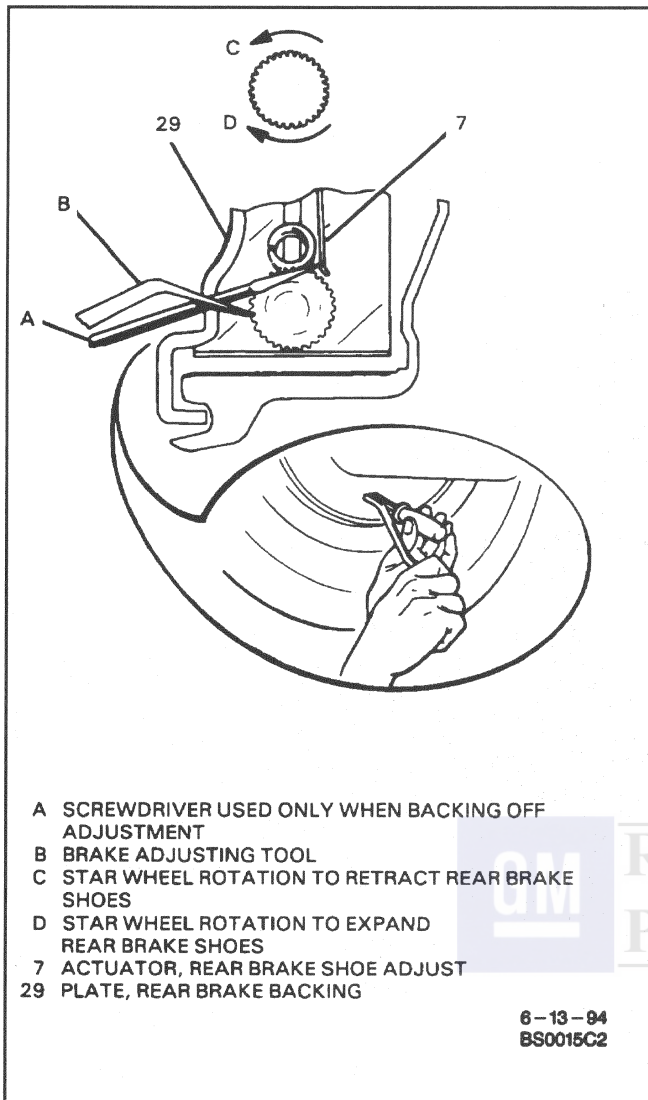


Figure 1 - Backing Off Rear Brake Shoe Adjustment

PRIMARY AND SECONDARY SHOES

Figures 2 and 3

Tools Required:

- J 8049 Brake Spring Remover and Installer
- J 8057 Brake Spring Pliers



Remove or Disconnect

1. Rear brake drum. Refer to "Rear Brake Drum" under "On-Vehicle Service" in this section.

CAUTION: Keep fingers away from rear brake shoe return springs to prevent fingers from being pinched between rear brake shoe return spring and shoe web or return spring and backing plate.

2. Springs (1 and 2) using J 8049.
3. Hold down springs (3) and pins (5) using suitable pliers.
4. Pivot (4).

5. Link (6) while lifting up on actuator (7).
6. Actuator (7), pawl (8), if equipped, and spring (9).
7. Guide (10), strut (11) and spring (12).
8. Primary shoe (13) and secondary shoe (14) from plate (29) and parking brake rear cable.
9. Adjuster (31) and spring (15).
10. Lever (20).
 - Unhook lever tab from slot in primary or secondary shoe (13 or 14).



Clean

1. Adjuster (31).
 - Clean adjuster threads with a wire brush.
 - Wash all components in clean denatured alcohol.
 - Apply brake lubricant GM P/N 1052196 or equivalent to the adjuster threads, inside diameter of socket (16) and socket face.
 - Adequate lubrication is achieved when a continuous bead of lubricant is at open end of nut (18) and socket (16) when threads are fully engaged.
2. Plate (29) and lubricate contact surfaces with brake lubricant GM P/N 1052196 or equivalent.



Inspect

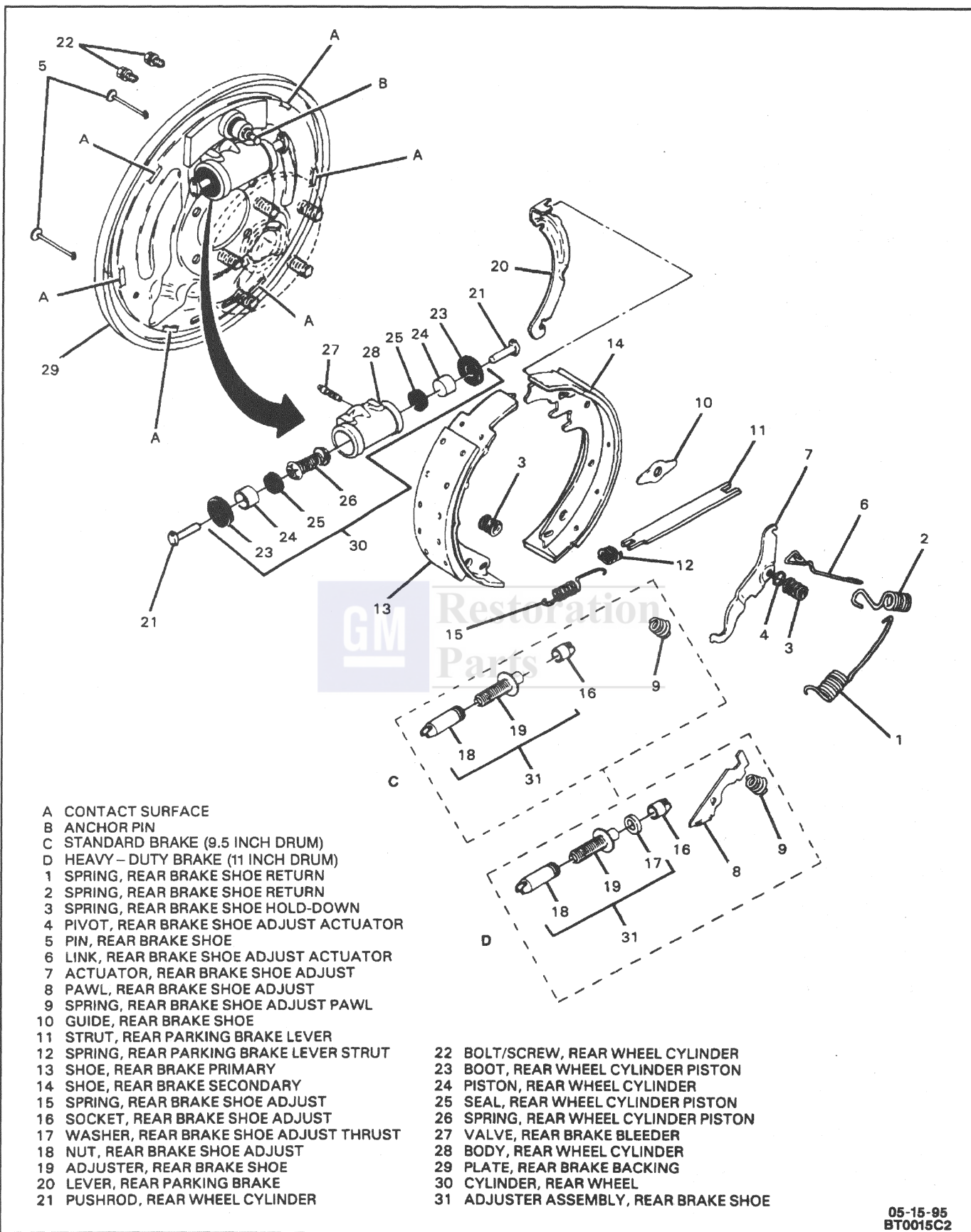
1. Threads of adjuster (19) for smooth rotation over full length.
2. All parts.
 - If any parts are of questionable strength or quality due to discoloration from heat, over-stress, or wear, the parts should be replaced.



Install or Connect

1. Lever (20).
 - Hook lever tab into slot in primary or secondary shoe (13 or 14).
2. Adjuster (31) and spring (15).
3. Primary and secondary shoe (13 and 14) to parking brake rear cable and plate (29).
4. Strut (11) and spring (12) by spreading primary and secondary shoes (13 and 14) apart.
 - The end without spring (12) engages the lever (20) and primary or secondary shoe (13 or 14).
 - The end with the spring (12) engages the opposite primary or secondary shoe (13 or 14).
5. Guide (10).
6. Pawl (8), if equipped, actuator (7) and spring (9).
7. Pins (5), pivot (4) and springs (3).
 - Use pliers or tool suitable to lock springs (3) onto pins (5).
8. Link (6) on anchor pin.
9. Link (6) into actuator (7) while holding up on actuator (7).
10. Springs (1 and 2) using J 8057.
11. Rear brake drum. Refer to "Rear Brake Drum" under "On-Vehicle Service" in this section.

5C2-4 DUO-SERVO DRUM BRAKES



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Figure 2 - Rear Brake Components

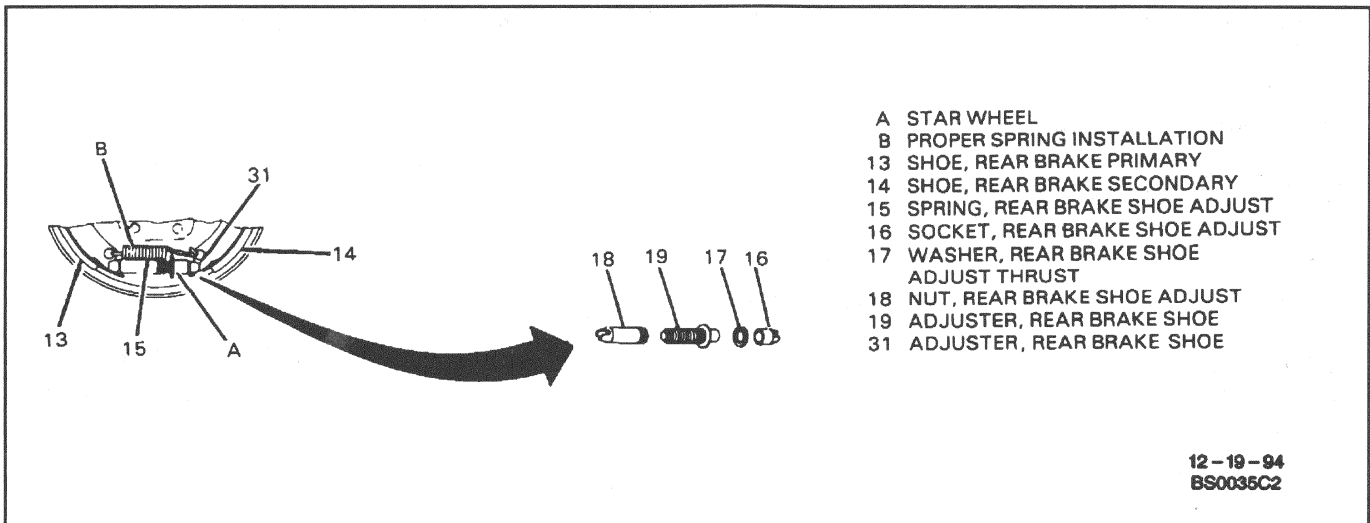


Figure 3 - Rear Brake Shoe Adjuster

REAR WHEEL CYLINDER**Figure 4****Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.

**Clean**

- Dirt and foreign material around cylinder (30) and rear brake rear pipe.
2. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
 3. Rear brake rear pipe from wheel cylinder (30).
 - Plug opening in rear brake rear pipe to prevent brake fluid loss and contamination.
 4. Pushrods (21).
 5. Bolts/screws (22).
 6. Wheel cylinder (30).

**Install or Connect**

NOTICE: Refer to "Notice" on page 5C2-1 of this section.

1. Wheel cylinder (30).
 - Hold in position.
2. Bolts/screws (22).

**Tighten**

- Bolts/screws (22) to 18 N.m (13 lb. ft.).
3. Pushrods (21).
 4. Rear brake rear pipe to wheel cylinder (30).

**Tighten**

- Rear brake rear pipe to 24 N.m (18 lb. ft.).

5. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
6. Lower vehicle.
7. Bleed the brake hydraulic system. Refer to SECTION 5.

BACKING PLATE**Figure 4****Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
3. Rear axle shaft. Refer to SECTION 4B.
4. Parking brake rear cable from plate (29).
 - Use a 1/2-inch box wrench to compress lock ring fingers.
5. Rear brake rear pipe from wheel cylinder (30).
6. Bolts/screws (22).
7. Wheel cylinder (30).

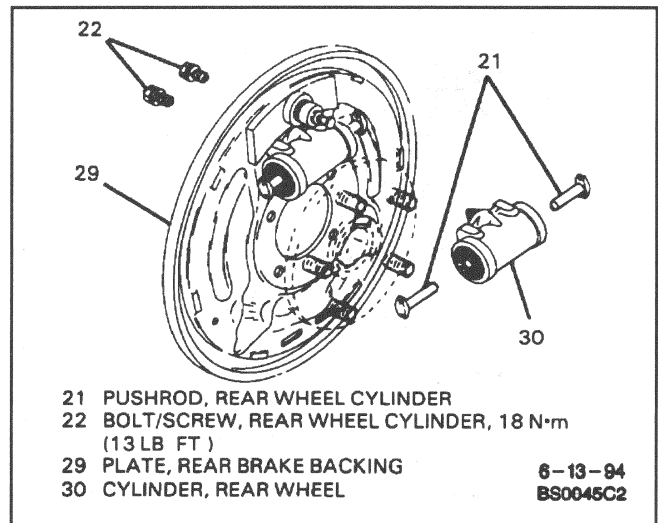


Figure 4 - Rear Wheel Cylinder

5C2-6 DUO-SERVO DRUM BRAKES

8. Rear brake backing plate nuts, washers and bolts/screws.
9. Plate (29).

Install or Connect

NOTICE: Refer to "Notice" on page 5C2-1 of this section.

1. Plate (29).
2. Rear brake backing plate bolts/screws, washers and nuts.

Tighten

- Rear brake backing plate nuts to 48 N.m (35 lb. ft.).
3. Wheel cylinder (30).
 4. Bolts/screws (22).

Tighten

- Bolts/screws (22) to 18 N.m (13 lb. ft.).
5. Rear brake rear pipe to wheel cylinder (30).

Tighten

- Rear brake rear pipe to 24 N.m (18 lb. ft.).
6. Parking brake rear cable to plate (29).
 - Make sure retainer fingers are seated.
 7. Rear axle shaft. Refer to SECTION 4B.
 8. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
 9. Bleed the brake hydraulic system. Refer to SECTION 5.

Adjust

- Rear brakes. Refer to "Rear Brake Adjustment" in this section.
 - Parking brake rear cable. Refer to SECTION 5F.
10. Lower vehicle.

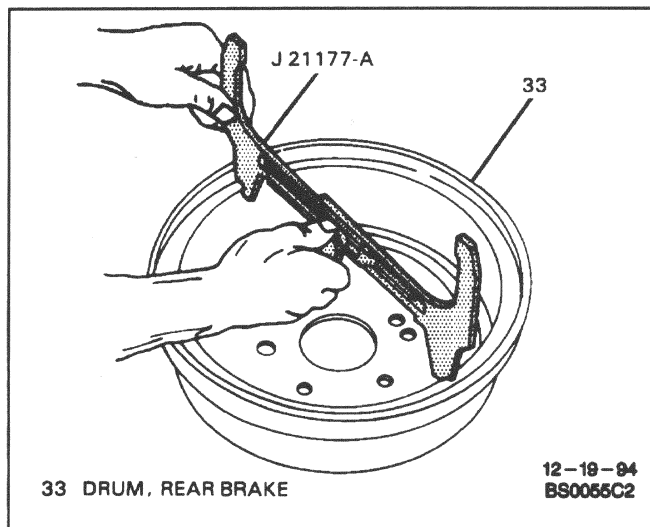


Figure 5 - Setting Tool to Rear Brake Drum

REAR BRAKE ADJUSTMENT

Figures 5 and 6

Tool Required:

J 21177-A Drum-to-Brake Shoe Clearance
Gage

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tires and wheels. Refer to SECTION 3E.
3. Rear brake drum. Refer to "Rear Brake Drum" under "On-Vehicle Service" in this section.

Adjust

- Rear brakes.
 - A. Set J 21177-A so that it contacts the inside diameter of the drum (33).
 - B. Position J 21177-A over the primary and secondary shoes (13 and 14).
 - C. Turn the star wheel on the adjuster (19) until the primary and secondary shoes (13 and 14) contact J 21177-A.
 - D. The outside diameter of the primary and secondary shoes (13 and 14) will be approximately 1.27 mm (0.050 inch) less than the inside diameter of the drum (33) on each wheel.

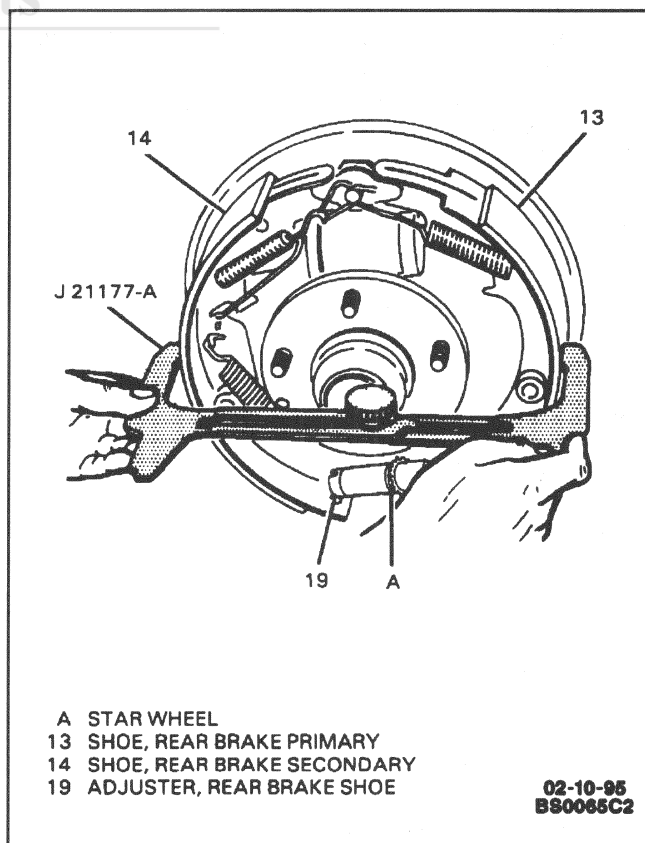


Figure 6 - Setting Rear Brake Primary and Secondary Shoes to Tool

**Install or Connect**

1. Drum (33).
 - Align locating marks on drum (33) and axle flange.
2. Tires and wheels. Refer to SECTION 3E.
3. Lower vehicle.
4. Make several alternate forward and reverse stops applying firm force to the brake pedal. Repeat until ample pedal reserve is built up.

UNIT REPAIR**REAR BRAKE DRUM****Cracked, Scored or Grooved**

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum. Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it may be necessary to refinish the drum braking surface.

If the brake linings are slightly worn, but still reusable, and the drum is grooved, polish the drum with fine emery cloth but do not refinish. Eliminating all grooves in drum and smoothing the ridges on lining would require removing too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained. If brake linings are to be replaced, refinish a grooved drum. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible, to obtain proper brake performance.

Out-Of-Round or Tapered

An out-of-round or tapered drum prevents accurate rear brake shoe adjustment and is likely to cause excessive wear of other brake parts due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the drum exceeds the specification limits in taper and/or out-of-round, refinish the drum to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer and extension rods. When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of the machined surface and at right angles (90 degrees) to each other.

Refinishing

All drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a drum that will not meet the specifications. Refer to "Specifications" at the end of this section. Any drum that does not meet specifications shown should be replaced.

When refinishing a drum, resurface the drum to no more than a dimension of 0.76 mm (0.030 inch) less than the discard diameter. The refinish diameter is the maximum diameter the drum should be refinished

to, and still allow safe braking action. If this dimension is exceeded, the drum will wear beyond the discard diameter during normal brake wear.

If a drum must be refinished, remove only enough metal to obtain a true, smooth braking surface. If a drum does not clean-up when refinished to a maximum rebore diameter as shown at the end of this section, replace it. Removal of more metal will affect heat dissipation and may cause rear brake drum distortion.

When refinishing drums, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish. The optimum spindle speed for refinishing braking surfaces is 200 rpm. Crossfeed for rough cutting should range from 0.15-0.25 mm (0.006-0.010 inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.05 mm (0.002 inch) per revolution.

Replacing Drums

When installing new drums, do not refinish the braking surface. New drums have the correct level of surface finish.

Balance

During manufacture, weights are used to balance drums. Do not remove these weights. After drums are refinished, or when maintaining wheel balance is difficult, check the drums for balance. They can be checked on most off-vehicle balancers. If found to be out of balance, replace drum.

REAR WHEEL CYLINDER**Figure 7****Disassemble**

1. Boots (23).
2. Pistons (24) and seals (25).
3. Spring (26).
4. Valve (27) from body (28).

**Inspect**

- Rear wheel cylinder bore for scoring, nicks, corrosion and wear.
 - Use crocus cloth to polish out light corrosion.
 - Replace cylinder if bore will not clean up with crocus cloth.
- Pistons (24) for scoring, nicks, corrosion and wear.

**Clean**

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.
- Lubricate new seals (25) with clean brake fluid.

5C2-8 DUO-SERVO DRUM BRAKES



Assemble

NOTICE: Refer to "Notice" on page 5C2-1 of this section.

1. Valve (27) into body (28).



Tighten

- Valve (27) to 7 N.m (62 lb. in.).
2. Spring (26).
 3. Seals (25) and pistons (24).
 4. Boots (23).

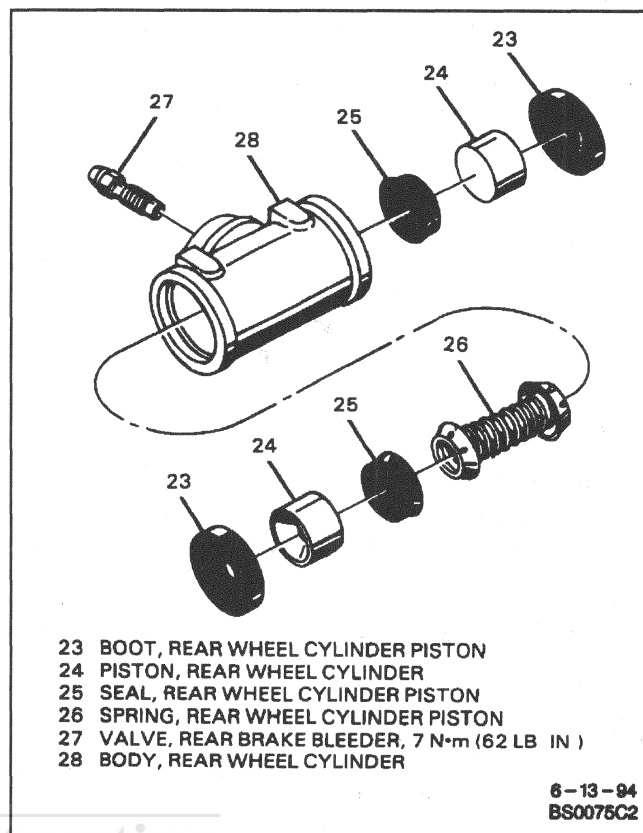


Figure 7 - Rear Wheel Cylinder Components

SPECIFICATIONS

GENERAL SPECIFICATIONS

Rear Wheel Cylinder Bore Diameter (Standard Brake, RPO-JA1)	22.2 mm (7/8 inch)
Rear Wheel Cylinder Bore Diameter (Heavy-Duty Brake, RPO-JA2)	25.4 mm (1.00 inch)
Brake Lubricant	GM P/N 1052196

REAR BRAKE DRUM (Standard Brake, RPO-JA1)

Inside Diameter (Nominal)	241.30 mm (9.500 inch)
Maximum Refinish Diameter	242.82 mm (9.560 inch)
Discard Diameter	243.59 mm (9.590 inch)
Maximum Runout	0.15 mm (0.006 inch)

REAR BRAKE DRUM (Heavy Duty Brake, RPO-JA2)

Inside Diameter (Nominal)	279.00 mm (11.000 inch)
Maximum Refinish Diameter	280.92 mm (11.060 inch)
Discard Diameter	281.68 mm (11.090 inch)
Maximum Runout	0.15 mm (0.006 inch)

All rear brake drums have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any rear brake drum which does not meet the specification should be replaced.

FASTENER TIGHTENING SPECIFICATIONS

Rear Brake Backing Plate Nut	48 N.m (35 lb. ft.)
Rear Brake Bleeder Valve	7 N.m (62 lb. in.)
Rear Brake Rear Pipe Fitting	24 N.m (18 lb. ft.)
Rear Wheel Cylinder Bolt/Screw	18 N.m (13 lb. ft.)

SPECIAL TOOLS



J 8049



J 21177-A



J 8057

- 1 BRAKE SPRING REMOVER AND INSTALLER
- 2 BRAKE SPRING PLIERS
- 3 DRUM-TO-BRAKE SHOE CLEARANCE GAGE

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BLANK



SECTION 5D1

VACUUM BOOSTER SYSTEM

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

POWER BRAKE BOOSTER

The power brake booster is a tandem vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, the tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist. When the service brake is released, the atmospheric air is shut off from one side of each diaphragm. The air is then drawn from the booster through the power brake booster vacuum check valve to the vacuum source. The internal components of the booster are non-serviceable and non-interchangeable.

ON-VEHICLE SERVICE

 Important

- Replace all components included in repair kits used to service this booster.
- Lubricate rubber parts with silicone grease, provided in kits, to ease installation.
- Do not use lubricated shop air on brake parts as damage to rubber parts may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

POWER BRAKE BOOSTER

Figure 1

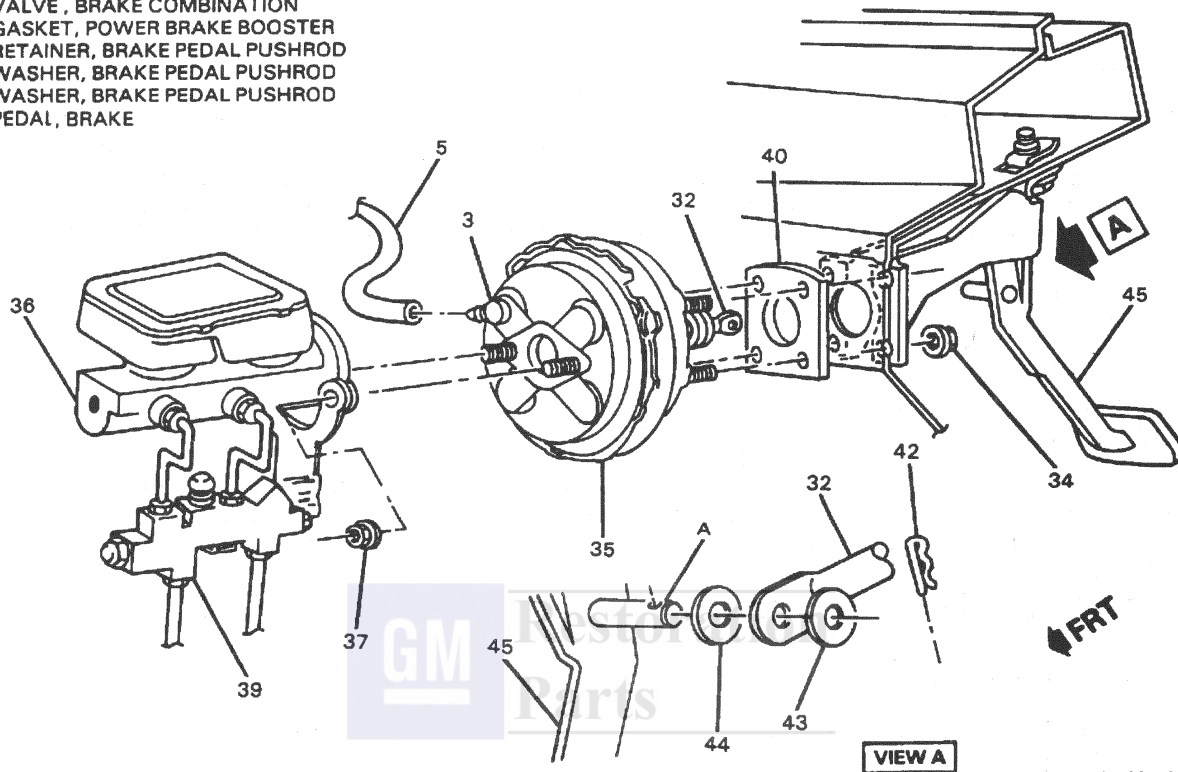
 Remove or Disconnect
 Important

- It is not necessary to remove or disconnect the master cylinder from the vehicle in order to remove the vacuum booster. However, if both the vacuum booster and master cylinder are to be removed, remove the master cylinder first, as described in SECTION 5A.

1. Left-hand sound insulator panel. Refer to SECTION 8C.
2. Hose (5) from valve (3).
3. Two nuts (37).
4. Valve (39) and cylinder (36) from booster (35).
 - Move master cylinder forward just enough to clear studs on vacuum booster. This will flex brake pipes slightly. Take care not to bend or distort brake pipes.
5. Four nuts (34).
6. Retainer (42), outer washer (43), pushrod (32) and inner washer (44) from pedal (45).
7. Daytime running lamp (DRL) diode, if equipped. Refer to SECTION 8C.
8. Booster (35) and gasket (40), if necessary.

5D1-2 VACUUM BOOSTER SYSTEM

- A BRAKE PEDAL PUSHROD ASSEMBLY PIN
- 3 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
- 5 HOSE, POWER BRAKE BOOSTER VACUUM
- 32 PUSHROD, POWER BRAKE BOOSTER POWER PISTON
- 34 NUT, BRAKE PEDAL BRACKET, 25 N·m (18 LB. FT.)
- 35 BOOSTER, POWER BRAKE
- 36 CYLINDER, BRAKE MASTER
- 37 NUT, BRAKE MASTER CYLINDER, 25 N·m (18 LB. FT.)
- 39 VALVE, BRAKE COMBINATION
- 40 GASKET, POWER BRAKE BOOSTER
- 42 RETAINER, BRAKE PEDAL PUSHROD
- 43 WASHER, BRAKE PEDAL PUSHROD
- 44 WASHER, BRAKE PEDAL PUSHROD
- 45 PEDAL, BRAKE



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Figure 1 - Power Brake Booster

Install or Connect

CAUTION: When replacing the power brake booster, make sure that the accelerator control and cruise control cable is not routed between the booster and the cowl. If the accelerator control and cruise control cable is damaged or pinched, it **MUST** be replaced. Failure to do this could result in possible personal injury.

NOTICE: Refer to "Notice" on page 5D1-1 of this section.

1. Position gasket (40) over studs on booster (35), if removed.
2. Booster (35).
 - Mounting surface must be free of sealant or any other foreign material.
3. Inner washer (44), pushrod (32), outer washer (43) and retainer (42) to pedal (45).
 - Lubricate brake pedal pin before installing inner washer (44).

4. Daytime running lamp (DRL) diode, if removed. Refer to SECTION 8C.

5. Four nuts (34).

Tighten

- Nuts (34) to 25 N·m (18 lb. ft.).
6. Valve (39) and cylinder (36) to booster (35).
 7. Two nuts (37).

Tighten

- Nuts (37) to 25 N·m (18 lb. ft.).
8. Hose (5) to valve (3).
 9. Left-hand sound insulator panel. Refer to SECTION 8C.

Exterior Components

Figure 2

Remove or Disconnect

1. Valve (3) and grommet (4).
2. Booster. Refer to "Power Brake Booster" under "On-Vehicle Service" in this section.
3. Boot (1) and filter (2).
4. Seal (7).

Inspect

- Boot (1), seal (7), and grommet (4) for cuts, nicks, and excessive wear.
— Replace any defective part.

Clean

- Boot (1), seal (7), and grommet (4) in clean denatured alcohol.
— Dry with unlubricated compressed air.

Install or Connect

1. Lubricate inside and outside diameters of grommet (4) and seal (7) with thin layer of silicone grease GM P/N 12345579 or equivalent.
2. Seal (7).
3. Filter (2) and boot (1).
4. Booster. Refer to "Power Brake Booster" under "On-Vehicle Service" in this section.
5. Grommet (4) and valve (3).

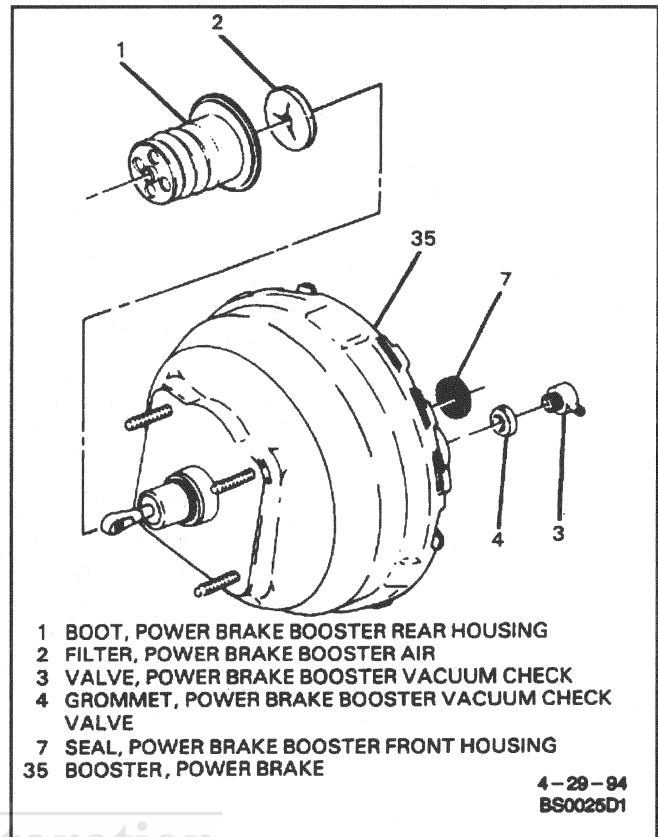


Figure 2 - Exterior Components

PUSHROD GAGING PROCEDURE

Figure 4

Tool Required:

J 37839 Pushrod Height Gage

1. Gage booster with 85 kPa (25 in. Hg) vacuum.
 - Booster can be gaged without being installed on vehicle by using either a suitable vacuum source or maximum vacuum available from engine.
2. After booster has been assembled, position J 37839 over pushrod (12).
 - Check both maximum and minimum pushrod length.
3. If pushrod length does not fall between maximum and minimum dimensions, replace booster.
 - Pushrod and output button (12) cannot be interchanged from booster to booster.

VACUUM HOSE

Figure 3

Remove or Disconnect

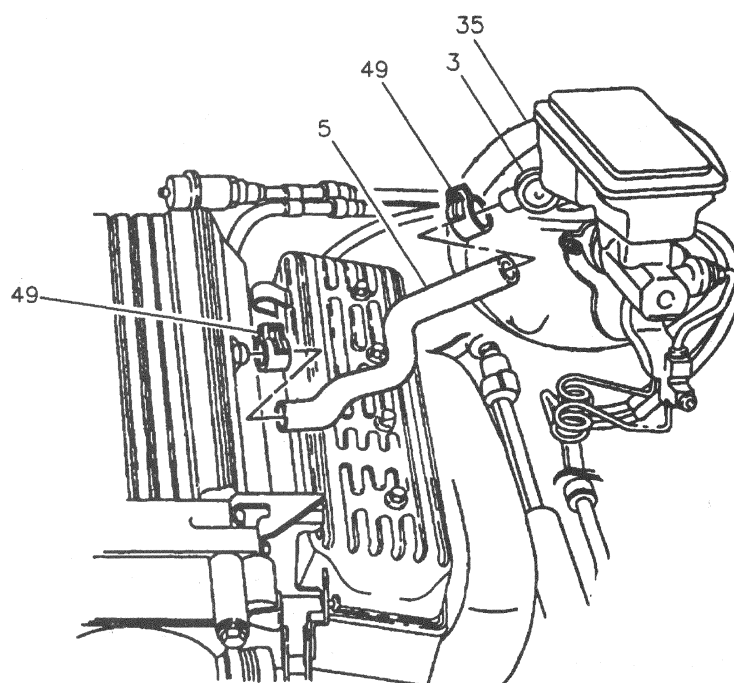
1. Air cleaner resonator. Refer to SECTION 6E3.
2. Clamps (49).
 - Squeeze clamps and slide inboard.
3. Hose (5) from engine and vacuum check valve (3).

Install or Connect

NOTICE: Refer to "Notice" on page 5D1-1 of this section.

1. Hose (5) to engine and vacuum check valve (3).
2. Clamps (49).
 - Squeeze clamps and slide into position.
3. Air cleaner resonator. Refer to SECTION 6E3.

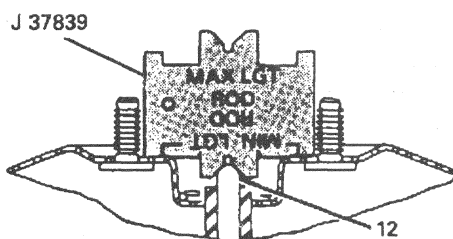
5D1-4 VACUUM BOOSTER SYSTEM



- 3 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
- 5 HOSE, POWER BRAKE BOOSTER VACUUM
- 35 BOOSTER, POWER BRAKE
- 49 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE

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Figure 3 - Power Brake Booster Vacuum Hose



- 12 PUSHROD, POWER BRAKE BOOSTER

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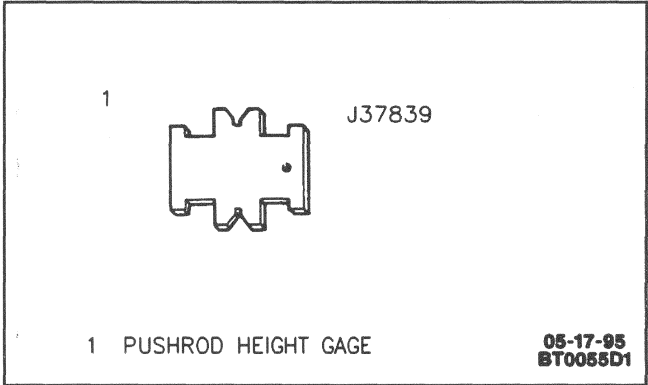
Figure 4 - Gaging Power Brake Booster Pushrod

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Brake Master Cylinder Nut.....	25 N.m (18 lb. ft.)
Brake Pedal Bracket Nut.....	25 N.m (18 lb. ft.)
Power Brake Booster Vacuum Tube Fitting.....	9.5 N.m (84 lb. in.)
Power Brake Booster Vacuum Tube Nut.....	5.8 N.m (51 lb. in.)

SPECIAL TOOLS





SECTION 5E1

ANTILOCK BRAKE SYSTEM (ABS)

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions: Eye contact - rinse thoroughly with water. Skin contact - wash with soap and water.

CAUTION: Certain components in the Antilock Brake System (ABS) are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures should be serviced.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

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5E1-2 ANTILOCK BRAKE SYSTEM (ABS)

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GENERAL DESCRIPTION

The purpose of the Antilock Brake System (ABS) is to minimize wheel lockup during heavy braking on most road surfaces. The ABS performs this function by monitoring the speed of each wheel and controlling the brake fluid pressure to individual front wheels and both rear wheels simultaneously during a braking maneuver. This allows the driver to retain directional stability and better steering capability.

ABBREVIATIONS/DEFINITIONS

Several abbreviations are commonly used throughout this section. They are presented here for reference.

ABS	Antilock Brake System
B+	Battery Voltage
BPMV	Brake Pressure Modulator Valve
CKT	Circuit
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DVM	Digital Volt Meter
EBCM	Electronic Brake Control Module
MSC	Mass Storage Cartridge
PCM	Power Train Control Module
WSS	Wheel Speed Sensor

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this basic knowledge, it will be difficult to use the diagnostic procedures contained in this section.

- Basic electrical circuits - You should understand the basic theory of electricity and know the meaning of voltage, current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.
- Use of circuit testing tools - You should know how to use a test light and how to use jumper wires to bypass components to test circuits. You should be familiar with the Digital Volt Meter (DVM) J 39200. You should be able to measure voltage, resistance and current and be familiar with the meter controls and how to use them correctly.
- Sources of additional information - If you need a review of basic electrical troubleshooting knowledge, SECTION 8A of this service manual contains helpful information in the introduction. Basic use of circuit testing tools is also covered in SECTION 8A.

SYSTEM OPERATION

Normal Braking

Using a front-rear split brake orientation and an add-on type ABS unit, the system operates normally while the ABS monitors wheel speeds. The foundation

brakes continue to operate normally until the EBCM detects a wheel beginning to lock. When this wheel locking condition exists, the brake system transfers from normal braking mode to antilock braking modes. The ABS remains in control until braking is no longer required, or the wheel locking conditions cease to exist.

Antilock Braking

When a Wheel locking condition exists, the Brake Pressure Modulator Valve (BPMV), controlled by the EBCM, isolates each individual wheel hydraulic circuit and begins modulating fluid pressure to each wheel using the ABS modes: pressure hold, pressure reduce, and pressure increase. The EBCM allows the BPMV to individually adjust each wheel's hydraulic pressure according to wheel speed input signals.

The BPMV has two solenoid valves per circuit, a normally open inlet and a normally closed outlet valve. These valves work in pairs to achieve the three ABS modes. The ABS system in reality isolates, monitors and controls all wheels simultaneously. The following descriptions explain the hydraulic control of a circuit during ABS braking.

PRESSURE INCREASE

The pressure increase position is the valve position for normal (non-ABS) braking. The EBCM does not energize either valve, leaving the inlet valve open and the outlet valve closed.

PRESSURE HOLD

The pressure hold position occurs when the EBCM first notices an impending wheel lockup condition, or excess hydraulic brake pressure at the locking wheel. The EBCM closes the corresponding inlet valve to avoid any additional hydraulic pressure increase at the wheel.

PRESSURE REDUCE

During a wheel lockup condition, the EBCM closes the inlet valve while opening the outlet valve. This decreases hydraulic pressure at a specific wheel without decreasing over all system pressure. The reduced hydraulic pressure allows greater wheel rotation, eliminating the wheel lockup condition.

Warning System Operation

The Electronic Brake Control Module (EBCM) continuously monitors all of its components and uses several methods of determining a fault and notifying the driver of a system malfunction. When the vehicle is started, a functional check of the ABS electrical circuitry is performed. As the vehicle speed reaches 6 km/h (4 mph) (15km/h (10mph) with the brake applied), a functional check of the Brake Pressure Modulator Valve (BPMV) takes place. During this check each valve is cycled and the pump motor is

turned on briefly. The driver may hear and feel this check take place when the vehicle begins to move. This test will occur only once per ignition cycle and should be considered normal operation.

Two methods are used to inform the driver that a malfunction has occurred in the brake system. The "BRAKE" warning lamp and the "ABS" indicator lamp, both located in the instrument cluster, will notify the driver if a problem exists in the brake system or with the antilock portion of the brake system. Their operation is described below.

"BRAKE" WARNING LAMP

The "BRAKE" warning lamp in the instrument cluster will illuminate to warn the driver of abnormal conditions in the brake system. Conditions which turn on the "BRAKE" warning lamp include the following:

1. Parking brake lever not fully released. If the parking brake lever is applied or not fully released, the parking brake switch located on the parking brake lever will ground the "BRAKE" lamp circuit and cause the light to turn on.
2. Unequal pressure in the two circuits of the hydraulic brake system. The combination valve contains a brake pressure differential warning switch which senses when unequal pressures exist between the two hydraulic circuits. When a difference of pressures is detected, the brake pressure differential warning switch will ground the "BRAKE" warning lamp circuit and turn on the light. This difference in pressures may be caused by low brake fluid or a leak in one of the hydraulic circuits. The "BRAKE" warning lamp will stay illuminated until the condition has been repaired. Refer to SECTION 5.
3. Instrument panel bulb check. When the ignition is turned to "START" the "BRAKE" warning lamp will turn on. The "BRAKE" warning lamp should turn off with the ignition switch in the "RUN" position.

"ABS" INDICATOR LAMP

The "ABS" indicator lamp is also located in the instrument cluster and will illuminate if a malfunction in the ABS is detected by the Electronic Brake Control Module (EBCM). The "ABS" indicator lamp informs the driver that a condition exists which results in disabling the antilock brake function. If only the "ABS" indicator lamp is on, normal braking with full power assist is available. If the "BRAKE" and "ABS" lamps are on, a problem may exist in the hydraulic brake system. Refer to SECTION 5. Conditions for the "ABS" indicator lamp to turn on are as follows:

1. ABS malfunction detected. As previously described the "ABS" indicator lamp turns on when a problem has been found in the ABS. The "ABS" indicator lamp indicates that the ABS has been disabled.
2. Instrument panel bulb check. When the ignition is turned to "RUN", the "ABS" indicator lamp will turn on for approximately two seconds and then

turn off. The "ABS" indicator lamp should turn off with the engine control switch in the "RUN" position.

! Important

- Illumination of the "BRAKE" warning lamp may indicate reduced braking ability.
- Illumination of the "ABS" indicator lamp without the "BRAKE" warning lamp on indicates only that antilock braking is no longer available. Power assisted braking without antilock control is still available.
- Refer to SECTION 5 for diagnosis of any condition which causes the "BRAKE" warning lamp to illuminate.
- Refer to "Diagnosis" in this section for any condition that causes the "ABS" indicator lamp to illuminate.

Tires and Antilock Brake System

SPARE TIRE

When using the compact spare tire, it will rotate faster than the other tires. Under most conditions the EBCM will compensate for this faster rotation so the ABS will not deactivate. It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause a wheel speed fault.

REPLACEMENT TIRES

For information on replacement tires for this vehicle, refer to SECTION 3E. Always use tires of the same type and size or the ABS may deactivate.

SYSTEM COMPONENTS

Figure 1

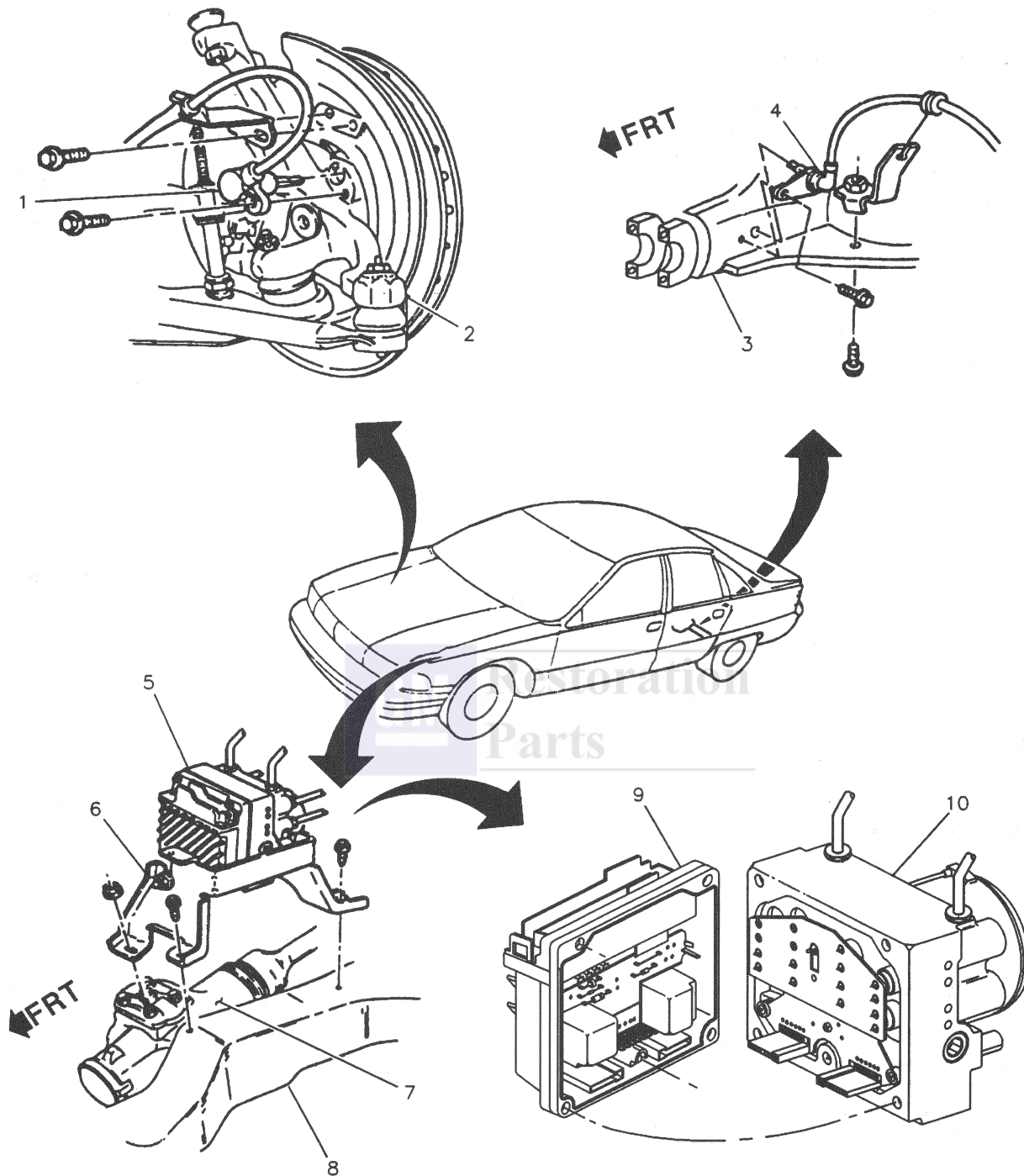
Brake Pressure Modulator Valve (BPMV)

The ABS Brake Pressure Modulator Valve (BPMV) is mounted to the left front frame rail near the steering gear. The modulator controls brake fluid pressure to each of the front wheel circuits, and a rear circuit which controls both rear brakes. These three circuits are individually controlled, as commanded by the Electronic Brake Control Module (EBCM), during antilock braking. The front and rear circuits are also hydraulically isolated so that a leak in one circuit will allow continued braking on the other circuit. During antilock mode, the BPMV can increase, maintain or reduce brake fluid pressure, however, it cannot apply the brakes or increase pressure above what is being applied by the master cylinder (operator). Although the BPMV is replaceable separately from the EBCM, it is not serviceable and no attempt to disassemble it should be made.

SOLENOID VALVES

Within the BPMV are six solenoid valves. The solenoid valves are used to control the flow of brake fluid to each of the three circuits. There is one pressure hold and one pressure release valve for each

5E1-4 ANTILOCK BRAKE SYSTEM (ABS)



- 1 FRONT WHEEL SPEED SENSOR
- 2 STEERING KNUCKLE (TYPICAL)
- 3 REAR DIFFERENTIAL
- 4 REAR WHEEL SPEED SENSOR
- 5 EBCM/BPMV

- 6 EBCM/BPMV MOUNTING BRACKET
- 7 STEERING GEAR
- 8 LEFT FRONT FRAME RAIL
- 9 ELECTRONIC BRAKE CONTROL MODULE (EBCM)
- 10 BRAKE PRESSURE MODULE VALVE (BPMV)

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Figure 1-ABS System

of the front brakes and one pressure hold and one pressure release valve to control the rear brakes. With the solenoid valves in the pressure increase position, fluid pressure is allowed to flow freely from the master cylinder to the front and rear brakes, as in normal braking. In the pressure hold position, the affected wheel is isolated from the master cylinder and fluid pressure is held constant. In the pressure reduce position, the solenoid valves allow the pump and motor to force fluid back into the master cylinder, thus reducing fluid pressure at the brake.

PUMP MOTOR

Within the brake pressure modulator is a pump and motor which is used to reduce brake pressure. This allows the wheel(s) to rotate (preventing lock-up) during antilock mode. The pump and motor are integral parts of the BPMV, and are not serviceable separately.

Electronic Brake Control Module (EBCM)

The Electronic Brake Control Module (EBCM) is attached directly to the Brake Pressure Modulator Valve (BPMV). The EBCM contains the electronic microprocessor which monitors the sensors and controls the system. The EBCM has the ability to do the following:

Monitor System and Detect Errors - The EBCM can monitor each of the three wheel speed sensor circuits individually and detects if the circuit is intact, and the wheel speed information the sensor is sending is accurate. The EBCM also monitors the solenoid valve and pump motor circuits to determine if they are also intact. If a fault exists in the information the EBCM is receiving, the EBCM will store Diagnostic Trouble Code(s) (DTC)'s, and disable the system until repairs have been made. Refer to "Diagnosis" in this section for details.

Control Wheel Locking Tendencies - The EBCM monitors each wheel speed circuit to determine if a wheel(s) are approaching lock-up. If this is detected, the EBCM will control the solenoid valves and pump motor to modulate the fluid pressure so that maximum deceleration and vehicle control is maintained.

Auto Test - At start up, the EBCM will perform an electrical circuit test. As the vehicle reaches approximately 6 k/m (4 mph) (15 km/h (10 mph) with the brake applied) a functional check of the BPMV takes place. During this check, each solenoid valve is cycled and the pump motor is briefly turned on. The driver may notice this as the vehicle begins to move. This only takes place once per ignition cycle and should be considered normal.

Pump Motor Relay and BPMV Relay

The pump motor relay provides power to the pump motor during antilock braking. The BPMV relay provides power to the solenoid valves in the Brake Pressure Modulator Valve (BPMV). Both of these relays are an integral part of the Electronic Brake Control Module (EBCM) and cannot be serviced separately.

Wheel Speed Sensors

The front wheel speed sensor is mounted in the front steering knuckle and is non-adjustable. The connectors for each speed sensor are located near each underhood wheelhouse panel.

The rear wheel speed sensor is mounted in the rear axle differential assembly and is non-adjustable.

The sensors transmit wheel speed information to the EBCM by means of a small AC voltage. This voltage is generated by magnetic induction caused by passing a toothed sensor ring past a stationary sensor. The signal is transmitted to the EBCM through shielded wires.

In this system, the speed of each toothed sensor ring is measured separately. The front wheels are controlled individually, the rear wheels together.

DIAGNOSIS

When an ABS malfunction occurs, indicated by the "ABS" indicator lamp turning on, perform the following preliminary checks:

1. Check to see if the EBCM connector is secure.
2. Check that all other ABS electrical connectors are secure.
3. Check for open fuses.
4. Check entire circuit for shorts or opens before replacing any component.



Important

- Use of the compact spare may result in activating a wheel sensor diagnostic trouble code. This will result in the "ABS" indicator lamp turning on and the deactivation of the antilock brake system. Recycling the ignition switch will reset the system.
- If the "ABS" indicator lamp flickers briefly, refer to "Diagnostic Trouble Code and Symptom Table" in this section.
- Refer to SECTION 8A for electrical wiring diagrams. When a diagnostic chart makes reference to removing/replacing or checking a component for proper mounting, refer to "On-Vehicle Service" in this section.

After all diagnosis and repairs are completed, road-test the vehicle to ensure proper ABS operation and that the "ABS" indicator lamp is off.



Important

- If the Tech 1 was used for diagnosis, disconnect it from the DLC and turn the ignition switch to "OFF" for at least 10 seconds before road testing. This is necessary to reset the EBCM; it is disabled during Tech 1 diagnostics, and does not reset until serial data communication is stopped and ignition power is lost.

DIAGNOSTIC PROCESS

Before beginning diagnosis on the ABS system, obtain a detailed description of when the condition occurred or occurs from the owner. This information

5E1-6 ANTILOCK BRAKE SYSTEM (ABS)

may be useful in duplicating the condition. Perform a quick visual check of all connectors, wiring, wire routing and retention, and system components. Many times, a disconnected or loose connector, open fuse, or misrouted wire can be the cause of a malfunction.

If a visual inspection does not reveal an obvious problem, perform the "ABS Diagnostic System Check" in this section. ALWAYS start with the "ABS Diagnostic System Check." This step is critical in quick and accurate diagnosis of any malfunction, as it will direct you to the specific system area that has a malfunction and will verify that the diagnostic system is functioning properly. Correct system diagnosis cannot be assured if the "ABS Diagnostic System Check" is not performed first.

SELF DIAGNOSTICS

The Electronic Brake Control Module (EBCM) performs system self-diagnostics to assure that the ABS is functioning properly. When the EBCM detects a system malfunction, it will set a Diagnostic Trouble Code (DTC) and alert the driver by turning "ON" the "ABS" indicator lamp, located in the instrument cluster. This DTC will aid the technician in isolating and correcting the system malfunction.

There are seventeen DTCs that may be set by the EBCM. All of the DTCs will disable ABS (allowing power assisted braking only) and turn "ON" the "ABS" indicator lamp for the remainder of the ignition cycle. Refer to "ABS Diagnostic Trouble Code and Symptom Table" in this section for a complete list of ABS DTCs.

The EBCM performs an Auto Test when the vehicle reaches approximately 4 mph (6 km/h) (15 km/h (10 mph) with the brake applied) in either forward or reverse. This test occurs once each ignition cycle. The Auto Test cycles each solenoid valve and the pump motor to check proper component operation. If any malfunction is detected, the EBCM will set a DTC as described above. The Auto Test may be heard and felt while it is taking place and should be considered a normal mode of operation.

DISPLAYING DTCs

The EBCM can display DTCs through the use of the Tech 1 scan tool. Refer to "Tech 1 Diagnostics" in this section for details on Tech 1 operation.

CLEARING DTCs

The DTCs in the EBCM memory are erased by using one of the two following methods:

1. Tech 1 method.
2. Ignition cycle default method.

These two methods are detailed below. Whichever method is used, be sure to verify proper system operation and absence of DTCs when clearing procedure is completed.

The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by unplugging the EBCM, disconnecting the battery cables, or by turning the ignition "OFF" (except on an ignition cycle default).

Tech 1 Method

The Tech 1 can clear ABS DTCs using the Mass Storage Cartridge (MSC) by performing the following steps:

1. Install the Tech 1.
2. Select ABS system features.
3. Select "F2: DTC(s)."
4. Select "Clear DTCs" function. Verify that all DTC(s) have been cleared by selecting the "DTCs" function and observing that no DTCs are present.

The ignition must be turned "OFF" and the Tech 1 disconnected before a road test to check system operation and/or for a DTC resetting. This is necessary because the EBCM will not set DTCs and ABS control functions are disabled when the Tech 1 is installed and monitoring the system. The Tech 1 will log DTCs during some of its diagnostic routines, which are described later.

Ignition Cycle Default Method

If the vehicle power is cycled 100 times without a particular malfunction reappearing, that particular DTC will be erased from EBCM memory, and the ignition cycle counter for that fault within the EBCM will be reset to zero.

INTERMITTENTS AND POOR CONNECTIONS

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault. Refer to "Intermittents and Poor Connections" in SECTION 8A-4 for a very detailed explanation of how to locate and repair intermittent conditions.

Due to the sensitivity of ABS components to Electro-Magnetic Interference (EMI), the following checks should be performed if an intermittent malfunction is suspected:

- Check for proper installation of wiring harnesses resulting from add-on options such as police packages.
- Visually inspect wheel speed sensor and toothed ring for looseness, damage, foreign material accumulation and proper mounting. Replace damaged components, remove any foreign material and properly attach all components.
- Check for proper routing of front wheel speed sensor wiring away from spark plug wires. Refer to service manual SECTION 6D4 for proper spark plug wire routing, SECTION 5E1 for proper wheel speed sensor wire routing.
- Using DVM J 39200, measure resistance of spark plug wires. If J 39200 displays "OL" (infinite) or greater than 30,000 ohms at any time, replace spark plug wires. Refer to SECTION 6D4 of the service manual.
- While test driving vehicle, monitor Tech 1 wheel speeds. If any wheel speed drops or displays an erratic speed, refer to the appropriate wheel speed DTC.

TECH 1 DIAGNOSTICS

Important

- When using the Tech 1 for ABS diagnosis, the antilock brake system is disabled by the EBCM when communicating with the Tech 1. The "ABS" indicator lamp will be illuminated, indicating that only normal power-assisted braking is available.
- After completing all diagnostic procedures with the Tech 1, cycle the ignition "OFF" for at least 10 seconds and disconnect the Tech 1. This will return the ABS to normal system operation.
- Refer to the Tech 1 Mass Storage Cartridge Operator's Manual for additional information about the cartridge.

The Tech 1 has five test modes for diagnosing the antilock brake system. The five test modes are as follows:

- Mode "F0: Data List": In this test mode, the Tech 1 continuously monitors wheel speed data, brake switch status, etc.

Important

- The BPMV relay is turned "OFF" by the EBCM when a DTC is set. When using the Tech 1 to monitor the data list when DTCs are set, the BPMV relay will be noted to be "OFF." This is normal and should not be considered a system malfunction.
- Mode "F1: DTC History": In this test mode, DTC history data is displayed. This data includes how many ignition cycles since the DTC occurred, along with other ABS information. History information on up to three DTCs can be stored.
- Mode "F2: DTC(s)": In this test mode, DTCs stored by the EBCM may be displayed or cleared.
- Mode "F3: Snapshot": In this test mode, the Tech 1 captures ABS data before and after a trigger condition.
- Mode "F4: Misc. Tests": In this test mode, the Tech 1 performs brake pressure modulator functional tests to assist in malfunction isolation during troubleshooting.

Mode F3 Snapshot triggering conditions and Mode F4 functions are detailed below.

Mode F3: Snapshot

Conditions which will cause triggering of the Tech 1 Snapshot feature are listed below. Tech 1 messages displayed when the malfunction is noted are shown in square brackets. Refer to the Tech 1 Operator's Manual for detailed information on use of the Snapshot feature.

- Loss of serial data.
- BPMV relay < 11 volts [low voltage].
- BPMV relay OFF (< 2 volts)(relay will be "OFF" if DTCs are set).

- One wheel speed ± 8 mph of others [intermittent wheel speed].
- Two wheel speeds ± 3 mph of each other and one ± 5 mph of the others [wheel speed out of range].
- Brake fluid pressure differential.
- System voltage > 17 volts [high voltage].
- Brake switch state change of "ON-OFF-ON" in <200 ms [intermittent brake switch].

Mode F4: Misc. Tests

The "Misc. Tests" mode performs functional tests on the antilock brake system which help verify proper operation. In this mode, malfunctions can be further identified by testing and observing the test results. DTCs must be cleared before any tests in Mode F4 (Misc. tests) can be performed. In the "Misc. Tests" mode, the following tests can be performed:

- Solenoid Valve - Pressure Release - This test indicates whether specific solenoid valves in the BPMV release pressure in assigned hydraulic wheel circuits.
- Solenoid Valve - Pressure Hold - This test indicates whether specific solenoid valves in the BPMV hold pressure in assigned hydraulic wheel circuits.
- Auto Test - This test cycles each solenoid valve and operates the pump motor briefly. The EBCM will store a DTC if the test conditions fail.

PRESSURE RELEASE TEST

The "PRESSURE RELEASE" test activates selected hydraulic wheel circuit valves, placing them in the pressure reduce position. Valve action can then be verified by checking the appropriate wheel for proper brake action. The Tech 1 will indicate whether the valve action was commanded properly. This test is used in conjunction with the "PRESSURE HOLD" test to completely check each solenoid valve. With an assistant, the "PRESSURE RELEASE" test can be verified as follows:

1. Ignition "OFF."
2. Install the Tech 1 with Mass Storage Cartridge.
3. Ignition to "RUN".
4. Raise the vehicle such that the wheels are about 6" off the floor.
5. Have an assistant press and hold the brake pedal.
6. Select "F4: Misc. Tests."
7. Select "F0: Solenoid Tests."
8. Select the solenoid to be tested.
9. Command the "PRESSURE RELEASE" on the Tech 1.
10. Try to spin the wheel being tested by hand; it should spin due to the "PRESSURE RELEASE" command, even though the assistant is applying pressure to the brake pedal.

PRESSURE HOLD TEST

The "PRESSURE HOLD" test activates selected hydraulic wheel circuit valves, placing them in the pressure hold position. Valve action can then be

5E1-8 ANTILOCK BRAKE SYSTEM (ABS)

verified by checking the appropriate wheel for proper brake action. The Tech 1 will indicate whether the valve action was commanded properly. This test is used in conjunction with the "PRESSURE RELEASE" test to completely check each solenoid valve. With an assistant, the "PRESSURE HOLD" test can be verified as follows:

1. Ignition "OFF."
2. Install the Tech 1 with Mass Storage Cartridge.
3. Ignition to "RUN".
4. Raise the vehicle such that the wheels are about 6" off the floor.
5. Select "F4: Misc. Tests."
6. Select "F0: Solenoid Tests."
7. Select the solenoid to be tested.
8. Command the "PRESSURE HOLD" with the Tech 1.
9. Have an assistant press and hold the brake pedal.
10. Try to spin the wheel being tested by hand; it should spin due to the "PRESSURE HOLD" command, even though the assistant is applying pressure to the brake pedal.

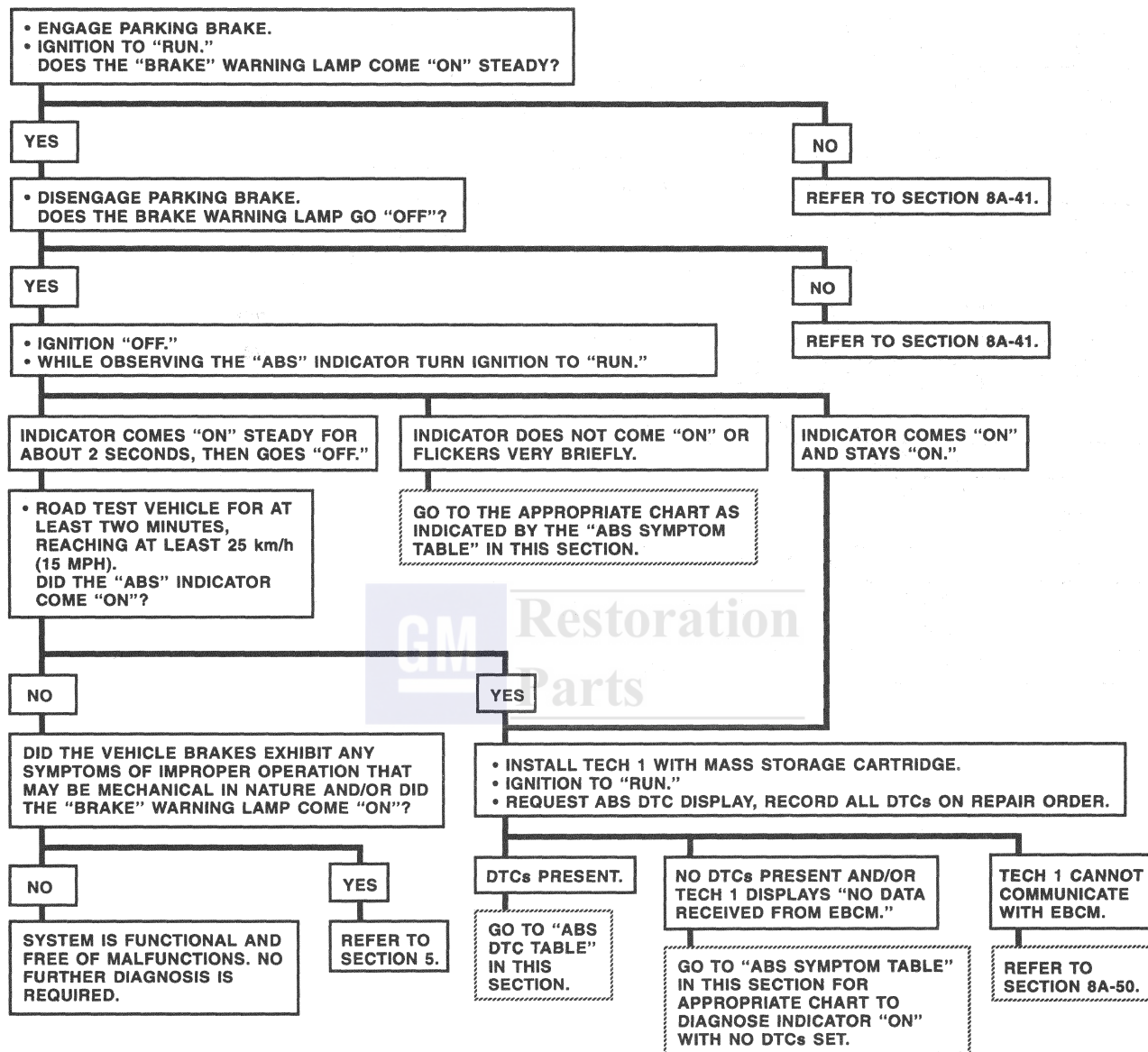
AUTO TEST

The "AUTO TEST" cycles each solenoid valve and the pump motor to check component operation. This test is identical to the "AUTO TEST" the system performs on itself once per ignition cycle when the vehicle speed reaches approximately 4 mph (6 km/h) (15 km/h (10 mph) with the brake applied) in either forward or reverse. If any malfunction is detected during this test, the EBCM will set a DTC and turn "ON" the "ABS" indicator lamp. Perform the test as follows:

1. Ignition "OFF."
2. Install the Tech 1 with Mass Storage Cartridge.
3. Ignition to "RUN".
4. Select "F4: Misc. Tests."
5. Select "F1: AUTO TEST."
6. Run the "AUTO TEST" by pressing "ENTER."
7. Note any DTCs that are set.



ABS DIAGNOSTIC SYSTEM CHECK



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

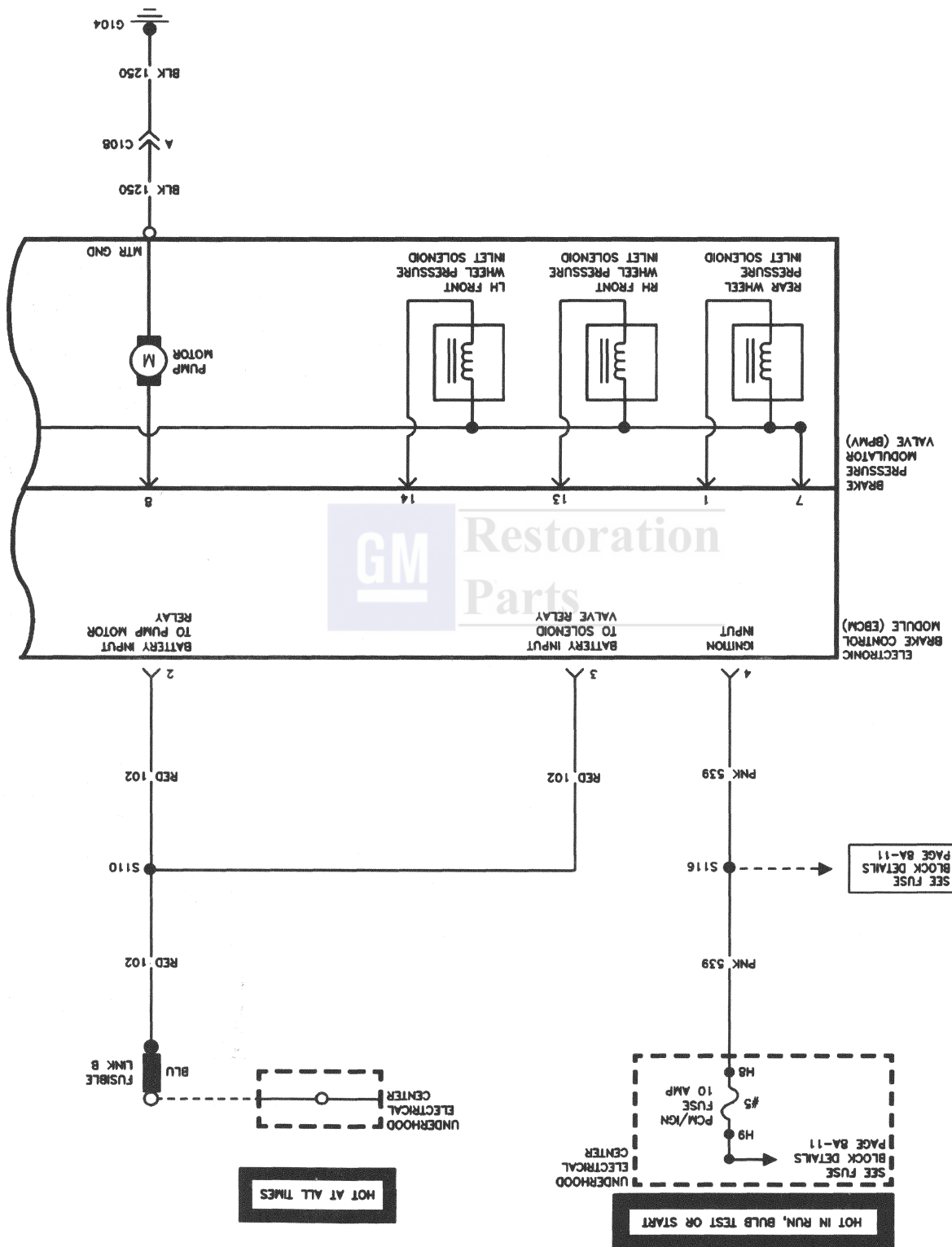
C10123

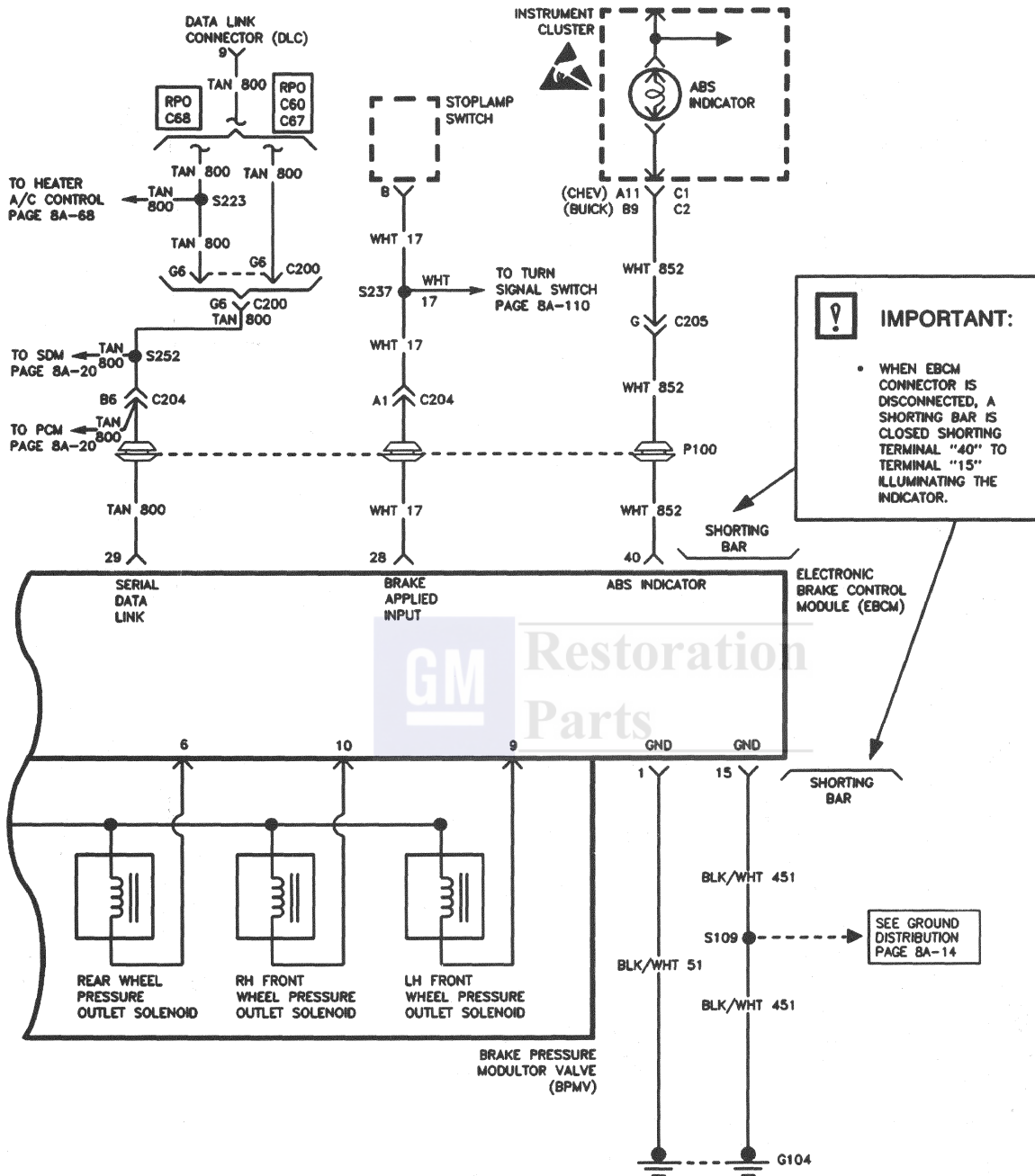
5E1-10 ANTILOCK BRAKE SYSTEM (ABS)

ABS DTC AND SYMPTOM TABLE		
DTC	DESCRIPTION	PAGE
21	RF Wheel Speed Sensor Circuit Malfunction	5E1-24
23	RF Wheel Speed Sensor Circuit Continuity Malfunction	5E1-32
25	LF Wheel Speed Sensor Circuit Malfunction	5E1-24
27	LF Wheel Speed Sensor Circuit Continuity Malfunction	5E1-32
28	Wheel Speed Sensor Circuit Frequency Malfunction	5E1-36
35	Rear Wheel Speed Sensor Circuit Malfunction	5E1-28
37	Rear Wheel Speed Sensor Circuit Continuity Malfunction	5E1-32
41	RF Inlet Valve Solenoid Malfunction	5E1-38
42	RF Outlet Valve Solenoid Malfunction	5E1-40
45	LF Inlet Valve Solenoid Malfunction	5E1-38
46	LF Outlet Valve Solenoid Malfunction	5E1-40
55	Rear Inlet Valve Solenoid Malfunction	5E1-38
56	Rear Outlet Valve Solenoid Malfunction	5E1-40
61	BPMV Pump Motor Malfunction	5E1-42
63	BPMV Power Supply Malfunction	5E1-46
71	EBCM Internal Malfunction	5E1-50
85	Low Voltage	5E1-52
CHART	SYMPTOM	
A	ABS Indicator "ON" With No DTCs Set.	5E1-18
B	ABS Indicator Inoperative Or Flickers Briefly At Ignition "RUN."	5E1-22
	"BRAKE" Warning Lamp "ON"	SECTION 5
	"BRAKE" Warning Lamp Inoperative	SECTION 8A



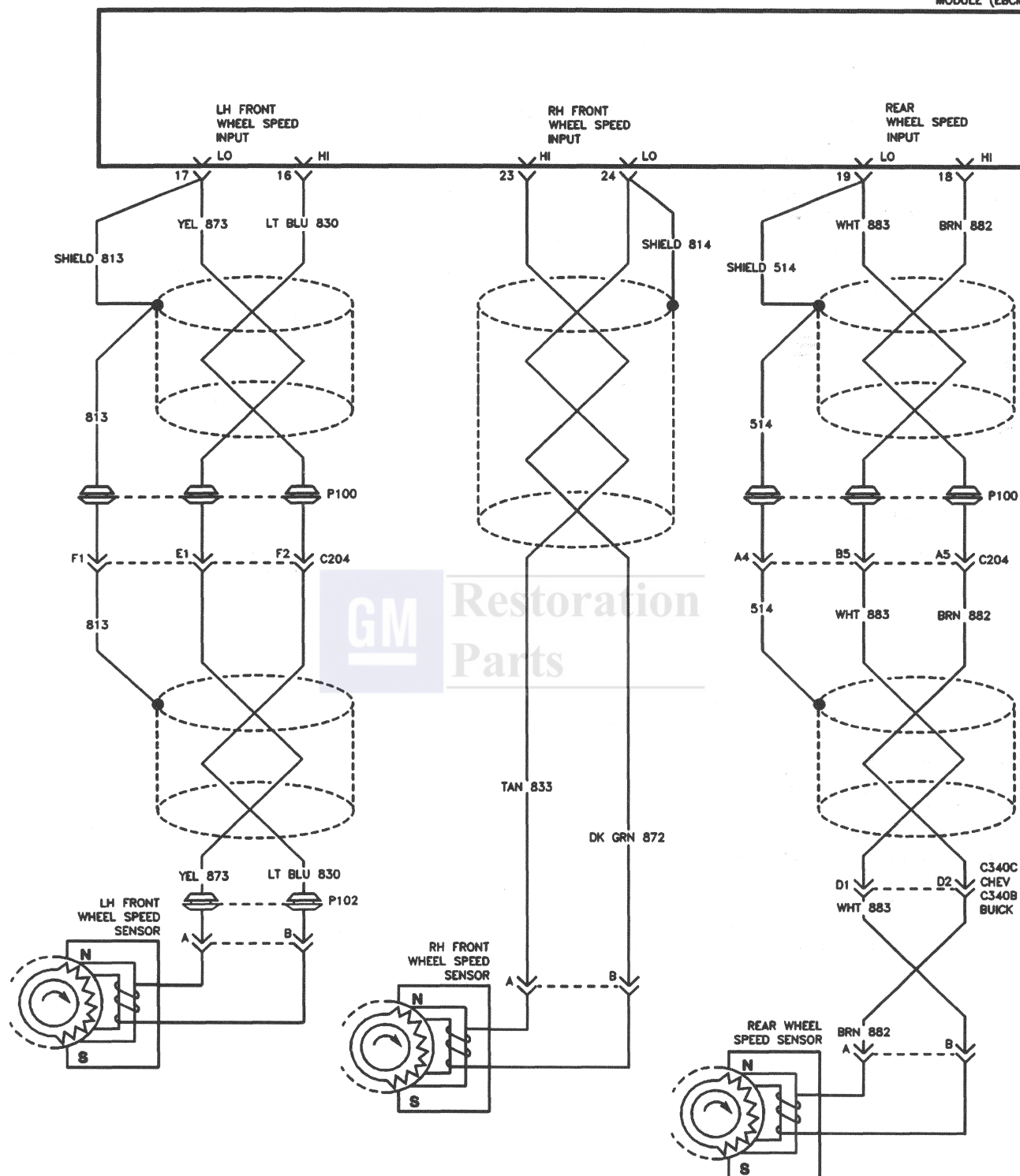
05-01-95
BT0166E1





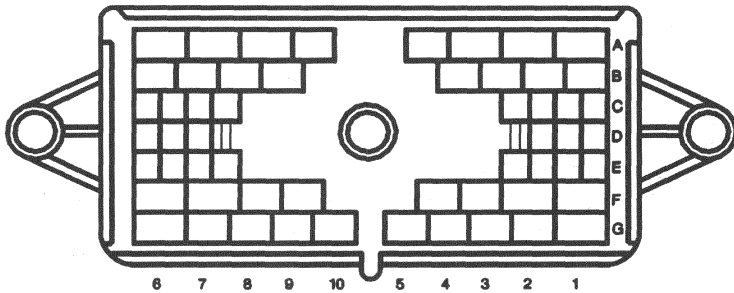
5E1-14 ANTILOCK BRAKE SYSTEM (ABS)

ELECTRONIC
BRAKE CONTROL
MODULE (EBCM)



05-10-95
BT0085E1

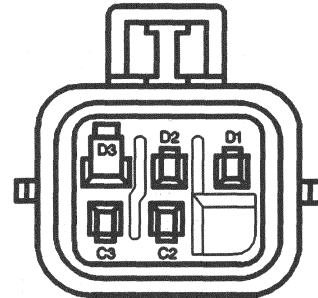
C200



12034257

56 – WAY F METRI – PACK MIXED SERIES
BLK

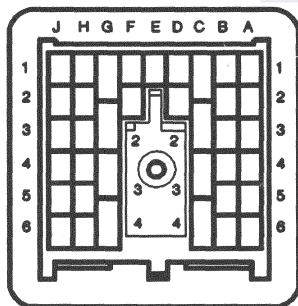
C340



12110481

5 – WAY F METRI – PACK 150, 280 SERIES
RED
ANTI LOCK BRAKE TO BODY HARNESS
SYSTEM HARNESS

C204

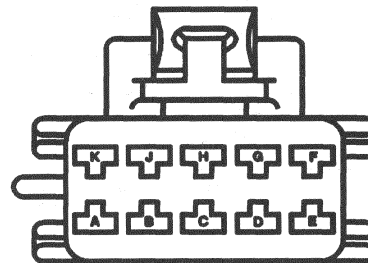


12020916

37 – WAY F METRI – PACK MIXED SERIES
BLK

BODY HARNESS TO
ENGINE HARNESS

C205

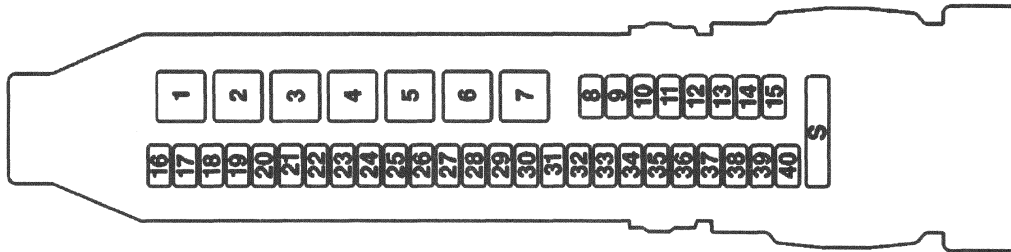


12064769

10 – WAY F METRI – PACK 150 SERIES
NAT
ENGINE HARNESS TO I/P HARNESS



5E1-16 ANTILOCK BRAKE SYSTEM (ABS)



12124389

40 - WAY F
NAT

BRAKE PRESSURE MODULATOR (BPM) VALVE
(WITH ELECTRONIC BRAKE CONTROL MODULE (EBCM))

01-09-95
BS00095E1

CAVITIES NOT LISTED ARE NOT USED

CAVITY	WIRE COLOR	CKT	DESCRIPTION
1	BLK/WHT	51	Ground
2	RED	102	Voltage Feed to BPMV Pump Motor Relay
3	RED	102	Voltage Feed to BPMV Solenoid Valve Relay
4	PNK	539	Ignition Feed
15	BLK/WHT	451	Ground
16	LT BLU	830	LH Front Wheel Speed Sensor Input
17	YEL	873	LH Front Wheel Speed Sensor Input Ground
18	BRN	882	Rear Wheel Speed Sensor Input
19	WHT	883	Rear Wheel Speed Sensor Input Ground
23	DK GRN	872	RH Front Wheel Speed Sensor Input
24	TAN	833	RH Front Wheel Speed Sensor Input Ground
28	WHT	17	Brake Applied Signal
29	TAN	800	Serial Data Line
40	WHT	852	"ABS" Indicator Control
S	-	-	Shorting Bar

T5089



5E1-18 ANTILOCK BRAKE SYSTEM (ABS)

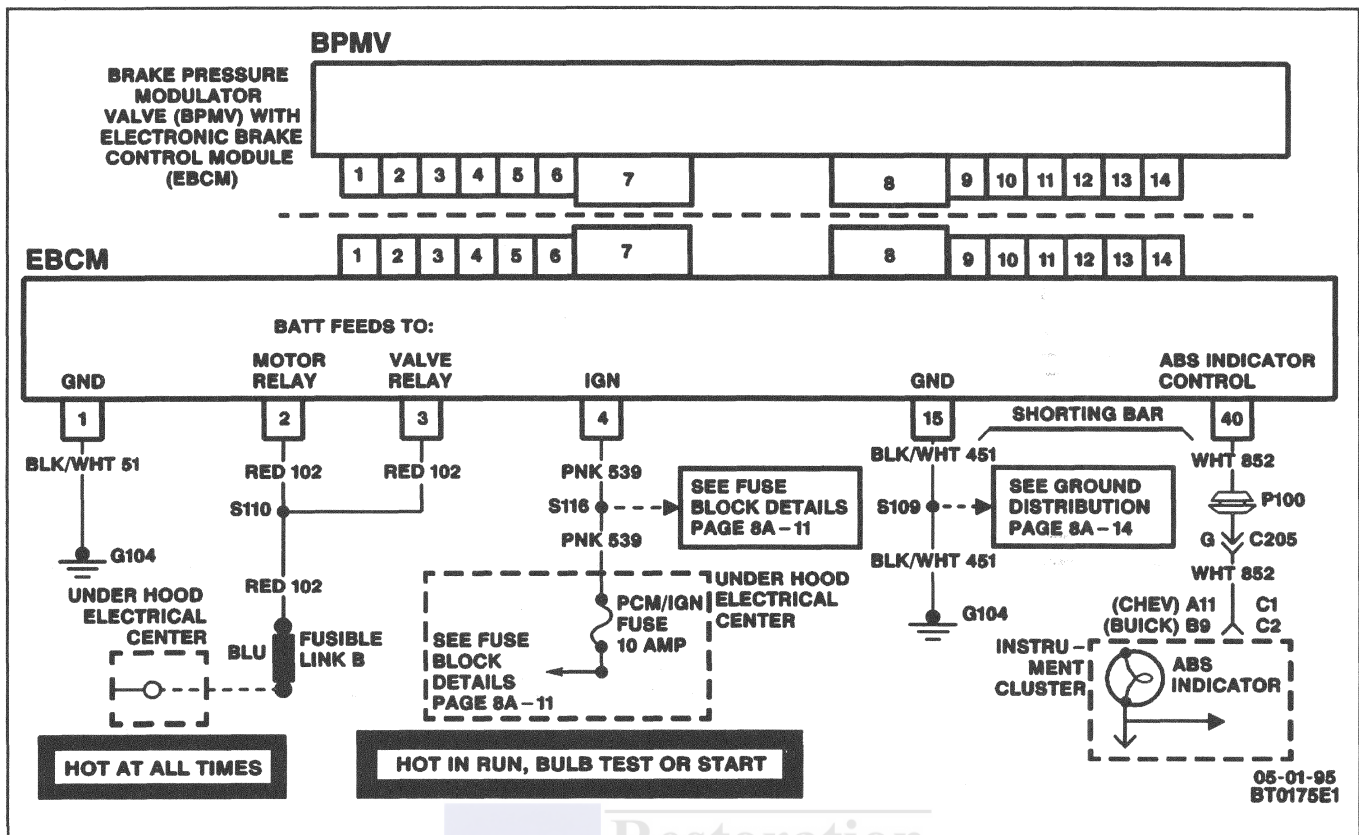


CHART A

(Page 1 of 2)

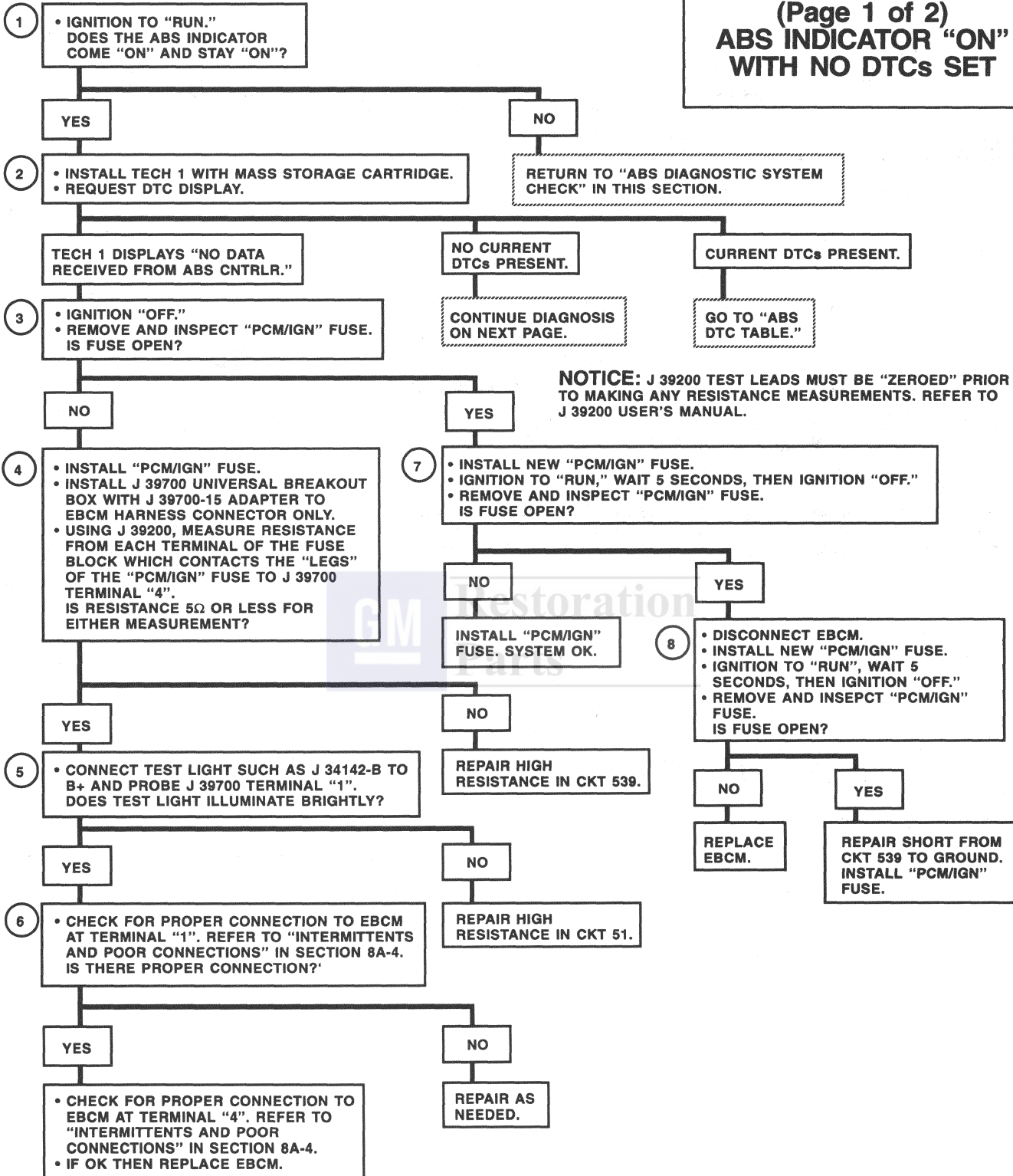
ABS INDICATOR "ON" WITH NO DTCs SET

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Confirms that a malfunction condition exists.
2. Determines whether the malfunction is due to a DTC setting condition, an indicator low side circuit malfunction, or an EBCM supply power malfunction.
3. Checks whether the malfunction is due to an open fuse.
4. Checks for an open power feed circuit.
5. Checks for an open in the ground feed to the EBCM.
6. Checks for proper connection of EBCM ground CKT 51.
7. Checks whether the fuse malfunction is due to a short to ground.
8. Identifies if the short to ground found in Step 7 is in CKT 539 or the EBCM.

CHART A (Page 1 of 2) **ABS INDICATOR "ON"** **WITH NO DTCs SET**



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

5E1-20 ANTILOCK BRAKE SYSTEM (ABS)

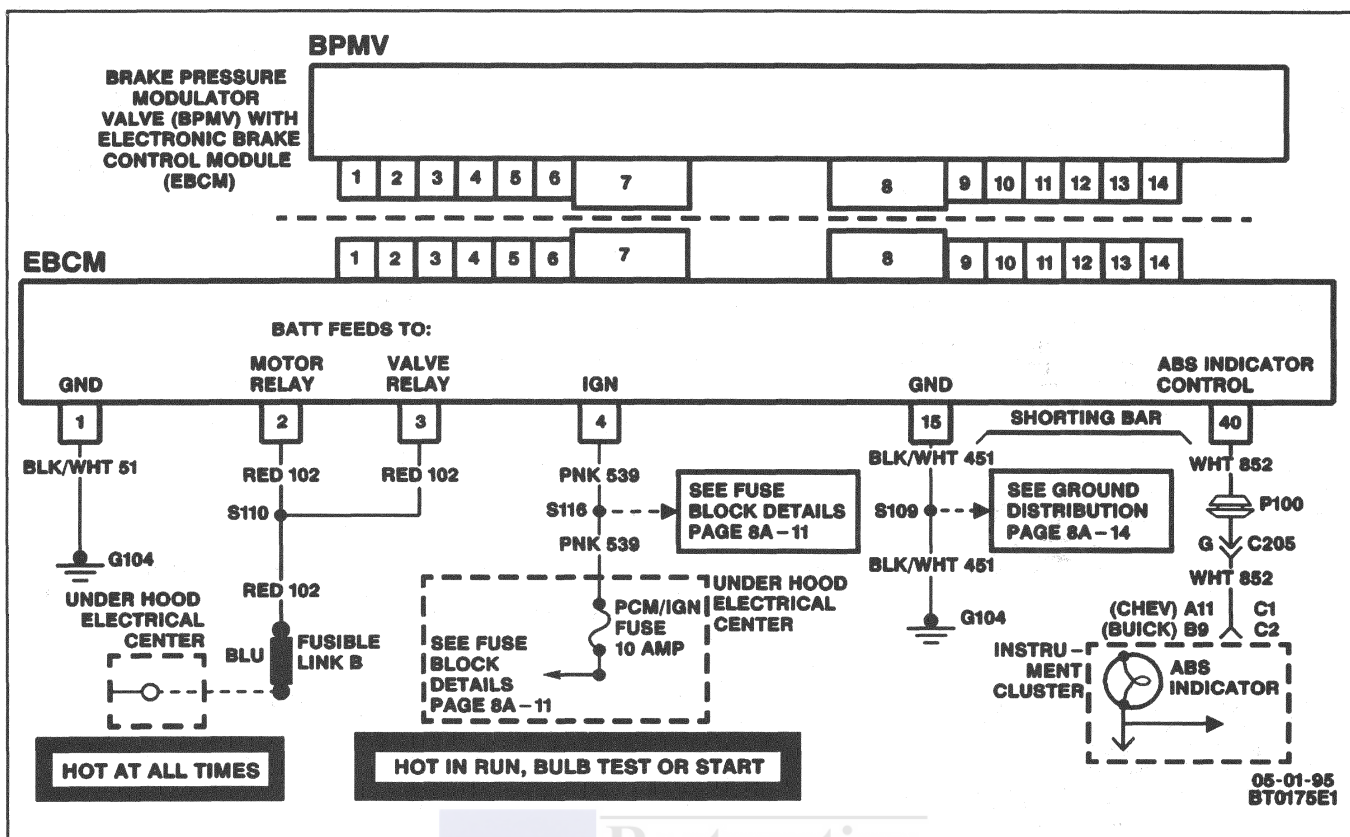


CHART A

(Page 2 of 2)

ABS INDICATOR "ON" WITH NO DTCs SET

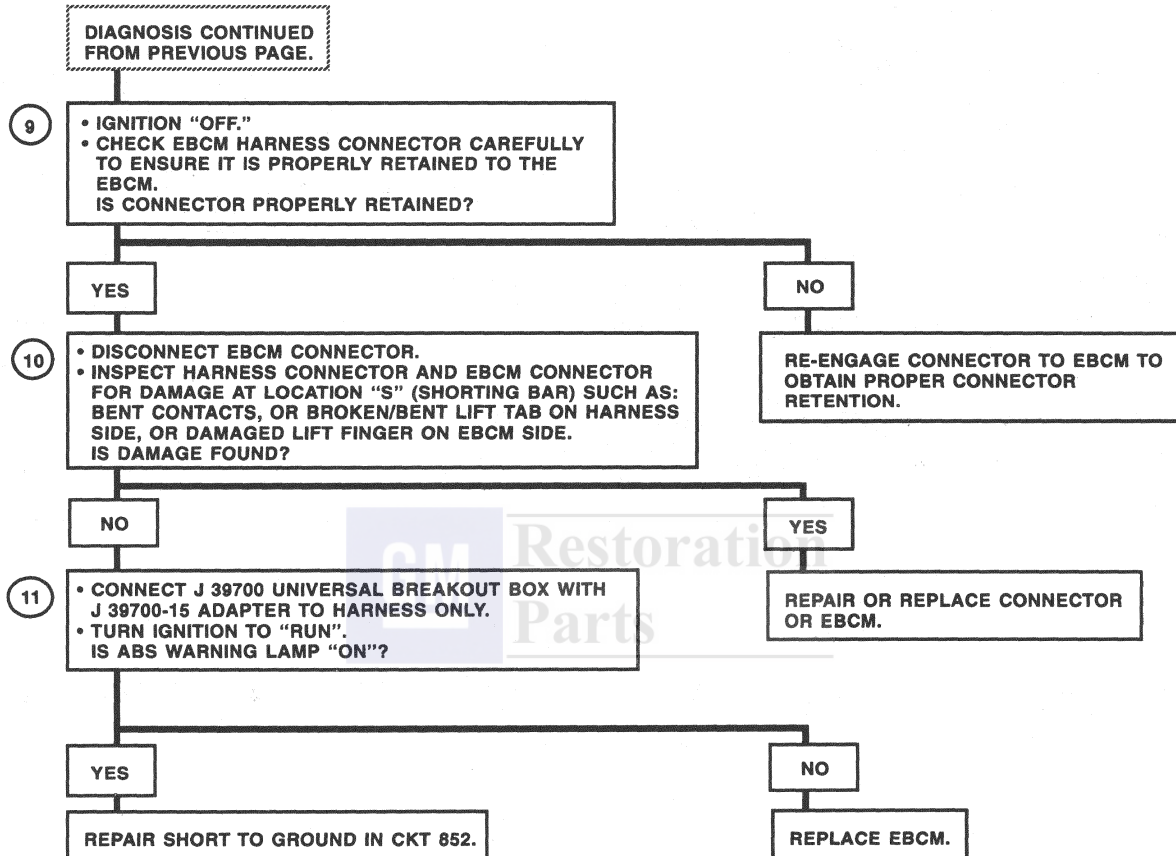
Chart Test description:

Number(s) below refer to circled number(s) on the diagnostic chart.

- Checks for proper retention of EBCM harness connector.

- Checks for damaged EBCM (connector), or EBCM harness connector.
- Checks for a damaged connector (broken lift finger) on the EBCM itself, or for a short to ground in circuit 852.

CHART A
(Page 2 of 2)
ABS INDICATOR "ON"
WITH NO DTCs SET



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6818

5E1-22 ANTILOCK BRAKE SYSTEM (ABS)

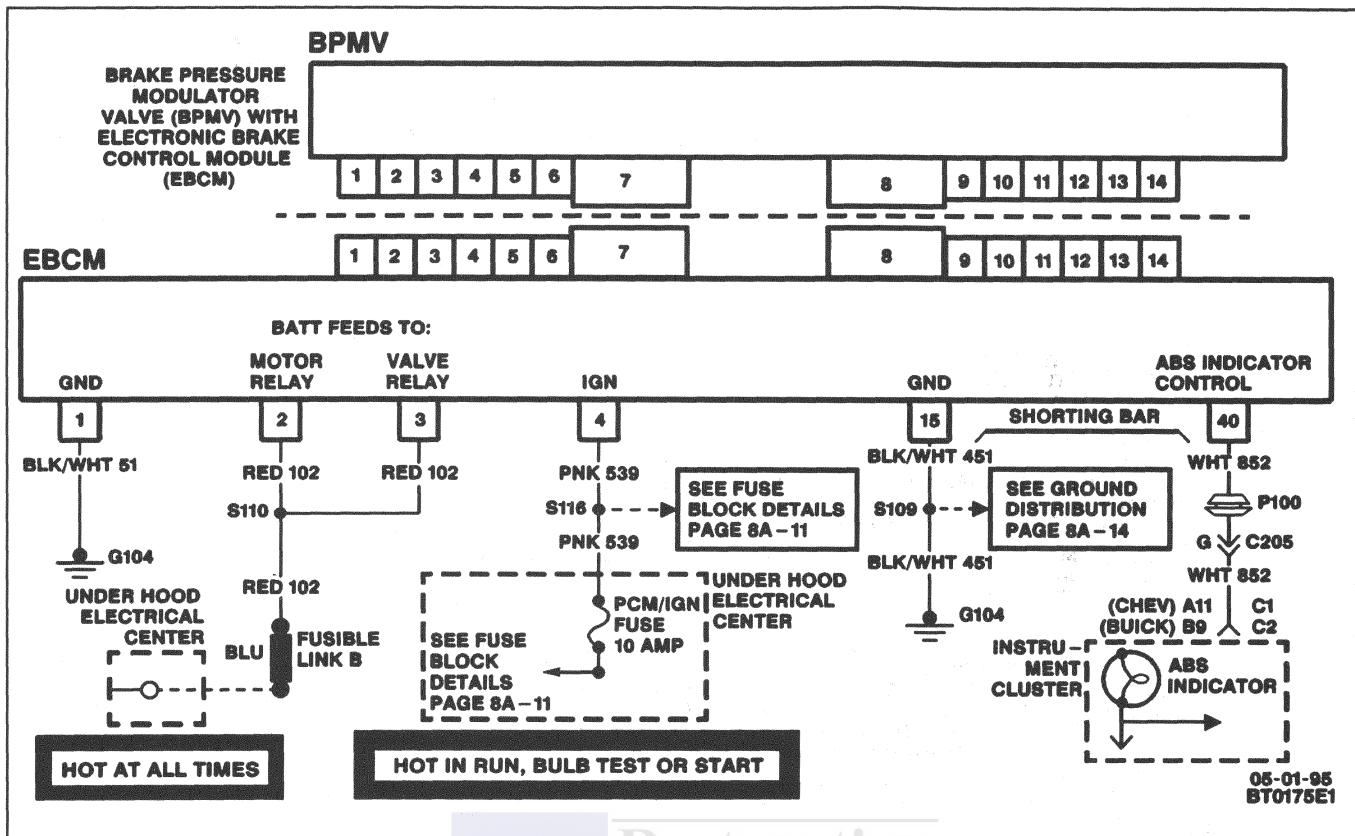


CHART B

ABS INDICATOR INOPERATIVE OR FLICKERS BRIEFLY AT IGNITION "RUN"

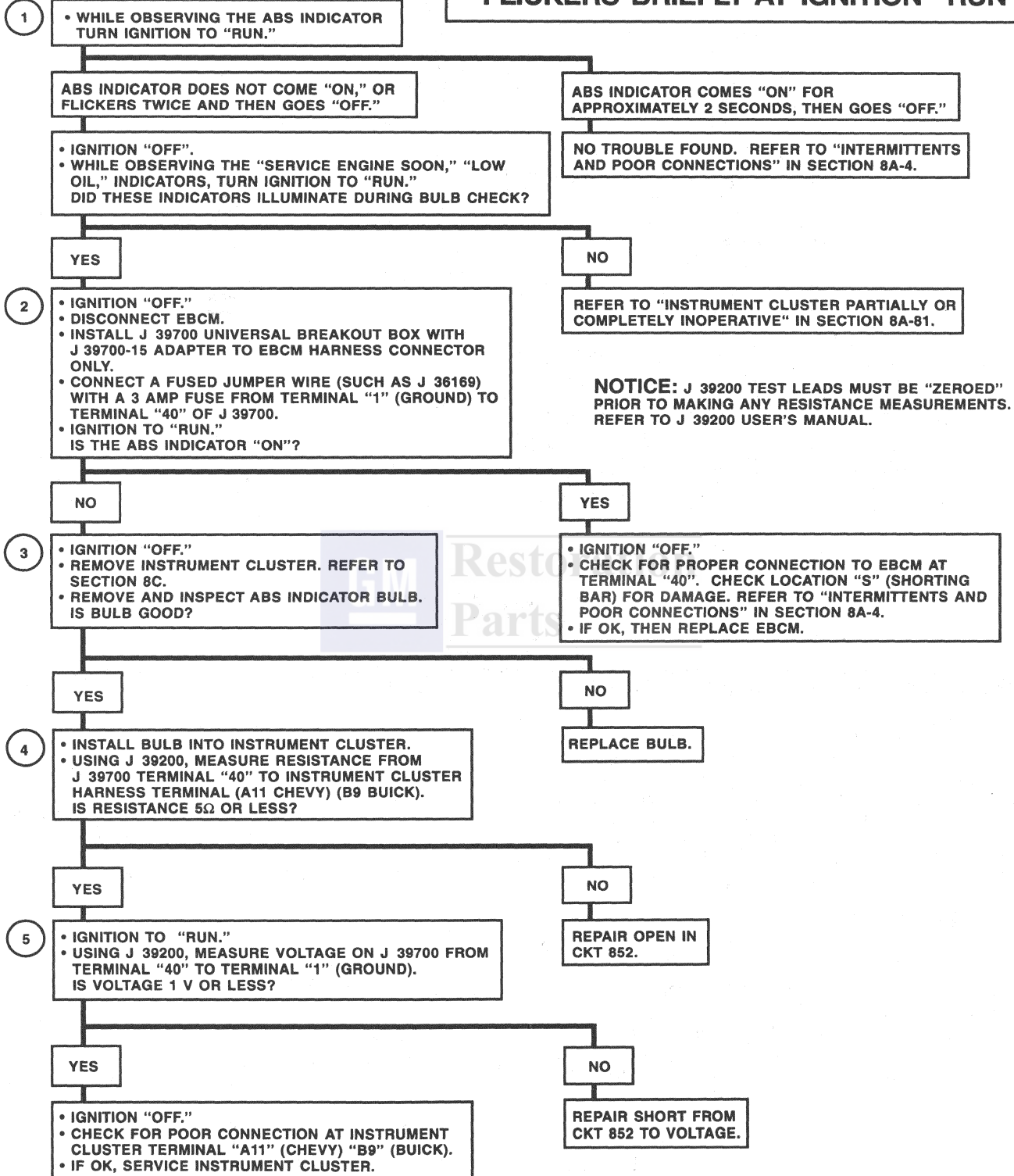
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Confirms that a malfunction condition exists.
2. Check to see if the indicator can be turned "ON" manually.

3. Checks the integrity of the indicator bulb.
4. Checks for an indicator low side circuit open.
5. Checks for an indicator low side circuit short to voltage.

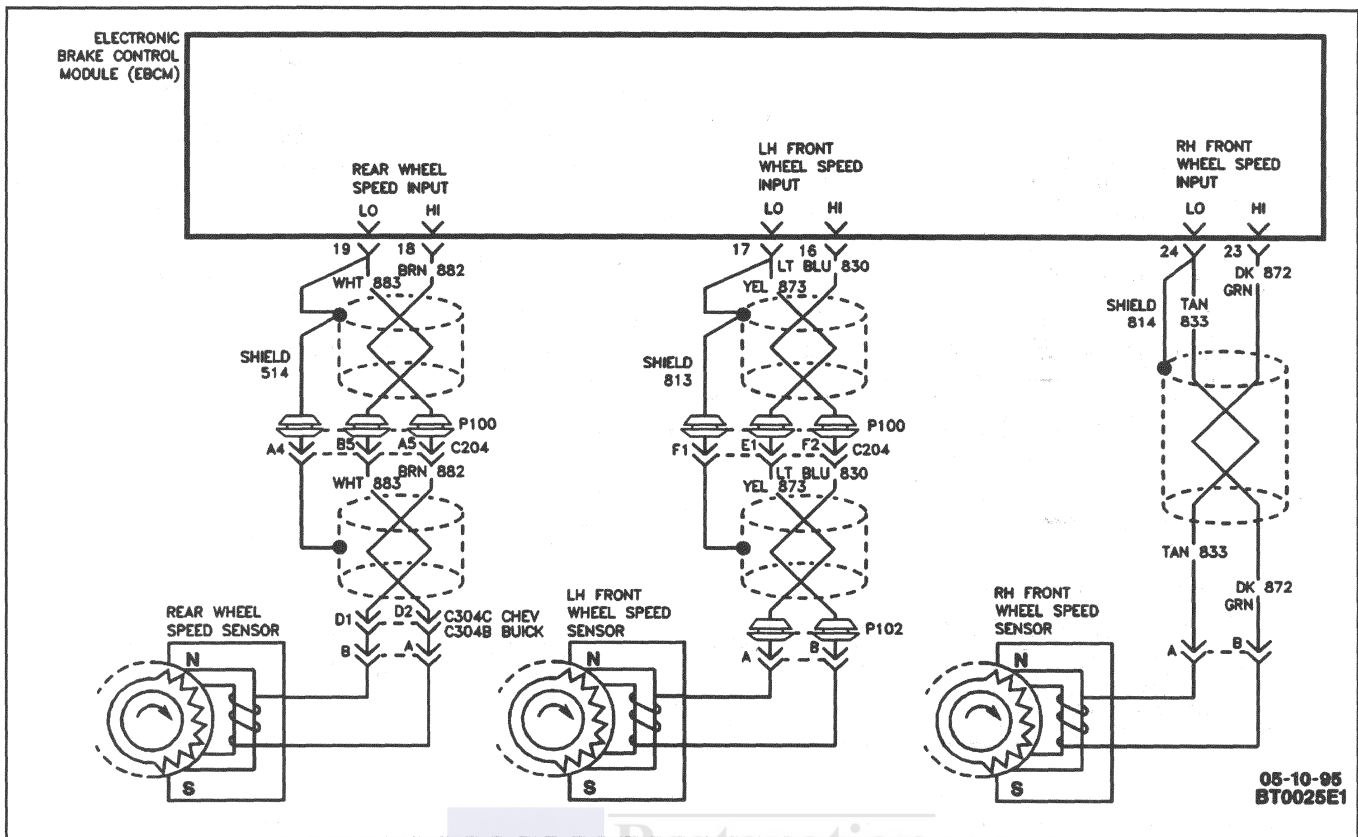
CHART B **ABS INDICATOR INOPERATIVE OR** **FLICKERS BRIEFLY AT IGNITION "RUN"**



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6819

5E1-24 ANTILOCK BRAKE SYSTEM (ABS)



DTC(s) 21,25 (Page 1 of 2)

FRONT WHEEL SPEED SENSOR CIRCUIT MALFUNCTION

Circuit Description:

The toothed wheel generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC Will Set When:

- There is a short to voltage or ground in (CKT 872 or 833 RF)(CKT 873 or 830 LF).
- There is a malfunctioning speed sensor.
- It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause this fault.

The test for this malfunction occurs when the vehicle is in motion; it will not set with the ignition in the "RUN" position and the vehicle at rest.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance in the sensor itself.

2. Checks for a short to voltage in either of the speed sensor circuit wires.
3. Checks for a short between the speed sensor circuit wires.
4. Checks for a short to ground in the speed sensor input circuit wire. The ground may be either a "hard" short to ground, or a resistive (partial) short. A short with a resistance less than 2 megohms, though not a hard short, can still cause the DTC to set.

Diagnostic Aids:

Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

The Tech 1 can also be used to monitor the wheel speeds during a road test. Watch the wheel speeds being displayed on the Tech 1 to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and road test monitoring wheel speeds with the Tech 1.

DTC(s) 21, 25
(Page 1 of 2)
FRONT WHEEL
SPEED SENSOR
CIRCUIT
MALFUNCTION

ENSURE SENSOR IS NOT VISIBLY DAMAGED; IF IT IS DAMAGED, REPLACE THE SENSOR, CLEAR DTCs, AND ROAD TEST TO SEE IF DTC RESETS.

1

- IGNITION "OFF".
- DISCONNECT SENSOR CONNECTOR.
- USING J 39200 AND ADAPTER FROM J 35616-A, CHECK SENSOR RESISTANCE BY PROBING SENSOR CONNECTOR TERMINALS. IS RESISTANCE 1015-1245 Ω ?

YES

NO

REPLACE SENSOR.

2

- DISCONNECT EBCM CONNECTOR.
- CONNECT J 39200 BETWEEN SENSOR HARNESS CONNECTOR TERMINAL "A" AND GROUND (USE DC VOLTAGE SETTING).
- IGNITION TO "RUN".
- NOTE VOLTAGE; REPEAT BETWEEN TERMINAL "B" AND GROUND. IS VOLTAGE GREATER THAN 1 V ON EITHER TERMINAL "A" OR "B"?

NO

YES

REPAIR SHORT TO VOLTAGE IN CKT:
 RF - 872 OR 833; LF 873 OR 830.

3

- IGNITION "OFF".
- INSTALL J 39700 UNIVERSAL BREAKOUT BOX WITH ADAPTER J 39700-15 TO EBCM HARNESS CONNECTOR ONLY.
- USING J 39200, MEASURE RESISTANCE BETWEEN J 39700 TERMINALS: RF - "23" AND "24", LF - "16" AND "17". DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO

REPAIR SHORT BETWEEN CKTS: 872 AND 833 FOR RF; 873 AND 830 FOR LF.

4

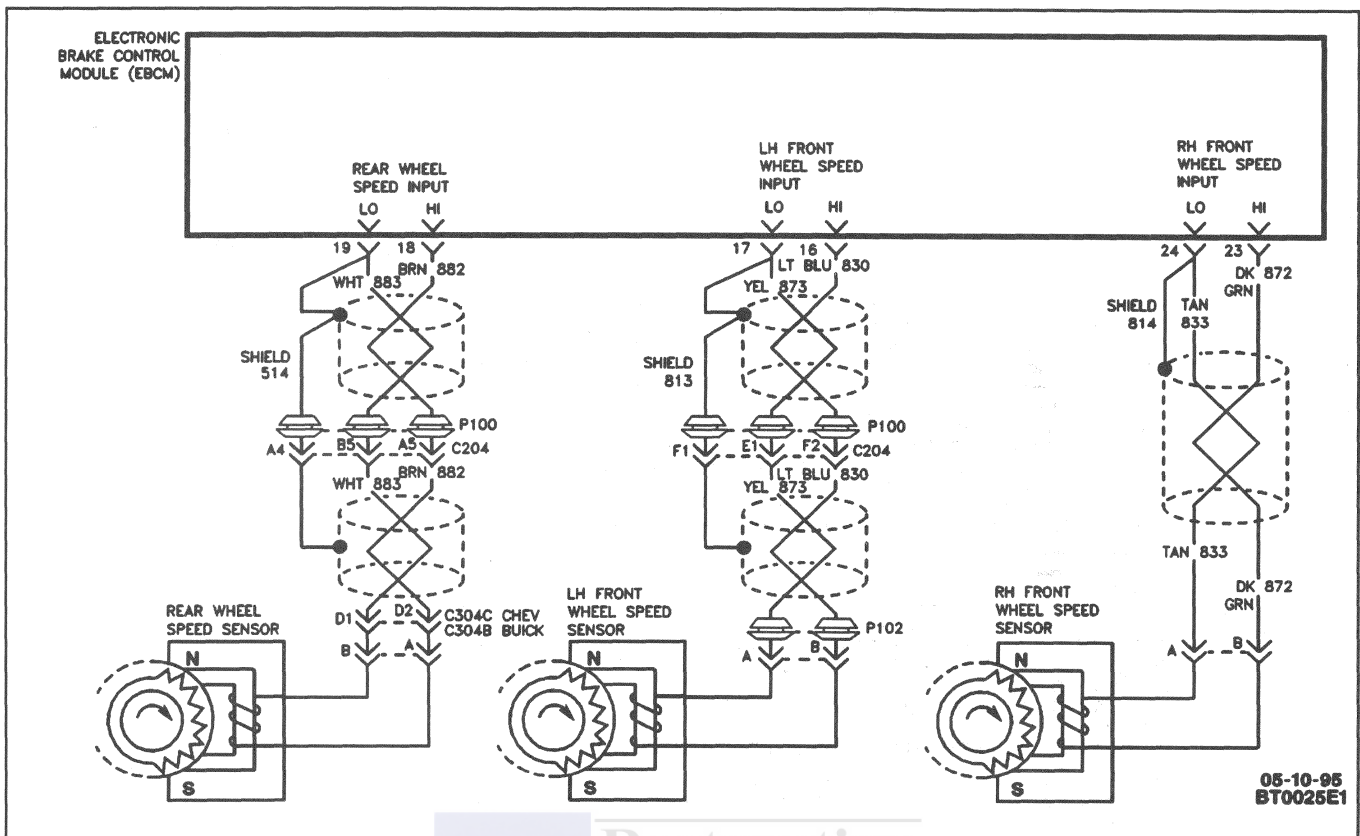
- USING J 39200, MEASURE RESISTANCE BETWEEN J 39700 TERMINAL "23" FOR RF OR "16" FOR LF, AND GROUND. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO

REPAIR SHORT TO GROUND IN CKT 872 FOR RF OR 830 FOR LF.

CONTINUE DIAGNOSTICS ON NEXT PAGE.



DTC(s) 21,25 (Page 2 of 2)

FRONT WHEEL SPEED SENSOR CIRCUIT MALFUNCTION

Circuit Description:

The toothed wheel generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC Will Set When:

- There is a short to voltage or ground in (CKT 872 or 833 RF)(CKT 873 or 830 LF).
- There is a malfunctioning speed sensor.
- It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause this fault.

The test for this malfunction occurs when the vehicle is in motion; it will not set with the ignition in the "RUN" position and the vehicle at rest.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks if the DTC resets during a road test. If so, since tests 1-4 have validated that the circuitry and

components are good, intermittent malfunctions are suspected.

6. Checks wiring and connectors for intermittents.
7. Replace the wheel speed sensor as it is likely the cause of a DTC reset experienced during the road test, since other portions of the circuit have checked out OK. If the DTC resets after sensor replacement, the EBCM must be concluding there is a malfunction present in the speed sensor circuit when there is not.
8. Ensures DTC was not set due to electromagnetic interference.

Diagnostic Aids:

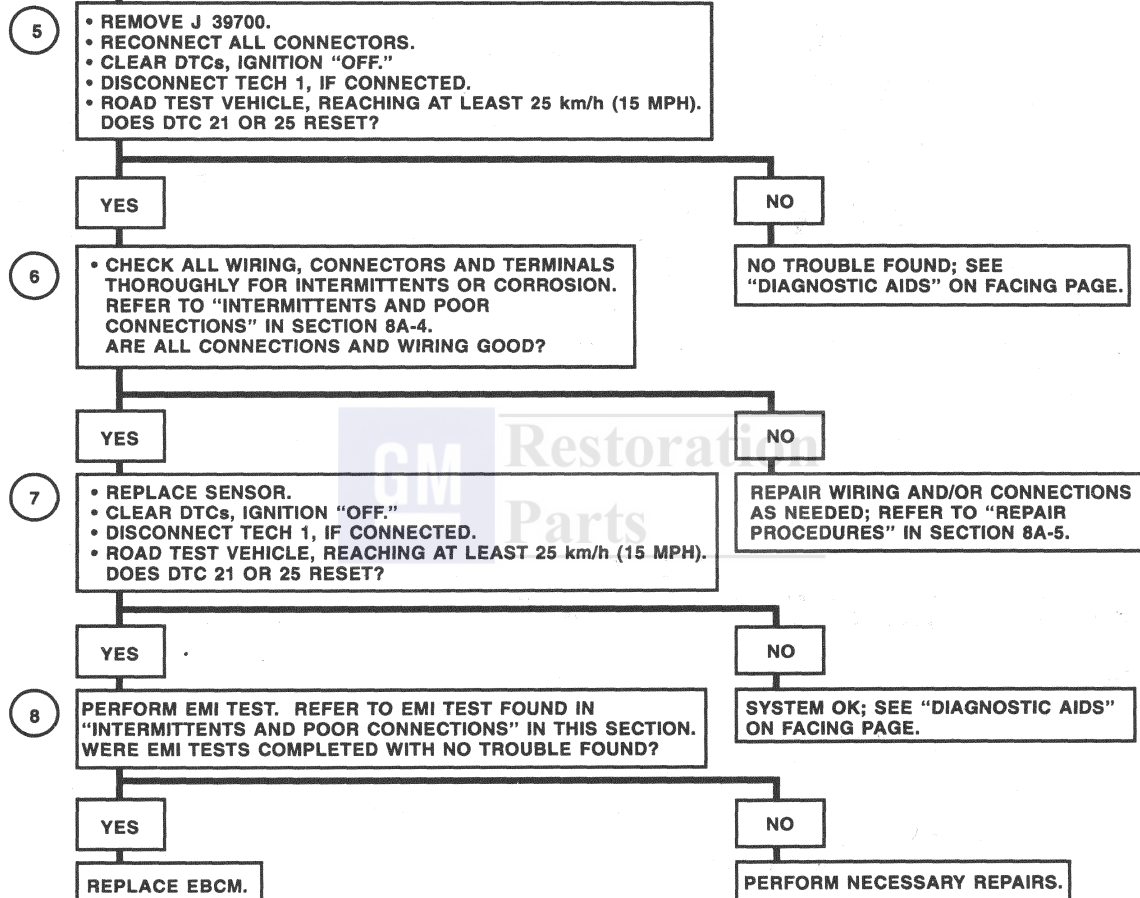
Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

The Tech 1 can also be used to monitor the wheel speeds during a road test. Watch the wheel speeds being displayed on the Tech 1 to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and road test monitoring wheel speeds with the Tech 1.

DTC(s) 21, 25
(Page 2 of 2)
**FRONT WHEEL SPEED
SENSOR CIRCUIT
MALFUNCTION**

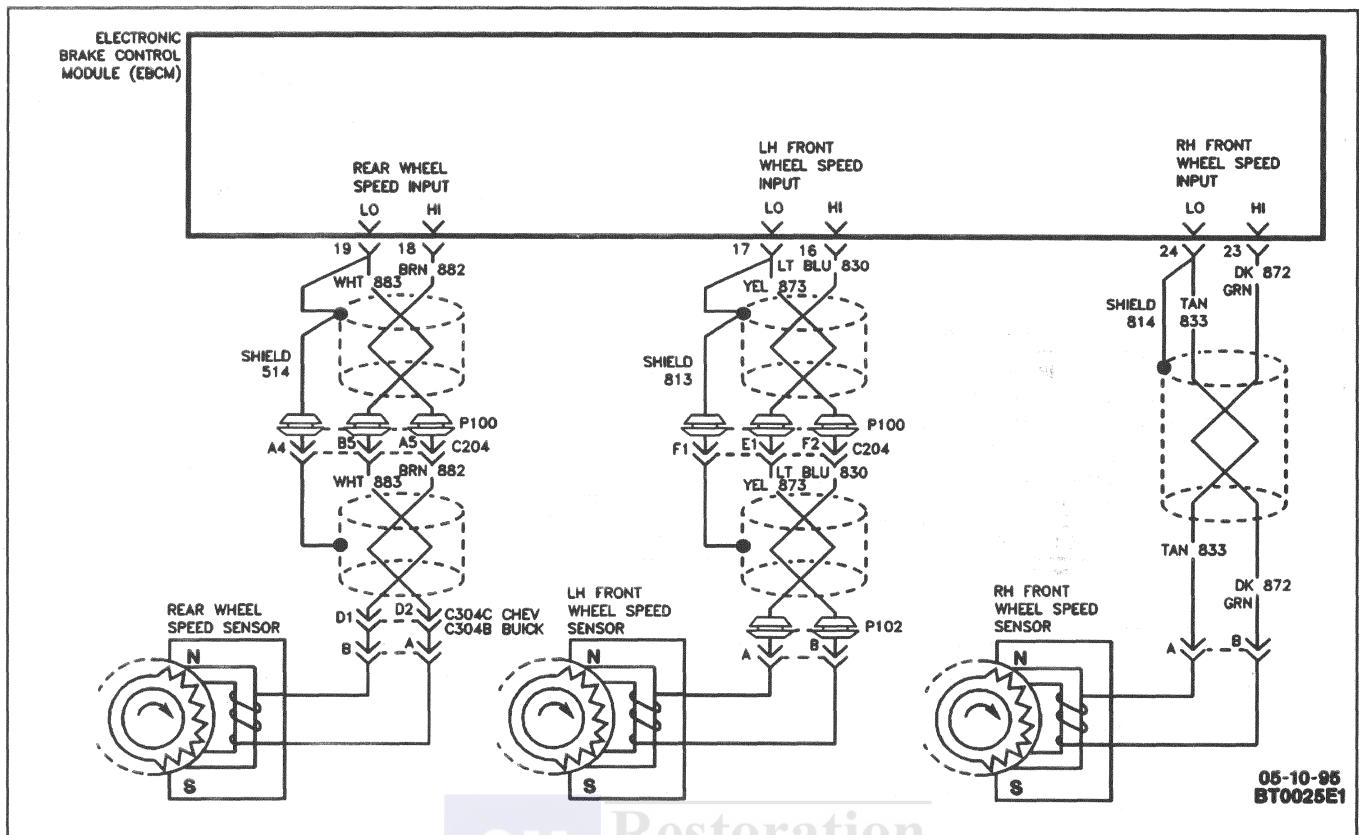
DIAGNOSTIC CONTINUED
FROM PREVIOUS PAGE.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C8439

5E1-28 ANTILOCK BRAKE SYSTEM (ABS)



DTC 35

(Page 1 of 2)

REAR WHEEL SPEED SENSOR CIRCUIT MALFUNCTION

Circuit Description:

The toothed wheel (mounted to the differential pinion gear) generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC 35 Will Set When:

- There is a short to voltage or ground in CKT 883 or 882.
- There is a malfunctioning speed sensor.
- It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause this fault

The test for this malfunction occurs when the vehicle is in motion; it will not set with the ignition in "RUN" and the vehicle at rest.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance in the sensor itself.

2. Checks for a short to voltage in either of the speed sensor circuit wires.
3. Checks for a short between the speed sensor circuit wires.
4. Checks for a short to ground in the speed sensor input circuit wire. The ground may be either a "hard" short to ground, or a resistive (partial) short. A short with a resistance less than 2 megohms, though not a hard short, can still cause DTC 35 to set.

Diagnostic Aids:

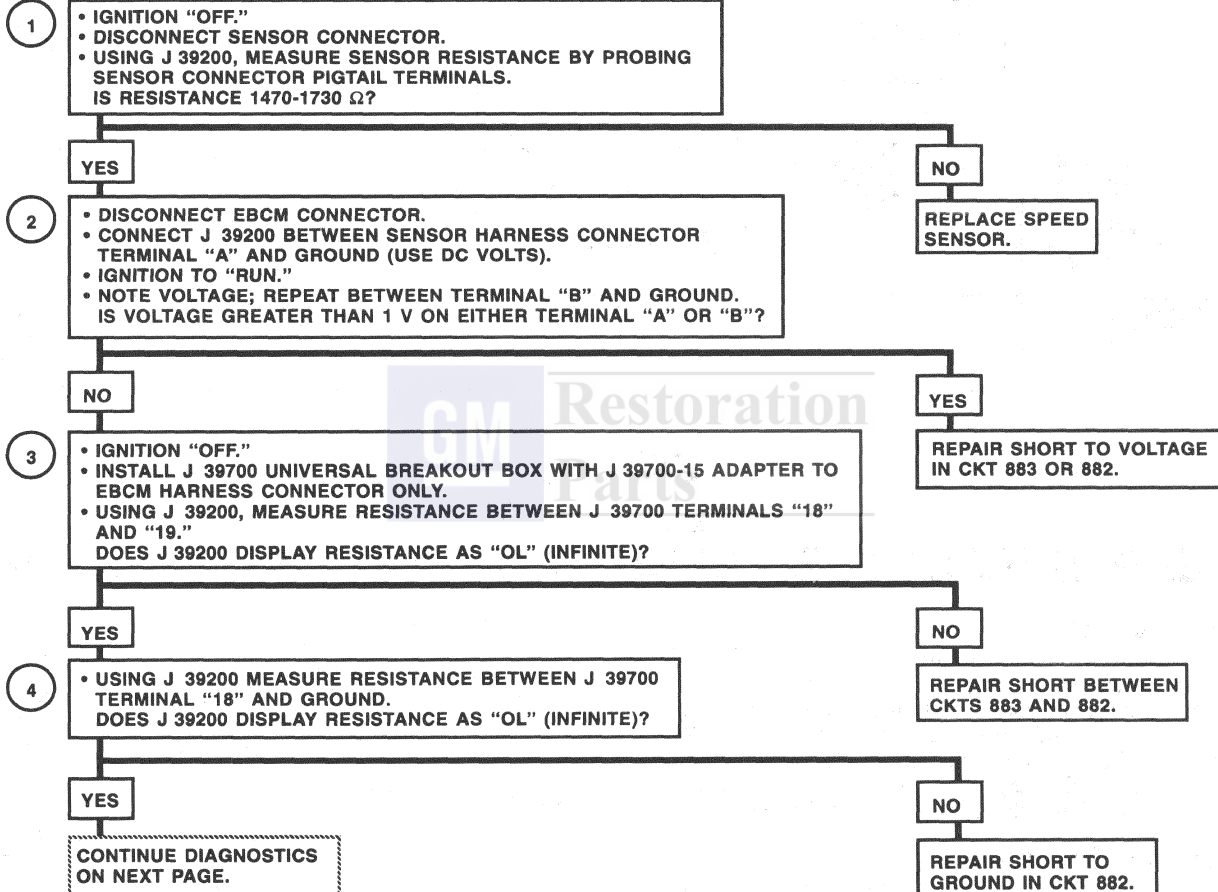
Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

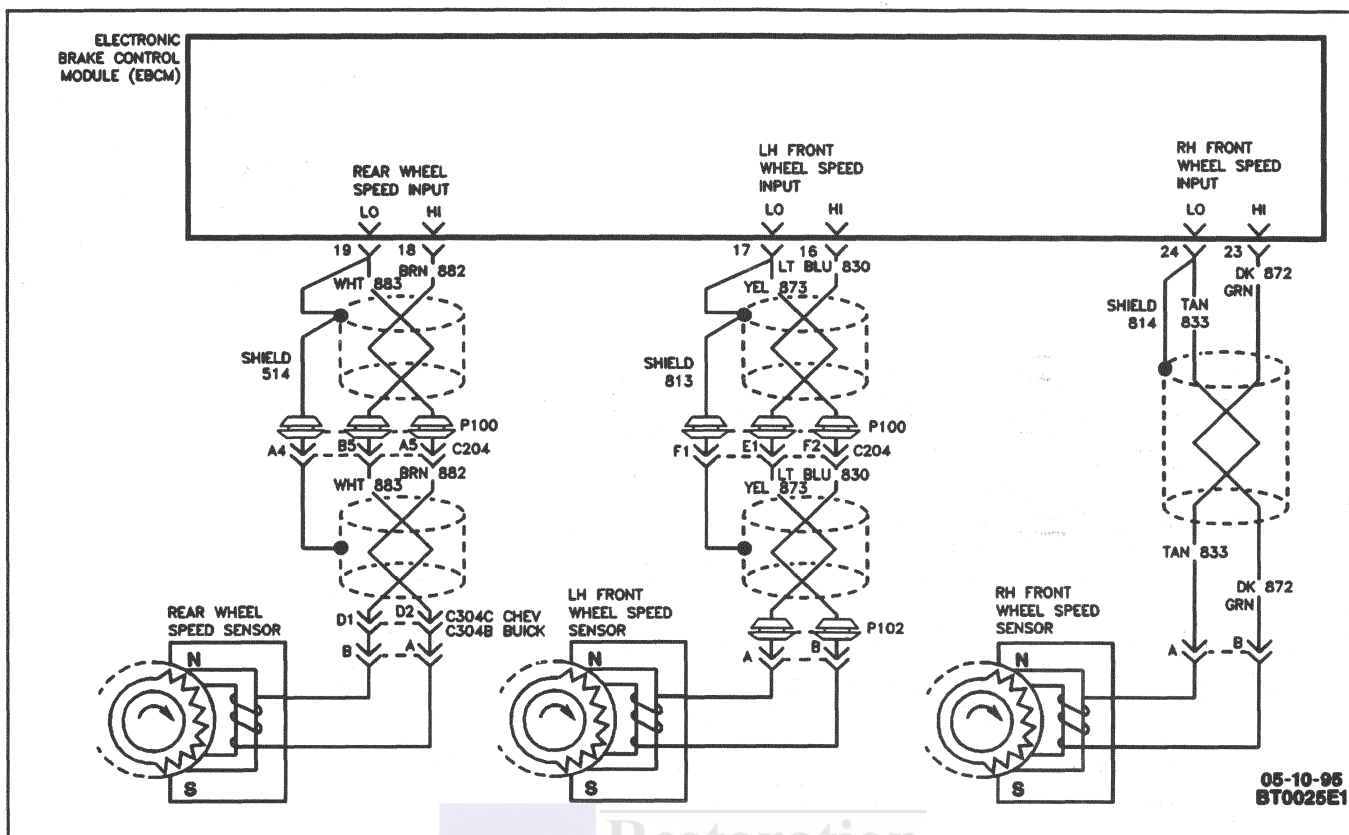
The Tech 1 can also be used to monitor the wheel speeds during a road test. Watch the wheel speeds being displayed on the Tech 1 to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and road test monitoring wheel speeds with the Tech 1.

DTC 35
(Page 1 of 2)
**REAR WHEEL
SPEED SENSOR
CIRCUIT
MALFUNCTION**

ENSURE SENSOR IS NOT VISIBLY DAMAGED, AND THAT IT IS PROPERLY MOUNTED. IF IT IS NOT PROPERLY MOUNTED OR RETAINED, PROPERLY ATTACH IT; IF IT IS DAMAGED, REPLACE IT. THEN, CLEAR DTCs AND ROAD TEST TO SEE IF DTC RESETS.



5E1-30 ANTILOCK BRAKE SYSTEM (ABS)



DTC 35

(Page 2 of 2)

REAR WHEEL SPEED SENSOR CIRCUIT MALFUNCTION

Circuit Description:

The toothed wheel (mounted to the differential pinion gear) generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC 35 Will Set When:

- There is a short to voltage or ground in CKT 883 or 882.
- There is a malfunctioning speed sensor.
- It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause this fault

The test for this malfunction occurs when the vehicle is in motion; it will not set with the ignition in "RUN" and the vehicle at rest.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks if the DTC resets during a road test. If so, since tests 1-4 have validated that all of the circuitry and components are good, intermittent malfunctions are suspected.

6. Checks wiring and connectors for intermittents.

7. Checks for sensor mounting and for damage to the toothed wheel which may be causing the malfunction.

8. Replace the speed sensor as it is likely the cause of a DTC reset experienced during the road test, since other portions of the circuit have checked out OK.

Diagnostic Aids:

Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

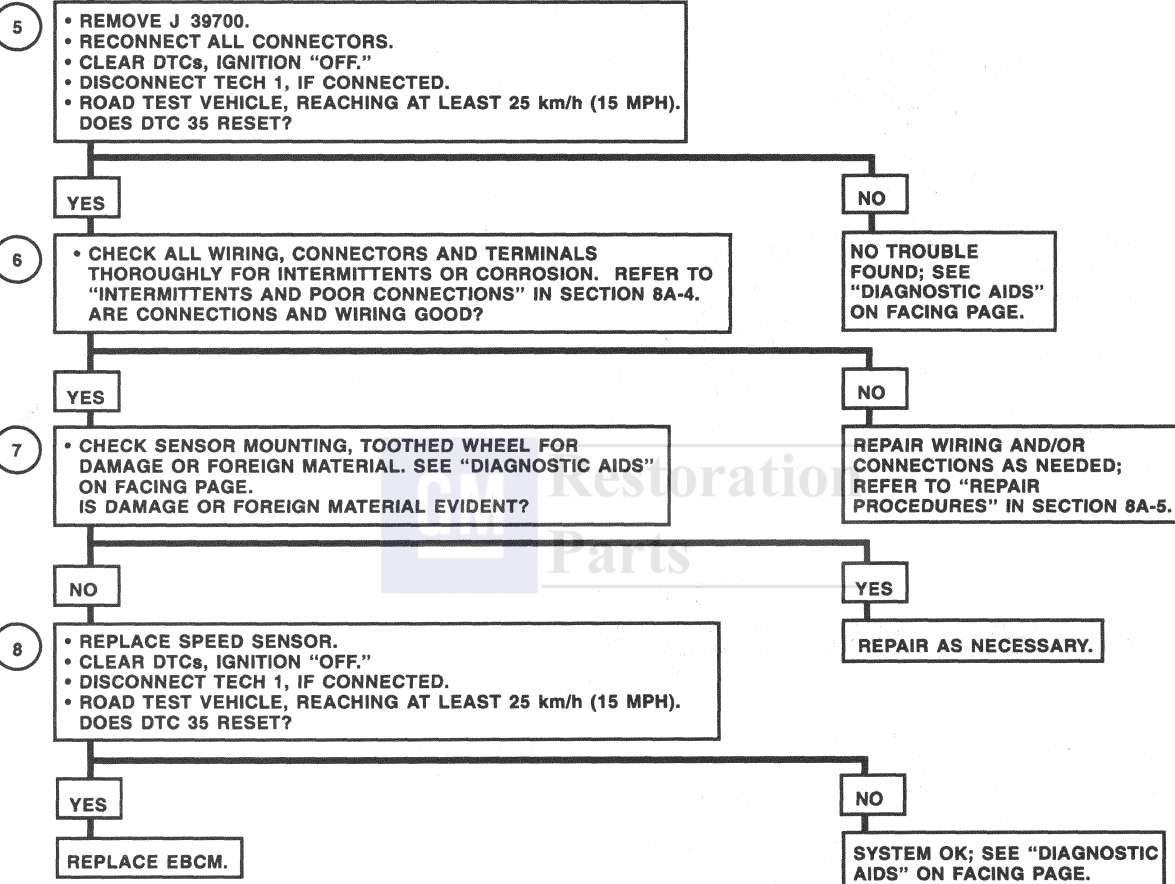
Check the toothed wheel for any large grooves, gouges, marks, or buildup of foreign material between the teeth, also check for metal shavings attached to sensor face that might influence the signal at the wheel speed sensor.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

The Tech 1 can also be used to monitor the wheel speeds during a road test. Watch the wheel speeds being displayed on the Tech 1 to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and road test monitoring wheel speeds with the Tech 1.

DTC 35
(Page 2 of 2)
**REAR WHEEL SPEED
SENSOR CIRCUIT
MALFUNCTION**

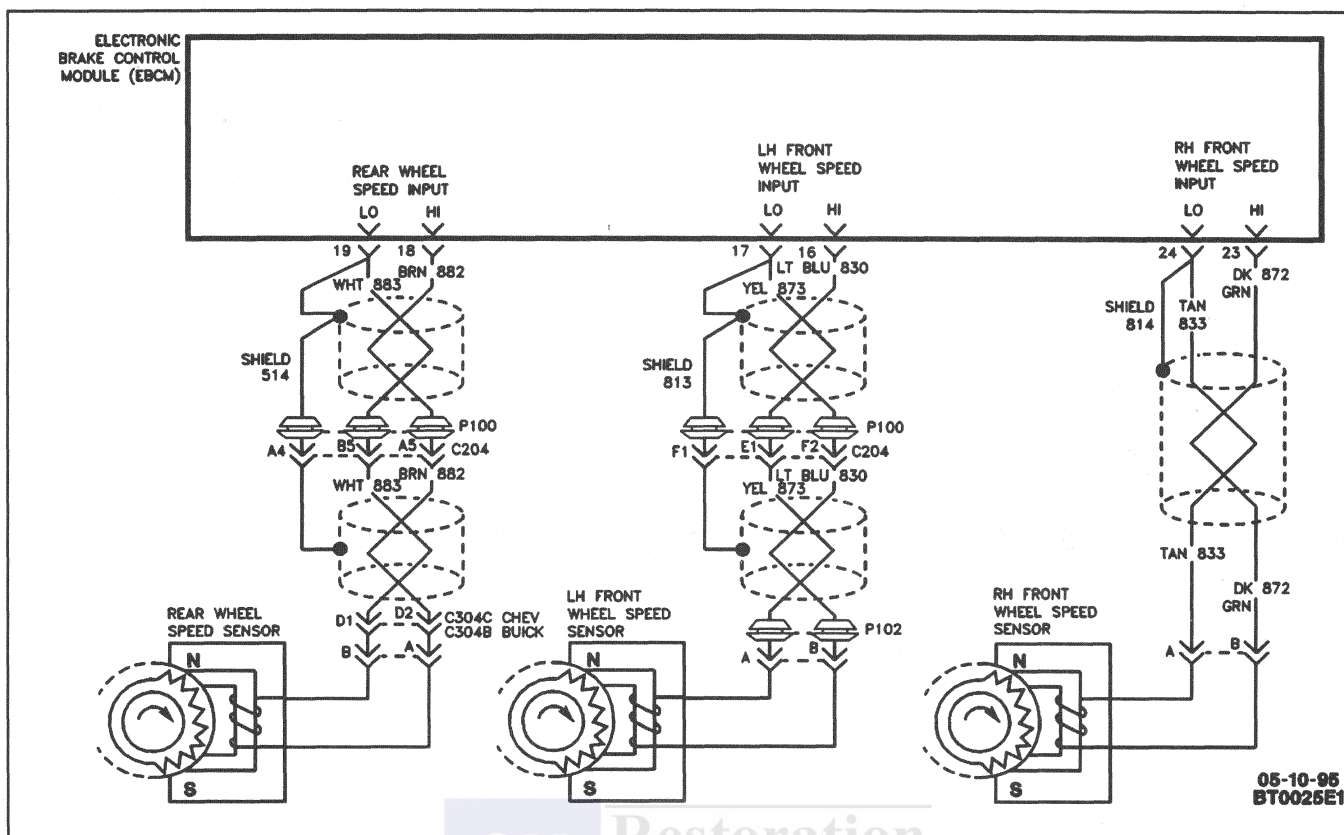
DIAGNOSTICS CONTINUED FROM
PREVIOUS PAGE.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C8438

5E1-32 ANTILOCK BRAKE SYSTEM (ABS)



DTC(s) 23,27,37
(Page 1 of 2)

WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION

Circuit Description:

The toothed wheel generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC Will Set When:

- There is a short to voltage or an open in the affected circuit.
- There is a malfunctioning speed sensor.

The test for this malfunction occurs any time with the ignition in the "RUN" position.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Check for proper resistance in the sensor itself.

2. Checks for a short to voltage in either of the speed sensor circuit wires.
3. Checks for an open in both the speed sensor circuit wires.
4. Manipulates wiring and connectors, trying to induce an intermittent malfunction not currently present.
5. This test checks if the DTC resets.

Diagnostic Aids:

Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC(s) 23, 27, 37
(Page 1 of 2)
WHEEL SPEED
SENSOR CIRCUIT
CONTINUITY
MAJFUNCTION

ENSURE SENSOR IS NOT VISIBLY DAMAGED; IF IT IS DAMAGED, REPLACE THE SENSOR, CLEAR DTCs, AND TURN IGNITION TO "RUN" TO SEE IF DTC RESETS.

1

- IGNITION "OFF."
- DISCONNECT SENSOR CONNECTOR.
- USING J 39200 AND ADAPTERS FROM J 35616-A, CHECK SENSOR RESISTANCE BY PROBING SENSOR CONNECTOR TERMINALS. IS RESISTANCE 1015-1245 Ω FOR FRONT, OR 1470-1730 FOR REAR?

YES

NO

2

- DISCONNECT EBCM CONNECTOR.
- CONNECT J 39200 BETWEEN SENSOR HARNESS CONNECTOR TERMINAL "A" AND GROUND (USE DC VOLTS).
- IGNITION TO "RUN."
- NOTE VOLTAGE; REPEAT BETWEEN TERMINAL "B" AND GROUND. IS VOLTAGE MORE THAN 1 V ON EITHER TERMINAL "A" OR "B"?

REPLACE SENSOR.

NO

YES

3

- IGNITION "OFF."
- INSTALL J 39700 UNIVERSAL BREAKOUT BOX WITH ADAPTER J 39700-15 TO EBCM HARNESS CONNECTOR ONLY.
- USING J 39200, MEASURE RESISTANCE BETWEEN J39700 TERMINAL AND SENSOR HARNESS AS SHOWN BELOW:

REPAIR SHORT TO VOLTAGE IN THE AFFECTED CIRCUIT.

J 39700 TERMINAL	SENSOR HARNESS	CKT	FOR DTC
24	A	833	23
23	B	872	23
17	A	873	27
16	B	830	27
18	A	882	37
19	B	883	37

IS MEASUREMENT GREATER THAN 5 Ω ?

NO

YES

4

- REMOVE J 39700; RECONNECT ALL CONNECTORS.
- CLEAR DTCs; IGNITION "OFF."
- DISCONNECT TECH 1, IF CONNECTED.
- IGNITION TO "RUN."
- WIGGLE ALL WIRING AND CONNECTORS TO TRY TO INDUCE A HIDDEN INTERMITTENT MALFUNCTION. DOES DTC RESET?

REPAIR OPEN IN THE AFFECTED CIRCUIT.

NO

YES

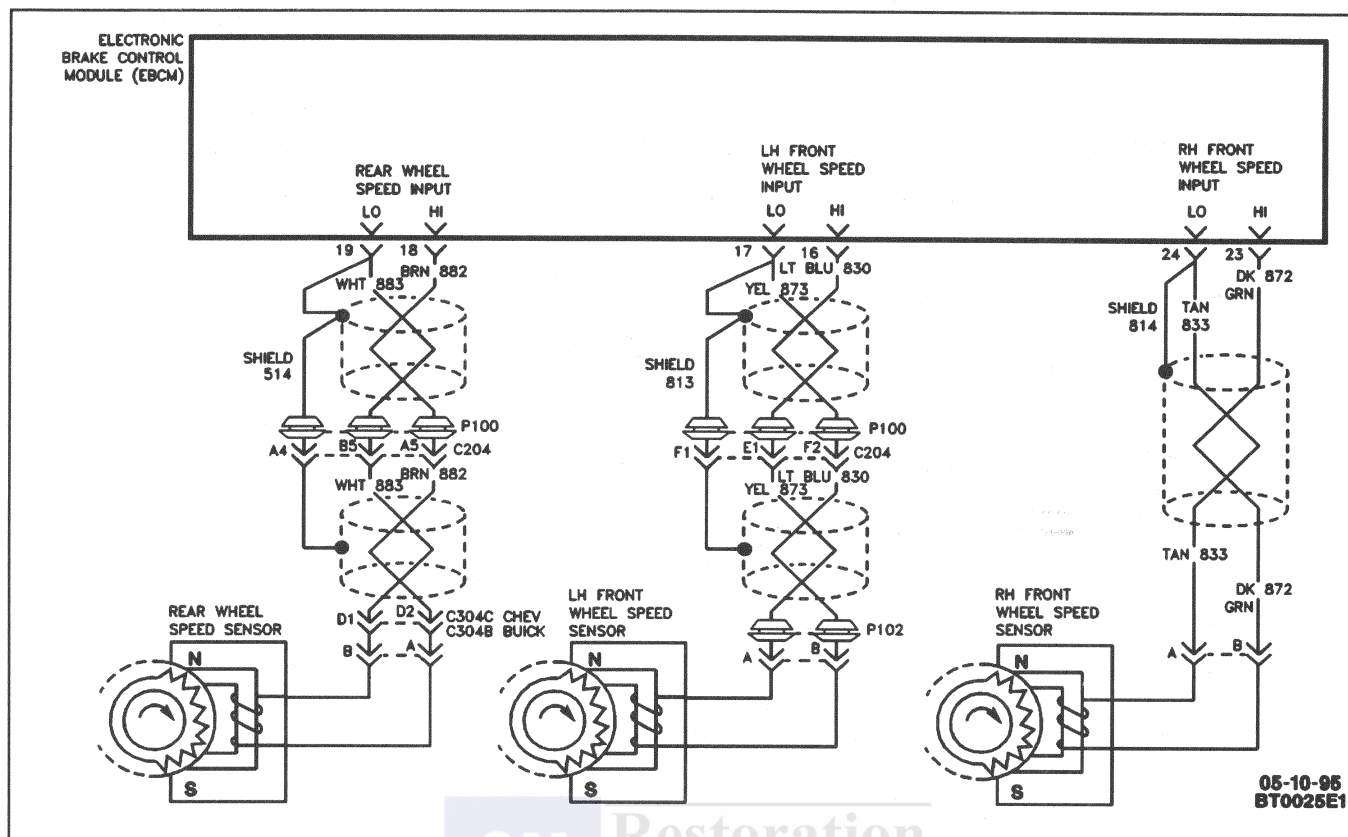
5

- CLEAR DTCs; IGNITION "OFF."
- DISCONNECT TECH 1, IF CONNECTED.
- IGNITION TO "RUN."
- DOES DTC RESET?

REPAIR INTERMITTENT IN CONNECTOR OR WIRING.

CONTINUE DIAGNOSTICS
ON NEXT PAGE

5E1-34 ANTILOCK BRAKE SYSTEM (ABS)



DTC(s) 23,27,37

(Page 2 of 2)

WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION

Circuit Description:

The toothed wheel generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC Will Set When:

- There is a short to voltage or an open in the affected circuit.
- There is a malfunctioning speed sensor.

The test for this malfunction occurs any time with the ignition in the "RUN" position.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

6. Checks if DTC (21 RF),(25 LF) or (35 R) sets during a road test.

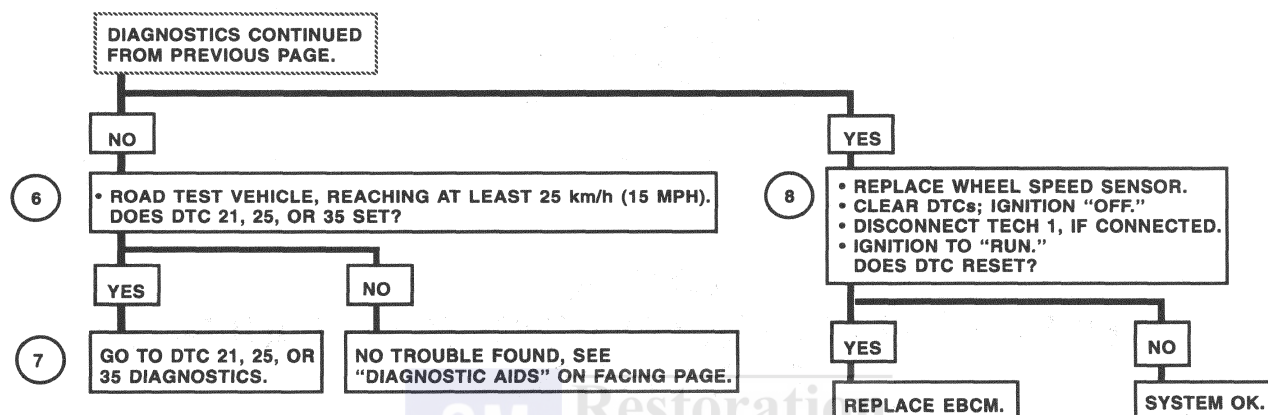
7. If the circuit malfunction DTC sets at this point, diagnostics for circuit malfunctions should be used.
8. The wheel speed sensor may be causing an intermittent malfunction. If DTC resets after sensor replacement, the EBCM must be concluding there is a malfunction present in the speed sensor circuit when there is not.

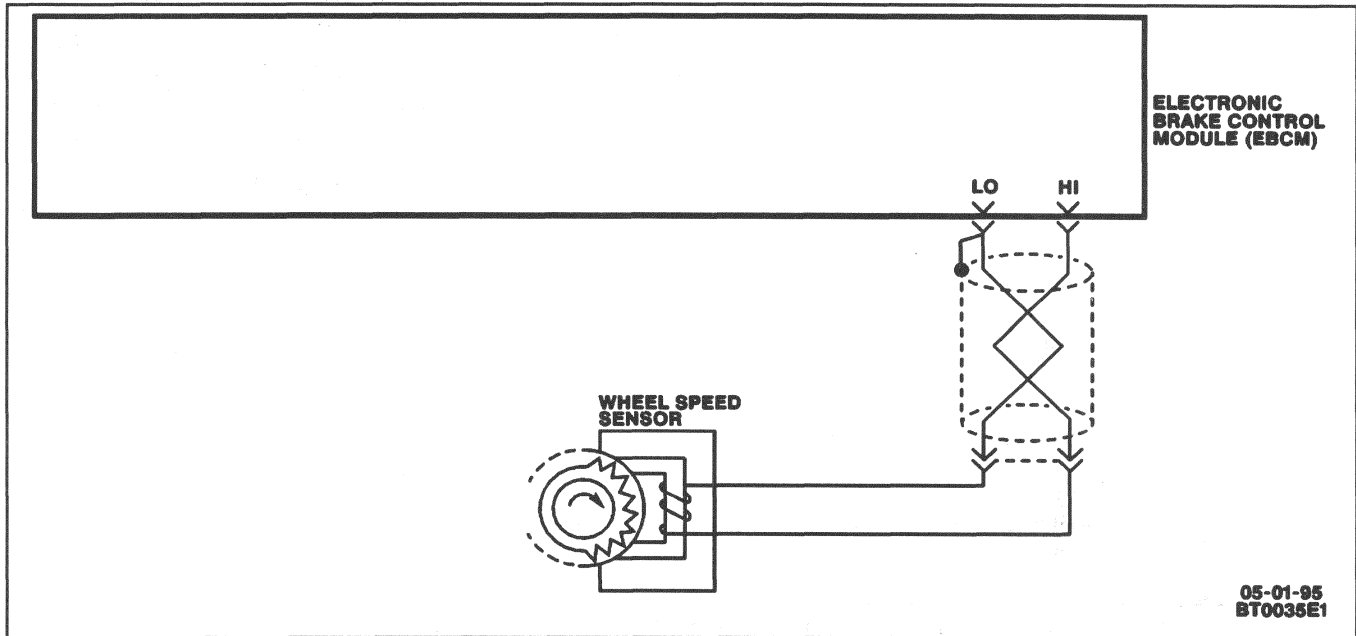
Diagnostic Aids:

Be sure the speed sensor wiring is properly routed and retained. This will help prevent false signals due to electrical noise being picked up by the wiring.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC(s) 23, 27, 37
(PAGE 2 OF 2)
WHEEL SPEED SENSOR
CIRCUIT CONTINUITY
MALFUNCTION





DTC 28 WHEEL SPEED SENSOR CIRCUIT FREQUENCY MALFUNCTION

Circuit Description:

The toothed wheel generates a voltage pulse as it moves past the sensor; each tooth-gap-tooth series on the wheel generates a pulse. The frequency of these pulses is used by the EBCM to determine wheel speed. The amplitude of the voltage generated in each pulse depends on the air gap between the sensor and the toothed wheel, and on wheel speed.

DTC 28 Will Set When:

- The EBCM cannot specifically identify which wheel speed sensor is causing the frequency error malfunction. If the EBCM can define the specific speed sensor causing the malfunction, the DTC associated with the sensor (21,25,35) will be set instead of DTC 28.
- It is possible that driving with a compact spare at speeds above 40 km/h (24 mph) may cause this fault.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks wiring and connections for malfunctions. It is critical that this step is performed thoroughly, as wiring/connector malfunctions are the most likely case for this DTC.
2. Uses the Tech 1 to monitor for vehicle electrical/electronic system "noise" being picked up by the speed sensor circuits.

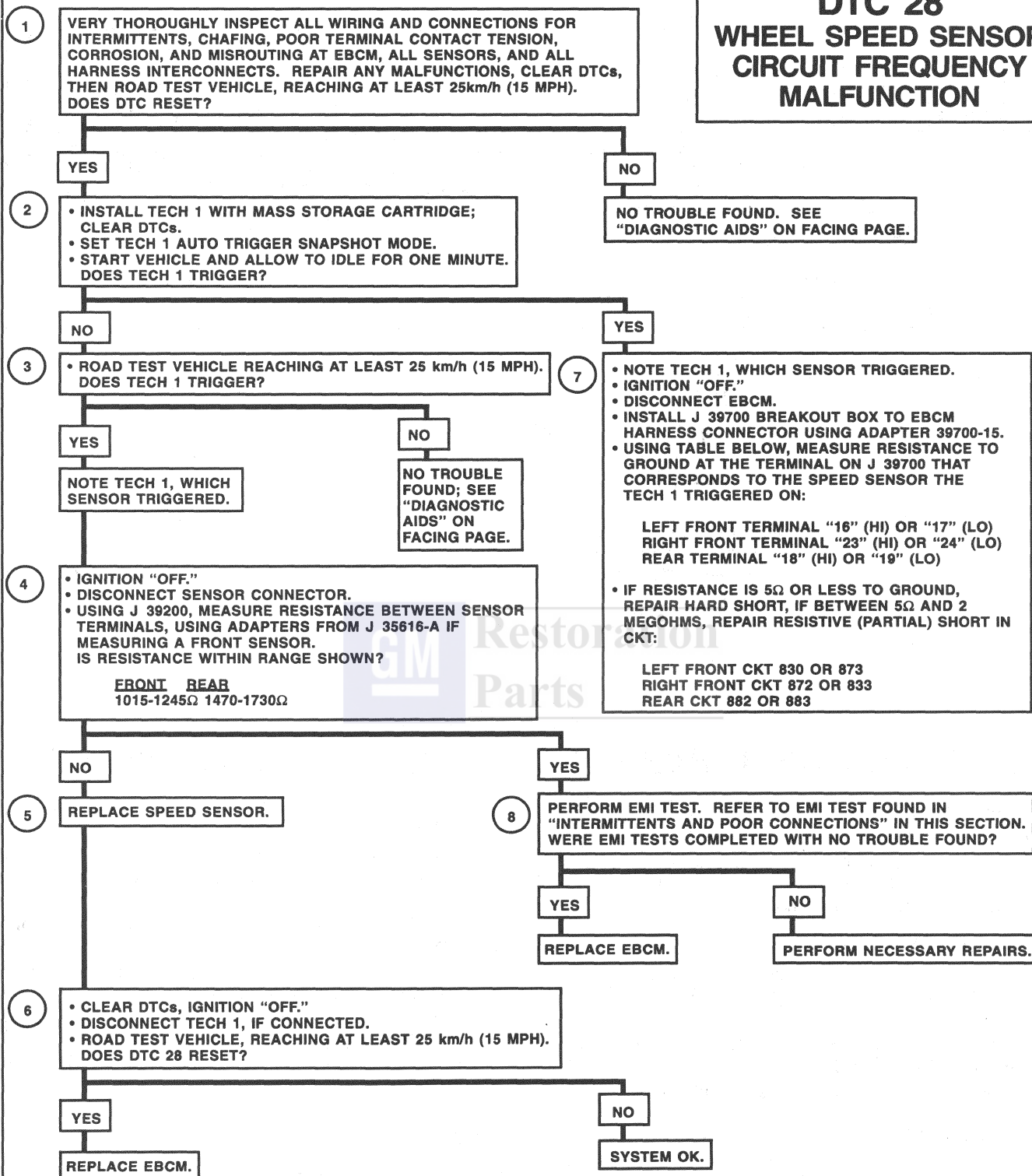
3. Uses the Tech 1 to monitor the wheel speed sensors while the vehicle is operating. If the Tech 1 auto-trigger snapshot mode triggers, the speed sensor or the wiring and/or connectors are going intermittent during the road test.
4. Checks for proper resistance in the sensor itself.
5. Replace wheel speed sensor as the likely cause of the triggering intermittent.
6. Ensures DTC does not reset due to a malfunctioning EBCM.
7. Checks for a short to ground in both the speed sensor "HI" and "LO" circuit wires. The circuit to be tested depends on which speed sensor triggered the Tech 1. The ground may be either a "hard" short to ground, or a resistive (partial) short. A short with a resistance less than 2 megohms, though not a hard short, can still cause DTC 28 to set.
8. Ensures DTC was not set due to electromagnetic interference.

Diagnostic Aids:

Check the toothed wheel for any large grooves, gouges, marks, etc. That might influence the tooth's signal at the wheel speed sensor. Also check for a buildup of foreign material in the gaps between teeth in the toothed wheel; this material may cause this malfunction.

A worn front hub/bearing assembly may cause this malfunction in extreme cases; the bearing play allows the sensor-toothed-ring gap to change excessively.

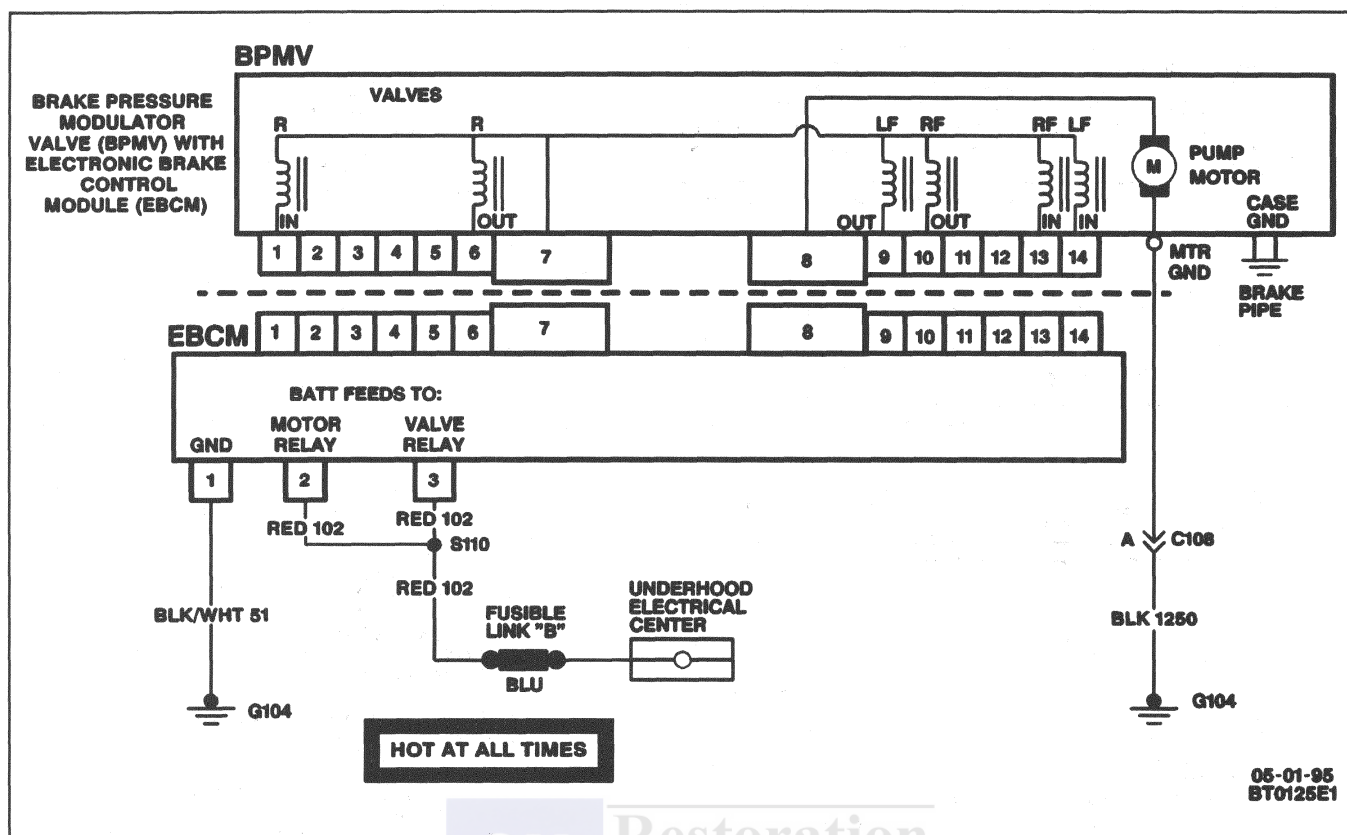
DTC 28 WHEEL SPEED SENSOR CIRCUIT FREQUENCY MALFUNCTION



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6823

5E1-38 ANTILOCK BRAKE SYSTEM (ABS)



DTC(s) 41,45,55

RF, LF, AND REAR INLET VALVE SOLENOID MALFUNCTION

Circuit Description:

The wheel valve solenoid circuits are supplied with battery power when the ignition is in the "RUN" position. The EBCM controls the valve functions by grounding the circuit when necessary.

DTC Will Set When:

- The EBCM senses a discrepancy such as an open, short to ground or voltage internal to the EBCM and BPMV.
- There is poor connection in the circuit internal to the EBCM and BPMV.
- There is a malfunctioning solenoid valve.

Action Taken:

The valve relay will turn "OFF," the "ABS" lamp will come "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if DTC 71 was set concurrently with valve DTC.

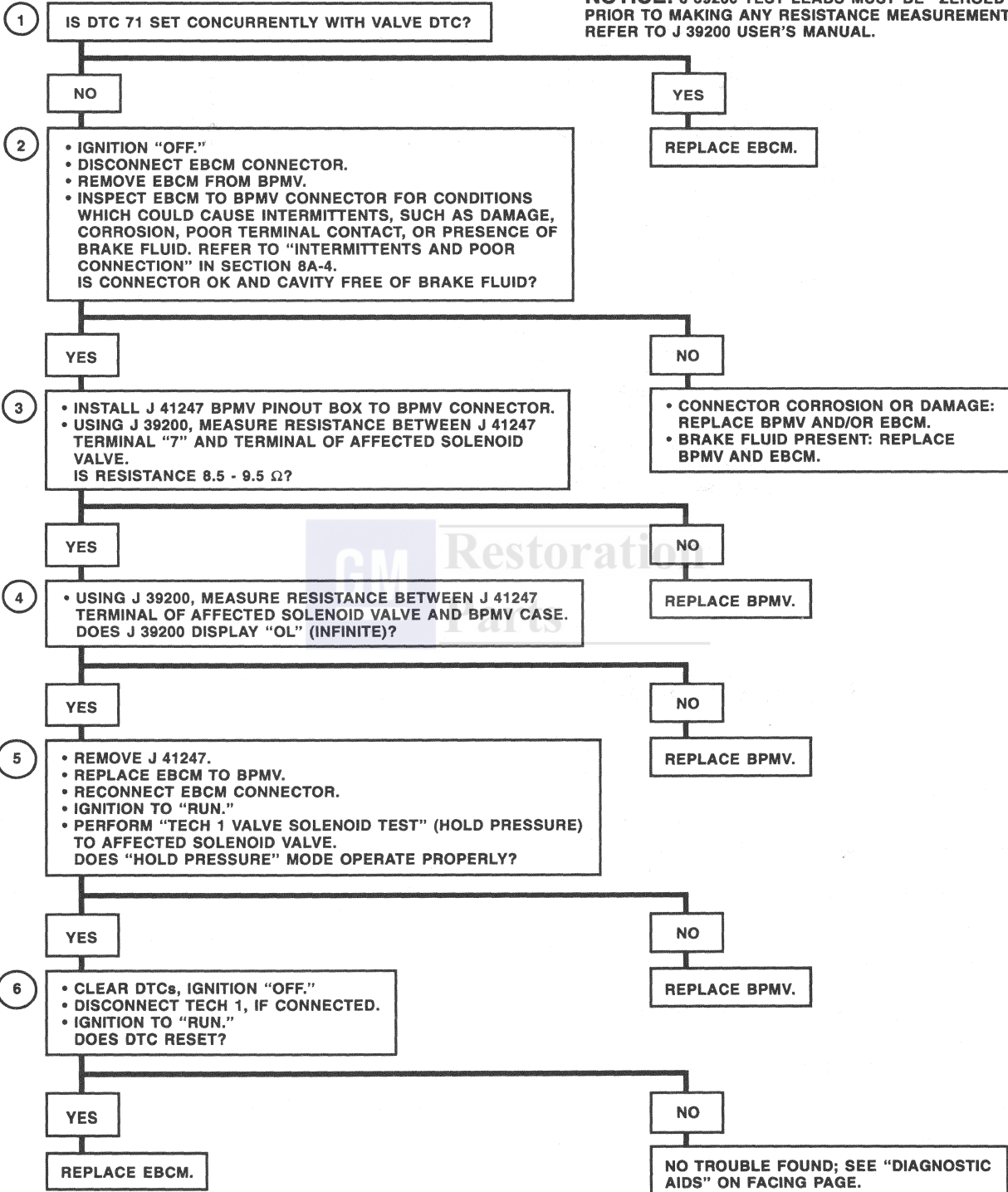
2. Checks condition of EBCM to BPMV connector, and for presence of brake fluid.
3. Checks the integrity of the affected valve solenoid circuitry internal to the BPMV, and the valve solenoid coil.
4. Checks for solenoid circuit short to ground (BPMV case).
5. Uses the Tech 1 to exercise the affected valve solenoid and check it for proper operation.
6. Checks for continued DTC setting after validating that the circuitry and the solenoid valve is good. If DTC resets, the EBCM is likely malfunctioning.

Diagnostic Aids:

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC(s) 41, 45, 55 **RF, LF, AND REAR INLET VALVE** **SOLENOID MALFUNCTION**

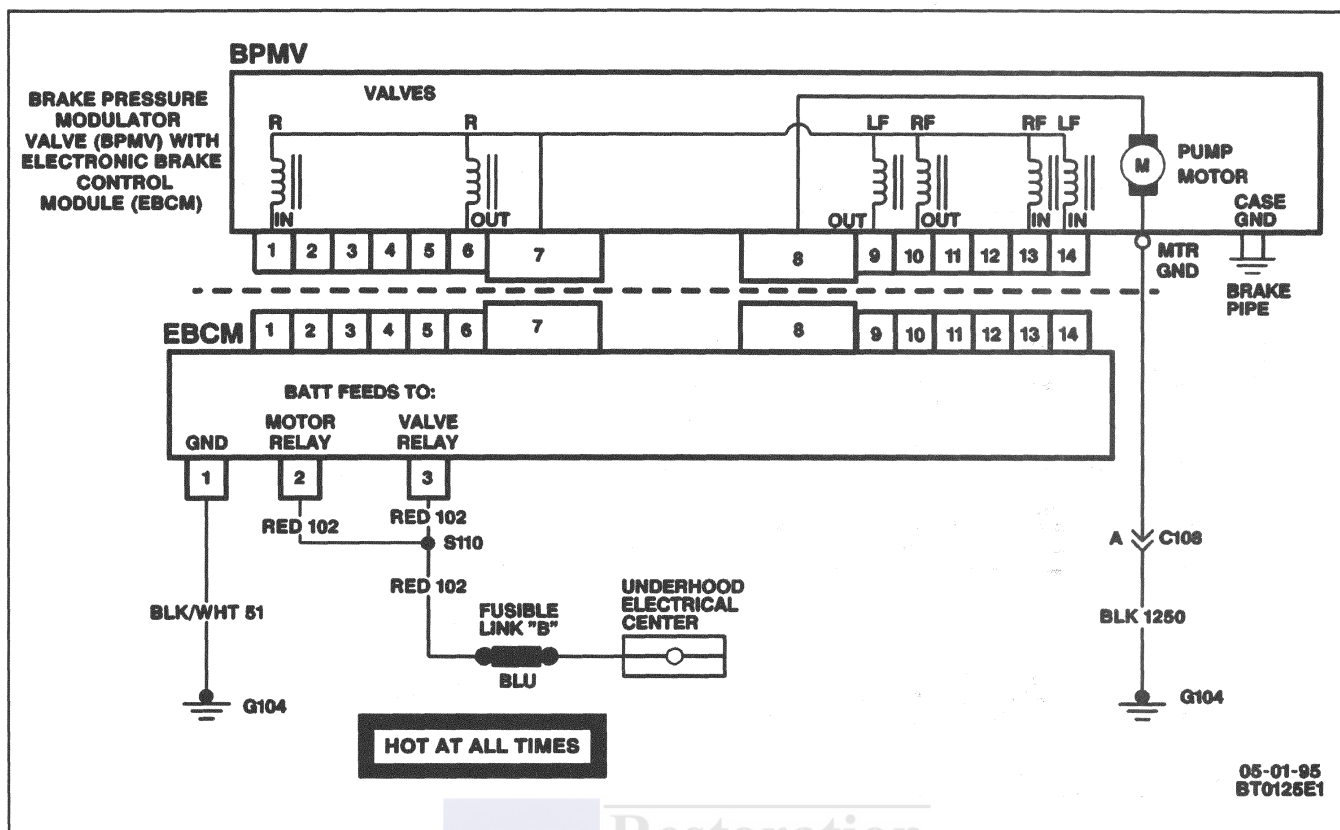
NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C10124

5E1-40 ANTILOCK BRAKE SYSTEM (ABS)



DTC(s) 42,46,56

RF, LF, AND REAR OUTLET VALVE SOLENOID MALFUNCTION

Circuit Description:

The wheel valve solenoid circuits are supplied with battery power when the ignition is in the "RUN" position. The EBCM controls the valve functions by grounding the circuit when necessary.

DTC Will Set When:

- The EBCM senses a discrepancy such as an open, short to ground or voltage.
- There is poor connection in the circuit internal to the EBCM and BPMV.
- There is a malfunctioning solenoid valve.

Action Taken:

The valve relay will turn "OFF," the "ABS" lamp will come "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if DTC 71 was set concurrently with valve DTC.
2. Checks condition of EBCM to BPMV connector,

and for presence of brake fluid.

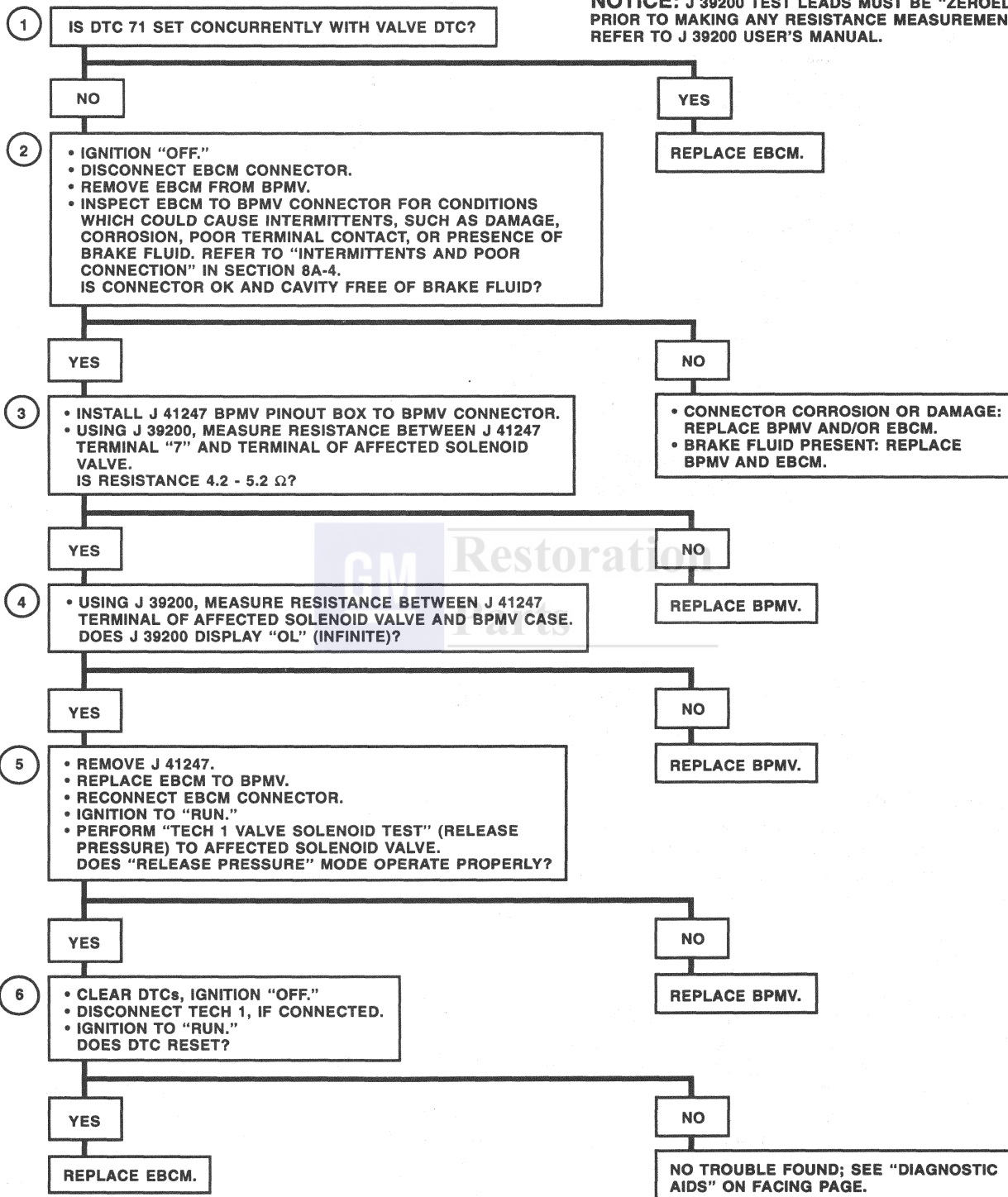
3. Checks the integrity of the affected valve solenoid circuitry internal to the BPMV, and the valve solenoid coil.
4. Checks for solenoid circuit short to ground (BPMV case).
5. Uses the Tech 1 to exercise the affected valve solenoid and check it for proper operation.
6. Checks for continued DTC setting after validating that the circuitry and the solenoid valve is good. If DTC resets, the EBCM is likely malfunctioning.

Diagnostic Aids:

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

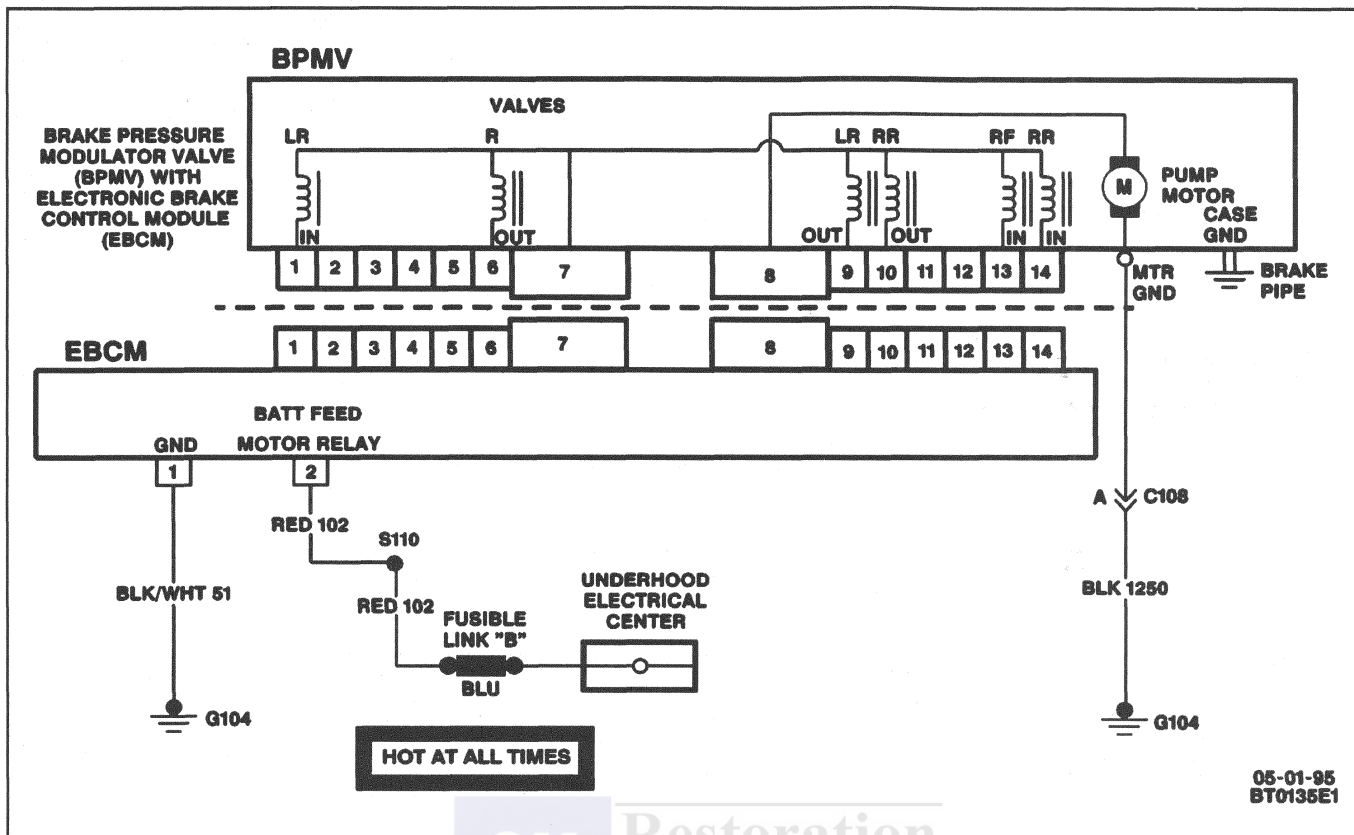
DTC(s) 42, 46, 56 RF, LF, AND REAR OUTLET VALVE SOLENOID MALFUNCTION

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C10125



DTC 61

(page 1 of 2)

BPMV PUMP MOTOR MALFUNCTION

Circuit Description:

When the pump motor relay is grounded by the EBCM, it closes and provides voltage to operate the pump. Once the motor circuit is energized, a "Pump ON" signal is sensed by the EBCM to verify pump operation.

DTC Will Set When:

- Voltage is present at the pump motor without pump motor relay activation from the EBCM.
- Voltage is NOT present at the pump motor within 40 milliseconds after the EBCM requests pump motor relay activation.
- The motor GND circuit is open.
- There is a pump motor malfunction.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks that Fusible Link "B" feeding the EBCM Motor Relay circuit is good.
2. Checks for an open in Pump Motor Ground CKT 1250.
3. Measures for appropriate voltage from the EBCM motor relay circuit, using the EBCM ground line to complete the circuit.
4. Checks EBCM connector terminals for good contact, i.e., not spread open, backed out of connector, corroded, etc.

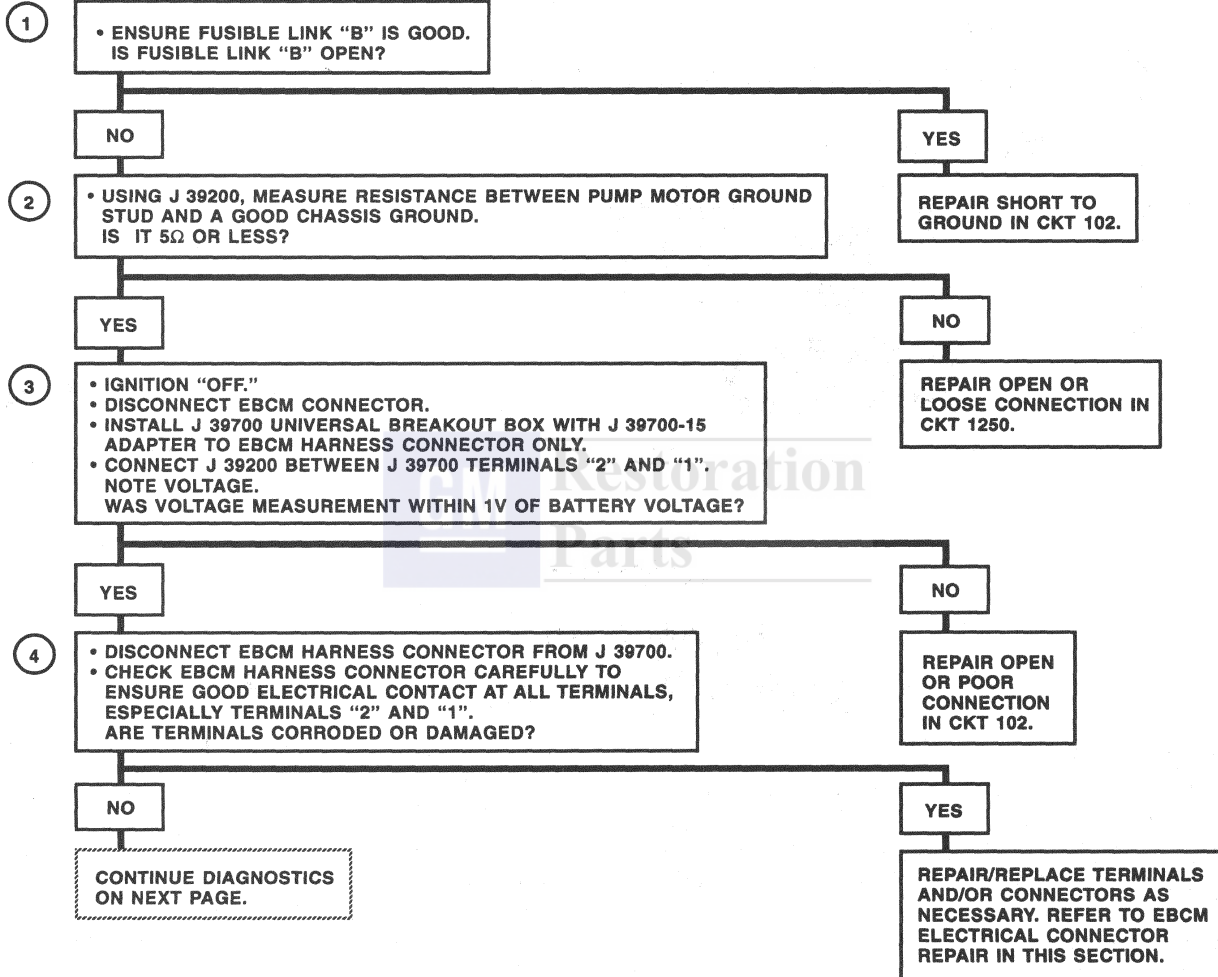
Diagnostic Aids:

All tests using J 39700 Universal Breakout Box terminal "1" are using the terminal as ground. These tests assume that the ground CKT at terminal "1" is good.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

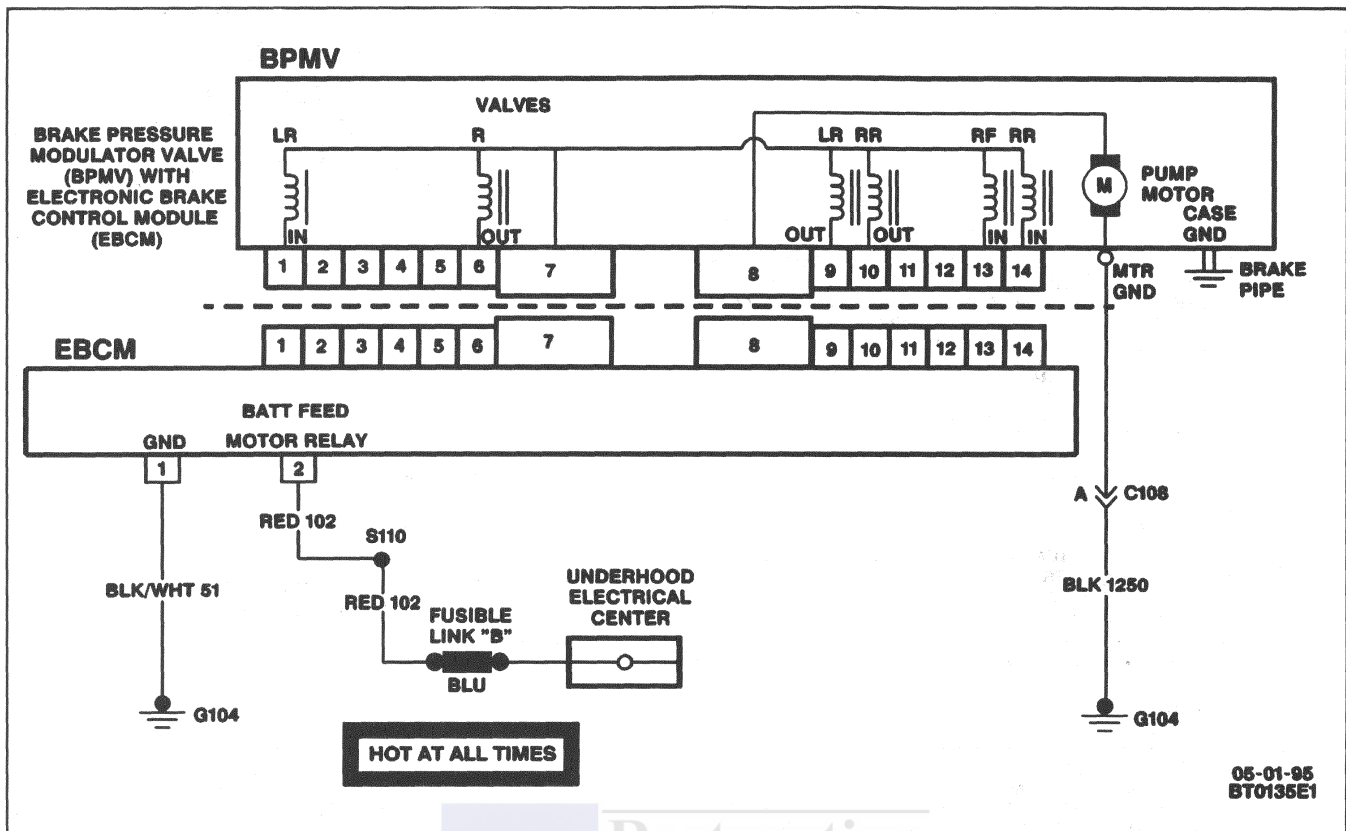
DTC 61
(Page 1 of 2)
BPMV PUMP
MOTOR MALFUNCTION

BEFORE BEGINNING TESTING, ENSURE THAT BATTERY IS FULLY CHARGED, AND THAT CHARGING SYSTEM IS OPERATING PROPERLY IF DISCHARGED BATTERY IS NOTED. REFER TO SECTION 6D1 FOR BATTERY INFORMATION AND/OR SECTION 6D3 FOR CHARGING SYSTEM INFORMATION.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6826



DTC 61

(Page 2 of 2)

BPMV PUMP MOTOR MALFUNCTION

Circuit Description:

When the pump motor relay is grounded by the EBCM, it closes and provides voltage to operate the pump. Once the motor circuit is energized, a "Pump ON" signal is sensed by the EBCM to verify pump operation.

DTC Will Set When:

- Voltage is present at the pump motor without pump motor relay activation from the EBCM.
- Voltage is NOT present at the pump motor within 40 milliseconds after the EBCM requests pump motor relay activation.
- The motor GND circuit is open.
- There is a pump motor malfunction.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks EBCM connector for good retention to EBCM when installed.
6. Checks for condition of EBCM to BPMV connector, and for presence of brake fluid.
7. Checks the integrity of the pump motor and pump motor circuitry internal to the BPMV.
8. Uses the Tech 1 to check for proper operation of the pump motor and associated circuitry.

Diagnostic Aids:

All tests using J 39700 Universal Breakout Box terminal "1" are using the terminal as ground. These tests assume that the ground CKT at terminal "1" is good.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC 61
(Page 2 of 2)
BPMV PUMP
MOTOR MALFUNCTION

DIAGNOSIS CONTINUED
FROM PREVIOUS PAGE.

5

- REMOVE J 39700.
 - RECONNECT EBCM.
- IS CONNECTOR PROPERLY RETAINED TO EBCM WHEN CONNECTED?

YES

NO

6

- IGNITION "OFF."
 - DISCONNECT EBCM CONNECTOR.
 - REMOVE EBCM FROM BPMV.
 - INSPECT EBCM TO BPMV CONNECTOR FOR CONDITIONS WHICH COULD CAUSE INTERMITTENTS SUCH AS DAMAGE, CORROSION, POOR TERMINAL CONTACT, OR PRESENCE OF BRAKE FLUID. REFER TO "INTERMITTENTS AND POOR CONNECTION" IN SECTION 8A-4.
- IS CONNECTOR OK AND CAVITY FREE OR BRAKE FLUID?

REPLACE OR REPAIR
WIRING HARNESS
CONNECTOR OR EBCM
AS NEEDED TO OBTAIN
PROPER CONNECTOR
RETENTION.

YES

NO

7

- INSTALL J 41247 BPMV PINOUT BOX TO BPMV CONNECTOR.
 - USING J 39200, MEASURE RESISTANCE BETWEEN J 41247 TERMINAL "8" AND PUMP MOTOR GROUND STUD.
- IS RESISTANCE .05-10 Ω ?

• CONNECTOR CORROSION OR
DAMAGE: REPLACE BPMV
AND/OR EBCM.
• BRAKE FLUID PRESENT:
REPLACE BPMV AND EBCM.

YES

NO

8

- REMOVE J 41247.
 - RE-INSTALL EBCM TO BPMV.
 - RE-CONNECT EBCM CONNECTOR.
 - IGNITION TO "RUN".
 - PERFORM TECH 1 AUTO TEST.
- DOES PUMP MOTOR RUN?

REPLACE BPMV.

YES

NO

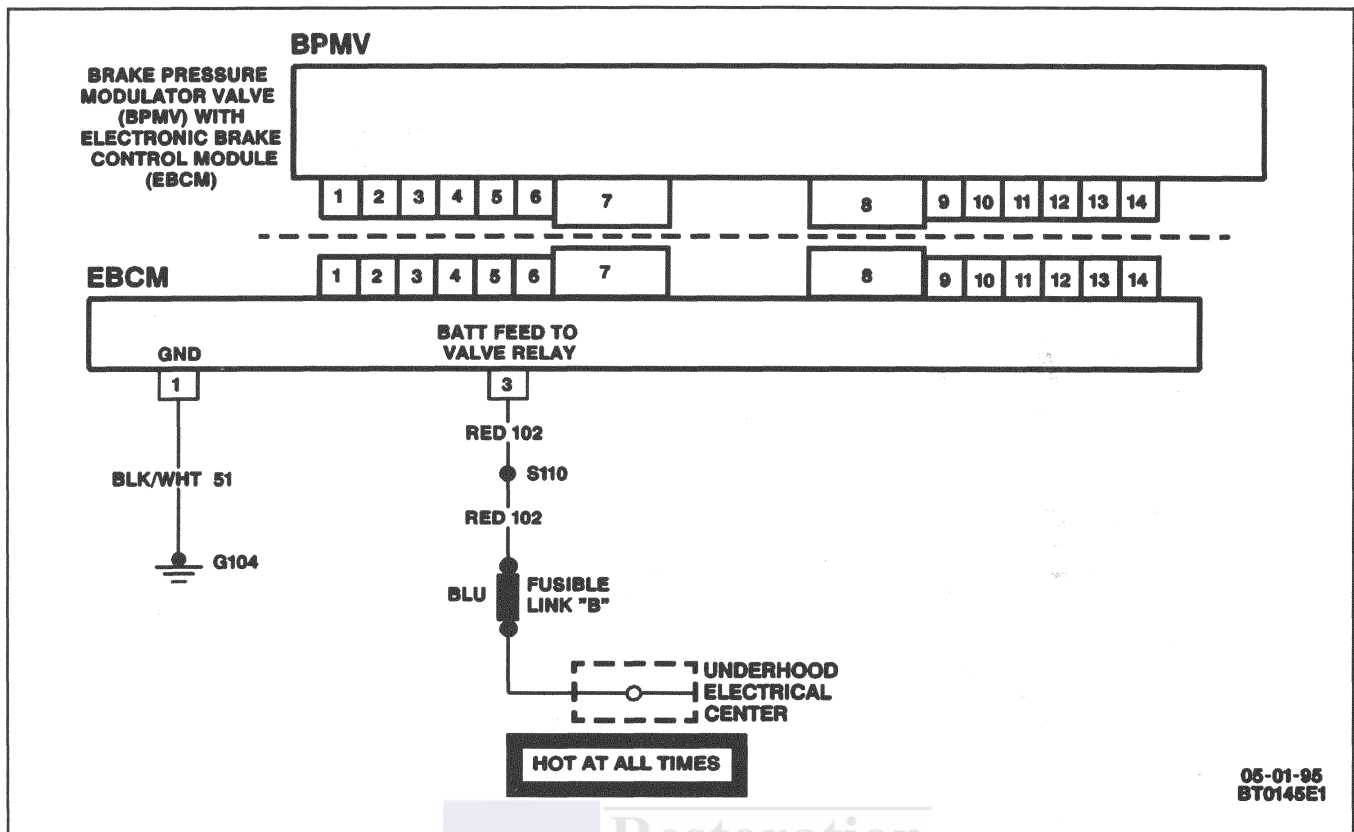
NO TROUBLE FOUND SEE "DIAGNOSTIC
AIDS" ON FACING PAGE.

REPLACE EBCM.

NOTICE: J39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY
RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6827



DTC 63

(Page 1 of 2)

BPMV POWER SUPPLY MALFUNCTION

Circuit Description:

The solenoid valves are supplied voltage from fusible link "B" through the valve relay to operate. The EBCM monitors the valve feed circuit to determine if a valve response to an EBCM activation request is detected.

DTC Will Set When:

- 2 or more valves do not respond to an EBCM request.
- The EBCM senses a discrepancy such as an open or a short to ground in the circuit.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks that Fusible Link "B" feeding the Valve Relay circuit is good.

2. Measures for appropriate voltage from the valve circuit supply voltage.
3. Checks EBCM connector terminals for good contact, i.e., not spread open, backed out of connector, corroded, etc.

Diagnostic Aids:

All tests using J 39700 Universal Breakout Box terminal "1" are using that terminal as ground. These tests assume that the ground at terminal "1" is good.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC 63 (Page 1 of 2) BPMV POWER SUPPLY MALFUNCTION

BEFORE BEGINNING TESTING, ENSURE THAT BATTERY IS FULLY CHARGED, AND THAT CHARGING SYSTEM IS OPERATING PROPERLY IF DISCHARGED BATTERY IS NOTED. REFER TO SECTION 6D1 FOR BATTERY INFORMATION AND/OR SECTION 6D3 FOR CHARGING SYSTEM INFORMATION.

1

- ENSURE FUSIBLE LINK "B" IS GOOD. IS FUSIBLE LINK "B" OPEN?

NO

YES

REPAIR SHORT TO GROUND IN CKT 102.

2

- IGNITION "OFF."
- DISCONNECT EBCM CONNECTOR.
- INSTALL J 39700 UNIVERSAL BREAKOUT BOX WITH J 39700-15 ADAPTER TO EBCM HARNESS CONNECTOR ONLY.
- CONNECT J 39200 BETWEEN J 39700 TERMINALS "3" AND "1". NOTE VOLTAGE.
- WAS VOLTAGE MEASUREMENT WITHIN 1V OF BATTERY VOLTAGE?

YES

NO

3

- DISCONNECT EBCM HARNESS CONNECTOR FROM J 39700.
- CHECK EBCM HARNESS CONNECTOR CAREFULLY TO ENSURE GOOD ELECTRICAL CONTACT AT ALL TERMINALS, ESPECIALLY TERMINALS "3" AND "1". ARE TERMINALS CORRODED OR DAMAGED?

REPAIR OPEN OR POOR CONNECTION IN CKT 102.

NO

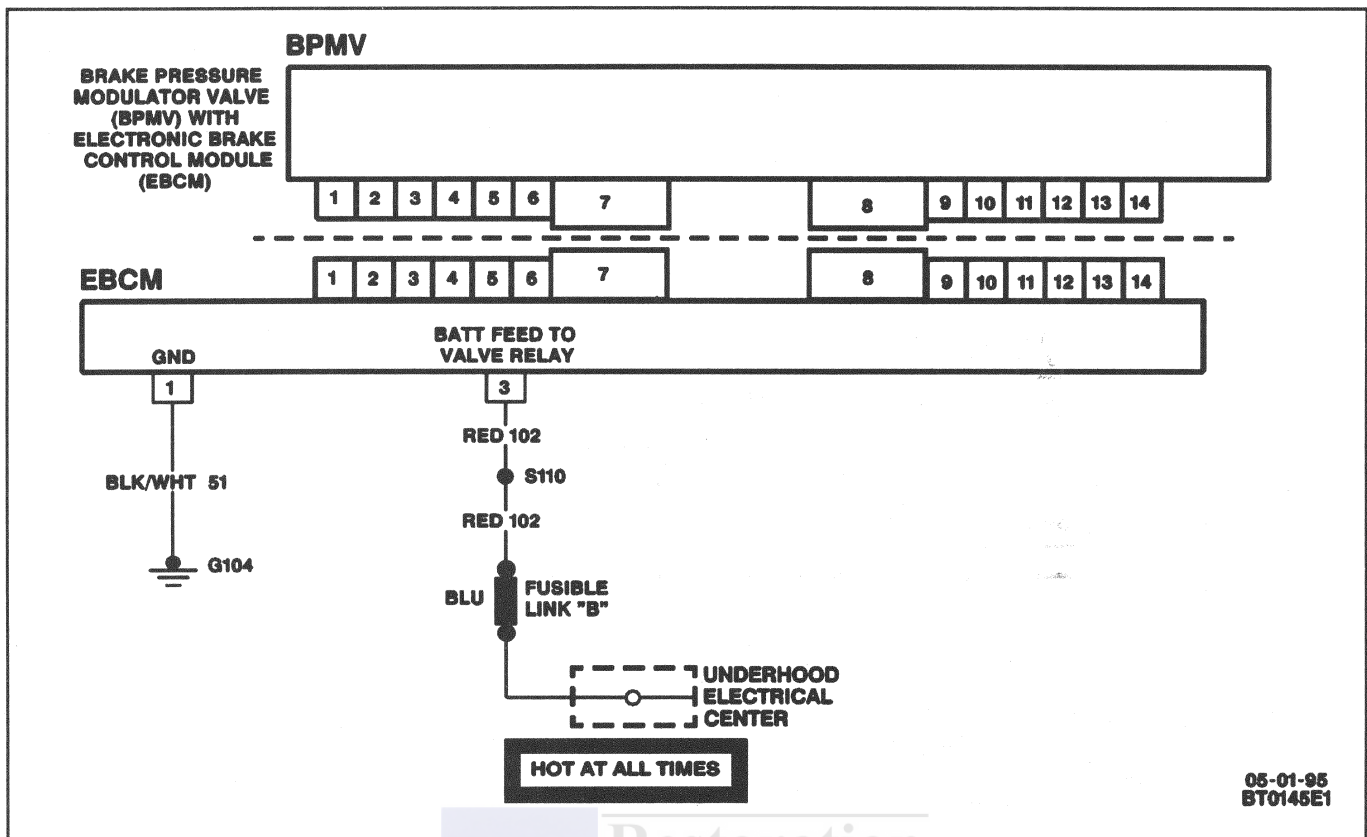
YES

CONTINUE DIAGNOSTICS ON NEXT PAGE.

REPAIR/REPLACE TERMINALS AND/OR CONNECTOR AS NECESSARY. REFER TO EBCM ELECTRICAL CONNECTOR REPAIR IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C6828



DTC 63

(Page 2 of 2)

BPMV POWER SUPPLY MALFUNCTION

Circuit Description:

The solenoid valves are supplied voltage from fusible link "B" through the valve relay to operate. The EBCM monitors the valve feed circuit to determine if a valve response to an EBCM activation request is detected.

DTC Will Set When:

- 2 or more valves do not respond to an EBCM request.
- The EBCM senses a discrepancy such as an open or a short to ground in the circuit.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

4. Checks condition of EBCM to BPMV connector, and for presence of brake fluid.

5. Checks EBCM connector for good retention to EBCM when installed.
6. Ensures DTC does not reset due to a malfunctioning EBCM.

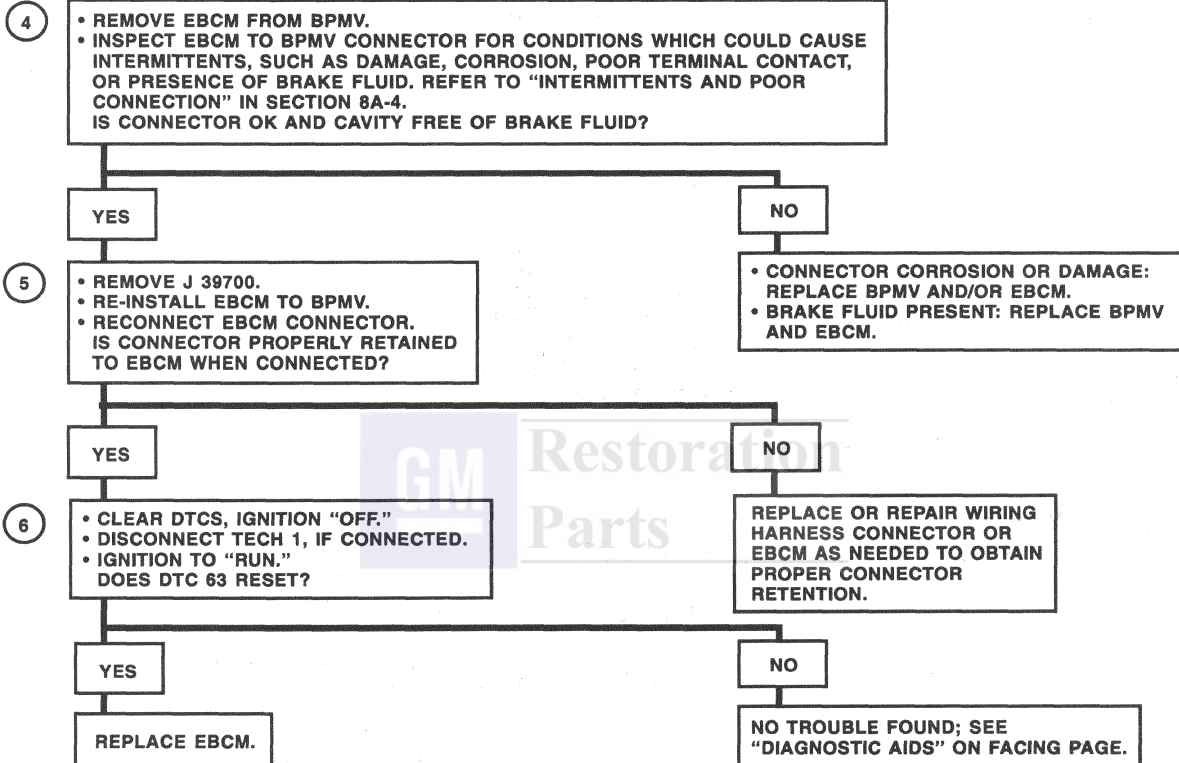
Diagnostic Aids:

All tests using J 39700 Universal Breakout Box terminal "1" are using that terminal as ground. These tests assume that the ground at terminal "1" is good.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

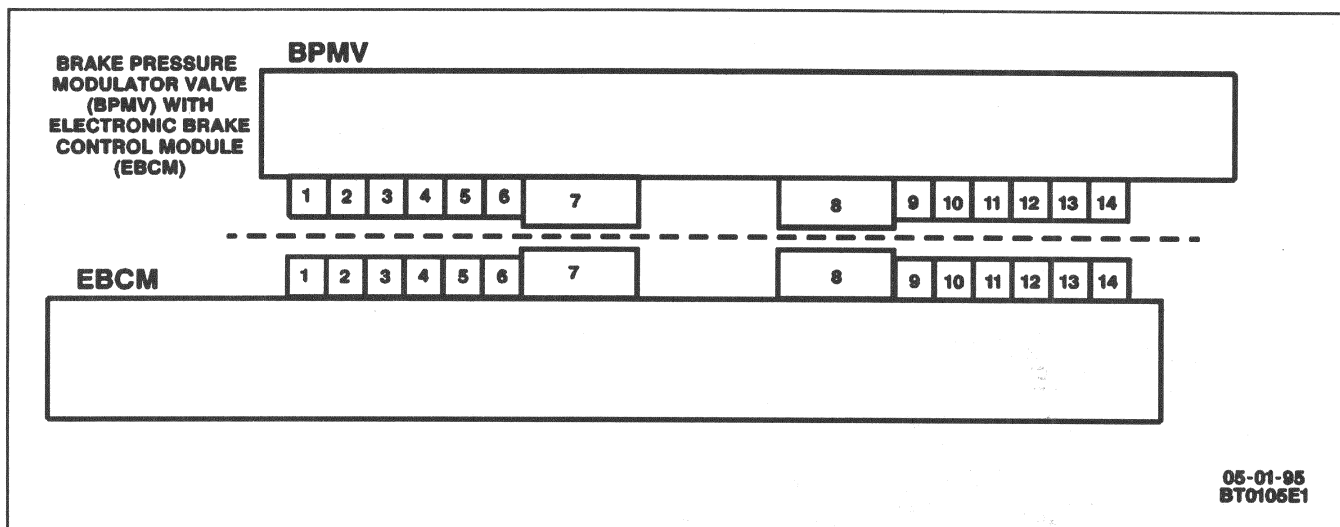
DTC 63
(Page 2 of 2)
**BPMV POWER SUPPLY
MALFUNCTION**

DIAGNOSTICS CONTINUED
FROM PREVIOUS PAGE



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C8436



DTC 71 EBCM INTERNAL MALFUNCTION

Circuit Description:

The EBCM performs various self diagnostics that can detect an internal malfunction within the module. If it detects a malfunction, DTC 71 will set.

DTC Will Set When:

- The EBCM finds an internal malfunction during self diagnostics.

Action Taken:

The "ABS" lamp will be "ON." ABS is disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for good connections from the harness to the EBCM itself.

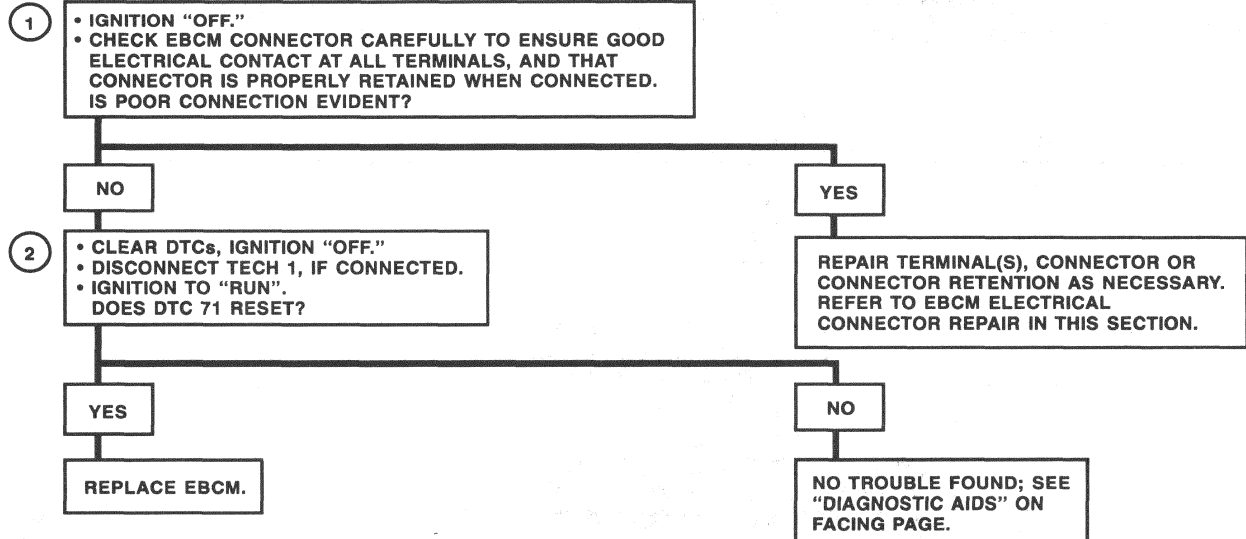
2. Checks to see if the malfunction was false. If DTC 71 resets, replace the EBCM.

Diagnostic Aids:

All tests using J 39700 Universal Breakout Box terminal "1" are using that terminal as ground. these tests assume that the ground at terminal "1" is good.

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis causing part replacement with reappearance of the malfunction.

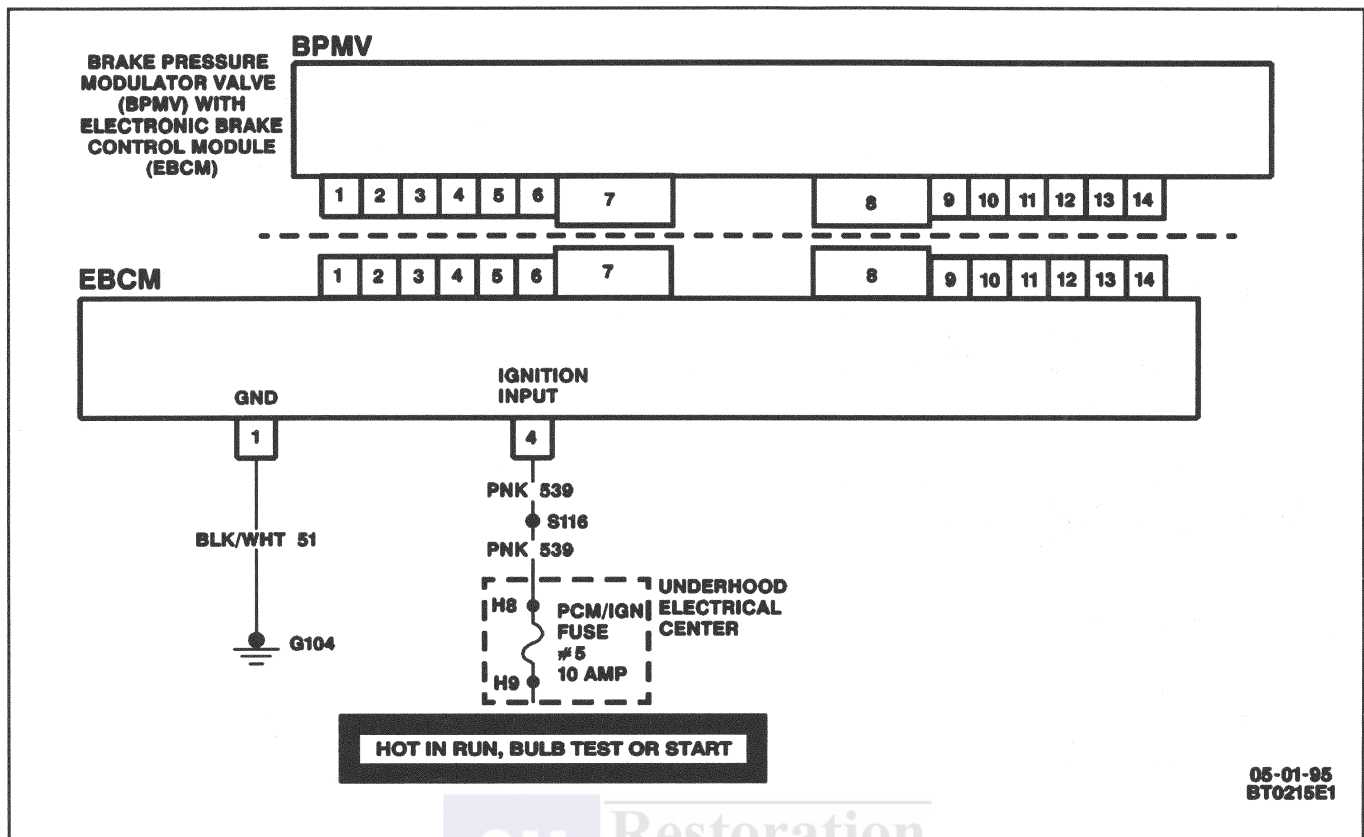
DTC 71 EBCM INTERNAL MALFUNCTION



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C10113

5E1-52 ANTILOCK BRAKE SYSTEM (ABS)



DTC 85 LOW VOLTAGE

Circuit Description:

The EBCM requires a certain minimum voltage to operate properly. It monitors the ignition feed circuit to determine if voltage falls below a minimum level.

DTC Will Set When:

- The EBCM operating voltage falls below 9.4 volts out of ABS control, 8.8 volts during ABS control and the low voltage is detected for more than 500 milliseconds with the vehicle speed above 6 km/h (3.6 mph).

Action Taken:

The ABS valves are switched passive, which prevents a possible pump start-up and the "ABS" lamp will be "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

- Checks that PCM/IGN fuse feeding the EBCM ignition circuit is good.

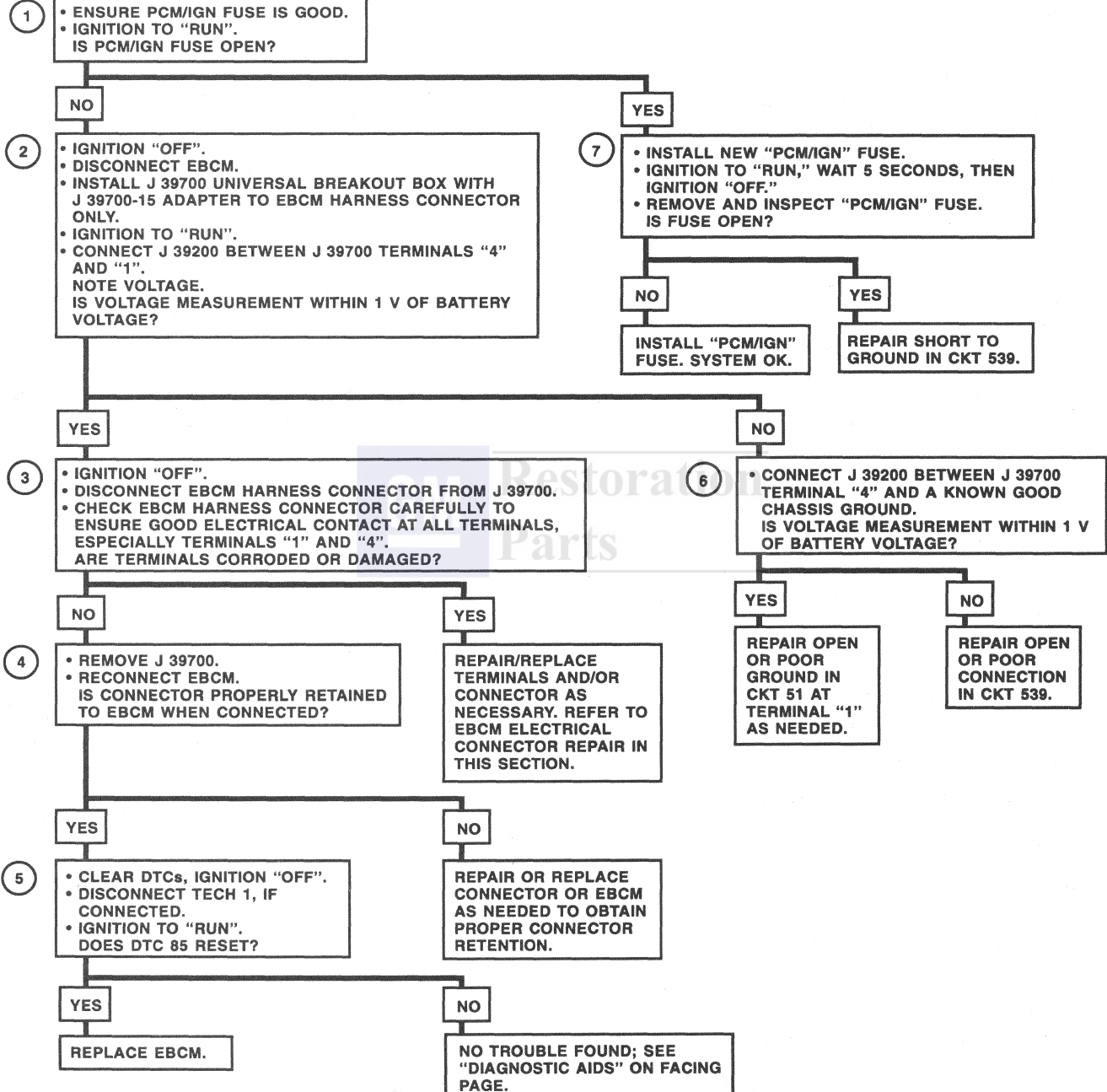
- Measures for appropriate voltage from the EBCM ignition circuit.
- Checks EBCM connector terminals for good contact, i.e., not spread open, backed out of connector, corroded, etc.
- Checks EBCM connector for good retention to EBCM when installed.
- Checks for DTC reset after other portions of the system have tested OK.
- Determines if a malfunction found in step 2 is due to an open or poor connection in the EBCM ignition feed CKT 539, or poor ground in CKT 51.
- Checks whether the fuse failure is due to a short to ground.

Diagnostic Aids:

It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.

DTC 85 LOW VOLTAGE

BEFORE BEGINNING TESTING, ENSURE THAT BATTERY IS FULLY CHARGED, AND THAT CHARGING SYSTEM IS OPERATING PROPERLY IF DISCHARGED BATTERY IS NOTED. REFER TO SECTION 6D1 FOR BATTERY INFORMATION AND/OR SECTION 6D3 FOR CHARGING SYSTEM INFORMATION.



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTCs AND VERIFY PROPER OPERATION.

C8435

ON-VEHICLE SERVICE**GENERAL SERVICE PRECAUTIONS**

NOTICE: The following are general precautions which should be observed when servicing the antilock brake system and/or other vehicle systems. Failure to observe these precautions may result in antilock brake system damage. See "CAUTIONS" and "NOTICES" on page 5E1-1.

- Before performing electric welding procedures, unplug the EBCM harness connector.
- Always carefully note the routing, position, mounting and location of ABS wiring, connectors, clips, brackets, etc. ABS components are extremely sensitive to Electro-Magnetic Interference (EMI). Proper mounting is critical when servicing ABS components.
- Do not use a quick charger for engine starting or for battery charging if the battery is still connected to the vehicle's electrical system. Failure to observe this precaution may cause the brake fuse to open or cause serious damage to other electrical components. Always disconnect the battery negative cable when charging a battery.
- Never disconnect the battery from the electrical system with the engine running.
- When disconnecting the EBCM connector, the ignition switch must be in the "OFF" position.
- Do not hang the suspension components by the wheel speed sensor cables, cable damage may result.
- Do not force the wheel speed sensors into place. The sensors are to be pushed in by hand only.
- During painting work, the EBCM may be subjected to a maximum of 95°C (203°F) for brief periods and a maximum of 85°C (184°F) for lengthy periods (about two hours).
- Many components of the Antilock Brake System are non-serviceable and must be replaced as assemblies. Do not disassemble any component which is designated as non-serviceable in this section.
- When filling the master cylinder, use only Supreme 11 (GM 1052542) or equivalent DOT 3 brake fluid. Do not use a container which has been used for petroleum based fluids, or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system, and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination.
- After replacement of the Brake Pressure Modulator Valve (BPMV), EBCM wheel speed sensors, wiring harness, or other work involving the ABS system, the entire ABS system must be checked using the Tech 1 Diagnostic Tester. Refer to "Diagnosis" in this section.

The above precautions are not exhaustive and are to be followed when working on an ABS equipped vehicle. Become familiar with the ABS and how it may be interrelated to other components on the vehicle when performing service work.

NOTICE: Do not use lubricated compressed air on brake parts as damage to rubber components may result.

? Important

- Replace all components included in repair kits used to service this system.
- Lubricate rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system. The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.
- Use of tire sizes other than those recommended may result in a reduction in the optimal performance of the antilock brake system and possibly set a wheel speed DTC.

FILLING MASTER CYLINDER RESERVOIRS

Refer to section 5A for information on filling master cylinder reservoirs.

BLEEDING BRAKE HYDRAULIC SYSTEM

Refer to section 5 for information on manual and pressure bleeding procedures. If desired brake pedal height results are not achieved, perform Auto Bleed Procedure outlined in this section.

Auto Bleed Procedure

The Auto Bleed Procedure is used to provide a complete brake system bleed on Bosch 5 equipped vehicles. The procedure cycles the system valves and runs the pump to purge air from secondary circuits normally closed off during non-ABS/TCS mode operation and bleeding. It is to be used when it is suspected that air has been ingested into the system secondary circuits, or when the Brake Pressure Modulator Valve (BPMV) has been replaced with a new unit.

To perform this procedure successfully, the following are required:

- Tech One Scan Tool with MSC
- A pressure brake bleeder capable of producing at least 30 psi. with suitable adapters and filled with Delco Supreme 11 brake fluid obtained from a sealed container.
- A hoist, or suitable stands to support vehicle.
- A bleeder bottle to receive vented brake fluid. The bottle should be constructed of unbreakable plastic, and should have a clear plastic hose sized to fit snugly on the bleeder valves. The hose should protrude into the bottle, with its end immersed in brake fluid.
- An assistant to pump the brake pedal during the procedure.
- Suitable safety attire, including safety glasses.

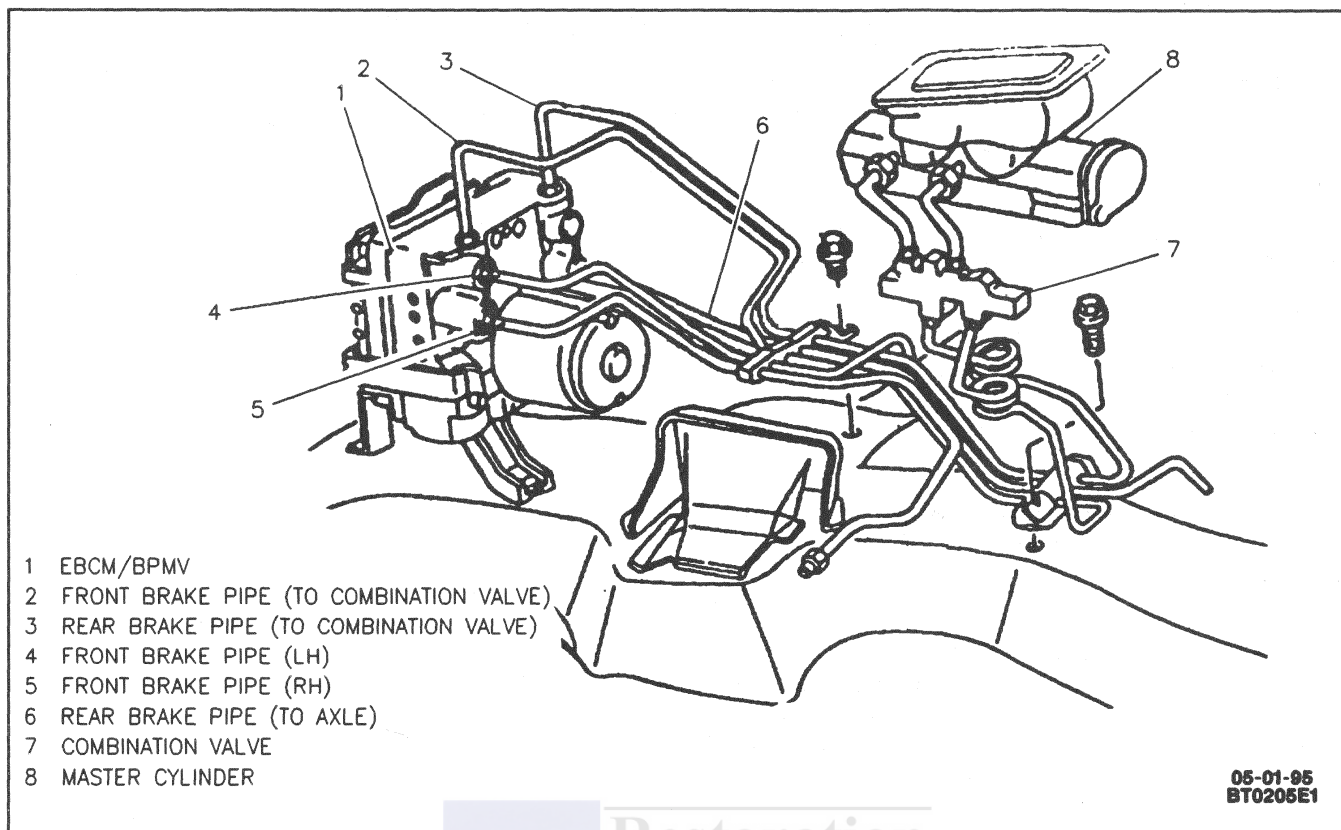


Figure 2-Brake Pipe location

BLEED INSTRUCTIONS

! Important

The Auto Bleed Procedure may be terminated at any time during the process by pressing the "EXIT" button. No further Tech One prompts pertaining to the Auto Bleed procedure will be given. After pressing "EXIT", relieve bleed pressure and disconnect bleed head from master cylinder, following bleed equipment manufacturers instructions.

1. Raise vehicle and support. Refer to GENERAL INFORMATION (Sect. 0A)
2. Remove all four wheels.
3. Inspect brake system for leaks or component damage. Correct all conditions found before starting procedure.
4. Assure vehicle battery is fully charged before beginning procedure.
5. Connect Tech One to DLC.
6. Turn Ignition to "RUN", do not start engine.
7. Establish communications with Tech One and select ABS/TCS system features.
8. Press "F4: Misc. Tests"
9. Select "Automated Bleed Procedure."
10. Bleed base brake system as instructed in GENERAL BRAKES (Sect. 5).
11. Press "UP" button. This conducts several tests which determine whether the ABS/TCS system condition is such that the bleed procedure can be performed. If any malfunctions are detected, the

bleed procedure will be aborted. If DTCs are present, the Tech One will display "DTCs PRESENT", or list the DTCs, depending on when the DTCs were set. DTCs can be displayed or cleared as appropriate in the "F2: Trouble Codes" mode. Refer to correct Service Manual section for those DTCs. If test is aborted but no DTCs are listed, go to the "ABS Diagnostic System Check" in this section. Correct all system malfunctions before attempting the bleed procedure again. If a road test is required for diagnosis and brake pedal is "spongy", perform a conventional brake bleed, achieving a firm pedal before driving vehicle.

12. Connect pressure bleed equipment described earlier, following manufacturer's instructions. Press "UP" button.
13. Apply bleed pressure, minimum 30 psi. Check for leaks at master cylinder reservoir bleeder cap and correct, if necessary.
14. Have assistant pump brake pedal continuously from this point on, making long, steady strokes. Press "UP".
15. Open left rear bleeder screw, use bleeder bottle. Press "ENTER" when prompted.
16. Close left rear bleeder screw when prompted. Press "UP" button.
17. Left rear bleed complete.
 - Repeat steps 15 through 17 on the right rear brake.
18. Open right front bleeder screw, use bleeder bottle. Press "ENTER".

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19. Have assistant pump brake pedal continuously, making long, steady strokes. Press "UP".
20. Close right front bleeder screw when prompted. Press "UP" button.
21. Right front bleed complete.
 - Repeat steps 18 through 21 on the left front brake.

At this time, the Tech One performs several tests to re-verify system operation. The Tech One does not verify bleed success. If any malfunctions are detected, relieve bleed pressure and disconnect bleed equipment, following manufacturer's instructions. If DTCs are present, the Tech One will display them. DTCs can be cleared in the "F2: Trouble Codes" mode. Press "EXIT" to return to Tech One main menu. Refer to correct Service Manual section for DTCs found. If test is aborted but no DTCs are listed, go to the "ABS Diagnostic System Check" in this section. Correct all system malfunctions before attempting to repeat the bleed procedure.

22. If screen displays "BLEED PROCEDURE COMPLETE", press "UP" button.
23. Release bleed pressure, following bleed equipment manufacturer's instructions. Press "UP" button.
24. Disconnect bleed equipment. Clean up any spilled brake fluid by wiping up as much as possible, then flushing area with water. Do not allow any water to enter master cylinder reservoir. Press "EXIT".
25. Depress brake pedal. It should be high and firm. If not, re-inspect brake system thoroughly for any conditions which could cause excess brake pedal travel. See Section 5 for details. If brake system is OK, and excess pedal travel persists, repeat Auto Bleed Procedure.
26. Turn ignition "Off."
27. Disconnect Tech 1. Reinstall wheels and tires and lower vehicle. Check brake fluid level in reservoir and fill if necessary. Road test vehicle, making several ABS actuations in a suitable area. Brake pedal should remain high and firm after road test.

HYDRAULIC COMPONENTS

NOTICE: The use of rubber hoses or parts other than those specified for the ABS may lead to functional problems requiring major overhaul.

Brake Pressure Modulator Valve (BPMV)

Figure 2, 3

CAUTION: The brake pressure modulator valve must not be repaired, the complete unit must be replaced. No screws on the brake pressure modulator valve may be loosened. If screws are loosened, it will not be possible to get the brake circuits leak-tight, and personal injury may result.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 6D1.



Remove or Disconnect

1. Battery negative cable.
2. Air intake duct and resonator assembly. refer to SECTION 6E3.
3. EBCM electrical connector
 - Unlock tab before removing connector.
4. BPMV motor ground cable connector.
5. EBCM insulators and three EBCM/BPMV assembly to bracket nuts.
6. Five brake pipes from BPMV.
 - Plug pipes to prevent loss of fluid and entrance of dirt.



Important

- Note location of brake pipes for aid during installation.
7. BPMV from vehicle.
 8. EBCM (as outlined in this section).
 - Transfer ground cable (if replacing BPMV).



Tighten

- Nut to 2.8 N.m (25lb. In.).

NOTICE: When removing the BPMV, protect vehicle exterior from possible brake fluid spillage.



Important

- Reposition brake pipes only as necessary to remove BPMV. Excessive bending of brake pipes may damage them.



Clean

- Any brake fluid spillage from the BPMV.



Install or Connect

NOTICE: See "Fasteners Notice" on page 5E1-1.

1. EBCM to BPMV.



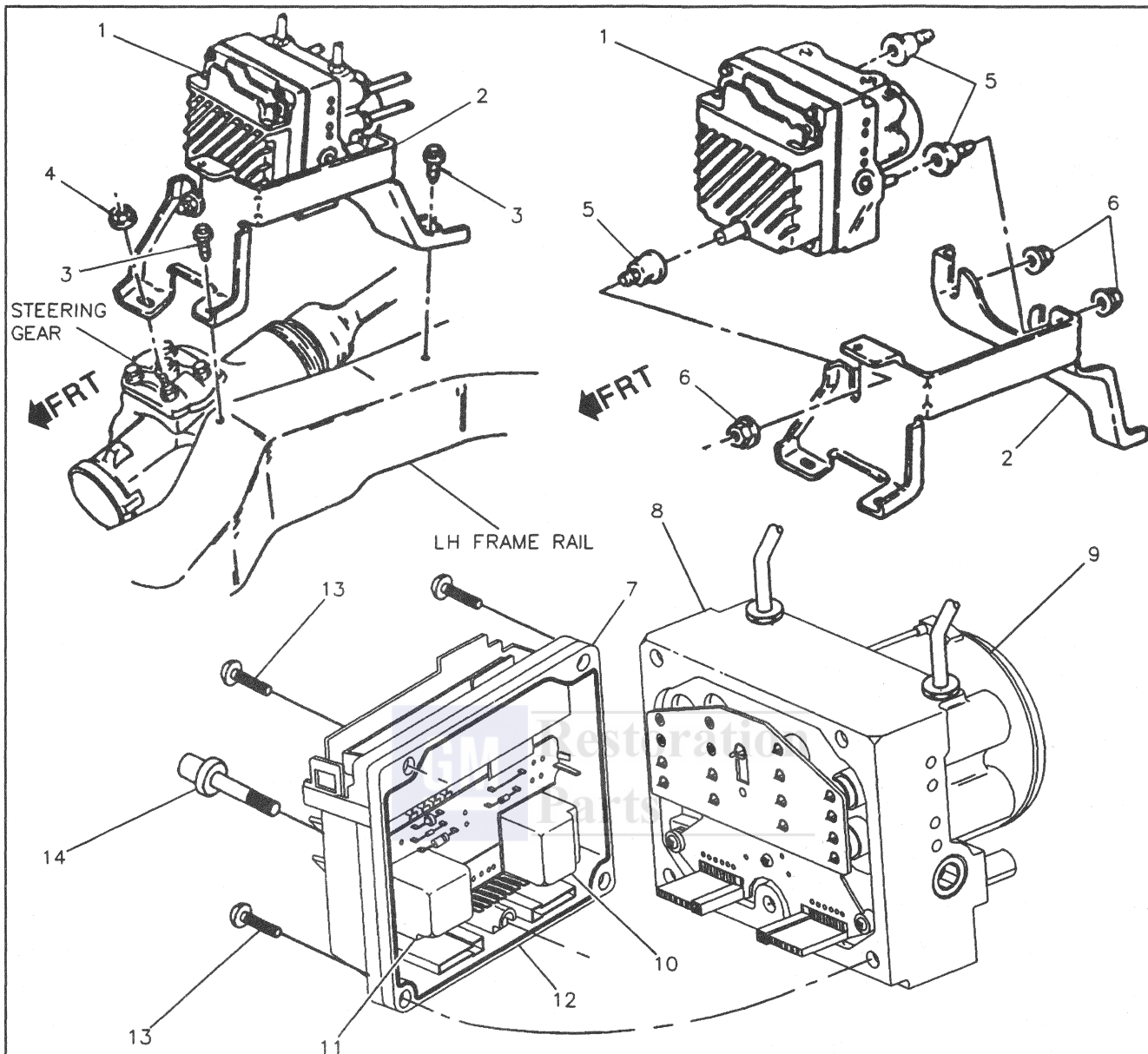
Tighten

- Four mounting bolts to 2.6 N.m (23 lb. in.). Insulator bolt to 15 N.m (11 lb. ft.).
2. Position EBCM/BPMV assembly in bracket and install insulators and bracket nuts.



Tighten

- Three nuts to 10 N.m (89 lb. In.).
3. If a new BPMV is being installed, remove shipping plugs from valve openings.



- 1 EBCM/BPMV
- 2 EBCM/BPMV MOUNTING BRACKET
- 3 BRACKET MOUNTING BOLT
- 4 EBCM/BPMV BRACKET TO STEERING GEAR NUT
- 5 EBCM/BPMV MOUNTING INSULATOR
- 6 EBCM/BPMV TO BRACKET NUT
- 7 ELECTRONIC BRAKE CONTROL MODULE (EBCM)
- 8 BRAKE PRESSURE MODULATOR VALVE (BPMV)
- 9 PUMP MOTOR (NOT SERVICEABLE, INTEGRAL TO BPMV)
- 10 VALVE RELAY (NOT SERVICEABLE, INTEGRAL TO EBCM)
- 11 PUMP MOTOR RELAY (NOT SERVICEABLE, INTEGRAL TO EBCM)
- 12 EBCM SEAL
- 13 EBCM TO BPMV BOLT
- 14 INSULATOR MOUNTING BOLT

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Figure 3-EBCM/BPMV assembly

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CAUTION: Make sure brake pipes are correctly connected to brake pressure modulator valve. If brake pipes are switched by mistake (inlet vs. outlet) wheel lockup will occur and personal injury may result. The only two ways this condition can be detected are by using the Tech 1, or during an ABS event.

4. 5 Brake pipes to BPMV.

Important

- Use locations noted during removal.

Tighten

- Brake pipe Fittings at BPMV to 16 N.m (12 lb. Ft).
5. Pump motor ground cable connector.
 6. EBCM electrical connector.
 - Lock tab.
 7. Air intake duct and resonator assembly.
 8. Battery negative cable.
 9. Fill and bleed brake hydraulic system. Refer to SECTION 5.
 10. Perform ABS Diagnostic System Check. Refer to "Diagnosis" in this section.

Brake Pressure Modulator Valve (BPMV) Bracket

Figure 3

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 6D1.

Remove or Disconnect

1. BPMV from bracket. Refer to BPMV removal in this section.
 - Position assembly inboard far enough to gain access to bracket.

CAUTION: Be careful not to damage brake pipes.

2. Nut attaching bracket to steering gear.
3. Two bolts/screws attaching bracket to frame.
4. Bracket

Install or Connect

NOTICE: See "Fasteners Notice" on page 5E1-1.

1. Bracket
2. Two bolts/screws attaching bracket to frame.

Tighten

- Two bolts/screws to 24 N.m (18 lb. ft.).
3. Nut attaching bracket to steering gear.

Tighten

- Nut to 24 N.m (18 lb. ft.)
4. Reposition EBCM/BPMV assembly in bracket and attach. Refer to BPMV installation in this section.

ELECTRONIC BRAKE CONTROL MODULE (EBCM)

Figure 3

NOTICE: Always connect or disconnect the wiring harness from the EBCM with the ignition switch in the "OFF" position.

Important

- The EBCM cannot be repaired. It must be replaced as an assembly, if faulty.

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 6D1.

1. Battery negative cable.
2. Air intake duct resonator assembly. Refer to section 6E3.
 - Clean EBCM/BPMV assembly to prevent dirt intrusion.
3. Loosen and move wire harness from bracket.
4. EBCM electrical connector.
 - Unlock tab before removing connector.
5. EBCM/BPMV assembly-to-bracket nuts.
 - Remove EBCM mounting insulator.
6. Brake pipe clip bolt downstream from EBCM/BPMV assembly.
 - Lift EBCM/BPMV assembly and support with wood block.
7. 4 EBCM to BPMV bolts.
8. Front insulator mounting bolt.
9. EBCM from BPMV.

Important

- Be careful not to damage EBCM seal or flex lead on solenoid valves in the BPMV by prying. If BPMV seal area, or connector is damaged from removal, replace BPMV.
10. Inspect for brake fluid and/or corrosion in EBCM/BPMV cavity.

Install or Connect

NOTICE: See "Fasteners Notice" on page 5E1-1.

1. EBCM to BPMV.

Tighten

- Four EBCM to BPMV bolts to 2.6 N.m (23 lb. in.). Insulator mounting bolt to 15 N.m (11 lb. ft.).

2. Remove wood block and position EBCM/BPMV assembly in bracket.
3. Brake clip bolt downstream from EBCM/BPMV assembly.
4. Install mounting insulators, (if removed) and EBCM/BPMV assembly-to-bracket nuts.

Tighten

- Nuts to 10 N.m (89 lb. in.)
5. EBCM electrical connector.
 - Lock tab.
 6. Wire harness to bracket.
 7. Air intake duct and resonator assembly.
 8. Battery negative cable.
 9. Perform ABS Diagnostic System Check. Refer to "Diagnosis" in this section.

WHEEL SPEED SENSORS

Figures 4,5,6,&7

Right or Left Front Wheel Speed Sensor

Figure 4 and 5

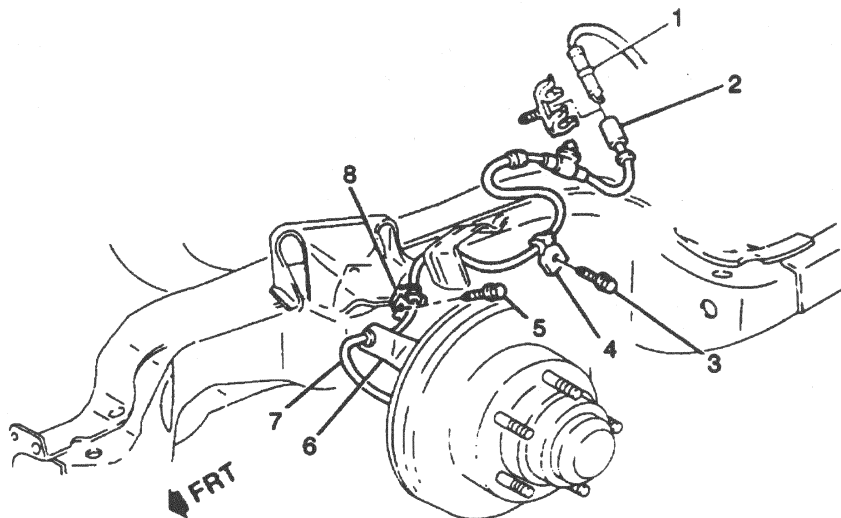
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

2. Left-hand or right-hand body harness connector and wheel speed sensor connector from clip.
3. Left-hand or right-hand body harness connector from wheel speed sensor connector.
4. Bolt/screw and bracket from frame rail.
5. Wheel speed sensor with grommets from brackets and if removing right-hand wheel speed sensor, brake pipe clip.
 - Note position of grommets and harness routing for installation.
6. Sensor retaining bolt/screw.
7. Front wheel speed sensor from steering knuckle.

Inspect

- Sensor face for accumulation of metallic particles, dirt, grease or other contaminants. Clean sensor face as required.
- Sensor face should show no evidence of damage or contact with the toothed sensor ring. If damage is noted, determine the cause and correct. Replace sensor if damage interferes with proper operation.



- 1 CONNECTOR, BODY HARNESS
- 2 CONNECTOR, WHEEL SPEED SENSOR
- 3 BOLT/SCREW, FRONT WHEEL SPEED SENSOR WIRE BRACKET
- 4 BRACKET, WHEEL SPEED SENSOR WIRE
- 5 BOLT/SCREW, WHEEL SPEED SENSOR WIRE BRACKET
- 6 BRACKET, WHEEL SPEED SENSOR WIRE
- 7 SENSOR, FRONT WHEEL SPEED
- 8 BRACKET, FRONT WHEEL SPEED SENSOR WIRE

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Figure 4-front Wheel Speed Sensor

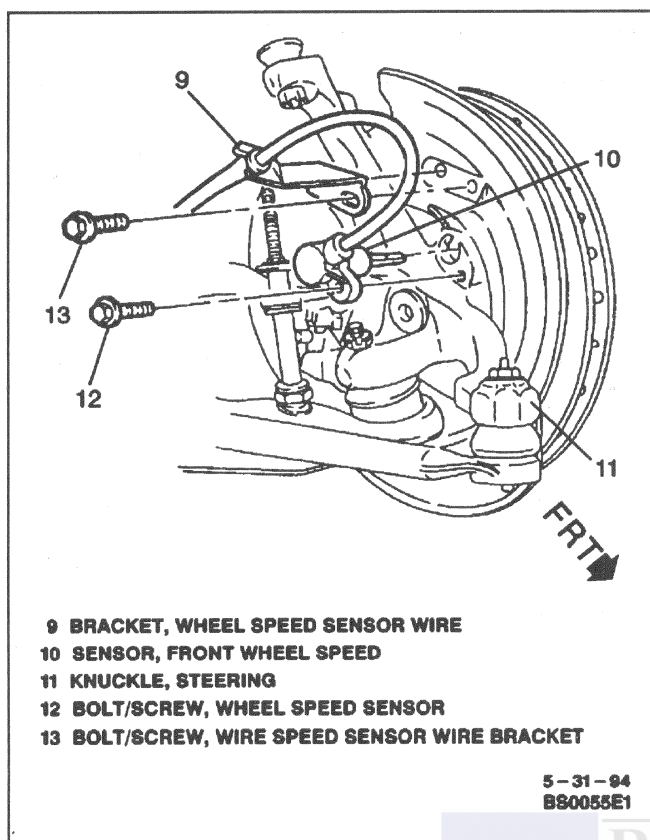


Figure 5—Front Wheel Speed Sensor (Typical)

Install or Connect

NOTICE: The wheel speed sensors are a tight fit into the knuckle and are to be pushed in by hand. DO NOT force the sensors into position. There are two individual wheel speed sensors that must be installed in their respective locations. Each replacement wheel speed sensor is identified with a white tag, located near the neck of the sensor and labeled L (left) or R (right) or a white letter on the wire. The wheel speed sensors must be given an anticorrosion coating before installation to prevent corrosion. Do not use grease. Use sealer, GM P/N 12345489 or equivalent.

NOTICE: See “fasteners Notice” on page 5E1-1.

1. Front wheel speed sensor into steering knuckle.
2. Sensor retaining bolt/screw.

Tighten

- Bolt/screw to 8 N·m (71 lb. in.).
3. Wheel speed sensor with grommets to brackets, and if installing right-hand wheel speed sensor brake pipe clip.

Important

- Proper installation of wheel speed sensor wire is critical to continued system operation. Be sure that the wire is installed in brackets. Failure to install the wire in brackets as shown in this section may result in contact with moving parts, spark plug wires, and/or over extension of the wire, resulting in circuit damage.

4. Bracket and bolt/screw to frame rail.

Tighten

- Bolt/screw to 10 N·m (89 lb. in.).
5. Wheel speed sensor connector to body harness connector.
 6. Wheel speed sensor connector and body harness connector into clip.
 7. Lower vehicle.
 8. Perform ABS Diagnostic System Check. Refer to “Diagnosis” in this section.

Front Wheel Speed Sensor Ring

The front wheel speed sensor ring is an integral part of the front brake rotor. The sensor ring is accessible for inspection by removing the brake rotor.

If sensor ring replacement is required, the brake rotor must be replaced. For brake rotor service procedures, refer to SECTION 5B1.

Important

- Inspect toothed sensor rings for missing or cracked teeth. Missing or damaged teeth can result in poor sensor signals.
- Toothed sensor rings should show no evidence of contact with the wheel speed sensor. If contact is observed, determine cause and correct.
- Excessive runout of the sensor ring can cause erratic wheel speed sensor signals. Replace the toothed sensor ring if runout exceeds approximately 0.25 mm (0.010 inch).

Rear Wheel Speed Sensor

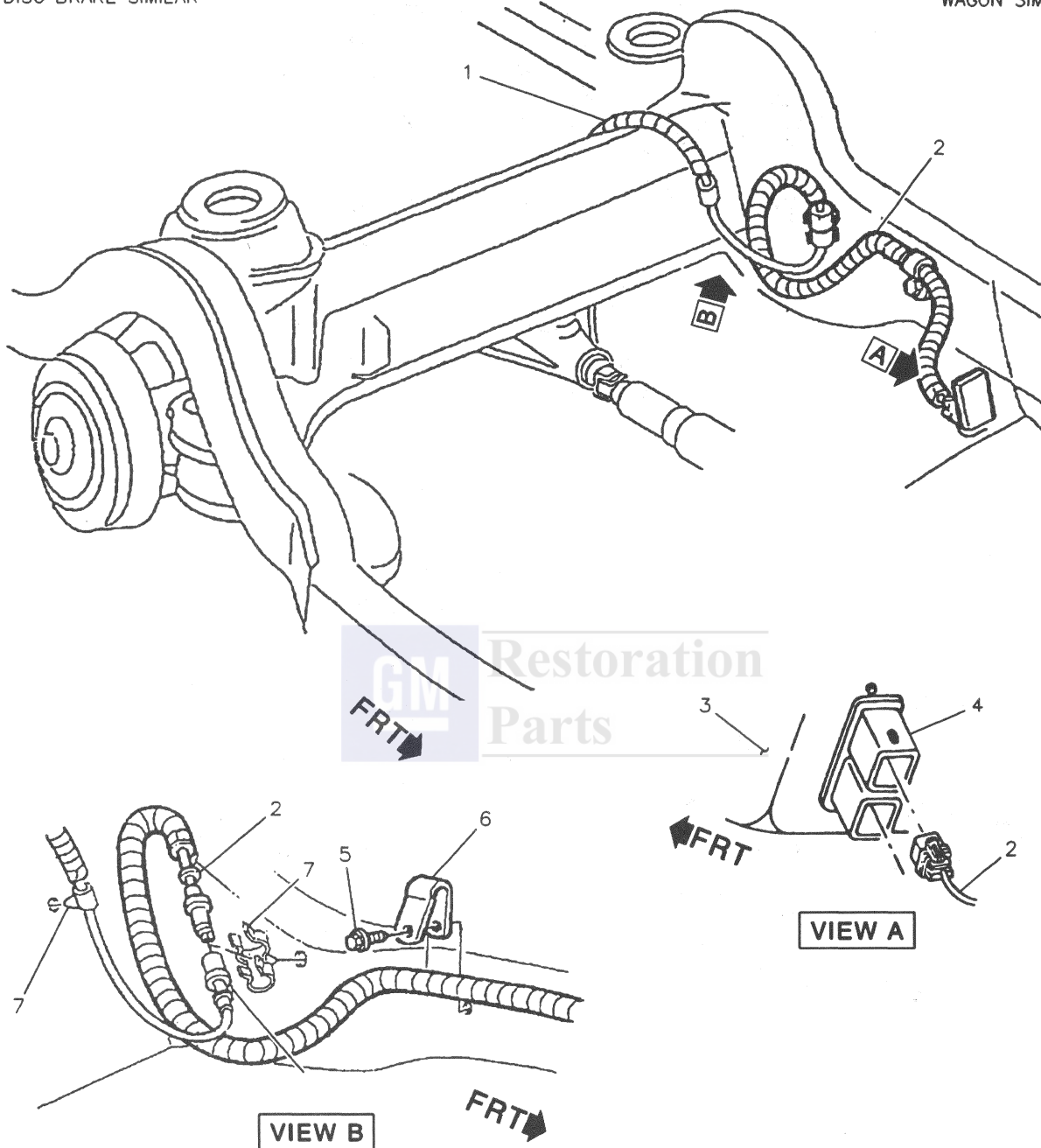
Figures 6 and 7

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Wheel speed sensor connector from electronic brake control wiring harness connector.
 - Unclip connectors from clip and separate.
3. Wiring harness with grommets from brackets.
 - Note position of grommets and harness routing for installation.
4. Bolt/screw and bracket from rear axle housing if removing rear axle.
5. Sensor retaining bolt/screw.
6. Rear wheel speed sensor from rear axle housing.

DRUM BRAKE SHOWN
DISC BRAKE SIMILAR

SEDAN SHOWN
WAGON SIMILAR

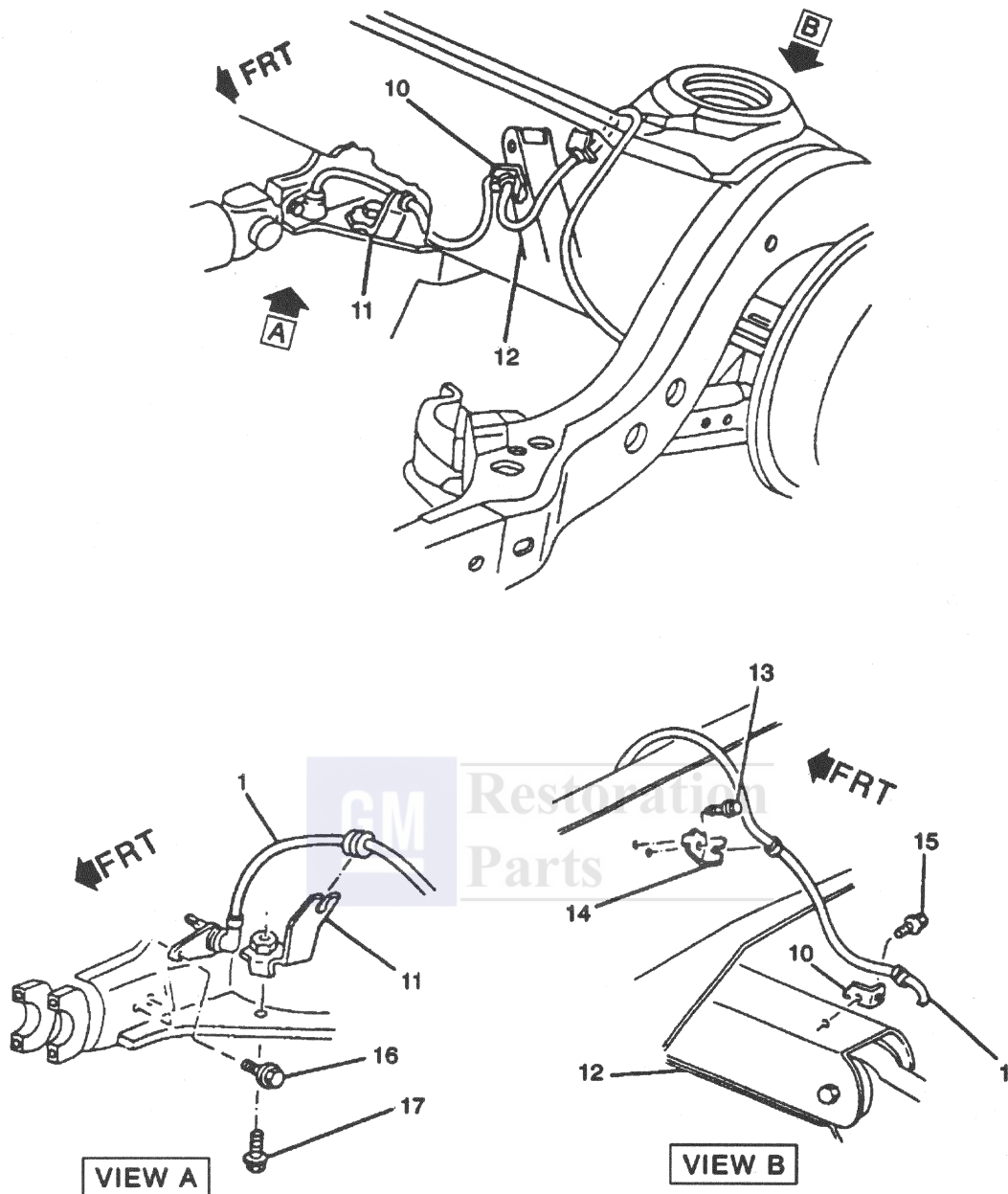


- 1 SENSOR, REAR WHEEL SPEED
- 2 HARNESS, ELECTRONIC BRAKE CONTROL WIRING
- 3 PAN, FLOOR
- 4 PASS-THROUGH, ANTILOCK BRAKE SYSTEM
- 5 BOLT/SCREW, ELECTRONIC BRAKE CONTROL WIRING HARNESS CLIP
- 6 CLIP, ELECTRONIC BRAKE CONTROL WIRING HARNESS
- 7 CLIP, WHEEL SPEED SENSOR WIRE

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Figure 6-Rear Wheel Speed Sensor Wiring

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- 1 SENSOR, REAR WHEEL SPEED
- 10 BRACKET, WHEEL SPEED SENSOR WIRE
- 11 BRACKET, WHEEL SPEED SENSOR WIRE
- 12 ARM, REAR AXLE UPPER CONTROL
- 13 BOLT/SCREW, REAR WHEEL SPEED SENSOR WIRE BRACKET
- 14 BRACKET, REAR WHEEL SPEED SENSOR WIRE
- 15 BOLT/SCREW, WHEEL SPEED SENSOR BRACKET
- 16 BOLT/SCREW, WHEEL SPEED SENSOR
- 17 BOLT/SCREW, WHEEL SPEED SENSOR WIRE BRACKET

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Figure 7-Rear Wheel Speed sensor


Inspect

- Sensor face for accumulation of metallic particles, dirt, grease or other contaminants.
- Clean sensor face as required.
- Sensor face should show no evidence of damage from contact with the toothed sensor ring. If damage is noted, determine the cause and correct. Replace sensor if damage interferes with proper operation.


Install or Connect

NOTICE: See “Fasteners Notice” on page 5E1-1.

NOTICE: The wheel speed sensor is a tight fit into the rear axle housing and is to be pushed in by hand. DO NOT force the sensor into position. Wheel speed sensors must be given an anti corrosion coating before installation to prevent corrosion. Do not use grease. Use sealer, GM P/N 12345489 or equivalent.

1. Rear wheel speed sensor into rear axle housing.
2. Sensor retaining bolt/screw.


Tighten

- Bolt/screw to 8 N.m (71 lb. in.).
3. Bracket and bolt/screw to rear axle housing if removed.


Tighten

- Bolt/screw to 8 N.m (71 lb. in.).
4. Wiring harness with grommets to brackets.


Important

- Proper installation of wheel speed sensor wire is critical to continued system operation. Be sure that the wire is installed in brackets. Failure to install the wire in brackets as shown in this section may result in contact with moving parts and/or over-extension of the wire, resulting in an open circuit.
5. Wheel speed sensor connector to electronic brake control wiring harness connector.
 - A. Make sure connection is tight.
 - B. Snap connectors into clip.
 6. Lower vehicle.
 7. Perform ABS Diagnostic System Check. Refer to “Diagnosis” in this section.

Rear Wheel Speed Sensor Ring

The rear wheel speed sensor ring is an integral part of rear axle differential drive pinion gear and may be inspected by removing the wheel speed sensor and

using a flashlight and mirror to inspect through the rear axle speed sensor mounting hole. If sensor ring replacement is required, the entire differential drive pinion gear must be removed. Refer to SECTION 4B.


Important

- Inspect toothed sensor rings for missing or damaged teeth. Missing or damaged teeth can result in erratic sensor signals.
- Toothed sensor rings should show no evidence of contact with the rear wheel speed sensor. If contact is observed determine cause and correct.
- Excessive runout of the sensor ring can cause erratic wheel speed sensor signals. Refer to section 4B for diagnostic and replacement procedures.

WARNING/INDICATOR LAMPS

For service information on the “ABS” indicator or “BRAKE” warning lamps, refer to section 8C.

EBCM ELECTRICAL CONNECTOR REPAIR

NOTICE: Always connect or disconnect the wiring harness connector from the EBCM with the ignition switch in the “OFF” position.

For general wiring and terminal repair procedures, see section 8A-5. The following repair procedure is for the ABS EBCM wiring harness connector.

1. Cut wire tie at connector head.
 - Be careful not to damage boot.
2. Remove connector center screw and screw seal.
3. Pull boot back until it is completely inside out. Wipe mastic material off boot and connector cover. New mastic will be used during reassembly.
4. Remove screws and loosen clamp attached to connector.
5. Remove rectangular connector seal and discard if damaged.
6. Push white contact carrier away from outer black shell.
7. Unlock connector lock by pushing with thumbs.
8. Replace terminals as needed using repair procedures described in Section 8A-5.
9. Take care to repair one wire at a time, replacing it into its proper cavity.
10. Reassemble connector using new components from service kit. New mastic and wire tie will be required for reassembly. Wrap the mastic twice around the wire groove area. Return the boot to its regular position and install new wire tie.

SPECIFICATIONS

GENERAL SPECIFICATIONS

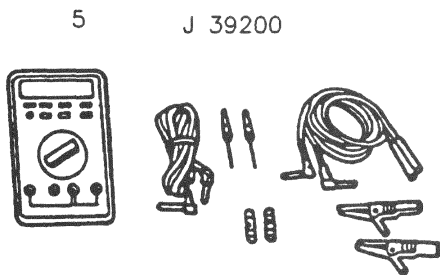
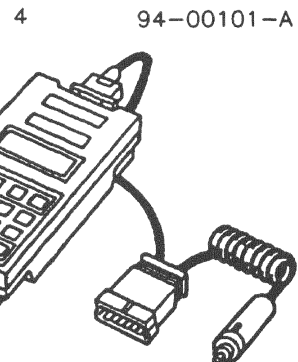
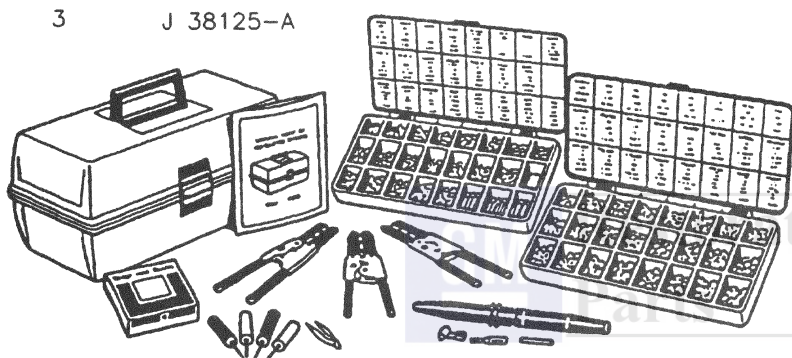
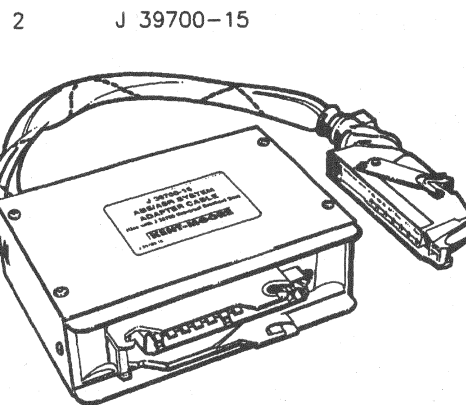
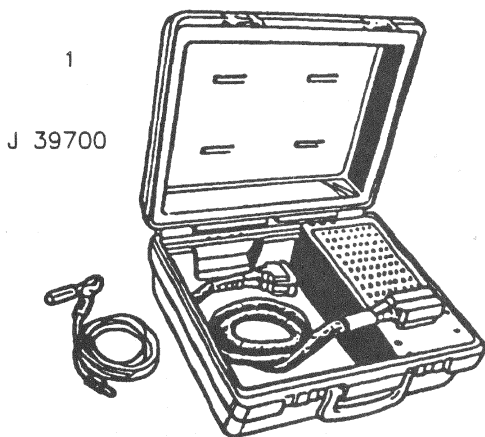
Speed Sensor Ring Runout0.25 mm (0.010")

FASTENER TIGHTENING SPECIFICATIONS

Antilock Brake System Fuse Bolt/Screw 1.7 N.m (15lb. in.)
Brake Pressure Modulator Valve (BPMV) Bracket Bolt/Screw 24 N.m (18 lb. ft.)
Brake Pressure Modulator Valve (BPMV) Bracket to Steering Knuckle Nut 24 N.m (18 lb. ft.)
Brake Pressure Modulator Valve (BPMV) Bracket to BPMV Nut 10 N.m (89 lb. in.)
Brake Pressure Modulator Valve (BPMV) Brake Pipe Fittings 16 N.m (12 lb. ft.)
Brake Pressure Modulator Valve (BPMV) Ground Cable Nut 2.8 N.m (25 lb. in.)
Electronic Brake Control Module to BPMV Bolt 2.6 N.m (23 lb. in.)
Electronic Brake Control Module Insulator Mounting Bolt 15 N.m (11 lb. ft.)
Forward Lamp Wiring Harness Nut 2.8 N.m (25 lb.in.)
Rear Wheel Speed Sensor Wire Bracket Bolt/Screw 10 N.m (89 lb. in.)
Wheel Speed Sensor Bolt/Screw 8 N.m (71 lb. in.)
Wheel Speed Sensor Bracket Bolt/Screw 6 N.m (53 lb.in.)
Wheel Speed Sensor Wire Bracket Bolt/Screw (Front) 10 N.m (89 lb. in.)
Wheel Speed Sensor Wire Bracket Bolt/Screw (Rear) 8 N.m (71 lb. in.)
Wheel Speed Sensor Wire Bracket-to-Splash Shield Bolt/Screw 9 N.m (80 lb. in.)

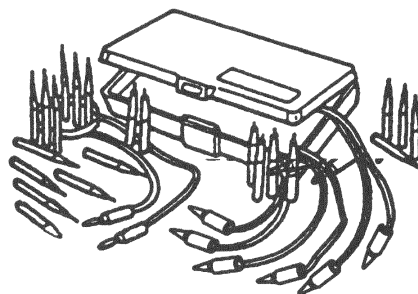


SPECIAL TOOLS



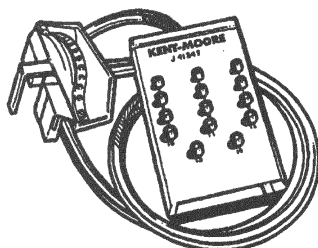
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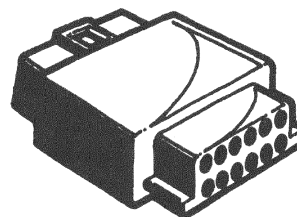
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- 1 UNIVERSAL BREAKOUT BOX
- 2 BOSCH ADAPTER CABLE
- 3 TERMINAL REPAIR KIT
- 4 TECH I DIAGNOSTIC COMPUTER
- 5 DIGITAL MULTIMETER
- 6 CONNECTOR TEST ADAPTER KIT
- 7 BPM VALVE PINOUT BOX
- 8 16/12 PIN DLC ADAPTER



SECTION 5F

PARKING BRAKE

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

PARKING BRAKE SYSTEM

The parking brake system is applied by depressing the parking brake pedal. Applying the parking brake pedal places tension on the parking brake cables, which actuates the rear parking brake mechanism. This system mechanically forces the rear brake shoes against the brake drums which locks the rear brakes.

Chevrolet's police vehicle, Impala SS, and certain taxi applications are equipped with four-wheel disc braking systems. The parking brake system on vehicles equipped with rear disc braking systems uses brake shoes which are located inside the rear brake rotors. The brake shoes are mechanically applied to brake drums which are cast to the rear brake rotors.

PARKING BRAKE LEVER

The lever, mounted on the driver's side door hinge pillar left of the brake pedal, is a ratcheting mechanism which must be pumped to set. Up to

3 1/2 full strokes of the pedal are required to fully apply the lever. Low pedal resistance may be felt during the first stroke of the lever application.

Parking brake pedal travel may increase with mileage as the rear brake linings wear. The parking brake system should be adjusted if a firm parking brake pedal feel is not achieved with less than 3 1/2 pedal strokes.

PARKING BRAKE CABLES

Two separate cables are used in the parking brake system. The front and rear cables are joined at the equalizer, with the rear cable running to the rear of the vehicle.

This vehicle is equipped with coated parking brake cables. The wire strand is coated with a plastic material which slides over plastic seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

BRAKE WARNING LAMP

The red "BRAKE" warning lamp will light when the ignition switch is in the "START" position

5F-2 PARKING BRAKE

or the pedal is applied or not fully released. The parking brake indicator switch, located in the parking brake pedal, grounds the "BRAKE" warning lamp circuit, causing the "BRAKE" warning lamp to light. For further information on the "BRAKE" warning lamp, refer to SECTION 5.

ON-VEHICLE SERVICE

PARKING BRAKE LEVER

Figures 1 through 3

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Loosen equalizer (19) to relieve tension on parking cable.
3. Lower vehicle.
4. Parking brake release handle (1) at lever (2).
5. Front cable (4) and casing at lever (2).
 - Use 1/2-inch box wrench to compress spring lock, then remove cable casing.
6. Nuts (3) and bolt/screw (6).
7. Electrical connector (9).
8. Lever (2).

Install or Connect

NOTICE: Refer to "Notice" on page 5F-1 of this section.

1. Lever (2).
2. Electrical connector (9).
3. Bolt/screw (6) and nuts (3).

Tighten

- Bolt/screw (6) to 25 N·m (18 lb. ft.).
 - Nuts (3) to 17 N·m (13 lb. ft.).
4. Front cable (4) and casing at lever (2).
 - Seat spring lock.
 5. Parking brake release handle (1) at lever (2).
 6. Raise and suitably support vehicle. Refer to SECTION 0A.

Adjust

- Parking brake. Refer to "Adjustment" in this section.
7. Lower vehicle.

PARKING BRAKE INDICATOR SWITCH

Figure 1

Remove or Disconnect

1. Electrical connector (9) from indicator switch (7).
2. Bolt/screw (8) attaching indicator switch (7) to lever (2).
3. Indicator switch (7).

Install or Connect

NOTICE: Refer to "Notice" on page 5F-1 of this section.

1. Indicator switch (7).
2. Bolt/screw (8) attaching indicator switch (7) to lever (2).

Tighten

- Bolt/screw (8) to 2.8 N·m (25 lb. in.).
3. Electrical connector (9) to indicator switch (7).

PARKING BRAKE RELEASE HANDLE

Figure 1

Remove or Disconnect

1. End of front parking brake cable from lever (2).
2. Front parking brake cable casing from lever (2).
3. Release handle (1) from lower instrument panel carrier.

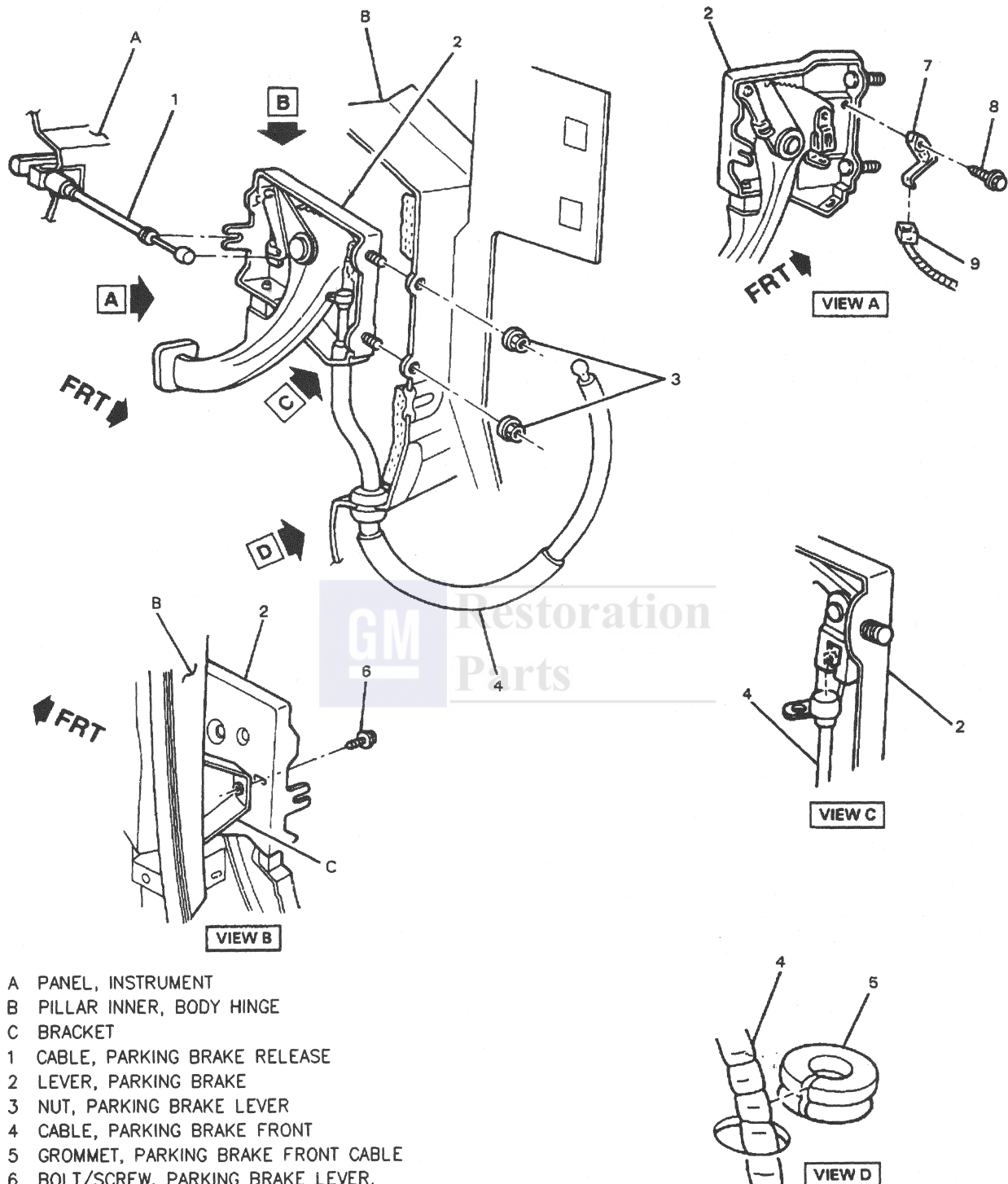
Install or Connect

1. Release handle (1) to lower instrument panel carrier.
2. Front parking brake cable casing to lever (2).
3. End of front parking brake cable to lever (2).

PARKING BRAKE CABLES

NOTICE: Handling these cables while servicing the parking brake system requires extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increased parking brake effort could result. Contacting the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided. To prevent damage to the threaded parking brake, the following is recommended:

1. Before attempting to turn adjusting nut, clean exposed threads on each side of nut.
2. Lubricate threads of adjusting rod before turning nut.



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Figure 1 - Parking Brake Lever

5F-4 PARKING BRAKE

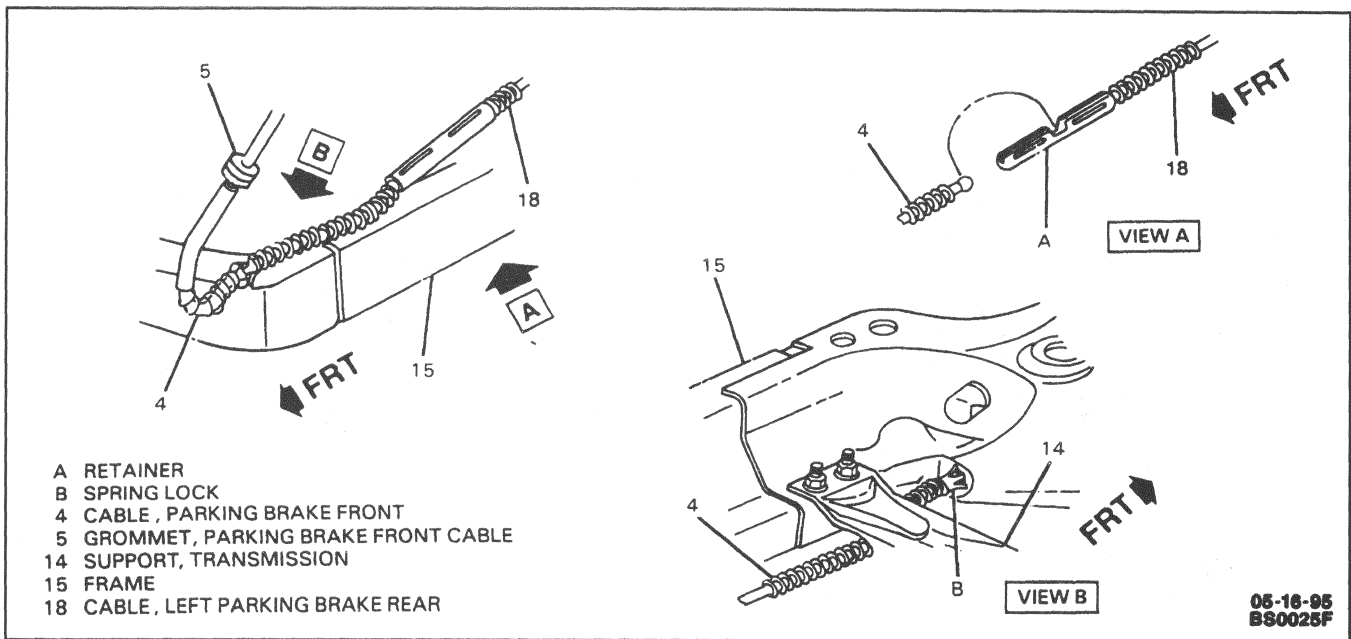


Figure 2 - Parking Brake Front Cable Routing

Front Parking Brake Cables

Figures 1 through 4

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Loosen equalizer (19) enough to gain necessary front cable slack.
3. Front cable (4) at retainer.
4. Cable casing at frame (15).
 - Use a 1/2-inch box wrench to compress spring, then remove cable casing.
5. Lower vehicle.
6. Driver's side wheelhouse panel bolts/screws (51 and 52) and pull out panel (50) to gain access to front cable (4).
7. Front cable (4) and casing at lever (2).
 - Use a 1/2-inch box wrench to compress spring, then remove cable casing.
8. Front cable (4) and grommet (5) from vehicle.

Install or Connect

NOTICE: Refer to "Notice" on page 5F-1 of this section.

1. Front cable (4) and grommet (5).
2. Front cable (4) and casing at lever (2).
 - Seat spring lock.
3. Front wheelhouse panel (50) and wheelhouse panel bolts/screws (51 and 52).

Tighten

- Wheelhouse panel bolts/screws (51) to 10 N.m (89 lb. in.).
 - Wheelhouse panel bolts/screws (52) to 25 N.m (18 lb. ft.).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
 5. Cable casing at frame (15).
 - Seat spring lock.
 6. Front cable (4) at retainer.

Adjust

- Parking brake. Refer to "Adjustment" in this section.
7. Lower vehicle.

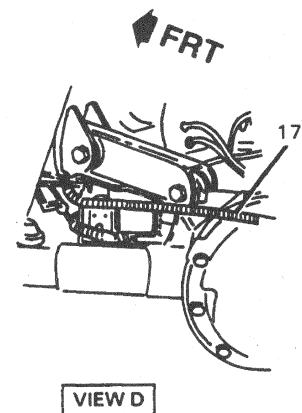
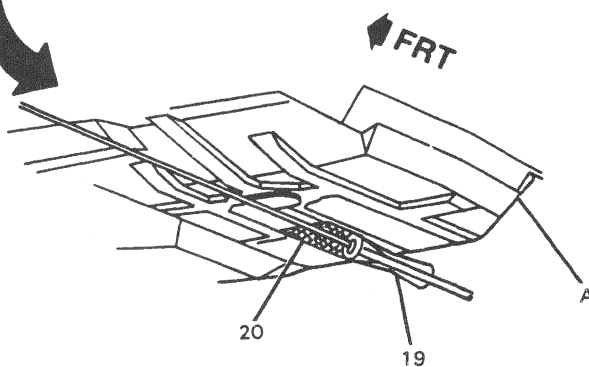
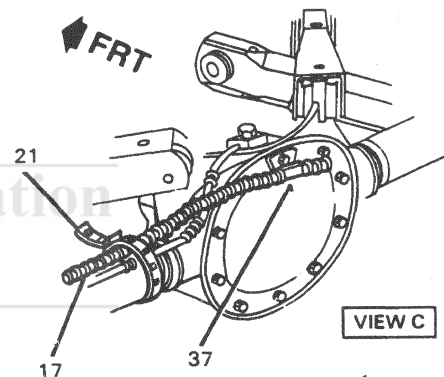
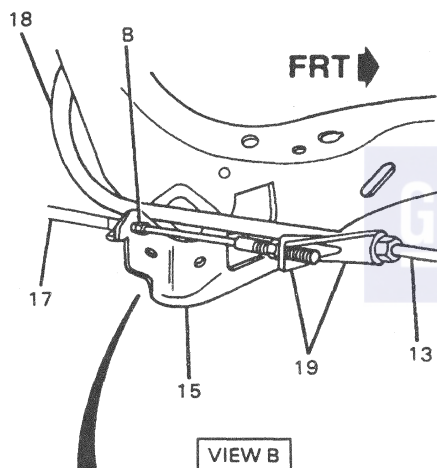
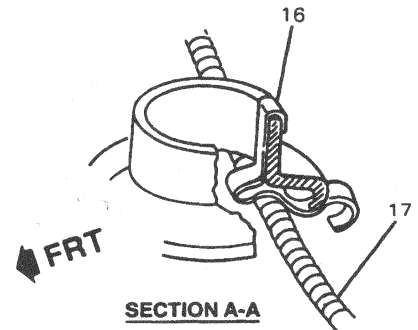
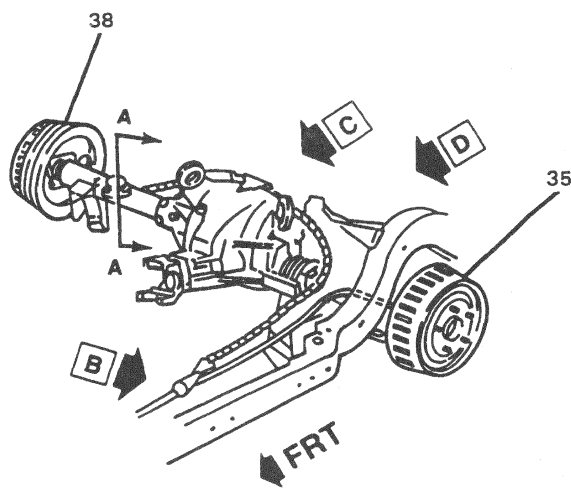
Rear Parking Brake Cables (Drum)

Figure 3

LEFT PARKING BRAKE REAR CABLE

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Loosen equalizer (19) enough to gain necessary cable slack.
3. Left rear cable (18) at retainer and equalizer (19).
4. Left rear tire and wheel. Refer to SECTION 3E.
5. Left rear brake drum (35).
6. Left rear brake shoes. Refer to SECTION 5C2.
7. Left rear cable (18) from left rear parking brake lever.
8. Left rear cable (18) and casing from brake backing plate.



- A UNDERBODY
- B SPRING LOCK
- 13 CABLE, PARKING BRAKE REAR
- 15 FRAME
- 16 CLIP, PARKING BRAKE REAR CABLE
- 17 CABLE, RIGHT PARKING BRAKE REAR
- 18 CABLE, LEFT PARKING BRAKE REAR

- 19 EQUALIZER
- 20 LUBRICANT, PARKING BRAKE CABLE
- 21 STRAP, PARKING BRAKE REAR CABLE
- 35 BRAKE DRUM, LEFT REAR
- 37 CLIP
- 38 BRAKE DRUM, RIGHT REAR

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Figure 3 - Rear Parking Brake Cable Routing (Drum)

5F-6 PARKING BRAKE

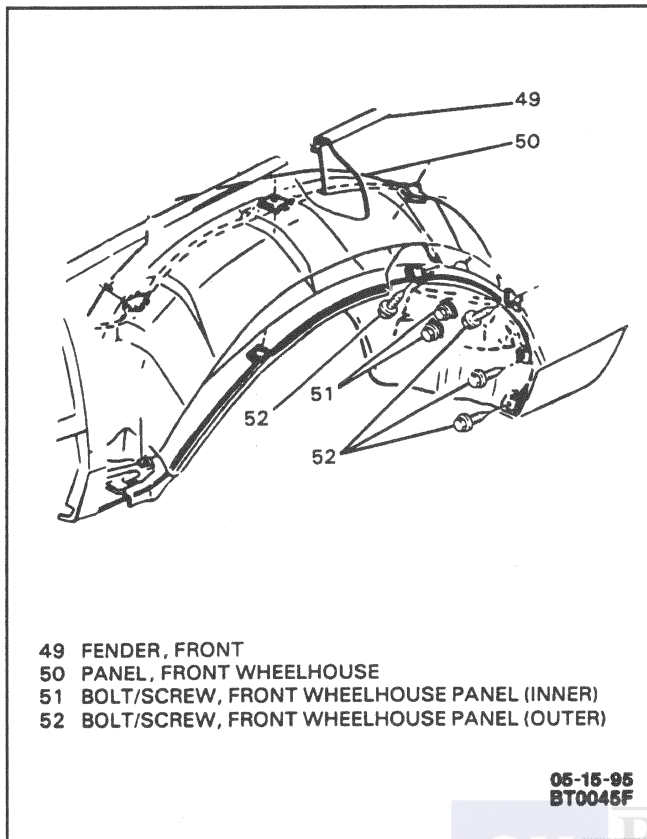


Figure 4 - Front Wheelhouse Panel

- Use a 1/2-inch box wrench to compress spring lock, then remove cable casing.

Install or Connect

1. Left rear cable (18) and casing into brake backing plate.
 - Seat spring lock.
2. Left rear cable (18) to left rear parking brake lever.
3. Left rear brake shoes.
4. Left rear brake drum (35). Refer to SECTION 5C2.
5. Left rear tire and wheel. Refer to SECTION 3E.
6. Left rear cable (18) to retainer and equalizer (19).

Adjust

- Parking brake. Refer to "Adjustment" in this section.

7. Lower vehicle.

RIGHT PARKING BRAKE REAR CABLE

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right rear cable (17) from equalizer (19).
3. Right rear cable (17) and casing from frame (15).
 - Use a 1/2-inch box wrench to compress spring lock, then remove cable casing.

4. Right rear cable (17) and casing from axle housing clips (37).
5. Right rear tire and wheel. Refer to SECTION 3E.
6. Right rear brake drum (38).
7. Right rear brake shoes. Refer to SECTION 5C2.
8. Right rear cable (17) from right rear parking brake lever.
9. Right rear cable (17) and casing from brake backing plate.
 - Use a 1/2-inch box wrench to compress spring lock, then remove cable casing.

Install or Connect

1. Right rear cable (17) and casing into brake backing plate.
 - Seat spring lock.
2. Right rear cable (17) to right rear parking brake lever.
3. Right rear brake shoes. Refer to SECTION 5C2.
4. Right rear brake drum (38).
5. Right rear tire and wheel. Refer to SECTION 3E.
6. Right rear cable (17) and casing into axle housing clips (37).
7. Right rear cable (17) and casing into frame (15).
 - A. Be sure cable is routed correctly.
 - B. Seat spring lock.
8. Right rear cable (17) to equalizer (19).

Adjust

- Parking brake. Refer to "Adjustment" in this section.
9. Lower vehicle.

Rear Parking Brake Cables (Disc)

Figure 5

LEFT PARKING BRAKE REAR CABLE

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Loosen equalizer (19) enough to gain necessary cable slack.
3. Left rear cable (18) at retainer and equalizer (19).
4. Unhook left rear cable (18) from left rear parking brake actuator lever.
5. Left rear cable (18) and casing from mounting plate.
 - Use a 1/2-inch box wrench to compress spring lock, then remove cable casing.

Install or Connect

1. Left rear cable (18) and casing into mounting plate.
 - Seat spring lock.
2. Left rear cable (18) to left rear parking brake actuator lever.
3. Left rear cable (18) to retainer and equalizer.

5F-8 PARKING BRAKE

ADJUSTMENT

Figures 3 and 6

NOTICE: To prevent damage to threaded parking brake adjusting rod when servicing parking brake, the following is recommended:

1. Before attempting to turn adjusting nut, clean exposed threads on each side of nut.
2. Lubricate threads of adjusting rod before turning nut.



Adjust

1. Brakes, if drum type. Refer to SECTION 5C2.
2. Parking brake.
 - A. Press parking brake lever ten ratchet clicks.
 - B. Raise and suitably support vehicle. Refer to SECTION 0A.
 - C. Tighten adjuster nut at equalizer (19) until right rear wheel can just be turned rearward with two hands but cannot be turned forward.
 - D. Release parking brake.
 - Rear wheels should now turn freely.
3. Lower vehicle.
4. Cycle pedal several times.
5. Park brake system must be able to apply at least 112 N (250 lbs. ft.) of force to the front cables.



Measure

- A. Pedal travel
 - Pedal from released position with an applied force of 556 N (125 lbs.) must travel 113.0mm (5.25 in.) to 171.0 mm (6.75 in.).
6. Confirm that brake light on Instrument Panel illuminates when pedal is applied.

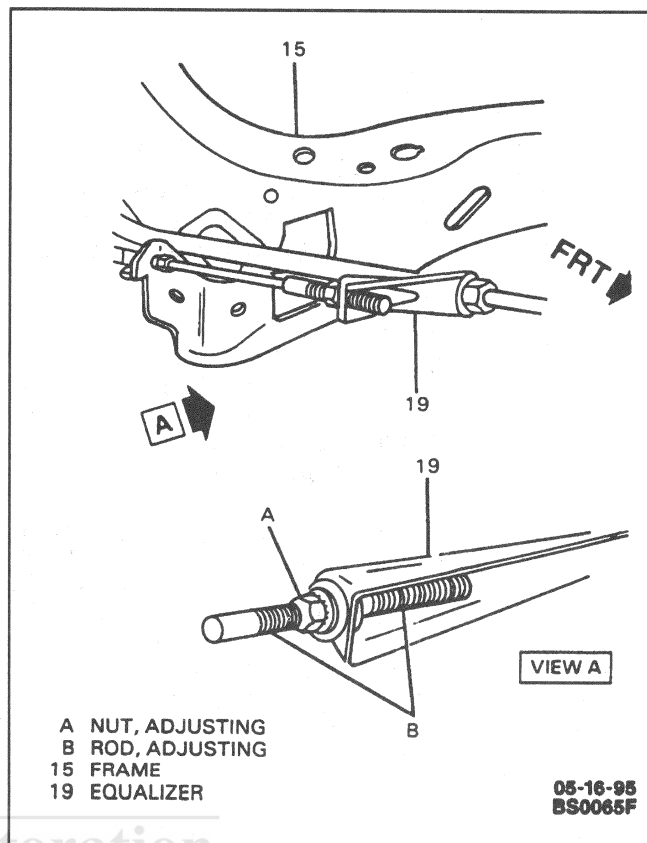


Figure 6 - Parking Brake Adjustment

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Wheelhouse Panel Bolt/Screw (Inner)	10 N.m (89 lb. in.)
Front Wheelhouse Panel Bolt/Screw (Outer)	25 N.m (18 lb. ft.)
Parking Brake Indicator Switch Bolt/Screw	2.8 N.m (25 lb. in.)
Parking Brake Lever Bolt/Screw	25 N.m (18 lb. ft.)
Parking Brake Lever Nut	17 N.m (13 lb. ft.)

SECTION 6

ENGINE GENERAL INFORMATION AND
MECHANICAL DIAGNOSIS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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GENERAL INFORMATION

CLEANLINESS AND CARE

The L99 and LT1 engines are a combination of many machined, honed, polished, and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaced on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated. Whenever valve train components are removed for service, they should be kept in order and they should be installed in the same locations, and with the same mating surfaces, as when removed. Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wiring harness or other electrical parts.

GENERAL INFORMATION ON ENGINE
SERVICE

! Important

- The following information on engine service should be noted carefully, as it is important in preventing damage and in contributing to reliable engine performance.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pick-up unit.

Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow that intake passage into the cylinder and cause extensive damage when the engine is started.

In the mechanical procedures described in this section, generally references will be made to the removal of equipment such as power steering pump,

6-2 ENGINE GENERAL INFORMATION AND MECHANICAL DIAGNOSIS

air conditioning compressor, etc. Should it become necessary to remove any such item to perform other services, refer to the appropriate section of this service manual for specific information.

ENGINE PERFORMANCE DIAGNOSIS

Engine performance diagnosis procedures are covered in Section 6E and should be consulted for diagnosis of any driveability, emissions, or "Service Engine Soon" light complaint.

- Refer to:
 - Section 6E - Driveability and Emissions - General Information.
 - Section 6E3 - Driveability and Emissions - Sequential Multiport Fuel Injection 4.3L RPO L99 & 5.7L RPO LT1 - VIN P.

ON-BOARD DIAGNOSTICS II (OBD II)

OBD II requires not only that emission components be monitored and tested, but that entire systems be tested as well. This diagnostic system now includes both active and passive tests. Operation of some of these systems, such as ignition control circuits, were already being monitored to provide better powertrain control. Additional system monitoring, such as catalyst efficiency, is being introduced with OBD II. The following is how OBD II monitoring and diagnostic testing is accomplished. For further information on OBD II diagnostics, refer to SECTION 6E.

HEATED OXYGEN SENSOR (H02S) MONITORING

The exhaust Heated Oxygen Sensor (H02S) monitoring diagnostic is designed to meet the following requirements:

- Monitor voltage and response rate of the primary (pre-catalyst) sensors.
- Monitor output voltage or response rate of any secondary sensors.
- Monitor the heating system for appropriate performance.

The heater circuit will be considered malfunctioning when its performance drops outside the manufacturer's specification. For further diagnostic information, refer to SECTION 6E.

CATALYST MONITORING

The OBD II catalyst monitor diagnostic measures oxygen storage capacity. To do this, oxygen sensors are installed before and after the Three-Way Catalytic Converter (TWC). Voltage variations between the sensors allow the PCM to measure the catalyst emission performance. When the TWC is operating properly, the post-catalyst oxygen sensor will have significantly less activity than the pre-catalyst oxygen sensor. This is because the TWC stores and releases oxygen as needed during its normal reduction and oxidation processes.

To help aid in these processes, most modern TWC's also contain a base metal known as cerium. Cerium has the ability to attract and release excess oxygen in the exhaust stream. This stabilizes the operation of the catalyst and enhances the effectiveness of the precious metals in converting undesirable by-products of combustion to harmless gasses. As a catalyst becomes less effective in promoting chemical reactions, its capacity to store and release oxygen generally degrades as well. The OBD II catalyst monitor diagnostic is based on an observed correlation between conversion efficiency and oxygen storage capacity. A good catalyst (e.g. 95% hydrocarbon conversion efficiency) will show a relatively flat output voltage on the post-catalyst (H02S). A poor catalyst (65% hydrocarbon conversion) will show peaks and valleys in output voltage. This indicates that the catalyst has lost some of its ability to process the exhaust gasses properly. The post-catalyst H02S is used to measure the oxygen storage/release capacity of the catalyst. From this we can infer the catalyst efficiency and the oxygen storage capacity of the catalyst. A high oxygen storage capacity indicates a good catalyst; low oxygen storage capacity indicates a catalyst that is failing. For further diagnostic information, refer to SECTION 6E.

MISFIRE MONITORING

Failure criteria for the misfire diagnostic includes the following:

- A level of misfire sufficient to result in emission levels exceeding 1.5 times the Federal Test Procedure (FTP) standard.
- A level of misfire sufficient to result in catalyst damage at the current operating condition (engine speed, engine load, and coolant temperature).
- A level of misfire sufficient to cause the vehicle to fail the California Inspection Maintenance (I/M) test.

Regulations require misfire monitoring under all positive speed and load conditions (defined as cruises, accelerations, and idle). The diagnostic must discriminate between single versus multiple cylinder misfiring. If a single cylinder misfires, the diagnostic must identify the specific cylinder and the conditions under which the misfire occurs. The misfire monitor diagnostic is based on the principle that crankshaft rotational velocity fluctuates as each cylinder contributes a power input. When the engine misfires, the crankshaft slows down momentarily. For non-catalyst damage misfire, the diagnostic will require between 1000 and 3200 engine revolutions to respond to the onset of a misfire, and up to 200 engine revolutions to respond to a catalyst damage misfire. The PCM monitors crankshaft rotational velocity using both the crankshaft and camshaft position sensors. The Malfunction Indicator Lamp (MIL) will turn on when misfire is detected for two consecutive trips, or there is a malfunction in two non-consecutive trips (not more than 80 trips apart) under similar engine speed, load and coolant temperature conditions. Flashing the MIL is intended to discourage the driver from operating the vehicle in this condition (to ease off the throttle) before catalyst

damage results. Rough roads may cause false misfire detections. A rough road will cause torque to be applied to the drive wheels and drivetrain. These torque spikes can temporarily and intermittently decrease the engine speed, and this may be detected as a false misfire. The solution to rough road misfire problems is to utilize the Anti-Lock Brake System (ABS) and/or ECM software to detect patterns characteristic of rough roads, and disable the diagnostic when rough roads are present. A feature that is incorporated into the OBD II system for diagnosing misfire problems is called "misfire accumulators." These "misfire accumulators" are basically a file on each engine cylinder. Anytime a cylinder misfires, the misfire diagnostic counts the misfire and notes in which cylinder it occurred. A misfire accumulator is maintained for each cylinder, and misfire accumulator data can be accessed by using a TECH 1. This will enable you to determine which cylinders misfired, even when dealing with a random misfire diagnostic trouble code (DTC). Misfire accumulator information will be found in the MISFIRE DATA sub-menu of the SPECIFIC ENG. MENU of the data list. For further diagnostic information, refer to SECTION 6E.

FUEL TRIM SYSTEM MONITORING

The operational theory for fuel trim includes monitoring the averages of long-term and short-term fuel trim. If these fuel trim values reach and stay at their limits for a period of time, a malfunction is indicated. The fuel trim diagnostic compares an average of long-term-trim value and short-term-trim value to rich and lean thresholds. If either value is within the thresholds, a pass is recorded. (The closed loop system still has control authority). If both values are outside of their thresholds, then a failure condition exists. This will cause a DTC to be stored, and the rich or lean condition to be recorded. The fuel trim diagnostic also conducts an intrusive test to determine if a rich condition is being caused by excessive vapor from the EVAP canister. OBD II's fuel trim monitoring system will be considered malfunctioning when it causes the emission levels to exceed the 1.5 times the Federal Test Procedure (FTP) standards. The operating conditions at the instant of fault detection must be stored in Freeze Frame data for the service technician. Like a misfire diagnostic, fuel trim faults do not have to occur on consecutive trips to store a DTC. The enabling criteria for system operation includes: coolant temperature, throttle position, vehicle speed, intake air temperature, long-term fuel trim learning (updating), engine speed/load values, and barometric pressure. For further diagnostic information, refer to SECTION 6E.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

The OBD II requirement states that the Exhaust Gas Recirculation (EGR) system must be monitored for abnormally low and high flow rate malfunctions. The diagnostic will consider the EGR malfunctioning when an EGR system component fails, or a change in the EGR flow rate results in the vehicle exceeding

1.5 times the Federal Test Procedure (FTP) emission standard. The (DTC) must set within two vehicle trips once the malfunction has been detected.

SECONDARY AIR INJECTION (AIR) SYSTEM MONITORING

OBD II diagnostics require monitoring for the presence of airflow in the exhaust stream, as well as functional monitoring of the secondary AIR pump, and any switching valves. For further diagnostic information, refer to SECTION 6E.

EVAPORATIVE EMISSION CANISTER PURGE VALVE MONITORING

OBD II diagnostics utilize an evaporative (EVAP) emission canister purge valve monitor which uses an EVAP diagnostic switch in the hose between the EVAP canister and purge valve to determine proper function of the EVAP purge valve. When the EVAP purge valve is closed (no purge), the switch should not indicate a vacuum. An EVAP purge valve stuck open will result in the switch consistently indicating the presence of vacuum at the switch. An EVAP purge valve stuck closed will result in the switch constantly indicating atmospheric pressure. A vacuum switch in the evaporative emission canister purge hose is the only additional piece of hardware required for this diagnostic.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR MONITORING

There are two separate Engine Coolant Temperature (ECT) sensor diagnostics; ECT out of range (high or low) and ECT input failed to enable closed loop within the proper time frame. The ECT out of range diagnostic monitors the temperature readings from the ECT sensor at approximately 100 millisecond intervals. For a fixed interval of time, the diagnostic counts the number of ECT readings outside of the sensor's expected output range. If the number of ECT readings in the high or low ranges exceeds a certain calibrated threshold, the sensor is indicated to be failed high or low accordingly. If a relatively small number of samples fall in either the high or low ranges, the sensor is diagnosed as intermittently out of range high or low. The intermittent diagnostic is not required by OBD II regulations, so no DTC is set. For further diagnostic information, refer to SECTION 6E.

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

ENGINE MISFIRE MECHANICAL DIAGNOSIS

This diagnostic chart will isolate any engine misfire due to a mechanical problem such as a faulty camshaft, leaking head gasket, etc. However, this chart will not isolate a crossed injector wire, faulty injector or any other electrical failure which may cause a misfire. Therefore, the "On Board Diagnostic System Check" must be performed first to insure the correct chart is followed for diagnosis of a misfire. Refer to SECTION 6E3-A, then refer to the following charts.

EXCESSIVE OIL LOSS

Excessive oil consumption, not due to leaks, is the use of 2 quarts (1.9L) or more of engine oil within 2,000 miles or 3,200 kilometers.

- External oil leaks. Tighten or replace bolts and/or replace gaskets and seals as necessary.
- Improper reading of oil level indicator (dipstick). Check oil with the vehicle on a level surface and allow adequate drain-down time.
- Improper oil viscosity. Use recommended SAE viscosity for prevailing temperatures. Refer to SECTION 0B for engine oil specifications.
- Continuous high speed driving, and/or severe usage such as trailer hauling, will normally cause decreased oil mileage.
- Crankcase ventilation system malfunctioning.
- Valve guides and/or valve stem seals worn, or seals omitted. Ream guides and install oversize service valves and/or new valve stem seals.
- Piston rings broken, improperly installed, worn, or not seated. Allow adequate time for rings to seat. Replace broken or worn rings as necessary.
- Piston improperly installed or misfitted.
- Intake manifold gasket leaking from underside of intake manifold. Replace intake manifold gasket.

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedure may help in finding and repairing most leaks.

Finding the Leak

1. Identify the fluid, determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. At what point is the fluid leaking from? After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper. After a few minutes, the approximate location of the leak should be found by drippings on the paper.
3. Visually check around the suspected components. Check around all gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.

4. If the leak still can't be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent. Clean the area well, then dry the area. Operate the vehicle for several miles at normal operating temperature and varying speeds. After operating the vehicle, visually check the suspected component. If leak still can't be located, try using the powder or black light and dye method.

POWDER METHOD

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected components. The leak path to the source should be found by tracing the white powder surface.

BLACK LIGHT AND DYE METHOD

A dye and light kit is available for finding leaks. Refer to the manufacturer's directions when using the kit.

1. Clean the suspected area.
2. Pour specified amount of dye into leaking component.
3. Operate the vehicle under normal operating conditions as directed in the kit.
4. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined, in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

GASKETS



Inspect

- Fluid level/pressure too high.
- Crankcase ventilation system malfunctioning.
- Improperly tightened fasteners or dirty/damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs, or other damage to the sealing surface.
- Damaged, improper, or worn gasket.
- Cracking or porosity of the component.
- Improper sealant used (where applicable).

SEALS

- Fluid level/pressure is too high.
- Crankcase ventilation system malfunctioning.
- Damaged seal bore (scratched, burred, or nicked).
- Damaged or worn seal.
- Improper installation.
- Cracks in components.
- Shaft surface scratched, nicked, or damaged.
- Loose or worn bearing causing excess seal wear.

LOW OR NO OIL PRESSURE

- Low oil level. Fill to full mark on oil level indicator.
- Slow idle speed.
- Incorrect or malfunctioning oil pressure switch.
- Incorrect or malfunctioning oil pressure gage. Replace with proper gage.
- Improper oil viscosity or diluted oil. Install oil of proper viscosity for expected temperature, or install new oil if diluted with moisture or unburned fuel mixtures.
- Oil pump worn or dirty.
- Plugged oil filter.
- Oil pickup screen loose or plugged.
- Hole in oil pickup tube.
- Excessive bearing clearance. Replace if necessary.
- Cracked, porous or plugged oil galleries. Repair or replace block.
- Gallery plugs missing or misinstalled. Install plugs or repair as necessary.
- Camshaft worn, or poorly machined. Replace camshaft.

ENGINE NOISE DIAGNOSIS

There are four steps to diagnosing engine noise. You must determine:

1. Type of noise.
2. Under which operating conditions it exists.
3. At what rate, and at what location in the engine.
4. Compare sounds in other engines to make sure the condition is not normal.

Identify the type of noise. For example, a light rattle or a low rumble. Determine the exact operating conditions under which the noise appears. Remember, engine noises are generally synchronized to either speed (caused by the crankshaft, connecting rods, or pistons) or one half engine speed (valve train noises). Try to determine the rate at which the noise is occurring. This can be installing a timing light to the vehicle and comparing the number of times the sound is heard per flash of light. One sound per flash of light generally indicates valve train component failure, two sounds per flash generally indicates piston rod bearing, crankshaft, or piston pin failure.

MAIN BEARING NOISE

Damaged or worn main bearing noise is revealed by dull thuds or knocks which happen on every engine revolution, and this noise is loudest when the engine is under heavy load. Excessive crankshaft end play is indicated by an intermittent rap or knock sharper than a worn main bearing. Causes of main bearing noises include:

- Low oil pump pressure.
- Thin, diluted or dirty oil and/or filter.
- Excessive main bearing clearance.
- Excessive crankshaft endplay.
- Out-of-round crankshaft journals.
- Excessive belt tension.
- Loose crankshaft pulley.
- Loose flywheel or torque converter.
- Loose main bearing cap.

CONNECTING ROD BEARING NOISE

A damaged or worn connecting rod bearing will produce knock under all speeds. During the early stages of wear, connecting rod noise may be confused with piston slap or loose wrist pins. Connecting rod knock noise increases with engine speed and is at its loudest on deceleration. Causes of connecting rod bearing noise include:

- Excessive bearing clearance.
- Worn crankshaft connecting rod journal.
- Thin, diluted or dirty oil and/or filter.
- Low oil pressure.
- Crankshaft connecting rod journals out-of-round.
- Misaligned connecting rod.
- Connecting rod bolts not properly torqued.
- Wrong bearing inserts or misaligned bearing half.

TIMING GEAR OR CHAIN AND SPROCKET NOISES

Engines designed with timing gears, or those equipped with timing chain and sprockets, can produce different noises. The most common noise is a high frequency, light knocking sound. This sound will generally be the same in intensity whether the engine is idling, operating at high speeds, or under load. Causes of timing gear or chain and sprocket noises include:

- Worn timing chain and/or gears.
- Misaligned gears.
- Excessive backlash.
- Damaged tooth.
- Gear or sprocket loose on shaft.
- Too much end play in the camshaft or crankshaft.

PISTON NOISES

Piston pin, piston, and connecting rod noises are hard to separate. A loose piston pin, for example, causes a sharp double knock usually heard when the engine is idling, or during sudden acceleration then deceleration of the engine. A piston pin that has been improperly fitted will emit a light ticking noise that is

6-6 ENGINE GENERAL INFORMATION AND MECHANICAL DIAGNOSIS

more noticeable with no load on the engine. Excessive piston-to-cylinder bore clearance will cause piston slap noise. The noise is similar to a metallic knock, as if the piston were "slapping" the cylinder wall during its stroke. As with most engine noises, understanding the cause of the noise will help you imagine what the noise sounds like. An indication of piston slap is a decrease in noise as the engine is cold, the piston-to-bore clearance is greater and piston slap will be louder. Causes of piston noises include:

- Worn or loose piston pin or bushing.
- Improper fit of piston pin.
- Excessive piston-to-cylinder bore clearance (piston slap).
- Lack of lubrication.
- Carbon deposits on top of piston striking cylinder head.
- Worn or broken ring land.
- Broken or cracked piston.
- Misaligned connecting rods.
- Worn or damaged rings.
- Worn or out-of-round cylinder walls.
- Excessive ring land clearance.
- Insufficient ring-end gap clearance.
- Piston 180 degrees out of position.
- Incorrect piston cam grind.

VALVE MECHANISM OR VALVE TRAIN NOISES

A light tapping at one-half engine speed, or any varying frequency, can indicate a valve train problem. These tapping noises increase with engine speed. Before attempting to judge valve train noises, thoroughly warm up the engine. This will bring all engine components to a normal state of expansion. If one of the valve train components is suspected, remove the air cleaner resonator and tape off the air intake duct opening. With the engine running, disconnect one fuel injector connector while listening to the noise. If the noise diminishes, the valve train components for that cylinder should be thoroughly inspected. If the noise did not diminish, continue with the remaining cylinders (one at a time) until the faulty cylinder is identified. Refer to SECTION 6A4A for valve train component replacement. Causes of valve mechanism noises include:

- Broken or weak valve spring(s).
- Sticking or warped valves.
- Bent pushrods.
- Dirty, stuck, worn or defective valve lifters.
- Damaged or improperly machined camshaft lobes.
- Insufficient or poor oil supply to valve train (low oil pressure).
- Excessive valve stem-to-guide clearance.
- Worn valve guides.
- Worn rocker arms or pushrods.
- Broken rocker arm stud.
- Loose or worn rocker arm attachments.
- Missing or mispositioned lifter guides (roller lifter engines).

FLYWHEEL NOISES

A loose or cracked flywheel will produce an irregular thud or click. To test for a loose or cracked flywheel, operate the vehicle at approximately 20 mph (32km/h) and shut off the engine. If a thud is heard, the flywheel may be loose or damaged. This type of thud is loudest on deceleration. Loose torque converter-to-flywheel-to-crankshaft bolts will sound similar to bearing knock. This condition produces several raps during quick acceleration on a free running engine. Depending on the idle smoothness, when the transmission is in gear, the noise may not appear. Check the torque converter-to-flywheel and flywheel to crankshaft bolts before attempting to investigate any bearing-related knock.

NOTICE: Be sure the converter-to-flywheel bolts are not too long. Converter bolts that are too long may dimple the torque converter clutch apply surface causing a shudder condition.

ENGINE KNOCK DIAGNOSIS

Noises in engines are sometimes characteristic of the design. Compare the sounds in other engines to make sure the condition is not normal.

KNOCKS COLD AND CONTINUES FOR TWO TO THREE MINUTES AND INCREASES WITH TORQUE

- Flywheel contacting splash shield. Reposition splash shield.
- Loose or broken balancer or drive pulleys. Tighten or replace as necessary.
- Excessive piston-to-bore clearance. Replace piston.
- Bent connecting rod. Replace as needed.
- Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.

HEAVY KNOCK HOT WITH TORQUE APPLIED

- Broken balancer or pulley hub. Replace parts as necessary.
- Loose torque converter bolts. Refer to SECTION 7A for torque specification.
- Exhaust system grounded. Reposition as necessary.
- Flywheel cracked. Replace as necessary.
- Excessive main bearing clearance. Replace as necessary.
- Excessive rod bearing clearance. Replace as necessary.

LIGHT KNOCK HOT

- Detonation or spark knock. Refer to SECTION 6E3.
- Loose torque converter bolts. Refer to SECTION 7A for torque specification.

- Exhaust leak at manifold. Tighten bolts and/or replace manifold.
- Excessive rod bearing clearance. Replace bearings as necessary.

KNOCKS ON INITIAL START-UP, BUT ONLY LASTS A FEW SECONDS

- Improper oil viscosity. Install proper oil viscosity for expected temperatures. Refer to SECTION 0B for engine oil specifications.
- Hydraulic lifter bleed down. Clean, test and replace as necessary.
 - When the engine is stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent.
 - An engine that is operated for only short periods between start-ups may have lifter noise that lasts for a few minutes. This is a normal condition.
- Excessive crankshaft end clearance. Replace crankshaft thrust bearing.
- Excessive front main bearing clearance. Replace worn parts.

KNOCKS AT IDLE HOT

- A/C compressor or generator bearing. Replace as necessary.
- Valve train. Replace parts as necessary.
- Improper oil viscosity. Install proper viscosity oil for expected temperature. Refer to SECTION 0B for engine oil specifications.
- Excessive piston pin clearance. Replace piston and pin.
- Connecting rod alignment. Check and replace rods as necessary.
- Loose crankshaft balancer. Torque and/or replace worn parts.
- Piston pin offset to wrong side. Install correct piston.

ENGINE COMPRESSION TEST

A compression pressure test is performed on the engine cylinders to determine the condition of the rings, valves and head gasket.

Remove or Disconnect

1. Run engine until it reaches normal operating temperature. Battery must be at or near full charge.
2. Turn engine off.

3. Electrical connectors from ignition coil.
4. Spark plugs from all cylinders.
5. Air cleaner resonator and air duct from throttle body.
 - Block throttle plate in open position.



Measure

- Engine compression.
 - A. Install compression gage into cylinder spark plug hole.
 - B. Have a helper crank the engine through at least four compression strokes in the cylinder being tested and check the readings on the gage at each stroke. Record the results.
 - C. Disconnect gage.
 - D. Repeat compression test for each cylinder.



Inspect

- Record compression readings from all cylinders. The lowest reading should not be less than 70 percent of the highest and no cylinder reading should be less than 689 kPa (100 psi).
- Problem areas can be identified as follows:
 - Normal - Compression builds up quick and evenly to specified compression on each cylinder.
 - Valves - Compression is low on first stroke and it does not tend to build up in following strokes. Compression does not improve much with the addition of oil. Use approximately three squirts from a plunger type oiler.
 - Head Gaskets - Leaking head gaskets give nearly the same test results as valve problems but may be recognized by engine coolant in the crankcase. Head gasket leakage between two cylinders will give low readings on both cylinders.



Install or Connect

1. Remove block from throttle plate.
2. Air cleaner resonator and air duct to throttle body.
3. Spark plugs.
4. Electrical connectors to ignition coil.

CHART A ENGINE MISFIRE MECHANICAL DIAGNOSIS

! IMPORTANT

**OBD II SYSTEM CHECK MUST BE
PERFORMED FIRST.**

REFER TO SECTION 6E3-A.

1. ARE THERE ANY OBVIOUS MECHANICAL NOISES?

NO

1. PERFORM VISUAL INSPECTION. CHECK SPARK PLUGS, WIRES, AND HOSES FOR PROPER HOOK UP AND DAMAGE.
2. IS THERE ANY APPARENT DAMAGE OR IMPROPERLY CONNECTED HOSES OR WIRES?

NO

1. REMOVE AND INSPECT SPARK PLUGS.
2. ARE ANY SPARK PLUGS CONTAMINATED WITH ENGINE COOLANT (THIS MAY SHOW UP AS A SPARK PLUG WHICH LOOKS EXCEPTIONALLY CLEAN)?

NO

1. ARE SPARK PLUG(S) CONTAMINATED WITH ENGINE OIL?

NO

1. PERFORM CYLINDER LEAK TEST. REFER TO "CYLINDER LEAK TEST" IN THIS SECTION.
2. DOES ENGINE PASS CYLINDER LEAK TEST?

YES

1. INSTALL SPARK PLUG(S). CHECK FOR CARBON TRACKING OF PLUG WIRES.
2. INSTALL A VACUUM GAUGE TO THE INTAKE MANIFOLD AND MEASURE MANIFOLD VACUUM WITH ENGINE AT IDLE AND RECORD.
3. DISCONNECT ALL VACUUM LINES FROM MANIFOLD AND PLUG ALL OPENINGS.
4. CHECK MANIFOLD VACUUM AGAIN WITH ENGINE AT IDLE.
5. ARE BOTH VACUUM READINGS THE SAME?

YES

A (CONTINUE ON NEXT PAGE)

YES

• REFER TO CHART B.

YES

• REPAIR OR REPLACE PARTS AS NECESSARY.

YES

• REMOVE CYLINDER HEAD AND GASKET. INSPECT AND REPAIR/REPLACE PARTS AS NECESSARY.

YES

• REMOVE INTAKE MANIFOLD. INSPECT MANIFOLD AND GASKET, IF O.K. REMOVE CYLINDER HEAD AND INSPECT VALVE GUIDES AND SEALS, IF O.K. REMOVE PISTON AND INSPECT PISTON, RINGS, AND CYLINDER FOR WEAR.

NO

• REPAIR AS DESCRIBED UNDER "CYLINDER LEAK TEST"

NO

B (CONTINUE ON NEXT PAGE)



(CONTINUE FROM PREVIOUS PAGE)

1. USING A SPRAY BOTTLE, LIGHTLY SPRAY THE SPARK PLUG WIRES AND DISTRIBUTOR/IGNITION MODULE WHILE LISTENING TO ENGINE.
2. DID THE ENGINE STUMBLE OR STALL?

NO

1. REMOVE INTAKE MANIFOLD AND CAREFULLY INSPECT INTAKE MANIFOLD GASKET AND TBI GASKET.
2. IS THERE ANY APPARENT DAMAGE OR PROBLEM WITH THE GASKETS OR SEALING SURFACE?

NO

1. WITH THE INTAKE MANIFOLD REMOVED, ROTATE THE ENGINE AND MEASURE CAMSHAFT LOBE LIFT (LIFTER MOVEMENT IN BORE).
2. IS CAMSHAFT WITHIN SPECIFICATIONS?

YES

1. IF PROBLEM IS STILL SUSPECTED TO BE MECHANICAL, REMOVE ENGINE AND PERFORM A COMPLETE DISASSEMBLY AND INSPECTION.

YES

- CHECK EACH VACUUM OPERATED ACCESSORY/ VACUUM LINE AND REPAIR ANY OPEN OR LEAKING COMPONENT.

- REPLACE SPARK PLUG WIRES AND/OR DISTRIBUTOR CAP AND ROTOR/IGNITION MODULE.

YES

- REPAIR OR REPLACE AS NECESSARY.

NO

- REPLACE CAMSHAFT.

Restoration
Parts

C7480

CHART B ENGINE MISFIRE MECHANICAL DIAGNOSIS

1. WITH THE ENGINE RUNNING, TRY TO DETERMINE IF THE NOISE IS TIMED TO CRANKSHAFT SPEED OR CAMSHAFT SPEED (USE TIMING LIGHT, TWO KNOCKS PER FLASH IS CRANKSHAFT, ONE KNOCK PER FLASH IS CAMSHAFT).
2. IS NOISE TIMED TO CRANKSHAFT SPEED?

NO

YES

1. IS NOISE TIMED TO CAMSHAFT SPEED?

• REMOVE ROD BEARINGS AND INSPECT BEARINGS AND JOURNALS FOR WEAR. IF O.K. REMOVE CRANKSHAFT AND INSPECT MAIN BEARINGS AND JOURNALS FOR WEAR. REPLACE PARTS AS NECESSARY.

YES

NO

1. REMOVE INTAKE MANIFOLD, ROTATE ENGINE AND MEASURE CAMSHAFT LOBE LIFT (LIFTER MOVEMENT IN BORE) AND COMPARE WITH SPECIFICATIONS IN SECTION 6A4A.
2. IS CAMSHAFT WITHIN SPECIFICATIONS?

• CHECK FOR LOOSE ACCESSORY ATTACHMENTS, FLYWHEEL, OR TORQUE CONVERTER.

YES

NO

1. REMOVE ROCKER ARMS, PUSHRODS AND LIFTERS. CAREFULLY INSPECT FOR EXCESSIVE WEAR OR DAMAGE, REPLACE PARTS AS NECESSARY.

• REPLACE CAMSHAFT.

SECTION 6A4A

4.3 AND 5.7 LITER V8 ENGINE ON-VEHICLE SERVICE RPO L99 -VIN W RPO LT1 - VIN P

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "On-Vehicle Service" and the SIR Components and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" or "hot at all times" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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ON-VEHICLE SERVICE

FUEL SYSTEM PRESSURE RELIEF

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components. After relieving system pressure, a small amount of fuel may be released when servicing fuel lines or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.

Tool Required:

J 34730-FF Fuel Pressure Gage

1. Disconnect battery negative cable terminal to avoid possible fuel discharge if an additional attempt is made to start the engine.
2. Loosen fuel filler cap to relieve tank vapor pressure.
3. Remove air cleaner resonator bracket nuts and resonator.
 - Loosen clamp and slide resonator off studs.
4. Connect gage J 34730-FF to fuel pressure connection located at the back of the manifold on the fuel crossover pipe.
 - Wrap shop towel around fitting while connecting gage to avoid spilling.
5. Install bleed hose into an approved fuel container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
6. Drain any fuel remaining in gage into approved fuel container.

SERPENTINE DRIVE BELT AND TENSIONER

Figures 1 and 2

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if the belt causes belt slip to occur or if sections of the belt ribs are missing.

A single serpentine drive belt is used to drive all engine accessories. On vehicles with RPO V08 heavy-duty cooling system, an additional belt is used to drive the mechanical cooling fan. All belt driven accessories are rigidly mounted to the engine with belt tension maintained by a spring loaded tensioner.



Inspect

- The indicator just behind the tensioner pulley must fall within the acceptable range once the belt is installed. Refer to Figure 1. If the indicator mark on the tensioner does not fall within the acceptable range, check for proper installation of the belt before replacing the belt.

Drive Belts

Figure 1



Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

1. Battery negative cable.
2. Fan belt (198) from tensioner (40), if equipped with mechanical fan.
 - Use 13-mm wrench to rotate tensioner pulley clockwise while sliding belt (198) from tensioner pulley.
3. Fan belt (198) from pulleys (41 and 192), if equipped with mechanical fan.
4. Radiator outlet pipe nuts at air conditioning compressor, if equipped with mechanical fan. Refer to SECTION 6B.
5. Raise and suitably support vehicle, if equipped with mechanical fan. Refer to SECTION OA.
6. Serpentine drive belt (148) from tensioner (253).
 - Use 9/16-inch off-set wrench to rotate tensioner pulley clockwise while sliding belt (148) from tensioner pulley.
7. Serpentine drive belt (148) from accessory pulleys.



Clean

- Serpentine drive belt surfaces.



Remove or Disconnect

1. Serpentine drive belt (148) to accessory pulleys.
2. Serpentine drive belt (148) to tensioner (253).
 - Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.
3. Lower vehicle.
4. Radiator outlet pipe nuts at air conditioning compressor, if removed. Refer to SECTION 6B.
5. Fan belt (198) to pulleys (41 and 192), if removed.
6. Fan belt (198) to tensioner (40), if removed.
7. Battery negative cable.

Drive Belt Tensioners

Figure 2



Remove or Disconnect

1. Radiator fan upper shroud, if equipped. Refer to SECTION 6B.
2. Drive belts. Refer to "Drive Belts" in this section.
3. Drive belt tensioner bolts/screws (150), if removing tensioner (40).
4. Tensioner (40) from bracket.
5. Raise and suitably support vehicle, if equipped with mechanical fan. Refer to SECTION OA.
6. Drive belt tensioner bolts/screws (152).

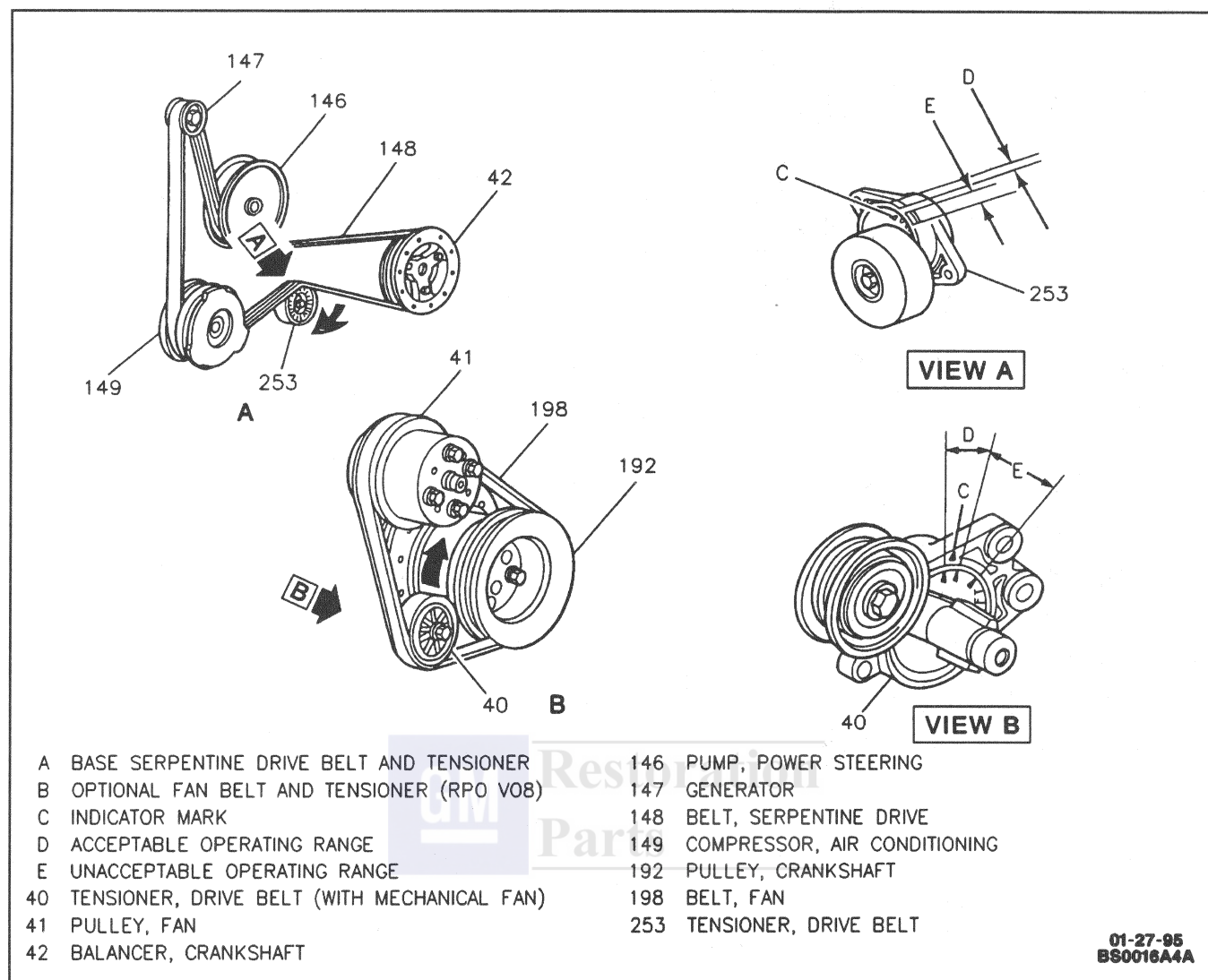


Figure 1 - Serpentine Drive Belt and Tensioner

7. Tensioner (253) from bracket.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Tensioner (253) to bracket.
2. Drive belt tensioner bolts/screws (152).

Tighten

- Drive belt tensioner bolts/screws (152) to 25 N.m (18 lb. ft.).
3. Lower vehicle.
 4. Tensioner (40) to bracket, if removed.
 5. Drive belt tensioner bolts/screws (150), if removed.

Tighten

- Drive belt tensioner bolts/screws (150) to 25 N.m (18 lb. ft.).

6. Drive belts. Refer to "Drive Belts" in this section.

7. Radiator fan upper shroud, if removed. Refer to SECTION 6B.

ENGINE MOUNTS AND BRACKETS

Figure 3

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan or any sheet metal. Due to small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pickup unit.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine mount through-bolts/screws (216) and nuts (236).
3. Raise engine with a jacking fixture.

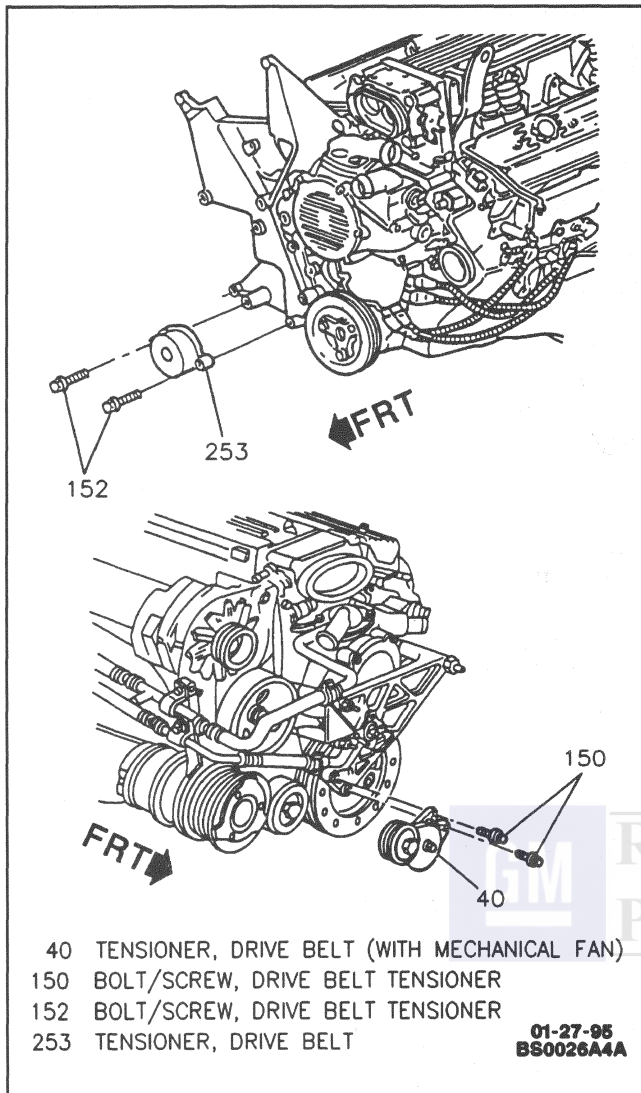


Figure 2 - Drive Belt Tensioner

4. Engine mount bolts/screws (237), engine mount nuts (238) and engine mount (208).
5. Engine mount bracket bolts/screws (215), washers (240) and engine mount brackets (239).

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Engine mount brackets (239), washers (240) and engine mount bracket bolts/screws (215).

Tighten

- Bolts/screws (215) to 47 N.m (35 lb. ft.).
2. Engine mount (208), engine mount bolts/screws (237) and engine mount nuts (238).

Tighten

- Engine mount bolts/screws (237) to 50 N.m (37 lb. ft.) -or- Engine mount nuts (238) to 48 N.m (35 lb. ft.).

3. Lower engine.
4. Engine mount through-bolts/screws (216) and nuts (236).

Tighten

- Engine mount through-bolts/screws (216) to 120 N.m (89 lb. ft.) -or- Nuts (236) to 80 N.m (59 lb. ft.).

5. Lower vehicle.

OIL LEVEL INDICATOR TUBE

Remove or Disconnect

1. Bolt/screw securing tube bracket to right lower side of engine block.
2. Level indicator tube from engine block.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Clean tube and apply sealant, GM P/N 12345493 or equivalent, around tube 12.7 mm (0.50 inch) below bead.
2. Tube into engine block and rotate into position.
3. Bolt/screw securing tube bracket.

Tighten

- Oil level indicator tube bolt/screw to 12 N.m (106 lb. in.).

INTAKE MANIFOLD

Figures 4 through 7

Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

Important

- This vehicle uses a sequential multiport fuel injected engine. Fuel injector connectors must be positioned onto their appropriate fuel injector or engine performance and exhaust emissions may be seriously affected. Fuel injector connectors are numbered to match their cylinders. If fuel injector connector numbers can not be identified, or are unreadable refer to SECTION 8A-20 for correct fuel injector connector wire color-to-fuel injector for each cylinder.

1. Battery negative cable.
2. Drain coolant. Refer to SECTION 6B.
3. Resonator bracket nuts (243).
4. Resonator (244).
 - Loosen clamp (242) and slide resonator (244) off studs (241).

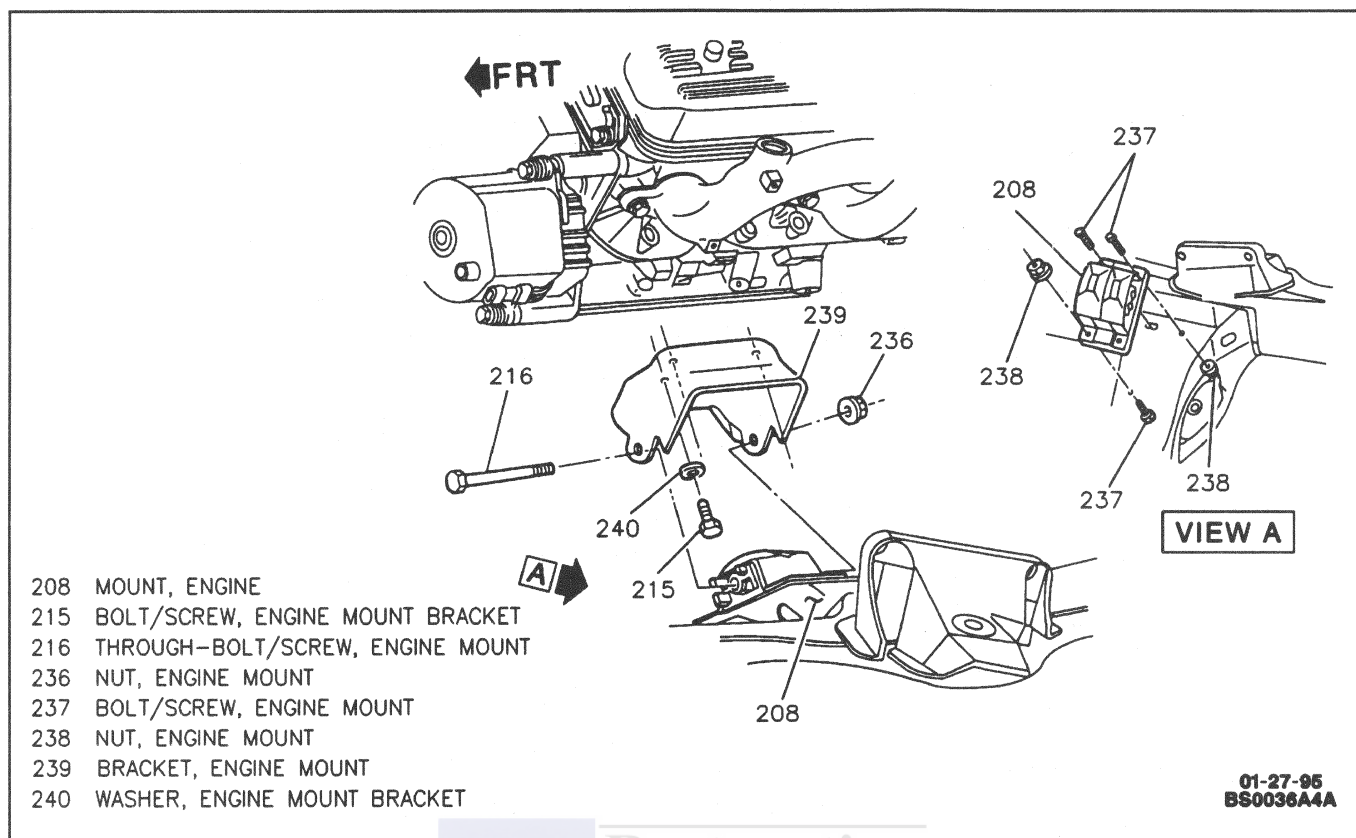


Figure 3 - Engine Mounts and Brackets

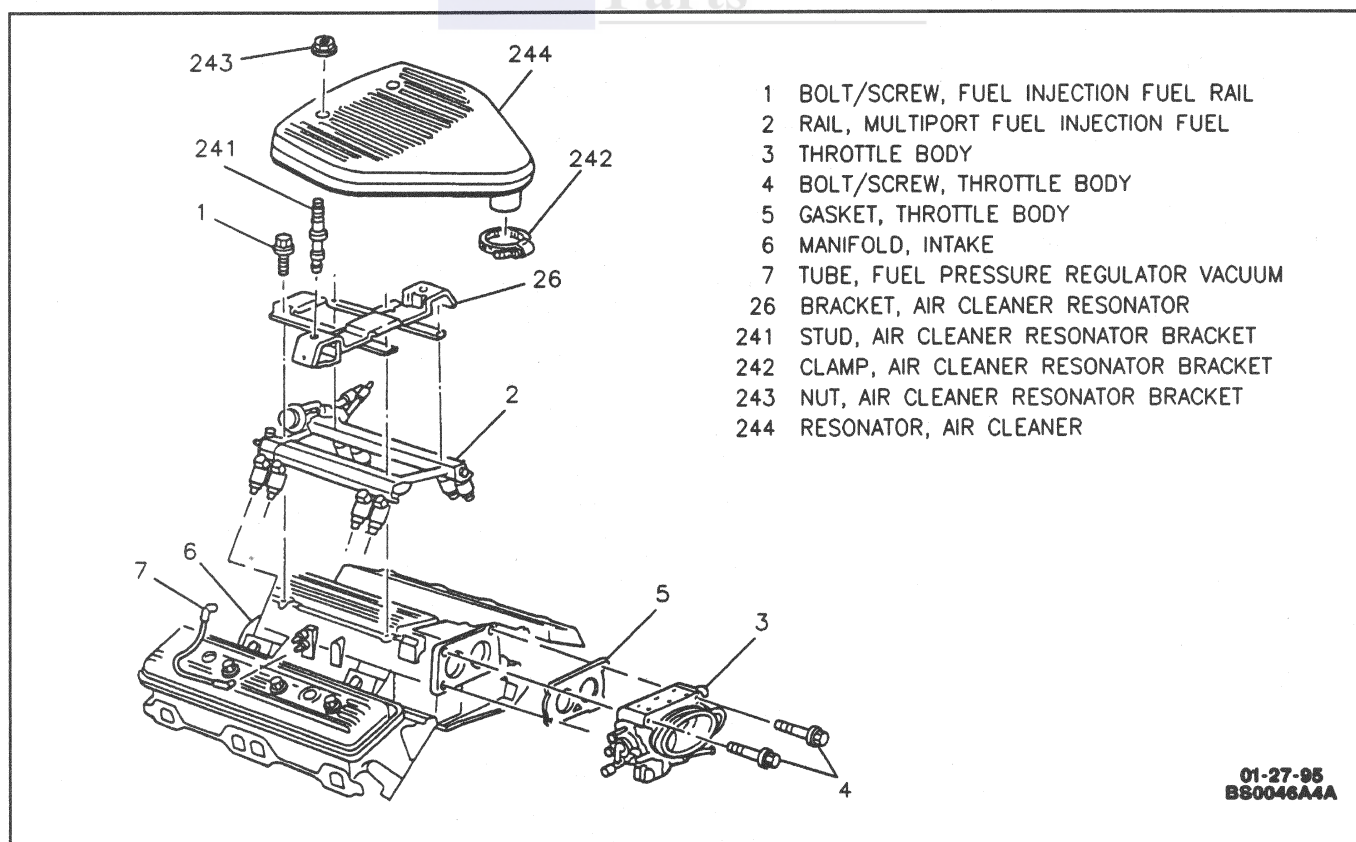


Figure 4 - Fuel Rail and Throttle Body

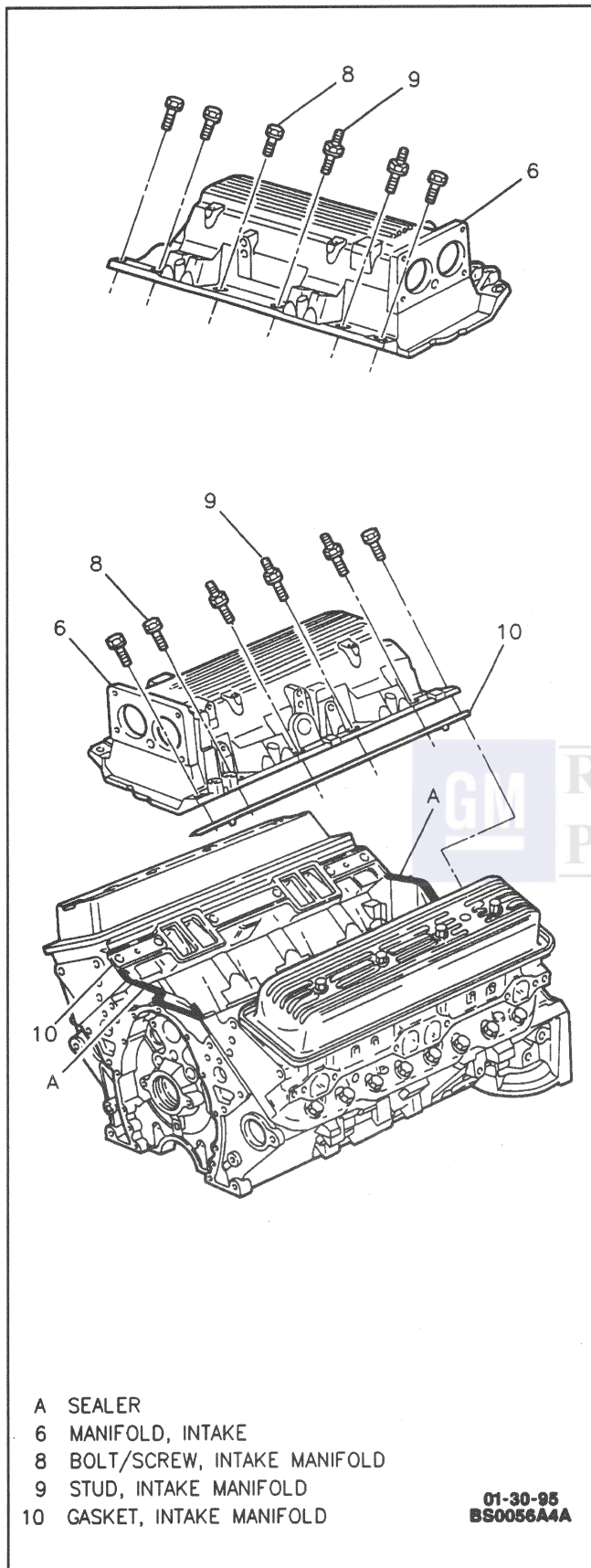


Figure 5 - Intake Manifold

5. Throttle body air duct.
6. Wiring harness connectors from fuel injectors.
7. Left and right wiring harness clips.
 - Lay wiring harnesses aside.
8. Accelerator control cable at throttle body (3).
9. Accelerator control cable bracket bolts/screws and bracket from throttle body (3).
10. Relieve fuel system pressure. Refer to "Fuel System Pressure Relief" in this section.
11. Fuel pipe connectors from fuel rail. Refer to SECTION 6C.
12. Fuel rail bolts/screws (1).
13. Resonator bracket (26) with canister purge solenoid attached.
14. Fuel pressure regulator vacuum tube (7).
15. Fuel rail (2) from intake manifold (6) and lay aside.
16. Exhaust gas recirculation (EGR) and distributor vacuum harness and crankcase vent hoses.
 - Plug all open vacuum/vent hoses.
17. Exhaust gas recirculation (EGR) control valve relay solenoid nut and control valve relay.
18. EGR valve pipe nuts (14), bolt/screw (229), pipe (12) and gasket (22).
 - Discard gasket (22).
19. Engine wiring harness bracket and nuts at left front corner of intake manifold (6).
20. Coolant hoses from throttle body (3).
21. Throttle body bolts/screws (4), throttle body (3) and gasket (5).
22. Intake manifold bolts/screws (8) and studs (9).
23. Intake manifold (6) and gaskets (10).
 - Discard gaskets (10).



Clean

- Intake manifold bolts/screws (8) and studs (9).
- Cylinder head, engine block and intake manifold sealing surfaces.



Install or Connect

NOTICE: Refer to "NOTICE" on page 6A4A-1 of this section.

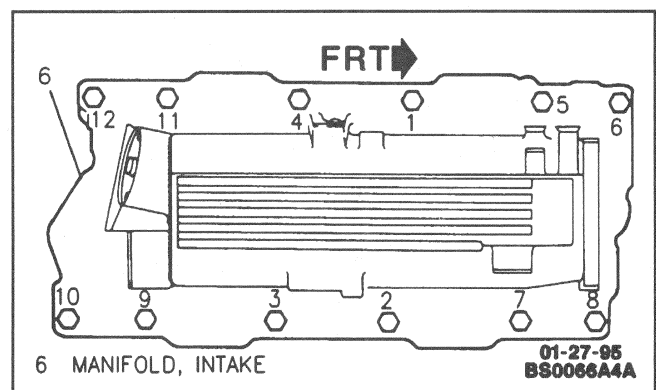


Figure 6 - Intake Manifold Tightening Sequence

1. Apply 5 mm (3/16-inch) bead of RTV sealer, GM P/N 1052366 or equivalent, to the front and rear of the engine block. Extend the bead 13 mm (1/2 inch) up each cylinder head to seal and retain the gaskets.
2. Intake manifold (6) with new gaskets (10).
3. Intake manifold bolts/screws (8) and studs (9).

Tighten

- Intake manifold bolts/screws (8) and studs (9) in a first pass to 8 N.m (71 lb. in.) in sequence as shown in Figure 6. Tighten in sequence in a second pass to final specifications of 48 N.m (35 lb. ft.).
4. Throttle body (3), gasket (5) and throttle body bolts/screws (4).

Tighten

- Throttle body bolts/screws (4) to 25 N.m (18 lb. ft.).
5. Coolant hoses to throttle body (3).
 6. Engine wiring harness bracket and nuts at left front corner of intake manifold (6).
 7. Gasket (22), EGR valve pipe (12), nuts (14) and bolt/screw (229).
 8. EGR control valve relay solenoid and nut.

Tighten

- EGR valve pipe nuts (14) to 25 N.m (18 lb. ft.).
 - EGR valve pipe bolt/screw (229) to 25 N.m (18 lb. ft.).
 - EGR control valve relay solenoid nut to 25 N.m (18 lb. ft.).
9. Exhaust Gas Recirculation (EGR) and distributor vacuum harness and crankcase vent hoses.
 10. Fuel rail (2) to intake manifold (6).
 11. Fuel pressure regulator vacuum tube (7).
 12. Resonator bracket (26) with canister purge solenoid attached.
 13. Fuel rail bolts/screws (1).

Tighten

- Fuel rail bolts/screws (1) to 10 N.m (89 lb. in.).
14. Fuel pipe connectors to fuel rail. Refer to SECTION 6C.
 15. Accelerator control cable bracket and bolts/screws to throttle body (3).

Tighten

- Accelerator control cable bracket and bolts/screws to 12 N.m (106 lb. in.).
16. Accelerator control cable at throttle body (3).
 17. Left and right wiring harness clips and harnesses.
 18. Wiring harness connectors to their appropriate fuel injector.

19. Throttle body air duct.
20. Resonator (244).
 - Slide resonator over studs (241) and tighten clamp (242) until snug.
21. Resonator bracket nuts (243).

Tighten

- Nuts (243) to 10 N.m (89 lb. in.).
22. Battery negative cable.
 23. Refill and bleed cooling system. Refer to SECTION 6B.

EXHAUST MANIFOLDS

Figures 7 and 8

Right Exhaust Manifold

Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

1. Battery negative cable.
2. Warm up three-way catalytic converter and gasket from exhaust manifold. Refer to SECTION 6F.
3. Oil level indicator tube. Refer to "Oil Level Indicator Tube" in this section.
4. Secondary air injection pipe fitting from exhaust manifold (19).
5. Generator rear lower braces. Refer to SECTION 6D3.
6. Exhaust manifold bolts/screws (21), studs (20) and spacers (245).
7. Exhaust manifold (19) and exhaust manifold gasket (18).

Clean

- Exhaust manifold and cylinder head sealing surfaces.
- Cylinder head exhaust manifold bolt/screw holes with a 3/8 inch - 16 NC tap, then flush out holes with brake cleaner solvent GM P/N 12345754 or equivalent.
- Exhaust manifold bolts/screws.

Install or Connect

NOTICE: Refer to "NOTICE" on page 6A4A-1 of this section.

1. Exhaust manifold gasket (18) and exhaust manifold (19).
 - Foil side of gasket (18) must face manifold (19).
2. Apply an 8mm (1/4 inch) band of GM PN 12345493 adhesive to bolts/screws (21) threads (figure 8).

3. Exhaust manifold spacers (245), studs (20) and bolts/screws (21).

 Tighten

- Exhaust manifold studs (20) and bolts/screws (21) to 35 N.m (26 lb. ft.).
4. Generator rear lower braces. Refer to SECTION 6D3.
 5. Oil level indicator tube. Refer to "Oil Level Indicator Tube" in this section.
 6. Warm up three-way catalytic converter and gasket to exhaust manifold. Refer to SECTION 6F.
 7. Secondary air injection pipe fitting to exhaust manifold (19).

 Tighten

- Secondary air injection pipe fitting to 55 N.m (41 lb. ft.).
8. Battery negative cable.

Left Exhaust Manifold

 Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

1. Battery negative cable.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Warm up three-way catalytic converter and gasket from exhaust manifold. Refer to SECTION 6F.
4. Lower vehicle.
5. Secondary air injection pipe fitting from exhaust manifold (16).
6. Exhaust manifold bolts/screws (21), spacers (245) and stud (20).
7. Exhaust manifold (16) and exhaust manifold gasket (17).

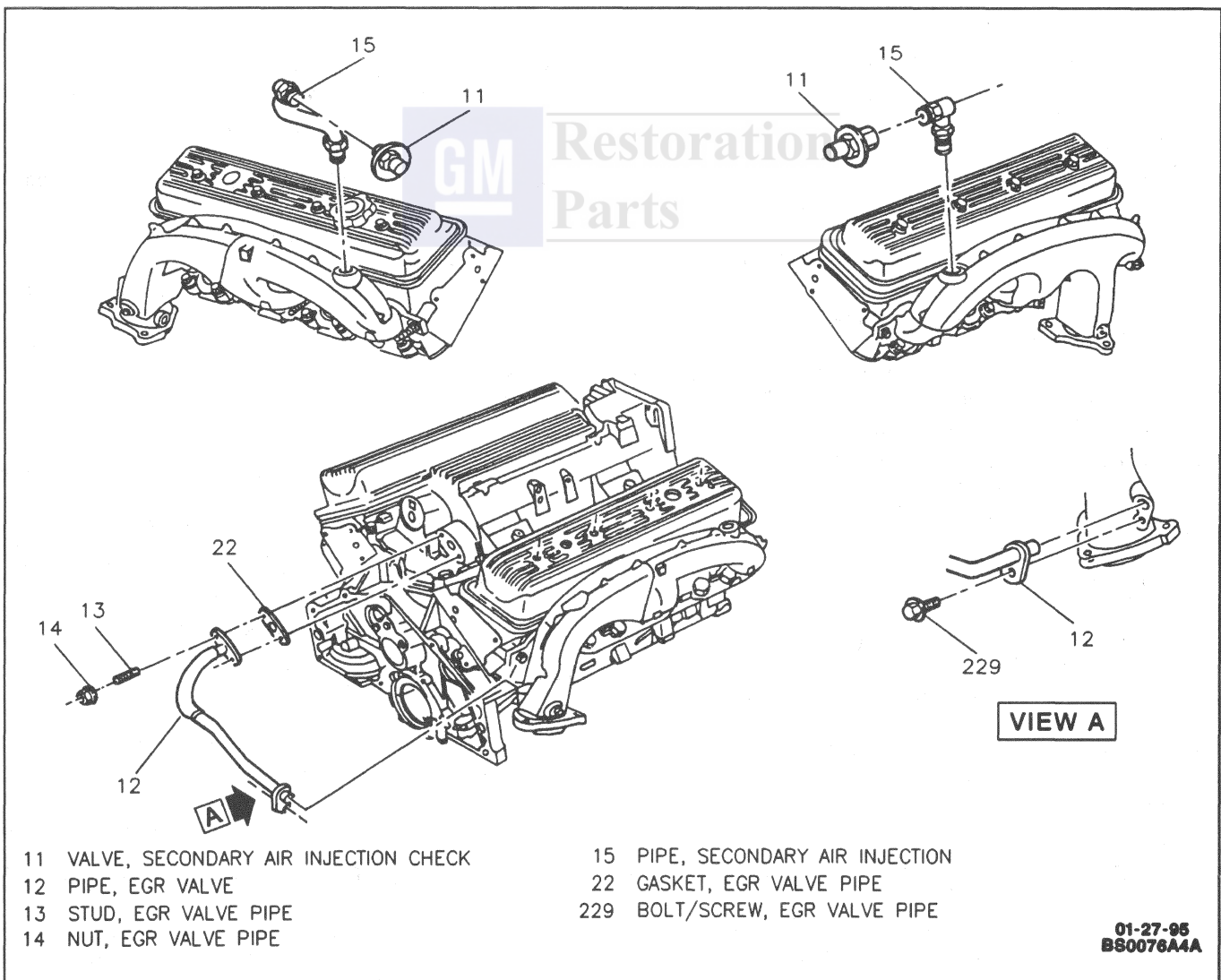


Figure 7 - Secondary Air Injection and EGR Valve Pipes



Clean

- Exhaust manifold and cylinder head sealing surfaces.
- Cylinder head exhaust manifold bolt/screw holes with a 3/8 inch - 16 NC tap, then flush out holes with brake cleaner solvent GM P/N 12345754 or equivalent.
- Exhaust manifold bolts/screws.



Install or Connect

NOTICE: Refer to "NOTICE" on page 6A4A-1 of this section.

1. Exhaust manifold gasket (17) and exhaust manifold (16).
 - Foil side of gasket must face manifold (16).
2. Apply an 8mm (1/4 inch) barrel of GM P/N 12345493 adhesive to bolts/screws (21) threads (Figure 8).
3. Exhaust manifold bolts/screws (21), studs (20) and spacers (245).



Tighten

- Exhaust manifold bolts/screws (21) and stud (20) to 35 N.m (26 lb. ft.).
4. Secondary air injection pipe fitting to exhaust manifold (16).



Tighten

- Secondary air injection pipe fitting to 55 N.m (41 lb. ft.).
5. Raise and suitably support vehicle. Refer to SECTION 0A.
 6. Warm up three-way catalytic converter and gasket to exhaust manifold. Refer to SECTION 6F.
 7. Lower vehicle.
 8. Battery negative cable.

VALVE ROCKER ARM COVERS

Figure 9

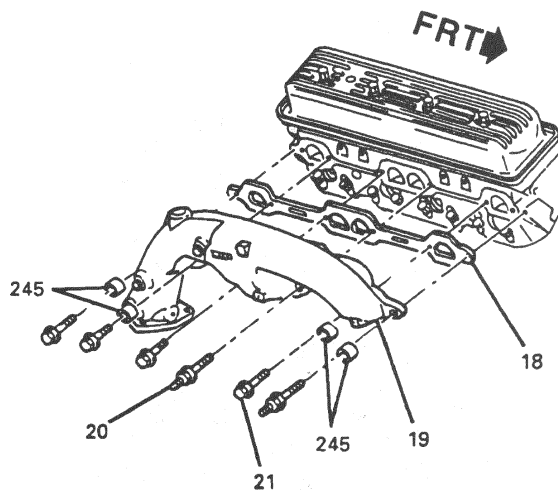
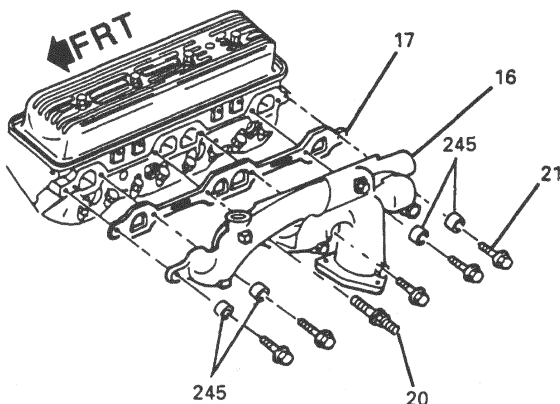
Right Cover



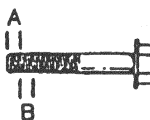
Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

1. Battery negative cable.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Serpentine drive belt from drive belt tensioner. Refer to "Serpentine Drive Belt and Tensioner" in this section.
4. Transmission fluid level indicator tube bracket from transmission housing and rear of cylinder head.



- A 1-3 THREADS FREE OF ADHESIVE
 B APPLY 8 mm (1/4 INCH) BAND OF ADHESIVE TO THE FULL CIRCUMFERENCE OF THREADS
- 16 MANIFOLD, EXHAUST
 17 GASKET, EXHAUST MANIFOLD
 18 GASKET, EXHAUST MANIFOLD
 19 MANIFOLD, EXHAUST
 20 STUD, EXHAUST MANIFOLD
 21 BOLT/SCREW EXHAUST MANIFOLD
 245 SPACER, EXHAUST MANIFOLD



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Figure 8 - Exhaust Manifolds

5. Lower vehicle.
6. Crankcase vent hose.
7. Generator. Refer to SECTION 6D3.
8. Rocker arm cover bolts/screws (24).
9. Rocker arm cover (23) and gasket (25).



Clean

- Rocker arm cover and cylinder head gasket surfaces.



Install or Connect

NOTICE: Refer to "NOTICE" on page 6A4A-1 of this section.

1. Gasket (25) and rocker arm cover (23).
2. Rocker arm cover bolts/screws (24).



Tighten

- Rocker arm cover bolts/screws (24) to 12 N.m (108 lb. in.).
3. Crankcase vent hose.
 4. Generator. Refer to SECTION 6D3.
 5. Raise and suitably support vehicle. Refer to SECTION 0A.
 6. Transmission fluid level indicator tube to transmission housing and rear of cylinder head.

7. Serpentine drive belt to drive belt tensioner. Refer to "Serpentine Drive Belt and Tensioner" in this section.
8. Lower vehicle.
9. Battery negative cable.

Left Cover



Install or Connect

1. Resonator bracket nuts (243).
2. Resonator (244).
 - Loosen clamp (242) and slide resonator (244) off studs (241).
3. Brake booster vacuum hose.
4. Rocker arm cover bolts/screws (24).
5. Rocker arm cover (23) and gasket (25).



Clean

- Rocker arm cover and cylinder head gasket surfaces.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Gasket (25) and rocker arm cover (23).
2. Rocker arm cover bolts/screws (24).



Tighten

- Rocker arm cover bolts/screws (24) to 12 N.m (106 lb. in.).
3. Brake booster vacuum hose.
 4. Resonator (244).
 - Slide resonator (244) over studs (241) and tighten clamp (242) snugly.
 5. Resonator bracket nuts (243).



Tighten

- Nuts (243) to 10 N.m (89 lb. in.).

VALVE ROCKER ARMS AND PUSHRODS

Figures 9 and 10



Install or Connect

1. Valve rocker arm covers. Refer to "Valve Rocker Arm Covers" in this section.
2. Rocker arm nuts (31) and rocker arm balls (30).
3. Rocker arms (29) and pushrods (27).
 - Place the rocker arms (29), rocker arm balls (30) and pushrods (27) in a rack so that they can be reinstalled in the same locations from which they were removed.

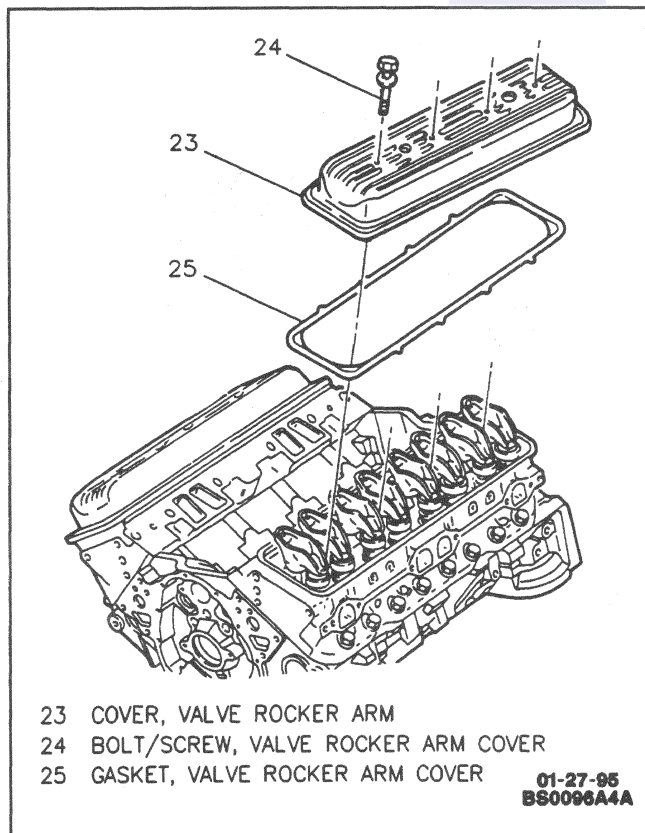


Figure 9 - Valve Rocker Arm Cover

! Important

- Refer to SECTION 6A4B for inspection of the rocker arms, studs and pushrods.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

! Important

- When installing rocker arms (29) and rocker arm balls (30), coat their bearing surfaces with prelude, GM P/N 1052365 or equivalent. Install these components and the pushrods (27) in the locations from which they were removed.

1. Pushrods (27).
 - Make sure pushrods (27) seat in lifter sockets.
2. Rocker arms (29).
3. Rocker arm balls (30) and rocker arm nuts (31).

⌚ Tighten

- Rocker arm nuts (31) until all lash is eliminated.

🔑 Adjust

1. Turn crankshaft until arrow on crankshaft hub (45) and balancer (42) are in 12 o'clock position and number 1 cylinder is in firing position (top dead center). Refer to Figure 15.
 - Watch number 1 cylinder valves as arrow approaches 12 o'clock position. If a valve moves as the arrow moves to position, the engine is in number 6 cylinder firing position. Crankshaft must then be turned one more time to reach number 1 cylinder firing position.
2. With engine in number 1 cylinder firing position, the following valves can be adjusted:
 - Exhaust 1, 3, 4, 8
 - Intake 1, 2, 5, 7
3. Back off rocker arm nut (31) until lash is felt in pushrod (27). Then tighten rocker arm nut (31) until all lash is removed. Zero lash can be felt by moving pushrod (27) up and down using thumb and forefinger until there is no more movement.
4. When all free play has been removed, tighten rocker arm nut (31) one additional turn.
5. Turn crankshaft one revolution until arrow is again at 12 o'clock position. This is number 6 cylinder firing position. The following valves can now be adjusted:
 - Exhaust 2, 5, 6, 7
 - Intake 3, 4, 6, 8
6. Install valve rocker arm covers. Refer to "Valve Rocker Arm Covers" in this section.

ROCKER ARM STUDS

Figures 10, 11 and 12

Tools Required:

- J 5802-01 Stud Remover
- J 5715 Reamer (0.0762 mm (0.003 inch) oversize)
- J 6036 Reamer (0.3302 mm (0.013 inch) oversize)
- J 6880 Stud Installer

Rocker arm studs that have damaged valve rocker arm nut threads should be replaced with new studs. This engine uses rocker arm studs that are pressed into the cylinder head. New studs are available in 0.0762 mm (0.003 inch) and 0.3302 mm (0.013 inch) oversize.

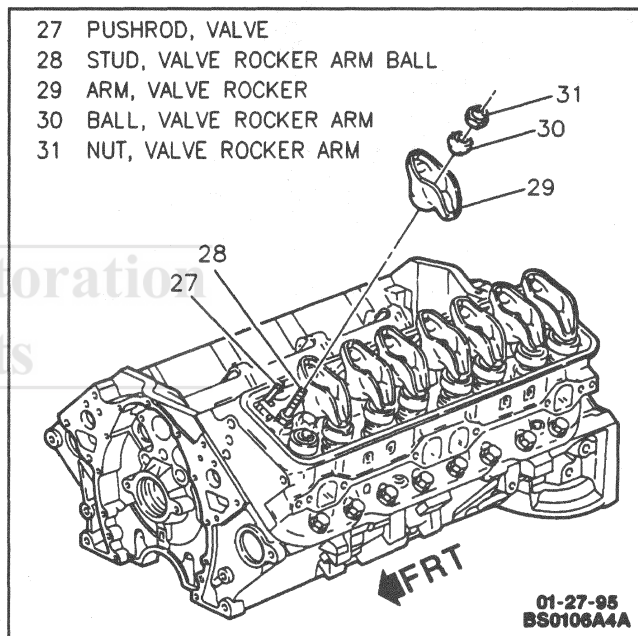


Figure 10 - Valve Rocker Arms and Pushrods

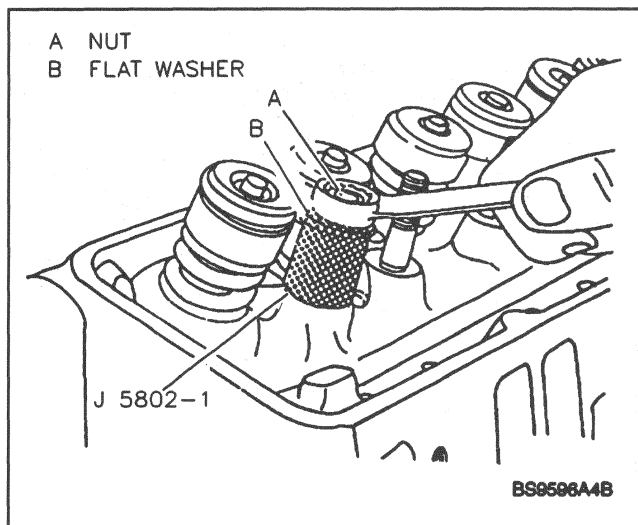


Figure 11 - Removing The Rocker Arm Stud

Remove or Disconnect

1. Valve rocker arm cover. Refer to "Valve Rocker Arm Covers" in this section.
2. Valve rocker arm. Refer to "Valve Rocker Arms and Pushrods" in this section.
3. Place J 5802-01 over the stud to be removed. Install a nut and flat washer. Remove the stud by turning the nut. Refer to Figure 11.
4. Ream the hole to the proper size for the replacement oversize stud. Use J 5715 for 0.0762 mm (0.003 inch) oversize studs; J 6036 for

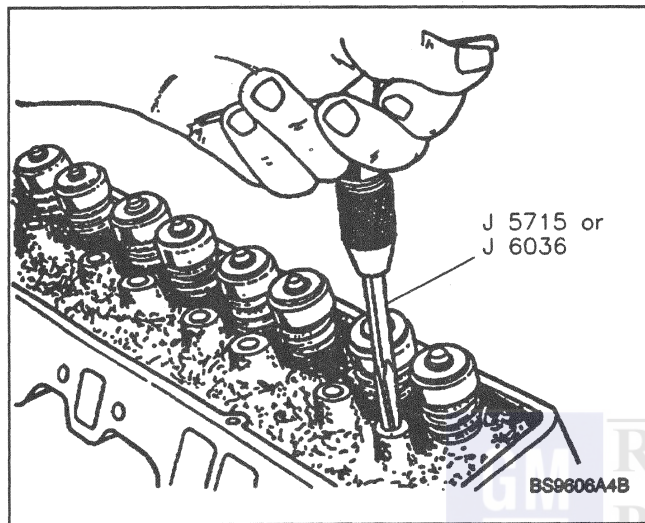


Figure 12 - Reaming The Rocker Arm Stud Bore

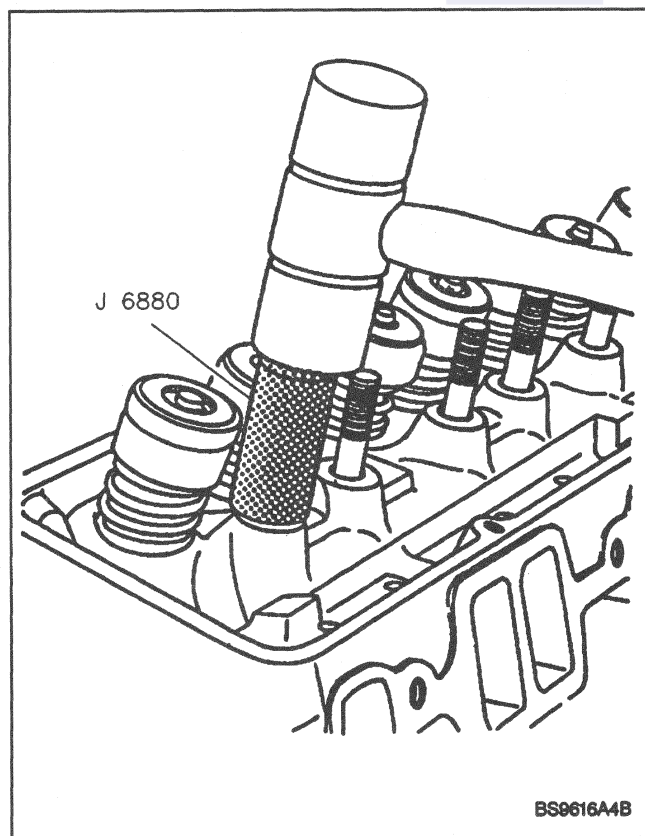


Figure 13 - Installing The Rocker Arm Stud

0.3302 mm (0.013 inch) oversize studs. Refer to Figure 12.

5. Coat lower end (press fit area) of stud with hypoid axle lubricant. Drive stud into place with a hammer and J 6880. Stud is installed to proper depth when the tool bottoms on the cylinder head. Refer to Figure 13

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Apply sealer, GM P/N 1052080 or equivalent, to threads of new rocker arm stud.
2. Rocker arm stud (28).

Tighten

- Rocker arm stud (28) to 68 N.m (50 lb. ft.).
3. Valve rocker arms. Refer to "Valve Rocker Arms and Pushrods" in this section.
 4. Valve rocker arm cover. Refer to "Valve Rocker Arm Covers" in this section.

VALVE LIFTERS

Figure 14

Tools Required:

J 3049-A Hydraulic Valve Lifter Remover (Plier Type)

J 9290-01 Hydraulic Valve Lifter Remover (Slide Hammer Type)

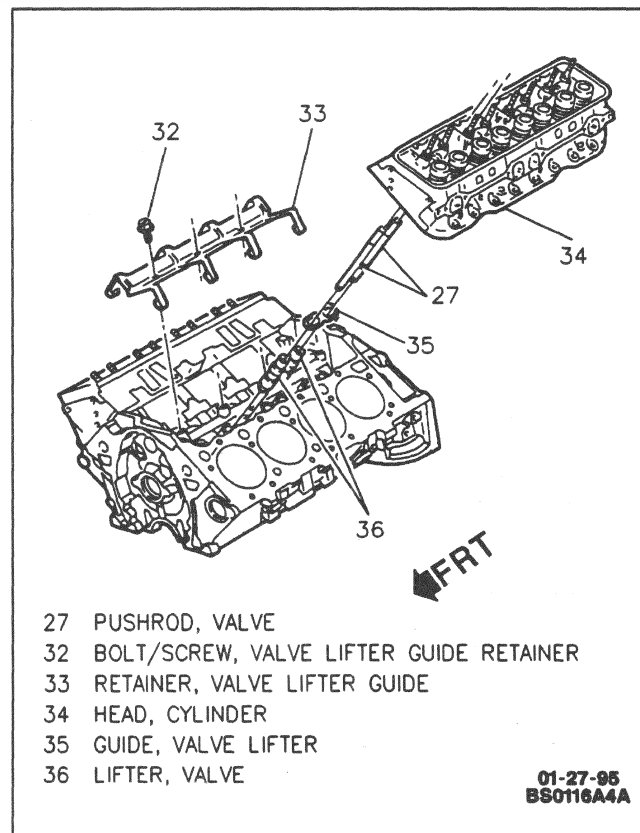


Figure 14 - Valve Lifters

4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P 6A4A-13

No service parts are available for valve lifters. They are replaced as a unit when worn and when a new camshaft is installed.

Remove or Disconnect

1. Intake manifold. Refer to "Intake Manifold" in this section.
2. Valve rocker arm covers. Refer to "Valve Rocker Arm Covers" in this section.
3. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
4. Valve lifter guide retainer (33) and bolts/screws (32).
5. Valve lifter guide (35) and valve lifter (36).
 - Some valve lifters (36) may be stuck in their bores because of gum or varnish deposits. These valve lifters (36) can be removed using J 3049-A or J 9290-01.

Important

- Refer to SECTION 6A4B for inspection of the valve lifters.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Coat valve lifter rollers with prelube, GM P/N 1052365 or equivalent.

2. Valve lifters (36) in the same location from which they were removed.
3. Valve lifter guides (35), valve lifter guide retainer (33) and bolts/screws (32).
4. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
5. Valve rocker arm covers. Refer to "Valve Rocker Arm Covers" in this section.
6. Intake manifold. Refer to "Intake Manifold" in this section.

Tighten

- Bolts/screws (32) to 25 N·m (18 lb. ft.).

WATER PUMP

Figure 16

The water pump is gear driven by the camshaft sprocket using a drive shaft and coupling. Keep ignition wires connected to the distributor until the water pump is removed and all coolant has been drained.

Remove or Disconnect

1. Drain engine coolant. Refer to SECTION 6B.
2. Air cleaner resonator bracket nuts, if equipped with mechanical fan.
3. Air cleaner resonator, if equipped with mechanical fan.
 - Loosen clamp and slide resonator off studs.

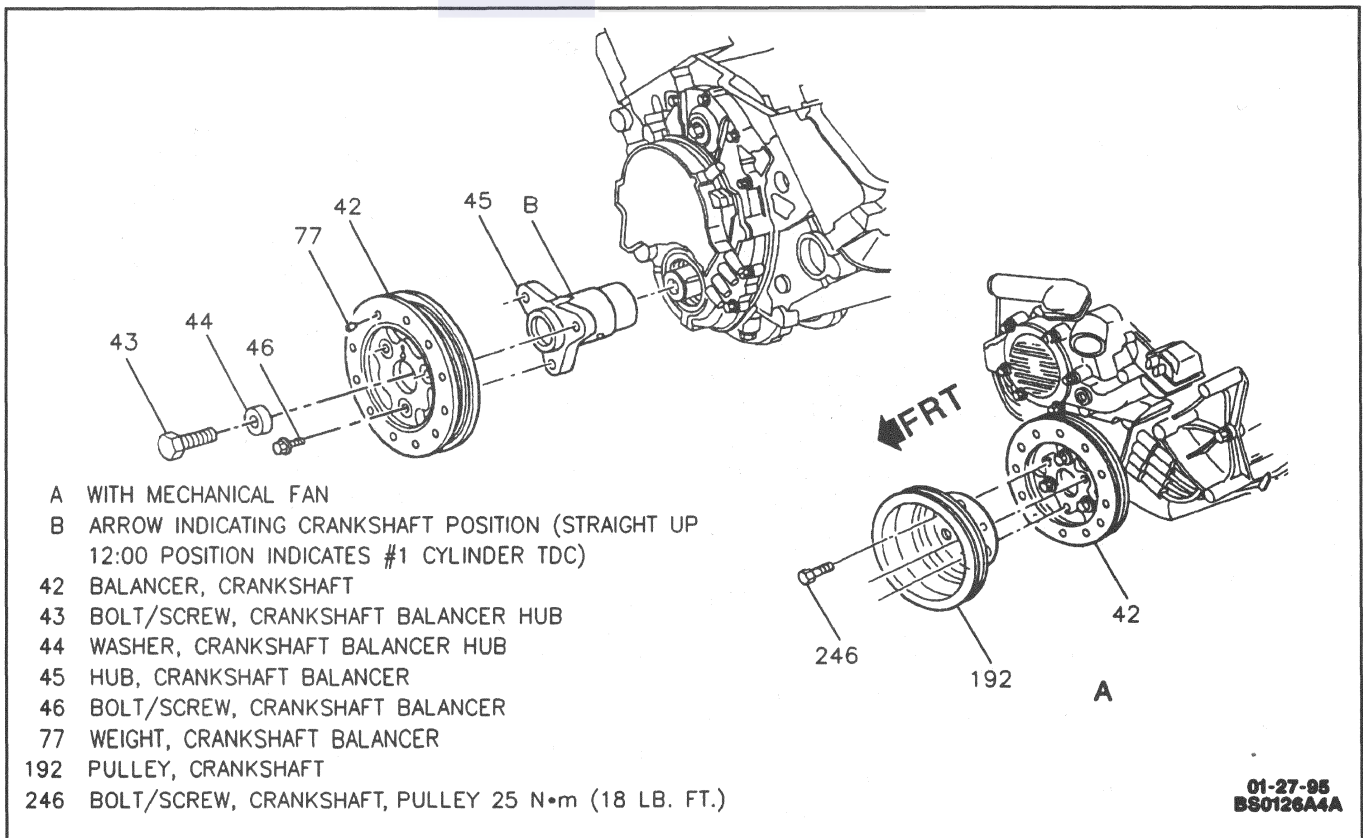


Figure 15 - Crankshaft Balancer and Hub

6A4A-14 4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P

4. Air intake duct, if equipped with mechanical fan.
5. Radiator fan upper shroud, if equipped with mechanical fan. Refer to SECTION 6B.
6. Fan belt from tensioner, if equipped with mechanical fan.
7. Fan blade clutch nuts (247) and fan blade (249) with clutch attached, if equipped with mechanical fan.
8. Engine coolant and heater hoses from water pump (37).
9. Fan pulley (41), if equipped with mechanical fan.
10. Coolant fan pulley bracket nuts (132), if equipped with mechanical fan.
11. Coolant fan pulley bracket (130), if equipped with mechanical fan.
12. Electrical connector from coolant sensor.
13. Secondary air injection pump and bracket. Refer to SECTION 6E3.
14. Water pump bolts/screws (127 and 129) and stud (128).
15. Water pump (37) and gaskets (38).

16. Water pump driveshaft coupling (39) and seals (156).
 - Discard seals (156).



Clean

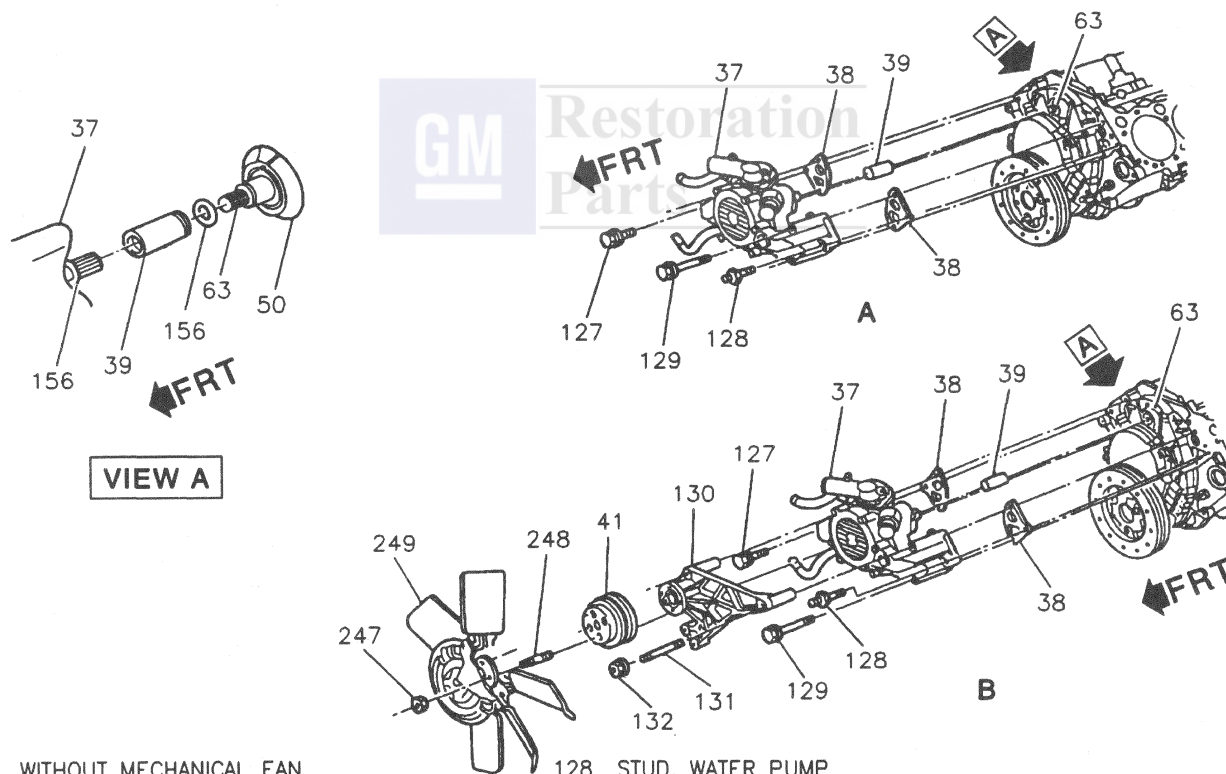
- Water pump gasket surfaces.
- Water pump bolts/screws (127 and 129).
- Coolant fan pulley bracket studs (131), if removed.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Water pump driveshaft coupling (39) and new seals (156).
2. Water pump (37) and gaskets (38).
3. Water pump bolts/screws (127 and 129) and stud (128).



- A WITHOUT MECHANICAL FAN
 B WITH MECHANICAL FAN
 37 PUMP, WATER
 38 GASKET, WATER PUMP
 39 COUPLING, WATER PUMP DRIVESHAFT
 41 PULLEY, FAN
 50 COVER, ENGINE FRONT
 63 DRIVESHAFT, WATER PUMP
 127 BOLT/SCREW, WATER PUMP

- 128 STUD, WATER PUMP
 129 BOLT/SCREW, WATER PUMP
 130 BRACKET, COOLANT FAN PULLEY
 131 STUD, COOLANT FAN PULLEY BRACKET
 132 NUT, COOLANT FAN PULLEY BRACKET
 156 SEAL, WATER PUMP DRIVESHAFT
 247 NUT, FAN BLADE CLUTCH
 248 STUD, FAN BLADE CLUTCH
 249 BLADE, FAN

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Figure 16 - Water Pump



Tighten

- Bolts/screws (127 and 129) and stud (128) to 40 N.m (30 lb. ft.).
- 4. Secondary air injection pump and bracket. Refer to SECTION 6E3.
- 5. Electrical connector to coolant sensor.
- 6. Coolant fan pulley bracket (130), if removed.
- 7. Coolant fan pulley bracket nuts (132), if removed.



Tighten

- Nuts (132) to 50 N.m (37 lb. ft.).
- 8. Fan pulley (41), if removed.
- 9. Fan blade (249) with clutch attached and nuts (247), if removed.



Tighten

- Nuts (247) to 26 N.m (19 lb. ft.).
- 10. Engine coolant and heater hoses to water pump (37).
- 11. Fan belt to tensioner, if removed.
- 12. Radiator fan upper shroud, if removed. Refer to SECTION 6B.
- 13. Air intake duct, if removed.
- 14. Air cleaner resonator, if removed.
 - Slide resonator over studs and tighten clamp until snug.
- 15. Air cleaner resonator bracket nuts, if removed.



Tighten

- Nuts to 10 N.m (89 lb. in.).
- 16. Refill and bleed cooling system. Refer to SECTION 6B.

CRANKSHAFT BALANCER AND HUB

Figures 15 and 22

Tool Required:
J 39046 Crankshaft Hub Remover and Installer



Remove or Disconnect

1. Raise and suitably support vehicle, if equipped with mechanical fan. Refer to SECTION 0A.
2. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner" in this section.
3. Crankshaft pulley bolts/screws (246) and pulley (192), if equipped with mechanical fan.
4. Balancer bolts/screws (46) and balancer (42).
5. Match mark crankshaft hub (45) to engine front cover.
 - Do not crank engine over after match marking crankshaft hub and engine front cover. Rotating crankshaft will misalign installation of crankshaft hub and balancer-to-crankshaft,

possibly resulting in engine imbalance. If engine must be rotated, then alternative method of alignment is outlined during installation.

6. Crankshaft hub bolt/screw (43) and washer (44).
7. Crankshaft hub (45) using J 39046.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Crankshaft hub (45) using J 39046.



Important

- The crankshaft hub (45) can be installed by a different procedure if the engine should accidentally be cranked over after match marking the hub and engine front cover.
 - A. Set number 1 piston to top dead center. When number 1 piston is at top dead center, crankshaft keyway should be in position shown in Figure 22.
 - B. Install crankshaft hub (45) with cast arrow on hub in the 12 o'clock position.
- 2. Crankshaft hub washer (44) and bolt/screw (43).
 - If balancer is replaced, new balance weights of the same size must be installed on the new balancer in the same hole locations used on the old balancer.
- 3. Crankshaft balancer (42) and bolts/screws (46).



Tighten

- Crankshaft balancer hub bolt/screw (43) to 100 N.m (74 lb. ft.).
- Crankshaft balancer bolts/screws (46) to 85 N.m (63 lb. ft.).
- 4. Crankshaft pulley (192) and bolts/screws (246), if removed.



Tighten

- A. Crankshaft pulley bolts/screws (246) in clockwise pattern to 10 N.m (89 lb. in.).
- B. Tighten again in clockwise pattern to 25 N.m (18 lb. ft.).
5. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner" in this section.
6. Lower vehicle.

DISTRIBUTOR

The distributor is mounted to the engine front cover and pin driven by the camshaft. Refer to SECTION 6D4 for the distributor service procedures.

CRANKSHAFT POSITION SENSOR

Figure 17

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Electrical connector from sensor (86).
3. Bolt/screw (87).
4. Sensor (86) from engine front cover.

Inspect

- Seal and cover surface. Replace seal if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Sensor (86) to engine front cover.
2. Bolt/screw (87).

Tighten

- Bolt/screw to (87) 12 N.m (106 lb. in.).
3. Electrical connector to sensor (86).
 4. Lower vehicle.

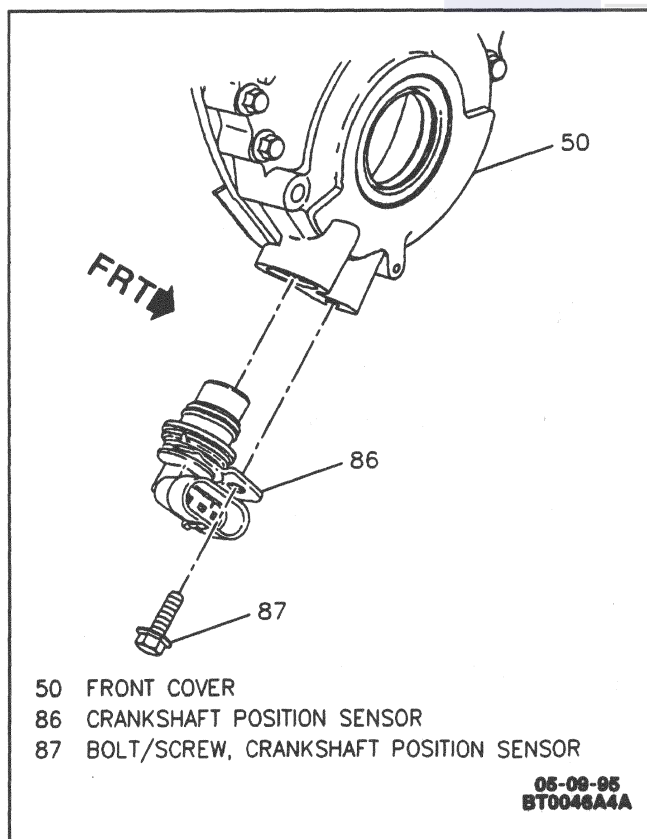


Figure 17 - Crankshaft Position Sensor

ENGINE FRONT COVER

Figure 18

Tool Required:

- J 39087 Driven Gear Shaft Front Cover Seal Protector
- J 39937 Distributor Driveshaft Front Cover Seal Installer

Remove or Disconnect

1. Water pump. Refer to "Water Pump" in this section.
2. Crankshaft balancer and hub. Refer to "Crankshaft Balancer and Hub" in this section.
3. Distributor. Refer to SECTION 6D4.
4. Oil pan. Refer to "Oil Pan" in this section.
5. Engine front cover bolts/screws (52).
6. Engine front cover (50) and gasket (51).
7. Crankshaft position sensor from engine front cover if replacing cover. "Refer to Crankshaft Position Sensor" in this section.
8. Distributor driveshaft seal from engine front cover (50).
 - Pry out with flat-bladed tool.

Clean

- Engine front cover and engine block gasket surfaces.

Inspect

- Engine front cover (50) for damage to the seals or gasket surface. Refer to SECTION 6A4B to replace front cover seals if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

NOTICE: Be careful not to damage the seal when installing the engine front cover over the water pump driveshaft.

1. New distributor driveshaft seal to engine front cover (50) using J 39937.
2. Crankshaft position sensor to front cover if removed. Refer to "Crankshaft Position Sensor" in this section.
3. Gasket (51) and engine front cover (50) using J 39087 on water pump driveshaft.
4. Engine front cover bolts/screws (52).

Tighten

- Engine front cover bolts/screws (52) to 11 N.m (100 lb. in.).
5. Oil pan. Refer to "Oil Pan" in this section.
 6. Distributor. Refer to SECTION 6D4.

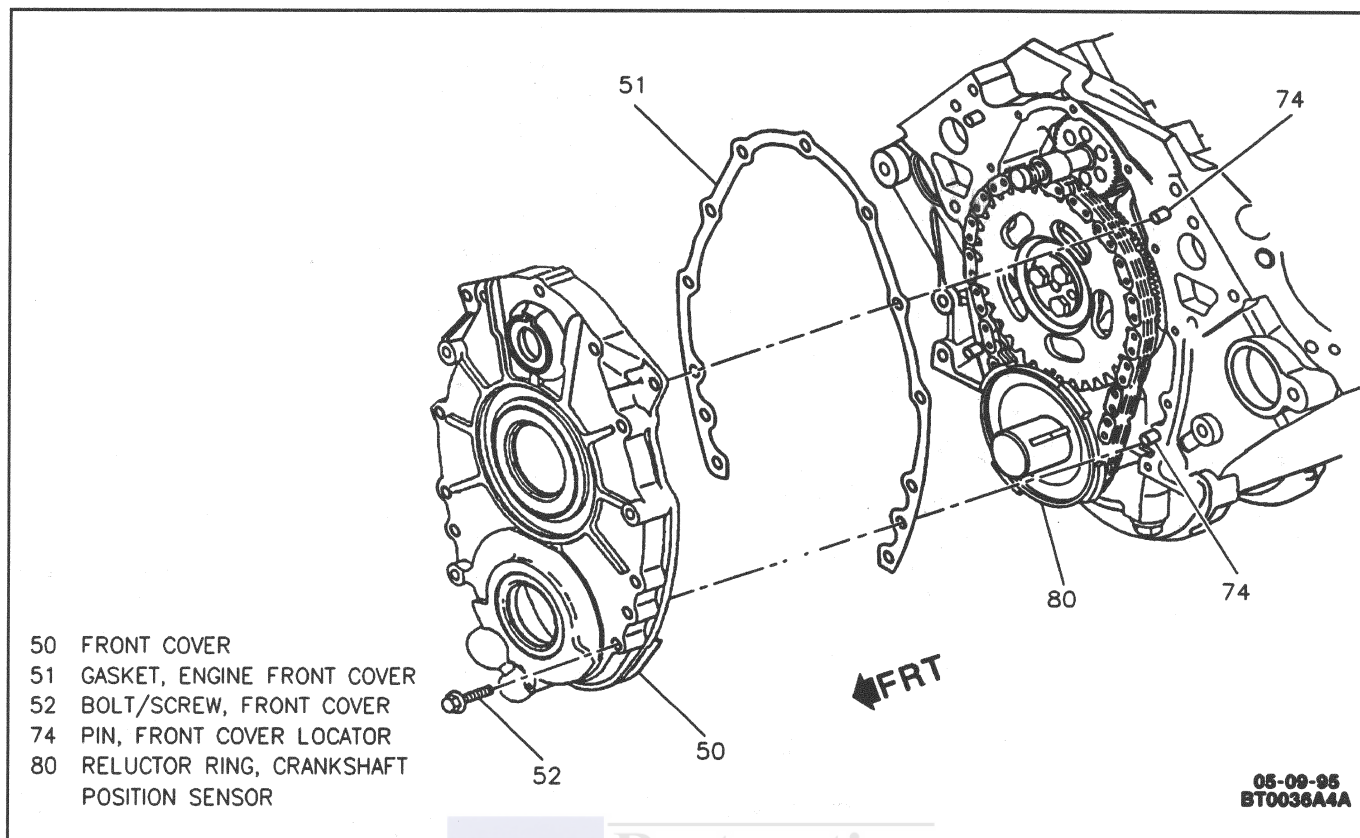


Figure 18 - Engine Front Cover

7. Crankshaft balancer and hub. Refer to "Crankshaft Balancer and Hub" in this section.

! Important

- Crankshaft balancer and hub must be oriented correctly on crankshaft or an engine vibration may result.
8. Water pump. Refer to "Water Pump" in this section.

TIMING CHAIN, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT

Figures 18 through 22

Tools Required:

- J 5825-A Crankshaft Gear Remover
- J 5590 Crankshaft Gear Installer
- J 39243 Water Pump Drive Shaft Remover
- J 41546 Water Pump Drive Shaft Installer
- J 39087 Driven Gear Shaft Front Cover Seal Protector
- J 39089 Driven Gear/Water Pump Shaft Seal Installer

↔ Remove or Disconnect

1. Water pump. Refer to "Water Pump" in this section.
2. Engine front cover. Refer to "Engine Front Cover" in this section.

3. Reluctor ring (80) from crankshaft hub.

4. Rotate crankshaft until timing marks punched on crankshaft sprocket (62) and camshaft sprocket (57) are aligned as shown in Figure 20. Camshaft sprocket bolts/screws (56).

5. Camshaft sprocket (57) and timing chain (61).

NOTICE: Do not turn the crankshaft after the timing chain has been removed to prevent damage to pistons or valves.

6. Water pump bearing retainer bolts/screws (64) and water pump driveshaft (63) using J 39243.
 - Remove and discard seal from water pump driveshaft (63).
7. Crankshaft sprocket (62) using J 5825-A.
8. Key, if necessary.

🔍 Inspect

- Camshaft and crankshaft sprockets (57 and 62) and water pump driveshaft (63) for wear.
 - One edge of teeth worn or teeth no longer concentric.
 - Valley between teeth worn.
- Key and crankshaft keyway for wear.
- Timing chain (61) for binding.
- Timing chain (61) for signs of contacting engine front cover.

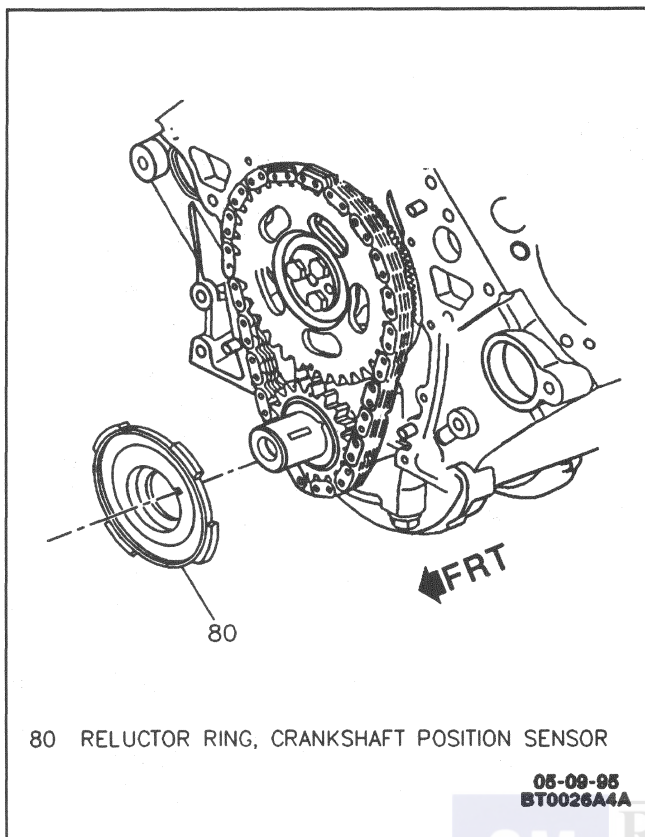


Figure 19 - Reluctor Ring

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Key, if previously removed.
2. Crankshaft sprocket (62) using J 5590.
3. Water pump driveshaft (63) using J 41546.
 - Place J 41546 over the water pump shaft with the three fingers of the tool passing through the gear. Use a mallet to drive the shaft into the block casting.
4. Water pump bearing retainer bolts/screws (64).

Tighten

- Water pump bearing retainer bolts/screws (64) to 12 N.m (106 lb. in.).
5. Camshaft sprocket (57) and timing chain (61).
 - Camshaft sprocket and water pump driveshaft gears must mesh, or damage to camshaft retainer (59) could occur.
 6. Camshaft sprocket bolts/screws (56).
 - Make sure that camshaft and crankshaft timing marks align as shown in Figure 20.

Tighten

- Camshaft sprocket bolts/screws (56) to 25 N.m (18 lb. ft.).
7. New seal to water pump driveshaft (63) using J 39089.

8. Reluctor ring (80) on crankshaft hub.
9. Engine front cover. Refer to "Engine Front Cover" in this section.
10. Water pump. Refer to "Water Pump" in this section.

CAMSHAFT

Figures 20 and 23 through 25

Tool Required:

J 7872 Magnetic Base Indicator Set

Remove or Disconnect

1. Recover R134a refrigerant. Refer to SECTION 1B.
2. Intake manifold. Refer to "Intake Manifold" in this section.
3. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
4. Bolt/screw (66) and oil pump driveshaft (65).
5. Water pump. Refer to "Water Pump" in this section.
6. Engine front cover. Refer to "Engine Front Cover" in this section.
7. Camshaft sprocket. Refer to "Timing Chain, Crankshaft and Camshaft Sprockets, and Water Pump Driveshaft" in this section.
8. Valve lifters. Refer to "Valve Lifters" in this section.
9. Radiator. Refer to SECTION 6B.
10. Air conditioning condenser. Refer to SECTION 1B.
11. Camshaft retainer bolts/screws (58) and camshaft retainer (59).

NOTICE: All camshaft journals are the same diameter so care must be used in removing the camshaft to avoid damage to the bearings.

12. Camshaft (60).
 - A. Install three 5/16-18 x 4-inch bolts/screws in camshaft bolt/screw holes (Figure 24).
 - B. Carefully rotate and pull camshaft (60) out of bearings.

Inspect

1. Camshaft journals with micrometer.
 - If journals are more than 0.025 mm (0.0010 inch) out-of-round, replace with new camshaft (60).
2. Camshaft runout using J 7872.
 - Mount camshaft (60) in V-blocks. Using J 7872, check intermediate camshaft journal. If runout exceeds 0.038mm (0.0015 inch), camshaft (60) is excessively bent and should be replaced.
3. Camshaft lobe lift with micrometer (Figure 25).

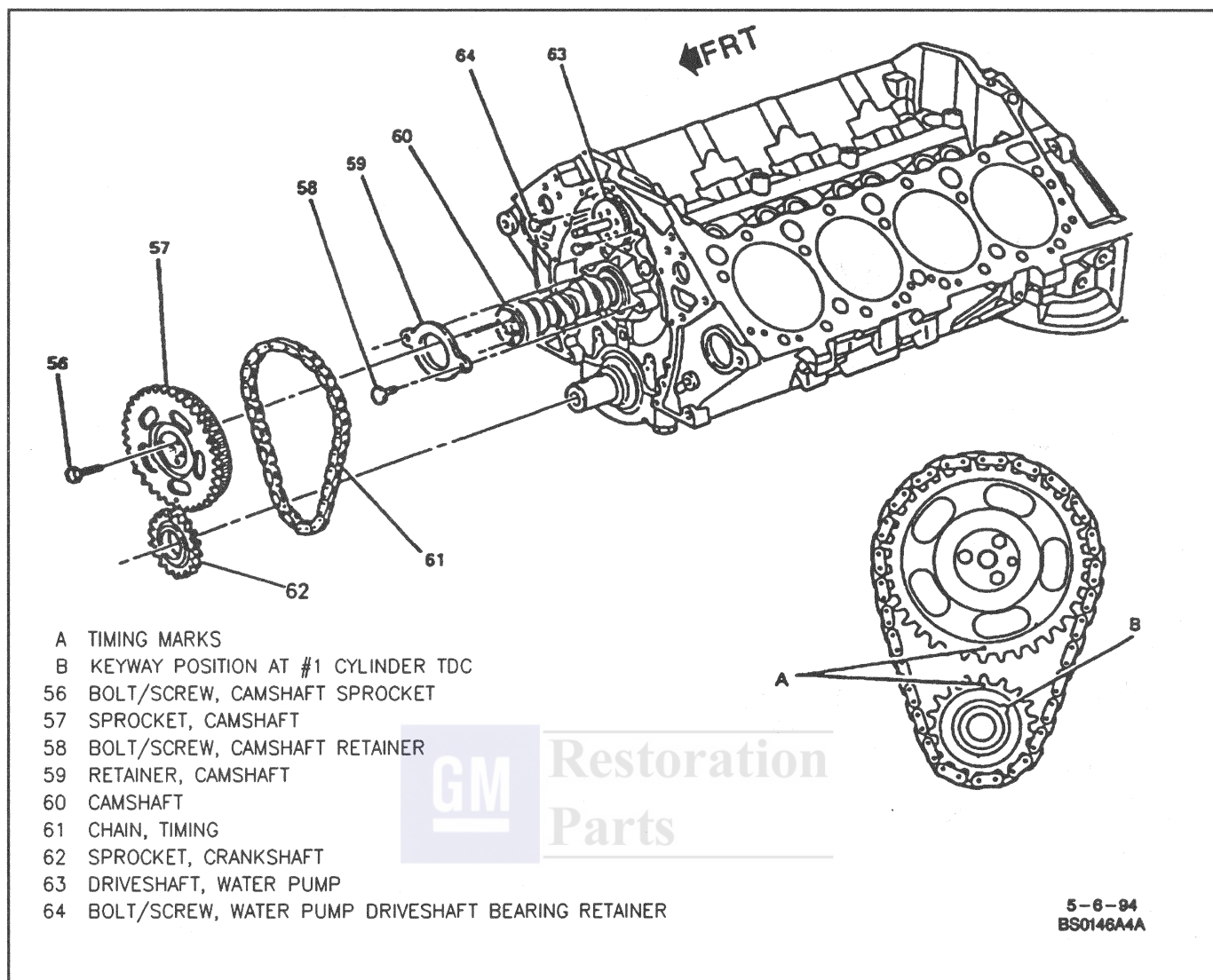


Figure 20 - Camshaft, Sprockets and Water Pump Driveshaft

**Measure**

- A. Camshaft lobe "high point."
- B. Camshaft lobe "low point."
- C. Subtract camshaft lobe "low point" from "high point" and compare to specifications under "Engine Specifications" at end of this section.
4. Camshaft bearings for scratches, pits, or loose fit in their bores. Replace the camshaft bearings, if necessary. Refer to SECTION 6A4B.

**Install or Connect**

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. When installing a new camshaft (60), coat camshaft lobes with "Molykote" or its equivalent.
2. When installing a new camshaft (60), replace all valve lifters to ensure durability of the camshaft lobes and lifter rollers.
3. Lubricate all camshaft journals with engine oil.
4. Camshaft (60).
5. Camshaft retainer (59) and camshaft retainer bolts/screws (58).

**Tighten**

- Camshaft retainer bolts/screws (58) to 12 N.m (106 lb. in.).
6. Air conditioning condenser. Refer to SECTION 1B.
 7. Radiator. Refer to SECTION 6B.
 8. Valve lifters. Refer to "Valve Lifters" in this section.
 9. Camshaft sprocket. Refer to "Timing Chain, Crankshaft and Camshaft Sprockets, and Water Pump Driveshaft" in this section.
 10. Engine front cover. Refer to "Engine Front Cover" in this section.
 11. Water pump. Refer to "Water Pump" in this section.
 12. Oil pump driveshaft (65) and bolt/screw (66).

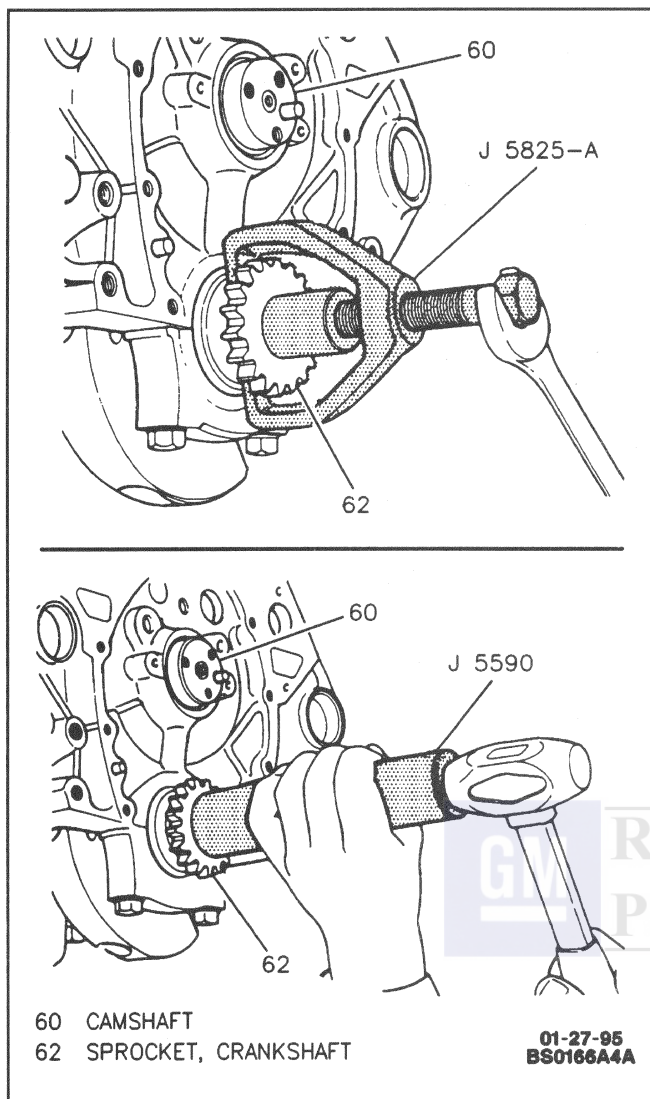


Figure 21 - Crankshaft Sprocket Replacement



Tighten

- Bolt/screw (66) to 18 N·m (13 lb. ft.).
- 13. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
- 14. Intake manifold. Refer to "Intake Manifold" in this section.
- 15. Charge air conditioning system with R134a refrigerant. Refer to SECTION 1B.

VALVE SPRING AND STEM SEAL

Figures 26 and 27

Tools Required:

- J 23590 Spark Plug Port Adapter
- J 5892-D Valve Spring Compressor (Head-On)

This procedure is for servicing valve springs and valve stem seals if cylinder head is not being removed. If cylinder head is also being removed, refer to SECTION 6A4B.

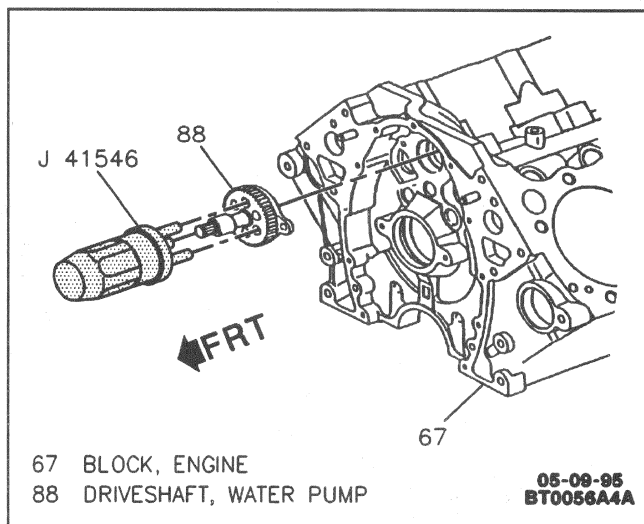


Figure 22 - Installing Water-Pump Driveshaft

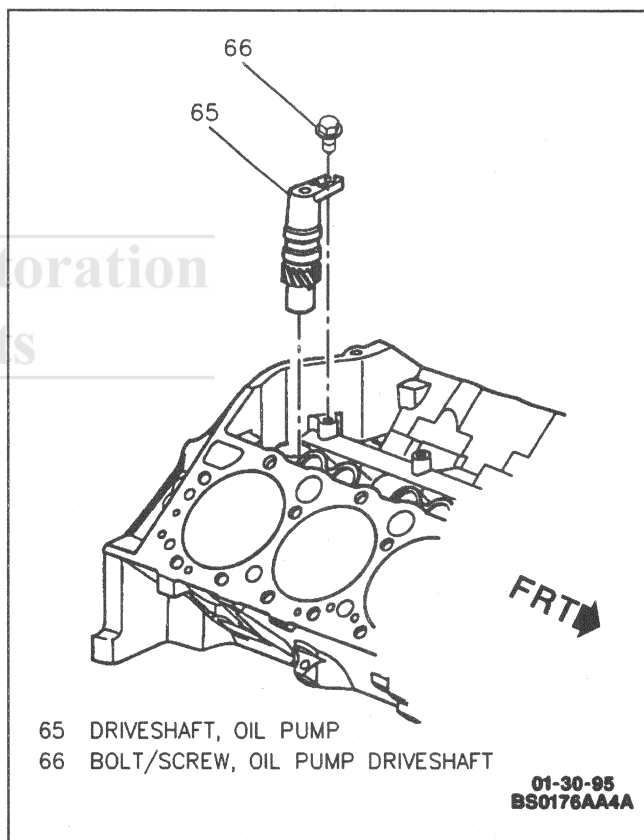


Figure 23 - Oil Pump Driveshaft



Remove or Disconnect

1. Valve rocker arms and pushrods at cylinder to be serviced. Refer to "Valve Rocker Arms and Pushrods" in this section.
2. Spark plug at cylinder to be serviced.
3. Install J 23590 to spark plug hole and apply compressed air to hold valves in place.
4. Compress valve spring (69) using J 5892-D (Figure 26).
5. Valve stem keys (72).

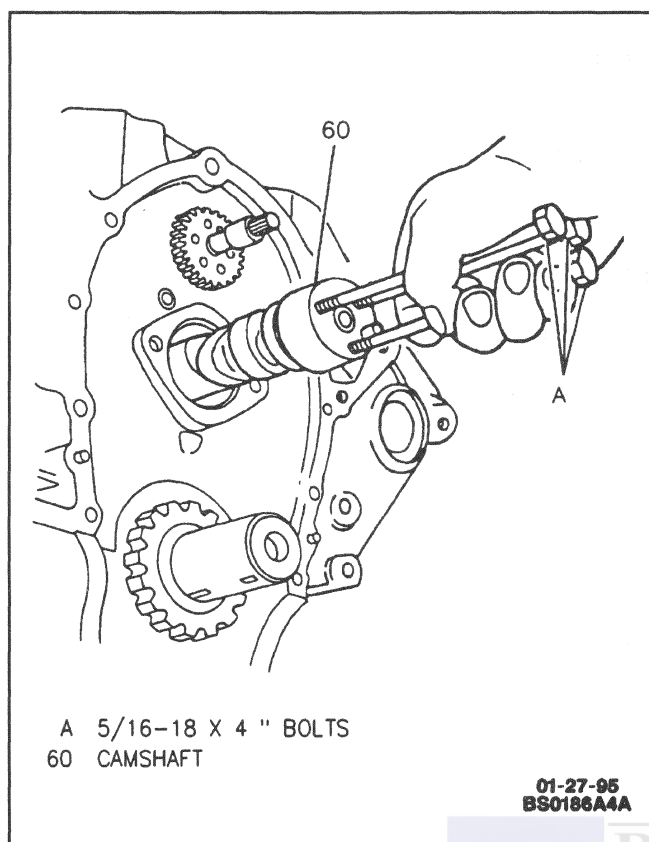


Figure 24 - Removing Camshaft

6. Valve spring cap (70).
7. Valve spring (69).
8. Valve stem oil seal (73).

Install or Connect

1. Valve stem oil seal (73) and seat seal against valve spring shim (76).
2. Valve spring (69).
3. Valve spring cap (70).
4. Compress valve spring (69) using J 5892-D.
5. Valve stem keys (72).
 - A. Use grease to hold keys (72) in place while disconnecting J 5892-D.
 - B. Remove J 23590.
 - C. Make sure keys (72) seat properly in upper groove of valve stem.
 - D. Tap end of stem with plastic-faced hammer to seat keys (72), if necessary.
6. Spark plug.

Tighten

- Spark plug to 30 N.m (22 lb. ft.) with new head installation.
 - Spark plug to 20 N.m (15 lb. ft.) for all subsequent installations.
7. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.

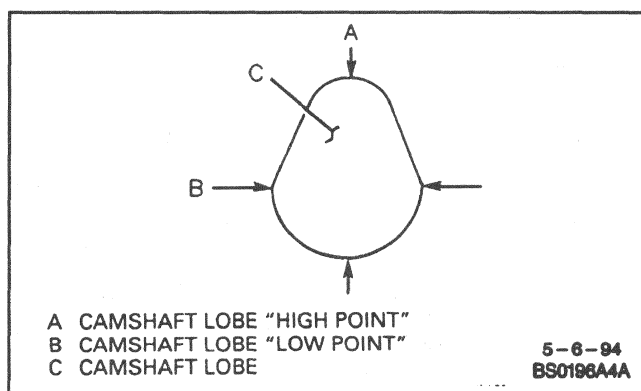


Figure 25 - Measuring Camshaft Lobe Lift

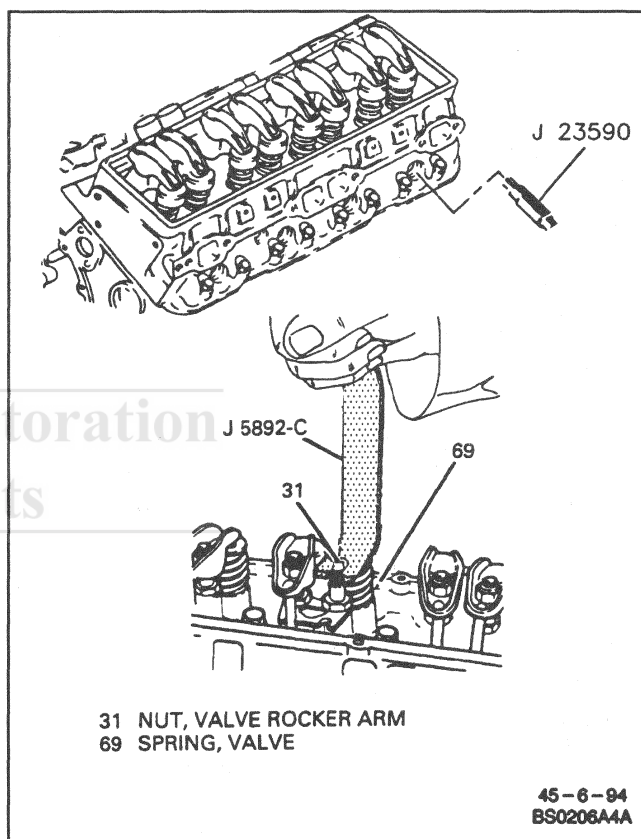


Figure 26 - Compressing Valve Spring

CYLINDER HEAD AND GASKET

Figure 28

Left Cylinder Head

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Warm up three-way catalytic converter and gasket from exhaust manifold. Refer to SECTION 6F.
4. Lower vehicle.
5. Intake manifold. Refer to "Intake Manifold" in this section.
6. Secondary air injection hose from check valve.

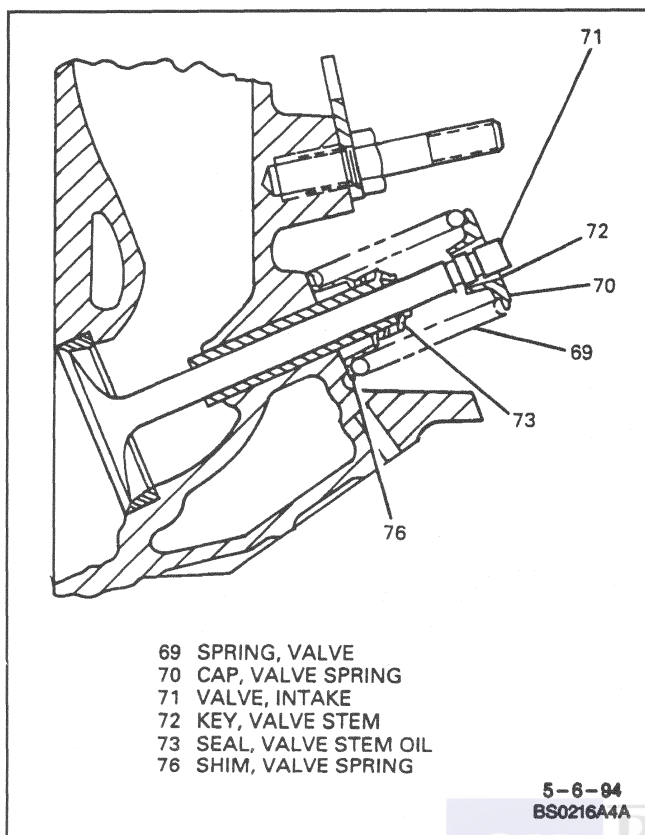


Figure 27 - Valve (Intake Shown, Exhaust Similar)

7. Coolant air bleed pipe bolt/screw from left cylinder head using a backup wrench on pipe fitting.
8. Ignition coil bolts/screws and coil. Refer to SECTION 6D4.
9. Left exhaust manifold. Refer to "Exhaust Manifolds" in this section.
10. Spark plug wire harness from clips.

11. Spark plug wire harness from spark plugs.
12. Spark plugs.
13. Coolant temperature sensor connector.
14. Rocker arm cover bolts/screws and cover. Refer to "Valve Rocker Arm Covers" in this section.
15. Rocker arm nuts, rocker arms, and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
16. Cylinder head bolts/screws (81).
17. Cylinder head (34) and cylinder head gasket (82).
 - Discard cylinder head gasket (82).



Important

- Refer to SECTION 6A4B for cylinder head cleaning, inspection and repair.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. New cylinder head gasket (82) with yellow tab facing up.
2. Cylinder head (34) over locator pins and cylinder head gasket (82).
3. Coat threads of cylinder head bolts/screws (81) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (81).



Tighten

- Cylinder-head bolts/screws (81) in sequence on first pass to 30 N.m (22 lb. ft.) (Figure 28).

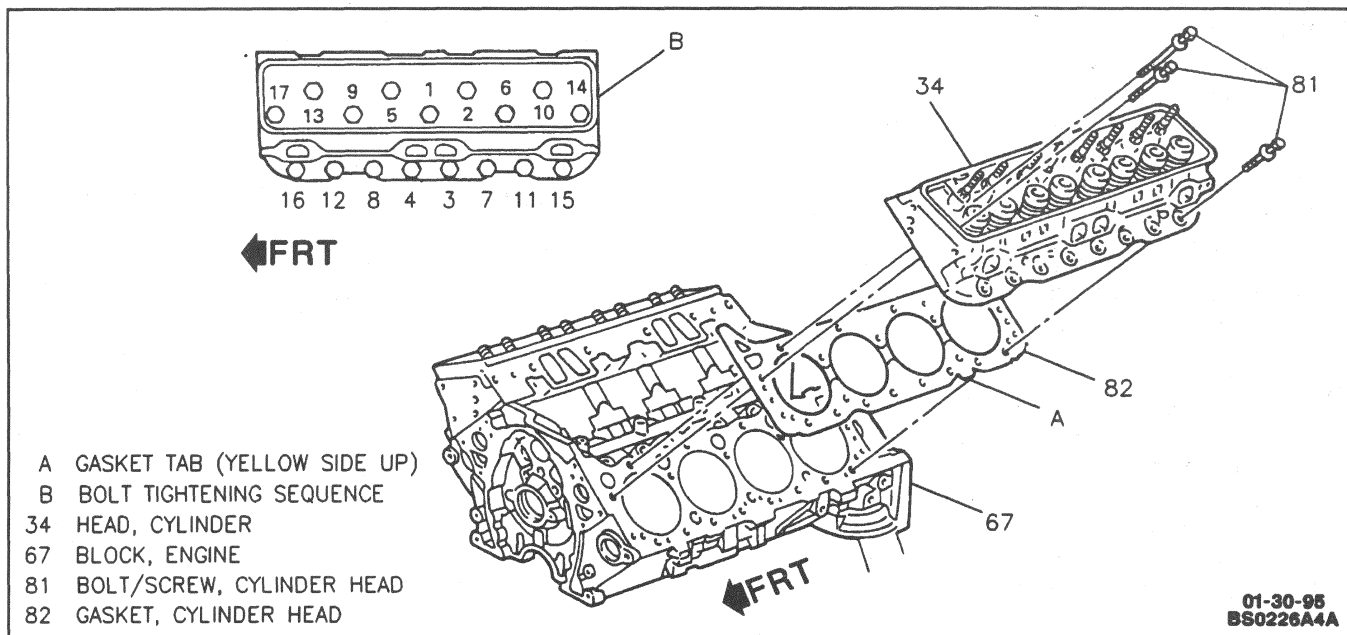


Figure 28 - Cylinder Head

- Cylinder-head bolts/screws (81) in sequence on second pass using J 36660 to:
 - Short bolts (3,4,7,8,11,12,15, & 16) additional 55 degrees.
 - Medium bolts (14 & 17) additional 65 degrees.
 - Long bolts (1,2,5,6,9,10 & 13) additional 75 degrees.
- 5. Pushrods and valve rocker arms. Refer to "Valve Rocker Arms and Pushrods" in this section.
- 6. Right valve rocker arm cover and bolts/screws.



Tighten

- Valve rocker arm cover bolts/screws to 12 N.m (106 lb. in.).
- 7. Coolant temperature sensor connector.
- 8. Spark plugs.



Tighten

- Spark plugs to 30 N.m (22 lb. ft.) with cylinder head replacement.
- Spark plugs to 20 N.m (15 lb. ft.) with existing cylinder heads.
- 9. Spark plug wire harness to spark plugs.
- 10. Spark plug wire harness to clips.
- 11. Left exhaust manifold. Refer to "Exhaust Manifolds" in this section.
- 12. Ignition coil bolts/screws and coil.



Tighten

- Ignition coil bolts/screws to 40 N.m (30 lb. ft.).
- 13. Engine coolant air bleed pipe and bolt/screw to left cylinder head using a backup wrench on pipe fitting.



Tighten

- Engine coolant air bleed pipe bolt/screw to 40 N.m (30 lb. ft.).
- 14. Secondary air injection hose to check valve.
- 15. Intake manifold. Refer to "Intake Manifold" in this section.
- 16. Raise and suitably support vehicle. Refer to SECTION 0A.
- 17. Warm up three-way catalytic converter and gasket to exhaust manifold. Refer to SECTION 6F.
- 18. Lower vehicle.
- 19. Refill with coolant and bleed system. Refer to SECTION 6B.

Right Cylinder Head



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.

3. Serpentine drive belt and belt tensioner. Refer to "Serpentine Drive Belt and Tensioner" in this section.
4. Transmission fluid level indicator tube bracket from transmission housing and rear of right cylinder head (34).
5. Air conditioning compressor rear brace bolt/screw from engine block.
6. Air conditioning compressor electrical connector.
7. Air conditioning compressor front mounting bolts/screws and lay air conditioning compressor aside.
8. Warm up three-way catalytic converter and gasket from exhaust manifold. Refer to SECTION 6F.
9. Lower vehicle.
10. Right exhaust manifold. Refer to "Exhaust Manifolds" in this section.
11. Generator. Refer to SECTION 6D3.
12. Right valve rocker arm cover. Refer to "Valve Rocker Arm Covers" in this section.
13. Intake manifold. Refer to "Intake Manifold" in this section.
14. Coolant air bleed pipe bolt/screw from both cylinder heads.
15. Radiator outlet hose from water pump and reposition.
16. Heater hoses from water pump and reposition.
17. Power steering pump. Refer to SECTION 3B.
18. Generator and air conditioning compressor and power steering pump bracket. Refer to SECTION 6D3.
19. Spark plug wire harness from spark plugs.
20. Spark plugs.
21. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
22. Engine coolant temperature sensor electrical connector on side of cylinder head.
23. Cylinder head bolts/screws (81).
24. Cylinder head (34) and gasket (82).
 - Discard gasket (82).



Important

- Refer to SECTION 6A4B for cylinder head cleaning, inspection and repair.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. New cylinder head gasket (82) with yellow tab facing up.
2. Cylinder head (34) over dowel pins and gasket (82).
3. Coat threads of cylinder head bolts/screws (81) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (81).

**Tighten**

- Cylinder-head bolts/screws (81) in sequence on first pass to 30 N·m (22 lb. ft.) (Figure 28).
- Cylinder-head bolts/screws (81) in sequence on second pass using J 36660 to:
 - Short bolts (3,4,7,8,11,12,15, & 16) additional 55 degrees.
 - Medium bolts (14 & 17) additional 65 degrees.
 - Long bolts (1,2,5,6,9,10 & 13) additional 75 degrees.
- 5. Engine coolant temperature sensor electrical connector on side of cylinder head.
- 6. Valve rocker arms and pushrods. Refer to "Valve Rocker Arms and Pushrods" in this section.
- 7. Spark plugs.

**Tighten**

- Spark plugs to 30 N·m (22 lb. ft.) with cylinder head replacement.
 - Spark plugs to 20 N·m (15 lb. ft.) with existing cylinder heads.
8. Spark plug wire harness to spark plugs.
 9. Generator and air conditioning compressor and power steering pump bracket and generator bracket bolts/screws.

**Tighten**

- Generator bracket bolts/screws to 40 N·m (30 lb. ft.).
10. Power steering pump. Refer to SECTION 3B.
 11. Right valve rocker arm cover. Refer to "Valve Rocker Arm Covers" in this section.
 12. Generator. Refer to SECTION 6D3.
 13. Heater hoses to water pump.
 14. Radiator outlet hose to water pump.
 15. Coolant air bleed pipe bolt/screws to both cylinder heads using backup wrench.

**Tighten**

- Engine coolant air bleed pipe bolts/screws to 40 N·m (30 lb. ft.).
16. Intake manifold. Refer to "Intake Manifold" in this section.
 17. Right exhaust manifold. Refer to "Exhaust Manifolds" in this section.
 18. Raise and suitably support vehicle. Refer to SECTION 0A.
 19. Warm up three-way catalytic converter and gasket to exhaust manifold. Refer to SECTION 6F.
 20. Air conditioning compressor front mounting bolts/screws.

**Tighten**

- Air conditioning compressor front mounting bolts/screws to 50 N·m (37 lb. ft.).

21. Air conditioning compressor electrical connector.
22. Air conditioning compressor rear brace bolt/screw to engine block.

**Tighten**

- Air conditioning compressor rear brace bolt/screw to 25 N·m (18 lb. ft.).
23. Transmission fluid level indicator tube bracket to transmission housing and rear of right cylinder head (34).
 24. Serpentine drive belt and belt tensioner. Refer to "Serpentine Drive Belt and Tensioner" in this section.
 25. Lower vehicle.
 26. Refill with coolant and bleed system. Refer to SECTION 6B.

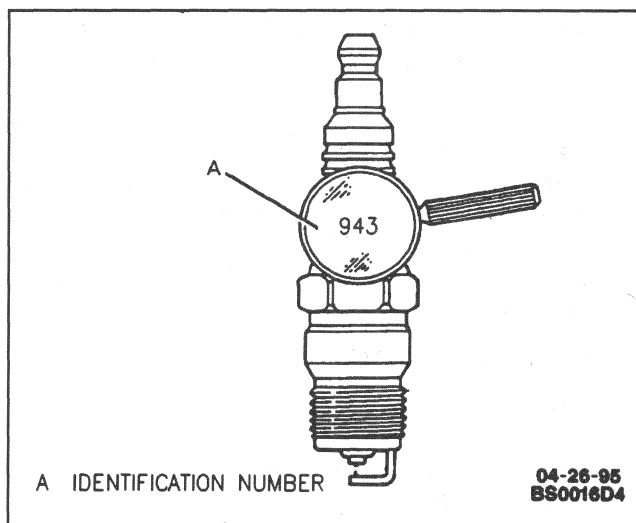
SPARK PLUG INSTALLATION**Figure 29**

Beginning with 1996 Caprices and Roadmasters, the correct spark plug (AC 41-943) tightening specifications are as follows:

- Spark plugs to 30 N·m (22 ft. lb.) with new cylinder head installation.
- Spark plugs to 22 N·m (15 ft. lb.) with existing engine assembly.

ENGINE OIL FILTER ADAPTER AND HOSE**Figure 30****Remove or Disconnect**

1. Engine oil cooler hose upper fitting at radiator.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Engine oil cooler hose lower fitting at radiator .
 - Place drain pan under radiator to catch oil.
4. Heated oxygen sensor electrical connector.

**Figure 29 - Spark Plug Identification**

4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P 6A4A-25

5. Engine oil cooler pipe clip nut (251) and hose nut (252).
6. Engine oil cooler hose (250).
 - Discard seals.
7. Engine oil filter (144).
8. Oil filter adapter bolt/screw (143) and washer (145).
9. Oil filter adapter (142), seal (141) and gasket (140).



Clean

- Any oil from exhaust components.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Oil filter adapter gasket (140), seal (141) and adapter (142).
2. Oil filter adapter washers (145) and bolts/screws (143).



Tighten

- Bolts/screws (143) to 25 N·m (18 lb. ft.).
3. Engine oil filter (144).
 - Hand tighten.

4. Engine oil cooler hose (250) with new seals.
5. Engine oil cooler pipe clip nut (251) and hose nut (252).



Tighten

- Nut (251) to 6 N·m (53 lb. in.).
- Nut (252) to 35 N·m (26 lb. ft.).
- 6. Heated oxygen sensor electrical connector.
 - Route sensor pigtail through engine oil cooler hose pipes.
- 7. Engine oil cooler hose lower fitting at radiator.



Tighten

- Lower fitting to 24 N·m (18 lb. ft.).
- 8. Lower vehicle.
- 9. Engine oil cooler hose upper fitting at radiator.



Tighten

- Upper fitting to 24 N·m (18 lb. ft.).



Inspect

- Engine oil level before and after running vehicle. If engine oil was also replaced, reset engine oil life monitor whether lamp came on or not. Refer to SECTION 0B.

GM

Restoration
Parts

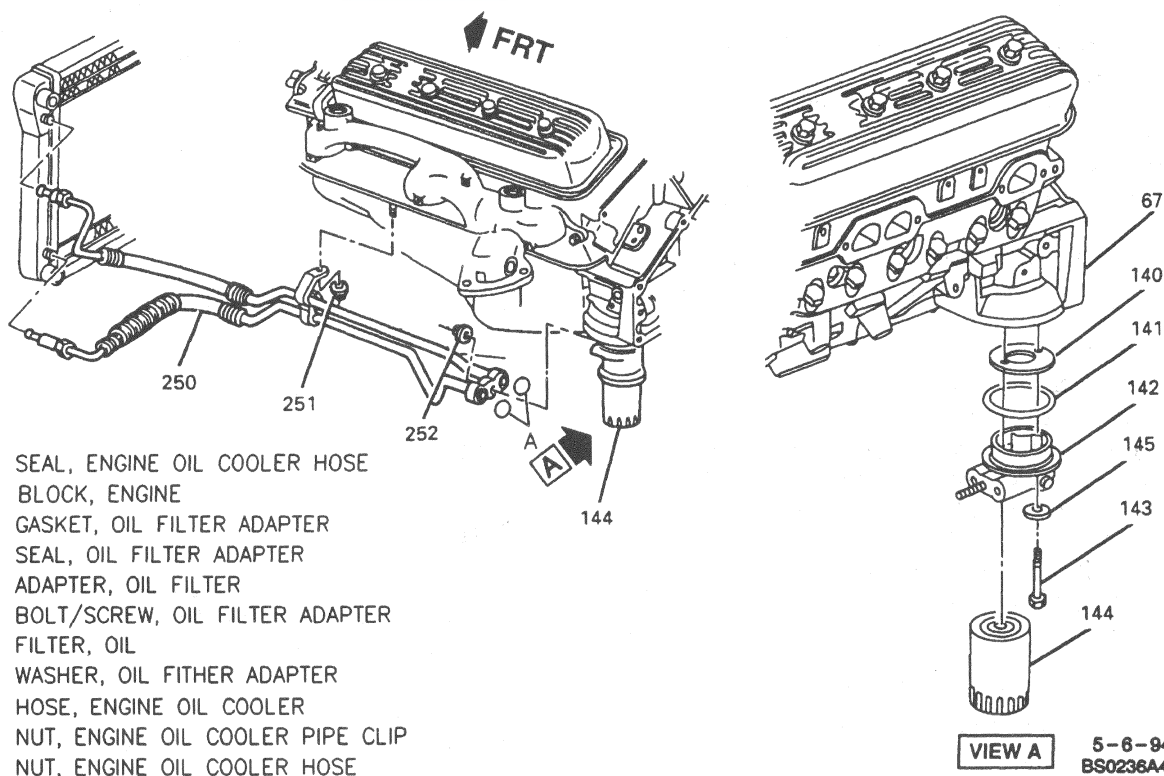


Figure 30 - Oil Filter Adapter and Hose

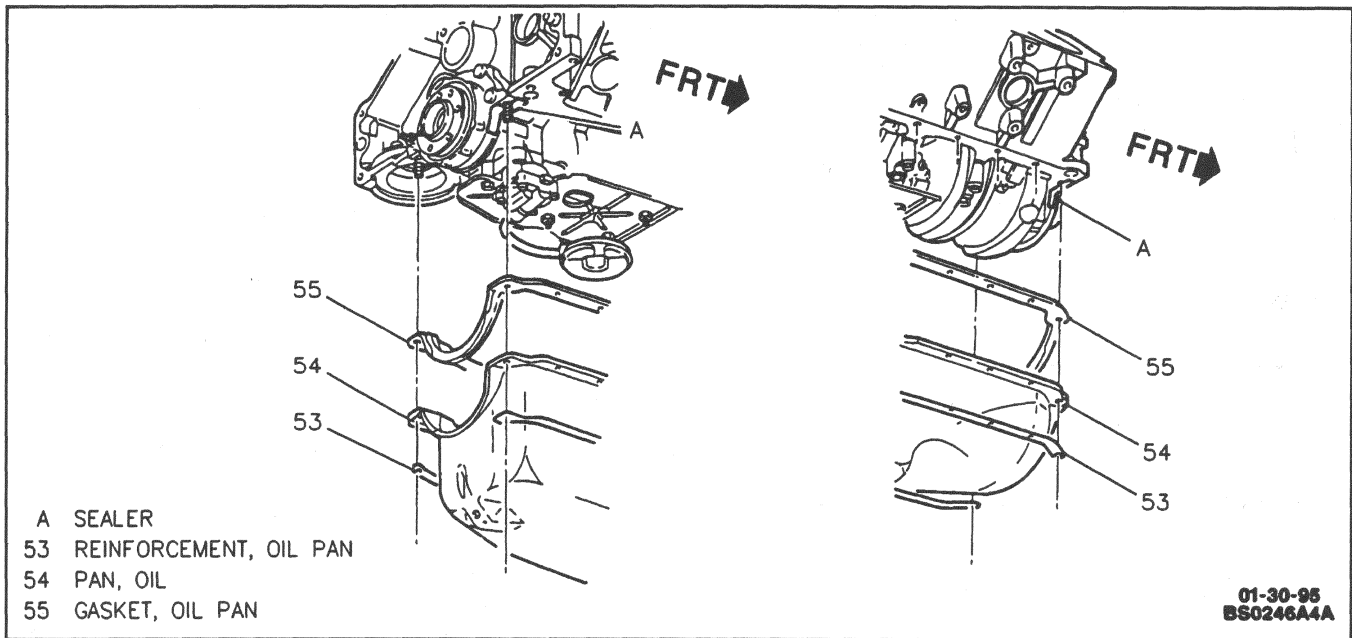


Figure 31 - Oil Pan Sealer

OIL PAN

Figures 4, 15, 31 and 32



Remove or Disconnect

CAUTION: Refer to "Caution" on page 6A4A-1 of this section.

1. Battery negative cable.
2. Air cleaner resonator bracket nuts (243).
3. Air cleaner resonator (244).
 - Loosen clamp (242) and slide resonator off studs (241).
4. Air intake duct.
5. Radiator fan upper shroud, if equipped with mechanical fan. Refer to SECTION 6B.
6. Windshield wiper motor electrical connector.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Drain engine oil.
9. Oil level sensor connector.
10. Oil level sensor (178).
11. Warm up three-way catalytic converters from exhaust manifolds. Refer to SECTION 6F.
12. Catalytic converter support-to-transmission bolts/screws and washers.
13. Engine oil filter adapter. Refer to "Engine Oil Filter Adapter and Hose" in this section.
14. Transmission fluid cooler lines from clip at oil pan.
15. Starter motor. Refer to SECTION 6D2.
16. Converter cover bolts/screws and cover.
17. Rotate crankshaft until arrow on crankshaft balancer is pointing straight down (six o'clock position). Refer to Figure 15.

18. Engine mount through-bolts/screws and nuts.
19. Raise engine with jacking fixture.
20. Oil pan bolts/screws (84), studs (83) and nuts (85).
21. Oil pan (54), reinforcements (53) and gasket (55).



Clean

- Oil pan and engine block gasket surfaces.
- Apply a small amount of sealer, GM P/N 1052914 or equivalent, to the front cover and engine block junction and to the rear oil seal housing and engine block junction. Apply sealer 25 mm (1 inch) in either direction of the radius cavity of these junctions. Refer to Figure 31.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Oil pan gasket (55), oil pan (54) and reinforcements (53).
2. Oil pan nuts (85), bolts/screws (84) and studs (83).



Tighten

- Corner oil pan bolts/screws (84) or stud (83), and nuts (85) to 20 N.m (15 lb. ft.).
 - Remainder of oil pan bolts/screws (84) and studs (83) to 12 N.m (106 lb. in.).
3. Lower engine.
 4. Engine mount through-bolts/screws and nuts.



Tighten

- Engine mount through-bolts/screws to 120 N.m (89 lb. ft.) or nuts to 80 N.m (59 lb. ft.).
- Oil level sensor (178).



Tighten

- Engine oil level sensor (178) to 35 N.m (26 lb. ft.).
- Converter cover and bolts/screws.
 - Starter motor. Refer to SECTION 6D2.
 - Transmission fluid cooler lines to clip at oil pan (54).
 - Engine oil filter adapter. Refer to "Engine Oil Filter Adapter and Hose" in this section.
 - Catalytic converter support-to-transmission bolts/screws and washers.



Tighten

- Catalytic converter support-to-transmission bolts/screws to 34 N.m + 55° (26 lb. ft. + 55°).
- Warm up three-way catalytic converters to exhaust manifolds. Refer to SECTION 6F.
 - Oil level sensor connector.
 - Lower vehicle.
 - Windshield wiper motor electrical connector.
 - Radiator fan upper shroud, if removed. Refer to SECTION 6B.
 - Air intake duct.
 - Air cleaner resonator (244).
 - Slide resonator onto studs (241) and tighten clamp (242) snugly.
 - Air cleaner resonator bracket nuts (243).



Tighten

- Nuts (243) to 10 N.m (89 lb. in.).
- Battery negative cable.
 - Refill engine with oil.
 - Refill with coolant. Refer to SECTION 6B.
 - If engine oil was also replaced, reset engine oil life monitor whether lamp came on or not. Refer to SECTION 0B.

OIL PUMP

Figure 33



Remove or Disconnect

- Oil pan. Refer to "Oil Pan" in this section.
- Oil pan baffle nuts.
- Bolt/screw (120) attaching oil pump (118) to rear crankshaft bearing cap.
- Oil pan baffle (119), oil pump (118), driveshaft (89) and retainer (95).



Important

- Refer to SECTION 6A4B for oil pump cleaning, inspection and repair.

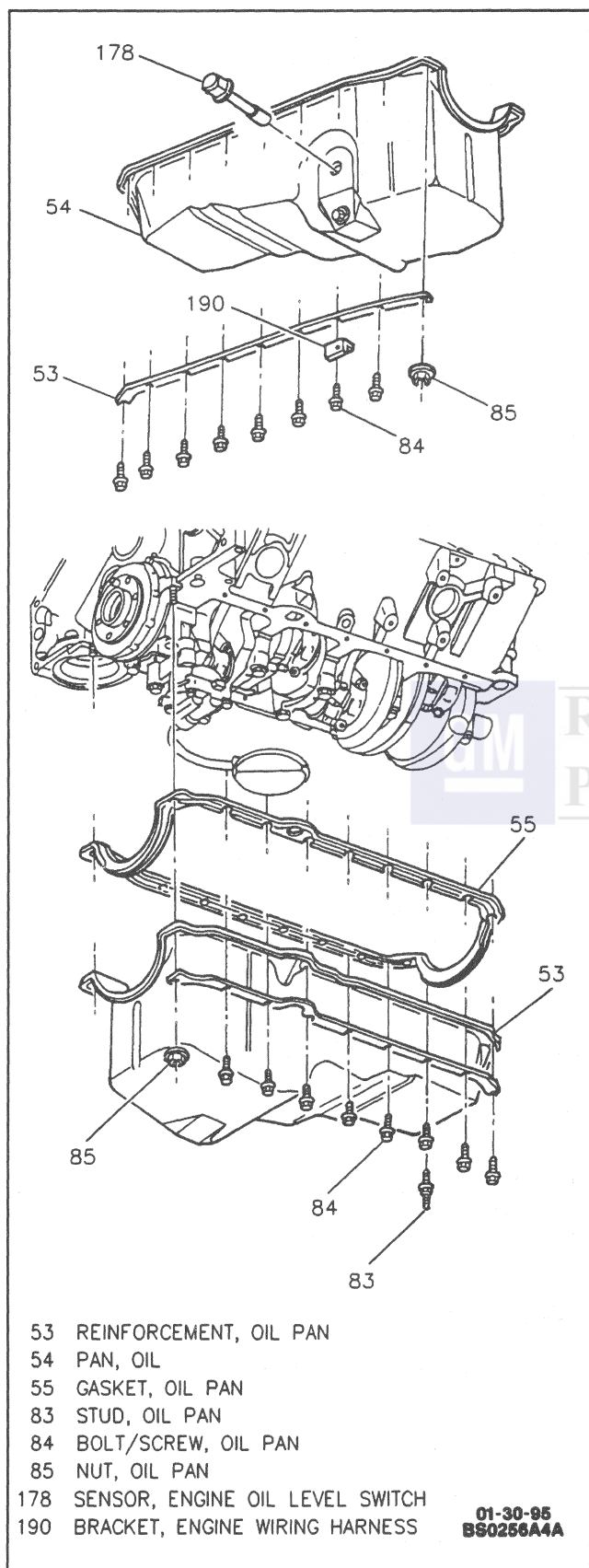


Figure 32 - Oil Pan

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Oil pump (118), and driveshaft (89) with retainer (95).
 - Align slot on end of driveshaft (89) with drive tang on oil pump (118).
2. Oil pan baffle (119).
3. Bolt/screw (120) attaching oil pump (118) to rear crankshaft bearing cap.
4. Oil pan baffle nuts.

Tighten

- Bolt/screw (120) to 90 N.m (66 lb. ft.).
 - Oil pan baffle nuts to 40 N.m (30 lb. ft.).
5. Oil pan. Refer to "Oil Pan" in this section.

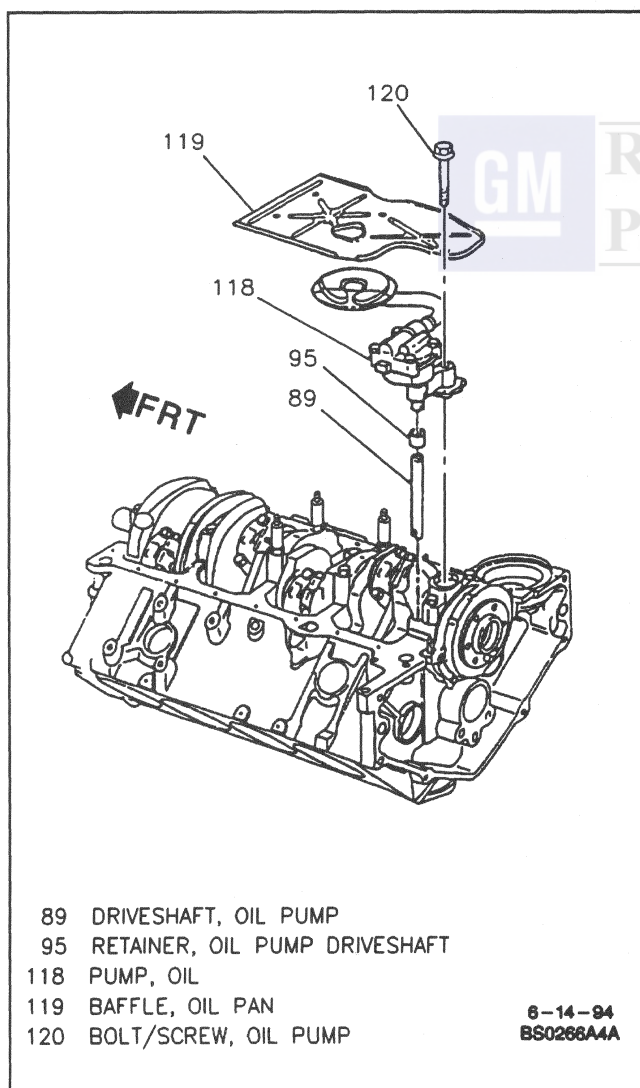


Figure 33 - Oil Pump

CONNECTING ROD BEARINGS

Figure 34

Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.001 and 0.002-inch undersize for use with new and used standard size crankshafts, and in 0.010 and 0.020-inch undersize for use with reconditioned crankshafts.

When removing a connecting rod cap, you may find a 0.010-inch undersize bearing. These are used in manufacturing for selective fitting.

Remove or Disconnect

1. Oil pan. Refer to "Oil Pan" in this section.
2. Oil pump. Refer to "Oil Pump" in this section.

Important

- Place match marks or numbers on connecting rods (104) and connecting rod caps (99). Connecting rod caps (99) must be assembled to their original connecting rods (104).
3. Connecting rod nuts (100).
 4. Connecting rod cap (99) and bearings (101).
 - Keep bearings (101) with their original connecting rods (104) and connecting rod cap (99) for reassembly.
 - Wipe oil from bearings (101) and crankpins.

Inspect

- Bearings (101) for excessive wear or damage.

Measure

1. Crankpin for out-of-round and taper with a micrometer. Compare measurements to "Engine Specifications" in this section.
 - If not within specifications, replace or recondition crankshaft (98).
 - If installing new bearings (101), determine new bearing size from maximum crankpin diameter.
2. Bearing clearances, using gaging plastic.
 - A. Place piece of gaging plastic the full width of bearing (101), (parallel to crankshaft (98)) onto crankpin.
 - Plastic gage should be positioned in middle of bearing (101). Bearing (101) is thickest in center and bearing clearance must be measured at this location.
 - B. Install connecting rod cap (99) with bearing (101) onto connecting rod (104).
 - Connecting rods (104) and connecting rod caps (99) have bearing locating notches to prevent bearings (101) from moving. These notches must face each other.
 - C. Install connecting rod nuts (100).

**Tighten**

- Connecting rod nuts (100), evenly, to 27 N.m + 55° (20 lb. ft. + 55°).

NOTICE: Do not turn the crankshaft with the gaging plastic installed or the accuracy of the measurement will be affected.

D. Remove connecting rod nuts (100) and connecting rod cap (99). The gaging plastic will be found adhering to either the connecting rod cap (99) or crankshaft journal. Leave the gaging plastic in place to measure it.

E. Measure gaging plastic at its widest, using scale provided with gaging plastic. Compare measurements to "Engine Specifications" in this section.

- If clearance is greater than specified, select an undersize bearing (101) and re-measure clearance.
- If clearance cannot be brought to specifications, regrind crankpin. If crankpin is already at maximum undersize, replace crankshaft (98).

F. Remove gaging plastic.

**Install or Connect**

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

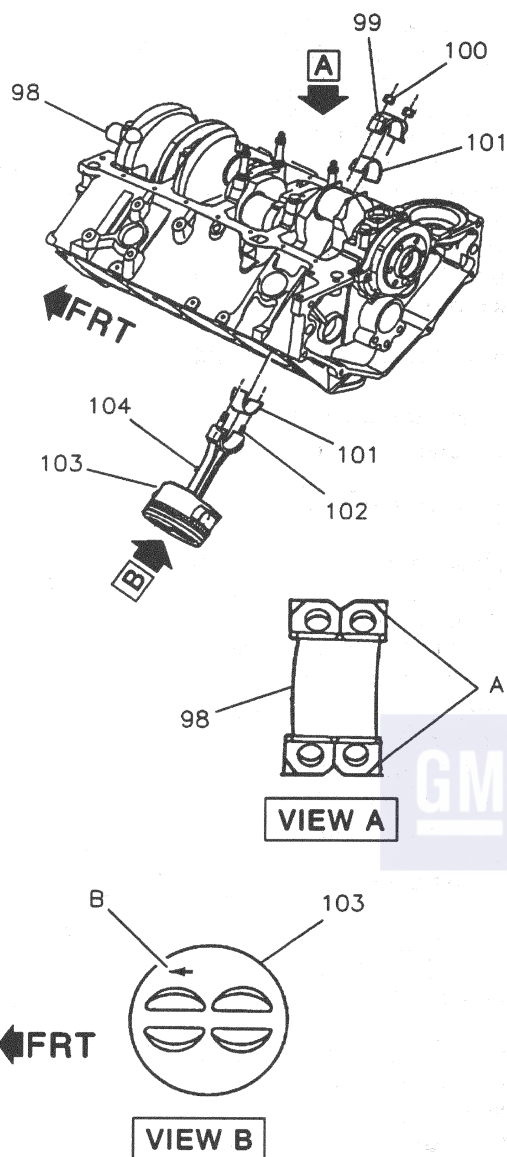
1. Coat inside surface of bearings (101) with engine oil.
2. Connecting rod cap (99) and bearings (101).
3. Connecting rod nuts (100).

**Tighten**

- Connecting rod nuts (100), evenly, to 27 N.m + 55° (20 lb. ft. + 55°).

**Measure**

- Connecting rod side clearance.
 - A. When all connecting rod bearings (101) have been installed, tap each connecting rod (104) lightly parallel to crankpin to make sure they have clearance.
 - B. Measure side clearance between connecting rod caps (99) using a feeler gage, or dial indicator.
 - C. Rod side clearance should be 0.16 to 0.35 mm (0.006 to 0.014 inch).
- 4. Oil pump. Refer to "Oil Pump" in this section.
- 5. Oil pan. Refer to "Oil Pan" in this section.



A FLANGES OF CONNECTING RODS MUST FACE TO THE FRONT IN THE LEFT BANK AND TO THE REAR IN THE RIGHT BANK

B ARROW TO BE ORIENTED TO FRONT OF ENGINE

98 CRANKSHAFT

99 CAP, CONNECTING ROD

100 NUT, CONNECTING ROD

101 BEARING, CONNECTING ROD

102 BOLT/SCREW, CONNECTING ROD

103 PISTON

104 ROD, CONNECTING

01-30-95
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Figure 34 - Piston and Connecting Rods

PISTONS AND CONNECTING RODS**Figure 34****Tools Required:**

J 8037 Piston Ring Compressor

J 5239 Connecting Rod Bolt Guide Set

**Remove or Disconnect**

1. Oil pan. Refer to "Oil Pan" in this section.
2. Oil pump. Refer to "Oil Pump" in this section.
3. Cylinder head. Refer to "Cylinder Head and Gasket" in this section.
4. Ring ridge.
 - A. Turn crankshaft (98) until piston (103) is at bottom of its stroke.
 - B. Place a cloth on top of piston (103).
 - C. Use a ridge reamer to remove ring ridge.
 - D. Turn crankshaft (98) so piston (103) is at top of its stroke.
 - E. Remove cloth and cutting debris.

**Important**

- Place match marks or numbers on connecting rods (104) and connecting rod caps (99). Connecting rod caps (99) must be assembled to their original connecting rods (104).
5. Connecting rod nuts (100) and connecting rod cap (99).
 6. Connecting rod (104) and piston (103) out of top of engine block using J 5239.

**Important**

- Refer to SECTION 6A4B for cleaning, inspection and repair of the piston and connecting rod.

**Clean**

1. Cylinder bores with hot water and detergent or with a light honing.
2. Swab bores with engine oil and a clean, dry cloth.

**Install or Connect**

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Coat piston (103), piston rings, cylinder bore, and bearing surfaces with engine oil.
2. Piston (103) into its original bore using J 5239 and J 8037 and lightly tapping top of piston (103) with a wooden hammer handle.
 - A. When installing piston (103) and connecting rod (104), stamped arrow on piston (103) must point to front of engine while flange on connecting rod (104) must face toward front of piston on left-hand side and face toward rear of piston on right-hand side. Refer to Figure 34.

B. Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.

3. Connecting rod caps (99) onto their original connecting rods (104).
 - Align match marks or numbers which were placed on connecting rod (104) and connecting rod cap (99) during removal.
 - Connecting rods (104) and connecting rod caps (99) have bearing locating notches to prevent bearings (101) from moving. These notches must face each other.
4. Connecting rod nuts (100).

**Tighten**

- Connecting rod nuts (100), evenly, to 27 N.m + 55° (20 lb. ft. + 55°).
5. Cylinder head. Refer to "Cylinder Head and Gasket" in this section.
 6. Oil pump. Refer to "Oil Pump" in this section.
 7. Oil pan. Refer to "Oil Pan" in this section.

CRANKSHAFT BEARINGS**Figures 31 and 32****Tool Required:**

J 8080 Main Bearing Shell Remover and Installer

Crankshaft bearings are of the precision insert type. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in both standard size and undersize. Selective fitting of both connecting rod and crankshaft bearing inserts is necessary in production in order to obtain close tolerances. For example, on a rear crankshaft bearing you may find one half of a standard insert with one half of a 0.001 inch undersize insert which will decrease the clearance 0.0005 inch from using a full standard bearing.

**Important**

- If replacing the rear crankshaft bearing, check for the correct part number. Some rear crankshaft bearings are 0.20 mm (0.008 inch) wider than standard. The crankshaft will be identified by "0.008" stamped on the rear counterweight.

**Remove or Disconnect**

1. Oil pan. Refer to "Oil Pan" in this section.
2. Oil pump. Refer to "Oil Pump" in this section.
3. Spark plugs.
4. Cap (107 or 109) and lower bearing of crankshaft bearing (110 or 111) requiring replacement.
5. Insert J 8080 into oil hole in crankshaft journal.
6. Rotate crankshaft (98) allowing J 8080 to push against crankshaft bearing's straight (unnotched) side. This will roll upper bearing out of block.

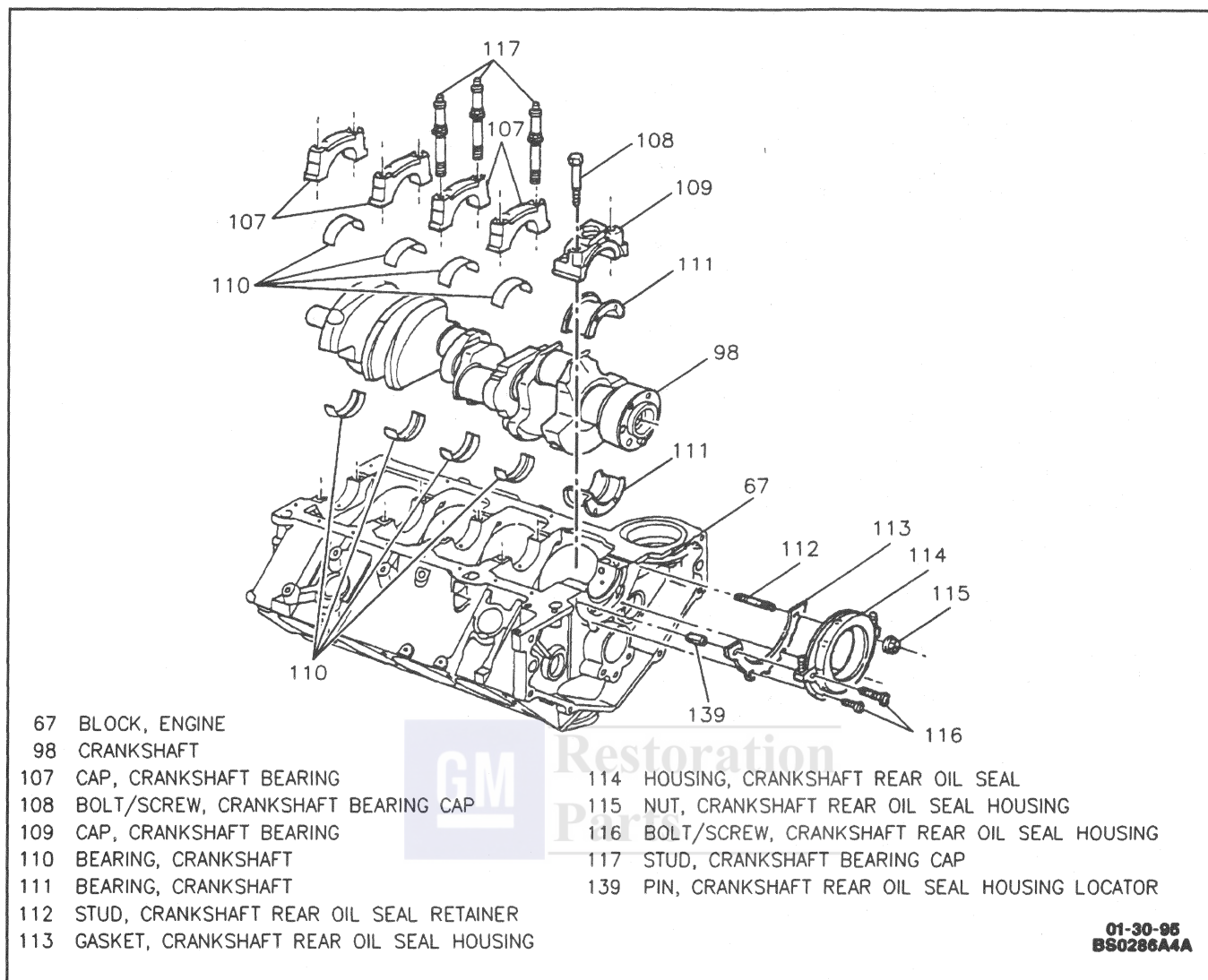


Figure 35 - Crankshaft

7. Remove J 8080 from crankshaft (98).



Inspect

- In general, the lower half of the crankshaft bearing (except # 1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.



Important

- To obtain the most accurate results when checking crankshaft bearing clearances, use gaging plastic.
- If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and

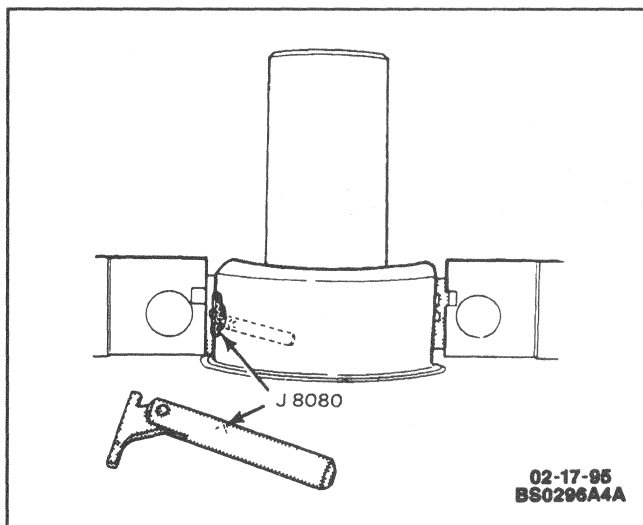


Figure 36 - Removing Crankshaft Bearing

journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal. To assure the proper seating of the crankshaft, all bearing cap bolts/screws should be at their specified torque. In addition, prior to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.



Measure

1. With oil pan and oil pumps removed, and starting with rear crankshaft bearing, remove bearing cap and wipe oil from journal and bearing cap. Note location of studs and bolts/screws.
2. Place a piece of gaging plastic the full width of bearing (parallel to the crankshaft) on journal.



Important

- Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install bearing cap and evenly tighten bearing cap bolts/screws to specifications. Bearing cap must be tightened to specification in order to assure proper reading. Variations in torque affect the compression of the gaging plastic.



Tighten

- Crankshaft bearing cap bolts/screws (108) and studs to 105 N.m (77 lb. ft.).
4. Remove bearing caps. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
 5. Without removing gaging plastic, measure its compressed width (at the widest point) with graduations on gaging plastic envelope. Normally crankshaft bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (0.001 inch maximum), be sure to fit to maximum diameter of journal: If bearing is fitted to minimum diameter, and journal is out-of-round 0.001 inch, interference between bearing and journal will result in rapid bearing failure. If flattened gaging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gaging plastic indicates more than 0.001 inch difference.
 6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace insert. Always replace both upper and lower inserts as a unit. When bearing cap is installed and clearance is less than 0.001 inch, inspect for burrs or nicks.

7. A standard, 0.001 inch or 0.002 inch undersize bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use with next undersize bearing. After selecting new bearing, recheck clearance.

8. Proceed to next bearing. When checking number 1 crankshaft bearing, loosen accessory drive belt so as to prevent tapered reading with gaging plastic. After all bearings have been checked, rotate crankshaft to see that there is no excessive drag.



Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Crankshaft bearings (110 and 111) into engine block (67) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109).
 - A. Coat crankshaft bearings (110 and 111) with oil.
 - B. Insert straight (unnotched) end of crankshaft bearing between crankshaft (98) and notched side of block (67). Rotate bearing into place using J 8080 as previously described, and remove J 8080 from oil hole in crankshaft journal.
2. Crankshaft bearing caps (107) and rear crankshaft bearing cap (109) with assembled crankshaft bearings (110 and 111) with arrows pointing toward front of engine.
3. Crankshaft bearing cap bolts/screws (108) and studs (117).
 - With crankshaft (98), crankshaft bearings (110 and 111) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109) installed and bolts/screws (108) and studs (117) started, thrust crankshaft (98) rearward to set and align bearing caps (107 and 109). Then thrust crankshaft (98) forward to align rear faces of rear crankshaft bearings (111).



Tighten

- Crankshaft bearing cap bolts/screws (108) and studs (117) to 105 N.m (77 lb. ft.).



Measure

- Crankshaft end play, using a dial indicator or feeler gage. Compare to "Engine Specifications" in this section.
- If using a feeler gage, measure between the front of the rear crankshaft bearing cap (109) and the crankshaft thrust surface.

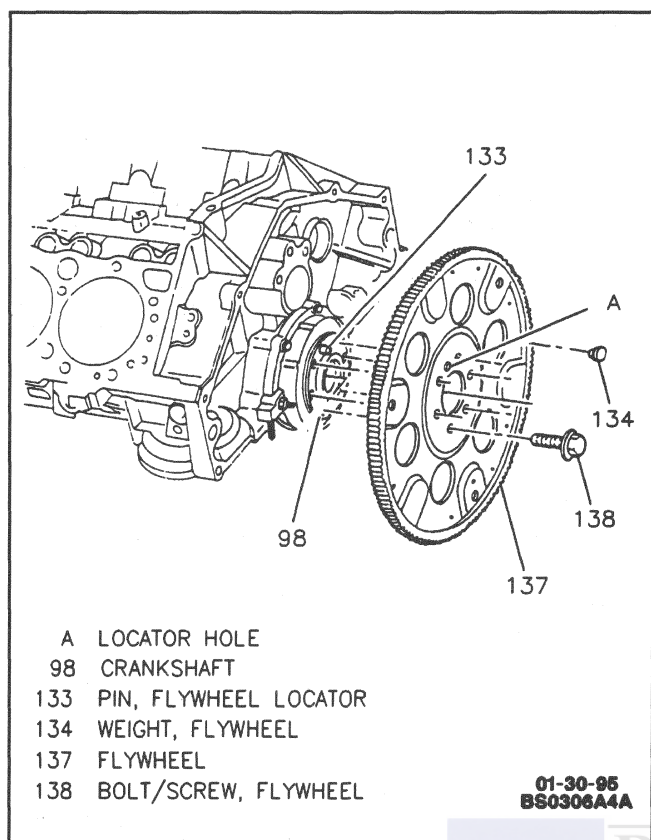


Figure 37 - Flywheel

FLYWHEEL

Figure 37

Remove or Disconnect

1. Transmission. Refer to SECTION 7A.
2. Flywheel bolts/screws (138) and flywheel (137).

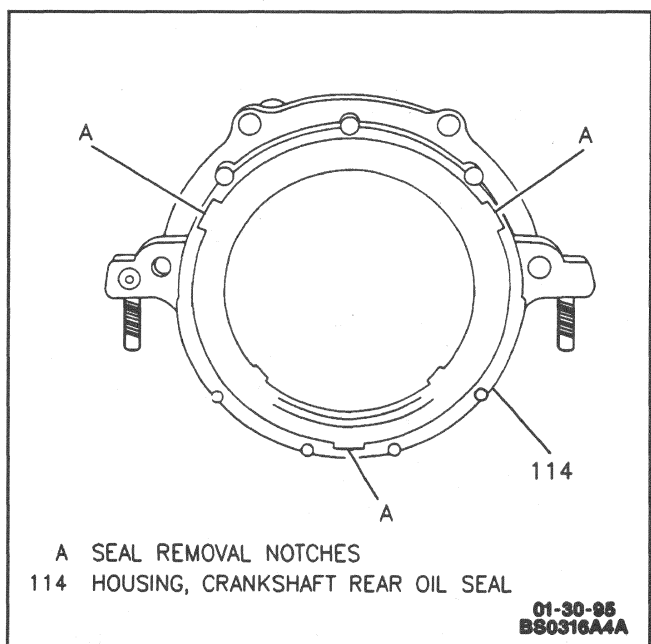


Figure 38 - Removing Crankshaft Rear Oil Seal

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.

1. Flywheel (137) and flywheel bolts/screws (138).

Tighten

- Flywheel bolts/screws (138) to 100 N.m (74 lb. ft.).
2. Transmission. Refer to SECTION 7A.

CRANKSHAFT REAR OIL SEAL

Figures 35, 38 and 39

Remove or Disconnect

Tool Required:

J 35621 Rear Main Seal Installer

1. Flywheel. Refer to "Flywheel" in this section.

Important

- Care should be taken not to nick crankshaft sealing surface when removing seal.
2. Crankshaft rear oil seal.
 - Using notches provided in crankshaft rear oil seal housing (114), pry out seal with a screwdriver.

Install or Connect

1. Coat new seal entirely with engine oil.
2. Seal assembly onto J 35621.
3. J 35621 onto rear of crankshaft (98). Tighten screws snugly to ensure seal will be installed squarely over crankshaft (98).
4. Crankshaft rear oil seal to crankshaft (98) and crankshaft rear oil seal housing (114).
5. Tighten wing nut on J 35621 until it bottoms.

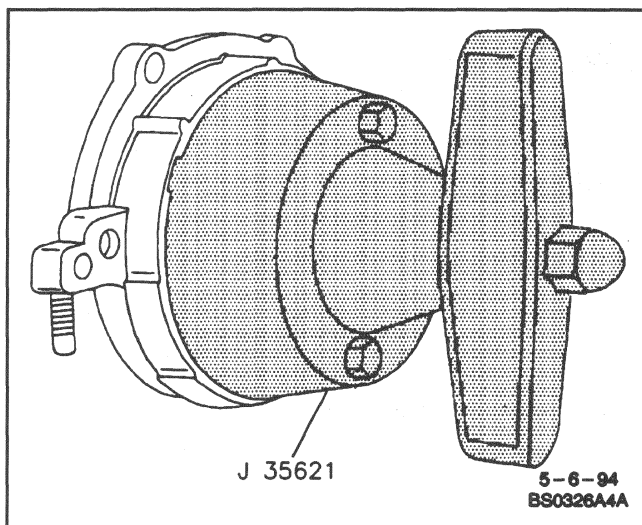


Figure 39 - Installing Crankshaft Rear Oil Seal

6. Remove J 35621 from crankshaft rear oil seal housing (114).
7. Flywheel. Refer to "Flywheel Replacement" under "Flywheel" in this section.

CRANKSHAFT REAR OIL SEAL HOUSING AND GASKET

Figures 35, 38 and 39

Remove or Disconnect

1. Flywheel. Refer to "Flywheel Replacement" in this section.
2. Oil pan. Refer to "Oil Pan" in this section.
3. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).
4. Crankshaft rear oil seal housing (114) with assembled seal, and gasket (113).
5. Crankshaft rear oil seal from crankshaft rear oil seal housing (114).



Clean

- Gasket surfaces.

Install or Connect

NOTICE: Refer to "Notice" on page 6A4A-1 of this section.



Important

- Always use a new crankshaft rear oil seal and a new oil seal housing gasket (113) during the installation of the crankshaft rear oil seal housing (114).
1. New oil seal housing gasket (113) and crankshaft rear oil seal housing (114) on studs (112).
 - It is not necessary to use any type of sealant to hold oil seal housing gasket (113) in place.
 2. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).



Tighten

- Crankshaft rear oil seal housing nuts (115) and bolts/screws (116) to 15 N.m (11 lb. ft.).



Inspect

- Oil pan gasket for damage. Replace gasket if necessary.
3. Oil pan. Refer to "Oil Pan" in this section.
 4. New crankshaft rear oil seal. Refer to "Crankshaft Rear Oil Seal" in this section.
 5. Flywheel. Refer to "Flywheel" in this section.

ENGINE



Important

- This vehicle uses a sequential multiport fuel injected engine. Fuel injector connectors must be positioned onto their appropriate fuel injector or engine performance and exhaust emissions may be seriously affected. Fuel injector connectors are numbered to match their correct fuel injector for that cylinder. If fuel injector connector numbers can not be identified, refer to SECTION 8A-20 for correct fuel injector connector wire color to fuel injector for each cylinder.



Remove or Disconnect

1. Battery negative cable.
2. Recover R134a refrigerant. Refer to SECTION 1B.
3. Drain coolant. Refer to SECTION 6B.
4. Air cleaner resonator bracket nuts.
5. Air cleaner resonator.
 - Loosen clamp at air intake duct and slide resonator off studs.
6. Air intake duct.
7. Fuel lines at fuel rail. Refer to SECTION 6C.
8. Radiator fan upper shroud, if equipped with mechanical fan. Refer to SECTION 6B.
9. Fan blade clutch nuts and fan blade with clutch attached, if equipped with mechanical fan.
10. Fan pulley, if equipped with mechanical fan.
11. Heater hose at water pump and bracket. Refer to "Water Pump" in this section.
12. Accelerator control cable at throttle body.
13. Radiator inlet and outlet hoses from water pump and engine.
14. Coolant hose at throttle body.
15. Raise and suitably support vehicle. Refer to SECTION 0A.
16. Engine oil filter adapter hoses, if equipped. Refer to "Engine Oil Filter Adapter and Hoses" in this section.
17. Drain engine oil.
18. Warm up three-way catalytic converters and gaskets from exhaust manifolds. Refer to SECTION 6F.
19. Converter cover bolts/screws and converter cover. Refer to SECTION 7A.
20. Converter bolts/screws. Refer to SECTION 7A.
21. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner" in this section.
22. Air conditioning compressor and condenser hose from compressor. Refer to SECTION 1B.
 - Plug open ends of lines and fittings.
23. Transmission fluid cooler lines from engine clips.
24. Radiator fan lower shroud, if equipped with mechanical fan. Refer to SECTION 6B.
25. Electric engine cooling fans. Refer to SECTION 6B.

26. Electrical connections from starter motor.
27. Electrical connectors from knock sensor and oxygen sensors.
28. Electrical connectors from engine oil level switch and fuel pump switch/engine oil pressure gage sensors.
29. Lower vehicle.
30. Power steering inlet and outlet hoses at pump.
 - Siphon fluid from reservoir to prevent excessive spillage.
31. Brake booster vacuum hose.
32. Generator wiring from generator.
33. Engine wiring harness connectors and ground straps. Reposition wiring harness.
34. Raise and suitably support vehicle. Refer to SECTION 0A.
35. Transmission-to-engine bolts/screws.
36. Transmission filler tube bolt/screw at rear of right side cylinder head.
37. Engine mount through-bolts/screws. Refer to "Engine Mounts and Brackets" in this section.
38. Lower vehicle.
39. Engine wiring harness support at left front corner of intake manifold.
40. Engine from vehicle.
 - Install engine lifting device to boss at left front corner of intake manifold using a 3/8-16 NC standard thread bolt. Use bolt long enough to thread into the intake manifold at least 25 mm (1 inch). Install other end of lifting device to fourth bolt position on right side of intake manifold. Use a 3/8-16 NC bolt long enough to thread into the cylinder head at least 25 mm (1 inch).

Important

- Refer to SECTION 6A4B for engine block cleaning, inspection, and repair.

Install or Connect

1. Engine to vehicle.
2. Engine wiring harness support at left front corner of intake manifold.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Engine mount through-bolts/screws. Refer to "Engine Mounts and Brackets" in this section.
5. Transmission filler tube bolt/screw at rear of right side cylinder head.

Tighten

- Transmission filler tube bolts/screws to 25 N.m (18 lb. ft.).
6. Transmission-to-engine bolts/screws.

Tighten

- Transmission-to-engine bolts/screws to 47 N.m (35 lb. ft.).

7. Lower vehicle.
8. Engine wiring harness, connectors and ground straps.
 - Fuel injector connectors must be connected to their appropriate fuel injector. Refer to SECTION 8A-20.
9. Generator. Refer to SECTION 6D3.
10. Generator wiring to generator.
11. Brake booster vacuum hose.
12. Power steering inlet and outlet hoses at pump.
13. Raise and suitably support vehicle. Refer to SECTION 0A.
14. Electrical connectors to engine oil level switch and fuel pump switch/engine oil pressure gage sensor.
15. Electrical connectors to knock sensor and oxygen sensor.
16. Electrical connections to starter motor.
17. Electric engine cooling fans. Refer to SECTION 6B.
18. Radiator fan lower shroud, if removed. Refer to SECTION 6B.
19. Transmission fluid cooler lines to engine clips.
20. Air conditioning compressor and condenser hose to compressor. Refer to SECTION 1B.
 - Unplug open ends of lines and fittings.
21. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner" in this section.
22. Converter bolts/screws. Refer to SECTION 7A.
23. Converter cover and converter cover bolts/screws. Refer to SECTION 7A.
24. Warm up three-way catalytic converters and gaskets to exhaust manifolds. Refer to SECTION 6F.
25. Engine oil filter adapter hoses, if equipped. Refer to "Engine Oil Filter Adapter and Hoses" in this section.
26. Lower vehicle.
27. Coolant hose at throttle body.
28. Radiator inlet and outlet hoses to water pump and engine. Refer to SECTION 6B.
29. Accelerator control cable to throttle body.
30. Heater hose to water pump and bracket. Refer to "Water Pump" in this section.
31. Fan pulley, if removed.
32. Fan blade with clutch attached and clutch nuts, if removed.

Tighten

- Fan blade clutch nuts to 26 N.m (19 lb. ft.).
33. Radiator fan upper shroud, if removed. Refer to SECTION 6B.
 34. Fuel lines at fuel rail. Refer to SECTION 6C.
 35. Air intake duct.
 36. Air cleaner resonator.
 - Slide resonator over studs and tighten clamp snugly.
 37. Air cleaner resonator bracket nuts.

**Tighten**

- Air cleaner resonator bracket nuts to 10 N.m (89 lb. in.).
- 38. Battery negative cable.
- 39. Refill with engine oil.
- 40. Refill and bleed cooling system. Refer to SECTION 6B.
- 41. Refill and bleed power steering system. Refer to SECTION 3B.
- 42. Charge air conditioning system with R134a and leak check air conditioning hose fitting at compressor. Refer to SECTION 1B.
- 43. Reset engine oil life monitor (unless oil was not changed). Refer to SECTION 0B.

THREAD REPAIR**Figure 40**

Damaged threads may be reconditioned by drilling out, re-threading and installing a suitable thread insert. General purpose thread repair kits are available commercially.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to required depth.

**Important**

- Refer to kit manufacturer's instructions regarding size of drill and tap to be used.
2. Drill out damaged thread. Clean out chips.
 3. Tap hole.
 - A. Lubricate tap with light engine oil.
 - B. Clean thread.

**Important**

- Avoid build-up of chips. Back out tap every few turns and remove chips.
4. Thread the thread insert onto mandrel of installer. Engage tang of insert onto end of mandrel.
 5. Lubricate insert with light engine oil (except when installing in aluminum) and install.

**Important**

- When correctly installed, insert should be flush to one turn below surface.
6. If tang of insert does not break off when backing out installer, break tang off with drift pin.

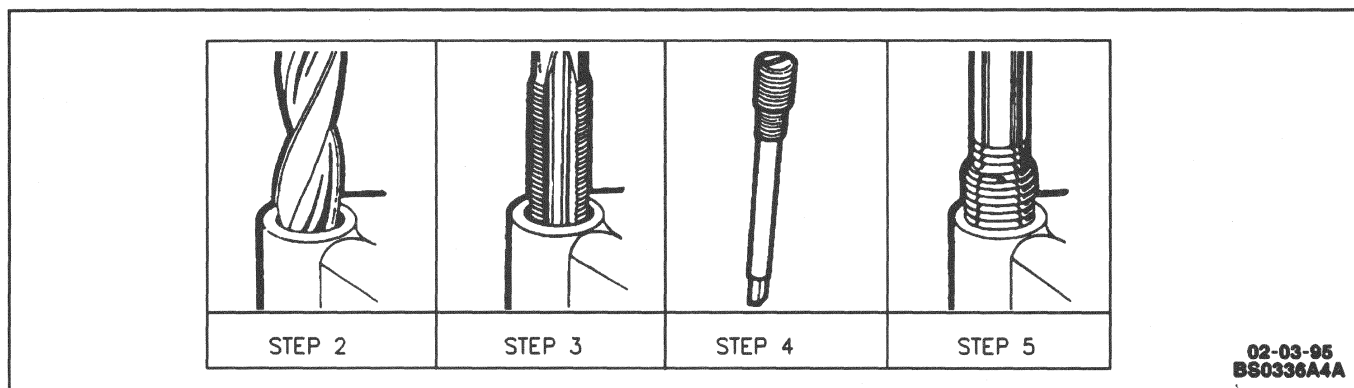


Figure 40 - Repairing Threaded Holes

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw.....	12 N.m (106 lb. in.)
Air Conditioning Compressor Front Mounting Bolt/Screw.....	50 N.m (37 lb. ft.)
Air Conditioning Compressor Rear Brace Bolt/Screw.....	25 N.m (18 lb. ft.)
Air Cleaner Resonator Bracket Nut.....	10 N.m (89 lb. in.)
Camshaft Retainer Bolt/Screw.....	12 N.m (106 lb. in.)
Camshaft Sprocket Bolt/Screw.....	25 N.m (18 lb. ft.)
Catalytic Converter Support-to-Transmission Bolt/Screw.....	34 N.m (26 lb. ft.)
Coolant Fan Pulley Bracket Nut.....	50 N.m (37 lb. ft.)
Connecting Rod Nut.....	27 N.m (20 lb. ft.) plus an additional 55 degrees
Crankshaft Balancer Bolt/Screw.....	85 N.m (63 lb. ft.)
Crankshaft Balancer Hub Bolt/Screw.....	100 N.m (74 lb. ft.)
Crankshaft Bearing Cap Bolt/Screw and Stud.....	105 N.m (77 lb. ft.)
Crankshaft Pulley Bolt/Screw (Vehicles With Mechanical Fan Only)	
First Pass.....	10 N.m (89 lb. in.)
Second Pass.....	25 N.m (18 lb. ft.)
Crankshaft Rear Oil Seal Housing Nut and Bolt/Screw.....	15 N.m (11 lb. ft.)
Cylinder Head Bolt/Screw	
First Pass all Bolt in Sequence.....	30 N.m (22 ft. lb.)
Second Pass all Bolt in Sequence:	
Short Bolt.....	55 additional degrees
Medium Bolt.....	65 additional degrees
Long Bolt.....	75 additional degrees
Distributor Bolt/Screw.....	12 N.m (106 lb. in.)
Drain Plug.....	20 N.m (15 lb. ft.)
Drive Belt Tensioner Bolt/Screw (Engine Accessory).....	25 N.m (18 lb. ft.)
Drive Belt Tensioner Bolt/Screw(Mechanical Fan).....	25 N.m (18 lb. ft.)
EGR Control Valve Relay Solenoid Nut.....	25 N.m (18 lb. ft.)
EGR Valve Nut.....	25 N.m (18 lb. ft.)
EGR Valve Pipe Bolt/Screw and Nut.....	25 N.m (18 lb. ft.)
Engine Block Oil Gallery Plug.....	20 N.m (15 lb. ft.)
Engine Coolant Air Bleed Pipe Bolt/Screw.....	40 N.m (30 lb. ft.)
Engine Front Cover Bolt/Screw.....	12 N.m (106 lb. in.)
Engine Mount Bracket Bolt/Screw.....	47 N.m (35 lb. ft.)
Engine Mount-to-Engine Bracket Through-Bolt/Screw.....	120 N.m (89 lb. ft.)
Engine Mount-to-Engine Bracket Nut.....	80 N.m (59 lb. ft.)
Engine Mount-to-Frame Bolt/Screw.....	50 N.m (37 lb. ft.)
Engine Mount-to-Frame Nut.....	48 N.m (35 lb. ft.)
Engine Oil Cooler Hose Fitting.....	24 N.m (18 lb. ft.)
Engine Oil Cooler Hose Nut.....	35 N.m (26 lb. ft.)
Engine Oil Cooler Pipe Clip Nut.....	6 N.m (53 lb. in.)
Engine Oil Level Switch Sensor.....	35 N.m (26 lb. ft.)
Exhaust Manifold Stud and Bolt/Screw.....	35 N.m (26 lb. ft.)
Fan Blade Clutch Nut.....	26 N.m (19 lb. ft.)
Fan Pulley Bracket Nut.....	50 N.m (37 lb. ft.)
Flywheel Bolt/Screw.....	100 N.m (74 lb. ft.)
Fuel Injection Fuel Rail Bolt/Screw.....	10 N.m (89 lb. in.)
Fuel Pump Switch and Engine Oil Pressure Gage Sensor.....	12 N.m (106 lb. in.)
Generator Bracket Bolt/Screw.....	40 N.m (30 lb. ft.)
Ignition Coil Stud.....	40 N.m (30 lb. ft.)
Intake Manifold Bolt/Screw and Stud	
First Pass.....	8 N.m (71 lb. in.)
Final Pass.....	48 N.m (35 lb. ft.)
Knock Sensor.....	20 N.m (15 lb. ft.)
MAP Sensor Bolt/Screw.....	6 N.m (53 lb. in.)
Oil Filter Adapter Bolt/Screw.....	25 N.m (18 lb. ft.)
Oil Filter.....	21 N.m (15 lb. ft.)
Oil Level Indicator Tube Bolt/Screw.....	12 N.m (106 lb. in.)
Oil Pan	
Corner Oil Pan Bolt/Screw, Stud and Nut.....	20 N.m (15 lb. ft.)
Side Rail Oil Pan Bolt/Screw and Stud.....	12 N.m (106 lb. in.)

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Oil Pan Baffle Nut	40 N.m (30 lb. ft.)
Oil Pan Drain Plug	20 N.m (15 lb. ft.)
Oil Pump Bolt/Screw-to-Rear Crankshaft Bearing Cap	90 N.m (66 lb. ft.)
Oil Pump Cover Bolt/Screw	9 N.m (80 lb. in.)
Oil Pump Driveshaft Bolt/Screw	18 N.m (13 lb. ft.)
Secondary Air Injection Pipe Fitting-to-Exhaust Manifold	55 N.m (41 lb. ft.)
Secondary Air Injection Pump Bracket Bolt/Screw and Nut	40 N.m (30 lb. ft.)
Spark Plugs	
With New Head Installation	30 N.m (22 lb. ft.)
All Subsequent Installations	20 N.m (15 lb. ft.)
Starter Motor Bolt/Screw	47 N.m (35 lb. ft.)
Transmission-to-Engine Bolt/Screw	47 N.m (35 lb. ft.)
Transmission Filler Tube Bolt/Screw	25 N.m (18 lb. ft.)
Throttle Body Bolt/Screw	25 N.m (18 lb. ft.)
Valve Lifter Guide Retainer Bolt/Screw	25 N.m (18 lb. ft.)
Valve Rocker Arm Cover Bolt/Screw	12 N.m (106 lb. in.)
Valve Rocker Arm Ball Stud	68 N.m (50 lb. ft.)
Water Pump Bolt and Stud	45 N.m (33 lb. ft.)
Water Pump Driveshaft Bearing Retainer Bolt/Screw	12 N.m (106 lb. in.)

ENGINE ASSEMBLY SPECIFICATIONS 4.3L - (L99)**GENERAL**

Type	V8
Displacement	45.7L (265 CID)
Bore	94.89 mm (3.736 in.)
Stroke	76.20 mm (3.000 in.)
Compression Ratio	9.93:1
Firing Order	1-8-4-3-6-5-7-2
Spark Plugs	
Type	AC41-943
Gap	1.27 mm (0.050 in.)
Oil Pressure (Minimum)	
1,000 engine rpm	41.4 kPa (6.0 psig)
2,000 engine rpm	124.1 kPa (18.0 psig)
4,000 engine rpm	165.5 kPa (24.0 psig)

CYLINDER BORE

Diameter	94.881 - 94.957 mm (3.7355 - 3.7385 in.)
Out-of-Round	
Production	0.02 mm (0.001 in.) MAX.
Service Limit	0.05 mm (0.002 in.) MAX.
Taper Production	
Thrust Side	0.012 mm (0.0005 in.) MAX.
Relief Side	0.025 mm (0.0010 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

PISTON

Piston Bore Clearance	
Production	0.025 - 0.068 mm (0.0010 - 0.0027 in.)
Service Limit	0.068 mm (0.0027 in.) MAX.

PISTON RINGS

Piston Compression Ring Groove Clearance	
Production Top	0.030 - 0.073 mm (0.0012 - 0.0029 in.)
Production 2nd	0.030 - 0.073 mm (0.0012 - 0.0029 in.)
Service Limit	0.107 mm (0.0042 in.) MAX.
Gap	
Production Upper	0.25 - 0.40 mm (0.010 - 0.016 in.)
Production Lower	0.46 - 0.66 mm (0.018 - 0.026 in.) MAX.
Service Limit	0.88 mm (0.035 in.) MAX.
Piston Oil Ring Groove Clearance	
Production	0.051 - 0.17 mm (0.002 - 0.007 in.)
Service Limit	0.20 mm (0.008 in.) MAX.

4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P 6A4A-39

Gap

Production	0.25 - 0.76 mm (0.010 - 0.030 in.)
Service Limit	1.65 mm (0.065 in.) MAX.

PISTON PIN

Diameter	23.545 - 23.548 mm (0.9270 - 0.9271 in.)
Clearance in Piston	
Production	0.0102 - 0.0203 mm (0.0004 - 0.0008 in.)
Service Limit	0.025 mm (0.0010 in.) MAX.
Fit In Connecting Rod.....	0.021 - 0.040 mm (0.0008 - 0.0016 in.) Interference

CRANKSHAFT

Main Journal

Diameter # 1	62.191 - 62.207 mm (2.4485 - 2.4491 in.)
Diameter #2, #3, #4	62.191 - 62.207 mm (2.4485 - 2.4491 in.)
Diameter #5	62.191 - 62.207 mm (2.4485 - 2.4491 in.)

Taper

Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Out-of-Round

Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Crankshaft Bearing Clearance

Production #1	0.022 - 0.051 mm (0.0009 - 0.0020 in.)
Production #2, #3, #4.....	0.022 - 0.051 mm (0.0009 - 0.0020 in.)
Production #5	0.025 - 0.053 mm (0.0010 - 0.0021 in.)
Service Limit #1	0.025 - 0.051 mm (0.0010 - 0.0020 in.)
Service Limit #2, #3, #4.....	0.025 - 0.064 mm (0.0010 - 0.0025 in.)
Service Limit #5	0.038 - 0.076 mm (0.0015 - 0.0030 in.)

Crankshaft End Play..... 0.05 - 0.20 mm (0.002 - 0.008 in.)

Crankshaft Runout (At Rear Flange)..... 0.038 mm (0.0015 in.)

CONNECTING ROD

Connecting Rod Journal Diameter..... 53.284 - 53.334 mm (2.0978 - 2.0998 in.)

Taper

Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Out-of-Round

Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Rod Bearing Clearance

Production	0.033 - 0.088 mm (0.0013 - 0.0035 in.)
Service Limit	0.076 mm (0.0010 - 0.0030 in.) MAX.

Rod Side Clearance..... 0.16 - 0.35 mm (0.006 - 0.014 in.)

CAMSHAFT

Journal Diameter.....47.440 - 47.490 mm (1.8677 - 1.8697 in.)

End Play..... 0.11 - 0.30 mm (0.004 - 0.012 in.)

Lobe Lift +/- 0.050 mm (0.002 in.)

Intake..... 7.02 mm (0.276 in.)

Exhaust..... 7.25 mm (0.285 in.)

VALVE SYSTEM

Lifter.....Hydraulic

Rocker Arm Ratio.....1.50:1

Valve Lash..... 1+/- 1/4 turn down from zero lash

Face Angle..... 45°

Seat Angle..... 46°

Seat Runout..... 0.05 mm (0.002 in.) MAX.

Seat Width

Intake......76 - 1.27 mm (0.030 - 0.050 in.)

Exhaust..... 1.52 - 2.03 mm (0.060 - 0.080 in.)

Stem Clearance

Production

Intake.....0.025 - 0.069 mm (0.0010 - 0.0027 in.)

Exhaust.....0.025 - 0.069 mm (0.0010 - 0.0027 in.)

6A4A-40 4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P

Service	
Intake	0.093 mm (0.0037 in.) MAX.
Exhaust 0.119 mm (0.0047 in.) MAX. Valve Spring Free Length	51.3 mm (2.02 in.)
Pressure	
Closed	338 - 374 N at 43.2 mm (76 - 84 lb. at 1.70 in.)
Open	832 - 903 N at 32.3 mm (187 - 203 lb. at 1.27 in.)
Installed Height	
Intake	44.2 mm (1.74 in.)
Exhaust	44.2 mm (1.74 in.)
Valve Lift	
Intake	10.52 mm (0.414 in.)
Exhaust	10.87 mm (0.428 in.)

ENGINE ASSEMBLY SPECIFICATIONS 5.7L - (LT1)

GENERAL

Type	V8
Displacement	45.7L (350 CID)
Bore	101.60 mm (4.000 in.)
Stroke	88.39 mm (3.480 in.)
Compression Ratio	10.4:1
Firing Order	1-8-4-3-6-5-7-2
Spark Plugs	
Type	AC41-906
Gap	1.27 mm (0.050 in.)
Oil Pressure (Minimum)	
1,000 engine rpm	41.4 kPa (6.0 psig)
2,000 engine rpm	124.1 kPa (18.0 psig)
4,000 engine rpm	165.5 kPa (24.0 psig)

CYLINDER BORE

Diameter	101.618 - 101.643 mm (4.0007 - 4.0017 in.)
Out-of-Round	
Production	0.02 mm (0.001 in.) MAX.
Service Limit	0.05 mm (0.002 in.) MAX.
Taper Production	
Thrust Side	0.012 mm (0.0005 in.) MAX.
Relief Side	0.025 mm (0.0010 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

PISTON

Piston Bore Clearance	
Production	0.025 - 0.068 mm (0.0010 - 0.0027 in.)
Service Limit	0.068 mm (0.0027 in.) MAX.

PISTON RINGS

Piston Compression Ring Groove Clearance	
Production Top	0.050 - 0.090 mm (0.0019 - 0.0035 in.)
Production 2nd	0.050 - 0.090 mm (0.0019 - 0.0035 in.)
Service Limit	0.107 mm (0.0042 in.) MAX.
Gap	
Production Upper	0.25 - 0.40 mm (0.010 - 0.016 in.)
Production Lower	0.46 - 0.66 mm (0.018 - 0.026 in.) MAX.
Service Limit	0.88 mm (0.035 in.) MAX.
Piston Oil Ring Groove Clearance	
Production	0.051 - 0.17 mm (0.002 - 0.007 in.)
Service Limit	0.20 mm (0.008 in.) MAX.
Gap	
Production	0.25 - 0.76 mm (0.010 - 0.030 in.)
Service Limit	1.65 mm (0.065 in.) MAX.

PISTON PIN

Diameter.....	23.545 - 23.548 mm (0.9270 - 0.9271 in.)
Clearance in Piston	
Production	0.0120 - 0.0210 mm (0.0004 - 0.0008 in.)
Service Limit	0.025 mm (0.0010 in.) MAX.
Fit In Connecting Rod.....	0.021 - 0.040 mm (0.0008 - 0.0016 in.) Interference

CRANKSHAFT

Main Journal	
Diameter # 1.....	62.189 - 62.212 mm (2.4484 - 2.4493 in.)
Diameter #2, #3, #4	62.182 - 62.205 mm (2.4481 - 2.4490 in.)
Diameter #5	62.177 - 62.199 mm (2.4479 - 2.4488 in.)
Taper	
Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.
Out-of-Round	
Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.
Crankshaft Bearing Clearance	
Production #1	0.017 - 0.053 mm (0.0007 - 0.0021 in.)
Production #2, #3, #4	0.022 - 0.061 mm (0.0009 - 0.0024 in.)
Production #5	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Service Limit #1	0.025 - 0.051 mm (0.0010 - 0.0020 in.)
Service Limit #2, #3, #4	0.025 - 0.064 mm (0.0010 - 0.0025 in.)
Service Limit #5	0.038 - 0.076 mm (0.0015 - 0.0030 in.)
Crankshaft End Play	0.05 - 0.20 mm (0.002 - 0.008 in.)
Crankshaft Runout (At Rear Flange).....	0.038 mm (0.0015 in.)

CONNECTING ROD

Connecting Rod Journal Diameter.....	53.284 - 53.334 mm (2.0978 - 2.0998 in.)
Taper	
Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.
Out-of-Round	
Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.
Rod Bearing Clearance	
Production	0.033 - 0.088 mm (0.0013 - 0.0035 in.)
Service Limit	0.076 mm (0.0010 - 0.0030 in.) MAX.
Rod Side Clearance	0.16 - 0.35 mm (0.006 - 0.014 in.)

CAMSHAFT

Journal Diameter.....	47.440 - 47.490 mm (1.8677 - 1.8697 in.)
End Play.....	0.11 - 0.30 mm (0.004 - 0.012 in.)
Lobe Lift +/- 0.050 mm (0.002 in.)	
Intake.....	7.02 mm (0.276 in.)
Exhaust.....	7.25 mm (0.285 in.)

VALVE SYSTEM

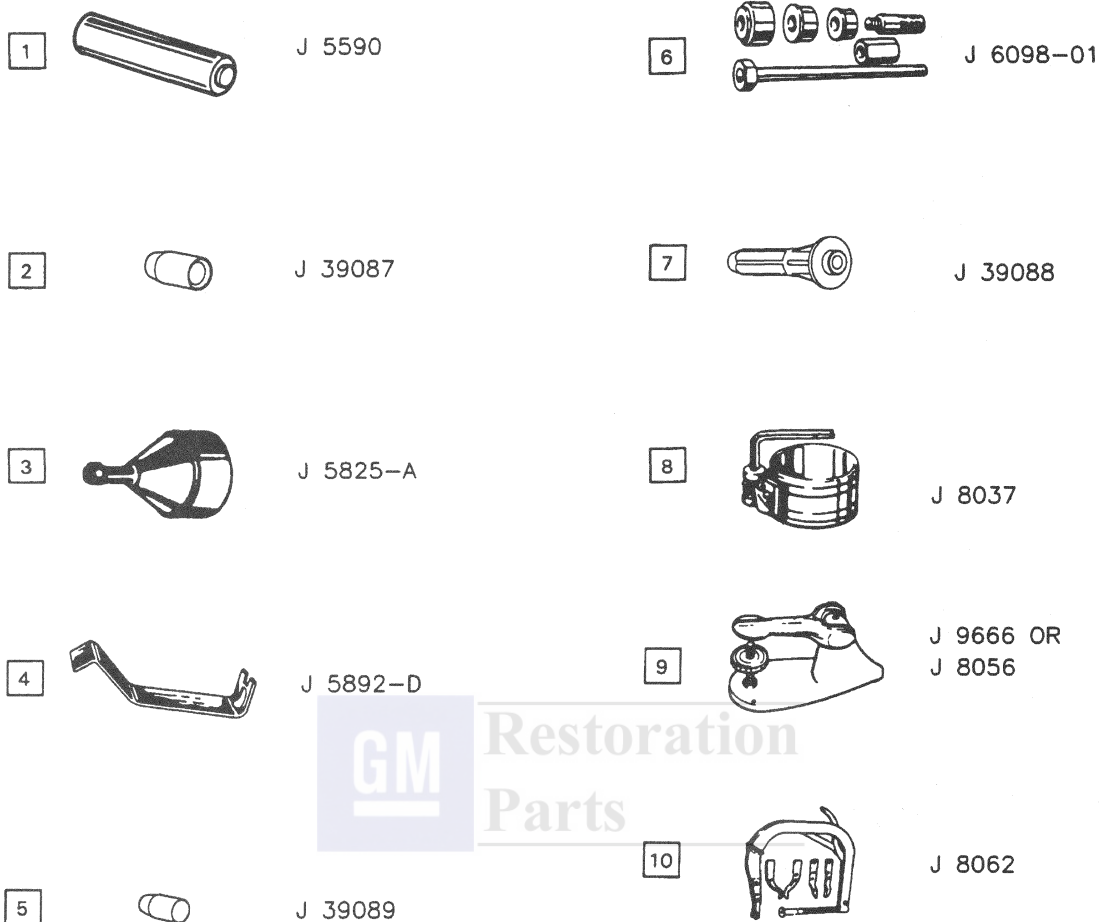
Lifter.....	Hydraulic
Rocker Arm Ratio	1.50:1
Valve Lash	1+/- 1/4 turn down from zero lash
Face Angle.....	45°
Seat Angle.....	46°
Seat Runout.....	0.05 mm (0.002 in.) MAX.
Seat Width	
Intake.....	.76 - 1.27 mm (0.030 - 0.050 in.)
Exhaust.....	1.52 - 2.03 mm (0.060 - 0.080 in.)
Stem Clearance Production	
Intake.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Exhaust.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)

6A4A-42 4.3L & 5.7L V8 ENGINE ON-VEHICLE SERVICE RPO L99 - VIN W & LT1 - VIN P

Service	
Intake	0.093 mm (0.0037 in.) MAX.
Exhaust 0.119 mm (0.0047 in.) MAX. Valve Spring Free Length	51.3 mm (2.02 in.)
Pressure	
Closed.....	338 - 374 N at 43.2 mm (76 - 84 lb. at 1.70 in.)
Open	832 - 903 N at 32.3 mm (187 - 203 lb. at 1.27 in.)
Installed Height	
Intake	44.2 mm (1.74 in.)
Exhaust.....	44.2 mm (1.74 in.)
Valve Lift	
Intake	10.52 mm (0.414 in.)
Exhaust.....	10.87 mm (0.428 in.)

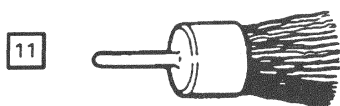


SPECIAL TOOLS



- 1 CRANKSHAFT GEAR INSTALLER
- 2 DRIVEN GEAR SHAFT FRONT COVER SEAL PROTECTOR
- 3 CRANKSHAFT GEAR REMOVER
- 4 VALVE SPRING COMPRESSOR (HEAD-ON)
- 5 DRIVEN GEAR/WATER PUMP SHAFT SEAL INSTALLER
- 6 CAMSHAFT BEARING REMOVER AND INSTALLER
- 7 DRIVEN GEAR SHAFT FRONT COVER SEAL INSTALLER
- 8 PISTON RING COMPRESOR
- 9 VALVE SPRING TESTER
- 10 VALVE SPRING COMPRESSOR (HEAD-OFF)

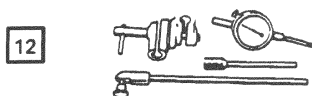
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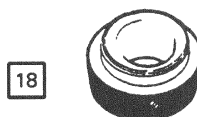
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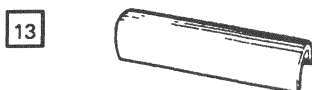
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J 8520



J 35468



J 21882



J 35621



J 39046



J 8101



J 23590



J 23738-A



J 41546



J 39937

- 11** CARBON REMOVING BRUSH
- 12** CAM LOBE LIFT INDICATOR
- 13** OIL SUCTION PIPE INSTALLER
- 14** CRANKSHAFT HUB REMOVER AND INSTALLER
- 15** SPARK PLUG PORT ADAPTER (14 MM TAPERED SEAT)
- 16** VALVE STEM SEAL TESTER (MITY-VAC)

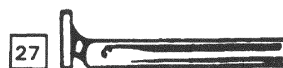
- 17** PISTON PIN REMOVER AND INSTALLER SET
- 18** FRONT COVER OIL SEAL INSTALLER
- 19** REAR MAIN SEAL INSTALLER
- 20** VALVE GUIDE CLEANER
- 21** DRIVEN GEAR ASSEMBLY INSTALLER
- 22** DISTRIBUTOR DRIVESHAFT FRONT COVER SEAL INSTALLER

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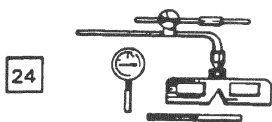
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J 3049



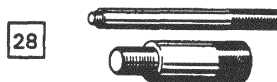
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J 8080



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J 7872



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J 5239



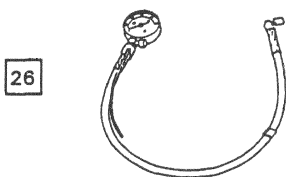
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J 8001



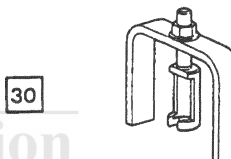
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J 9290-01



26

J 34730-FF



30

J 39243



23 HYDRAULIC VALVE
LIFTER REMOVER (PLIER TYPE)

24 MAGNETIC BASE INDICATOR
SET

25 DIAL INDICATOR SET

26 FUEL PRESSURE GAGE

27 MAIN BEARING SHELL
REMOVER & INSTALLER

28 CONNECTING ROD BOLT GUIDE SET

29 HYDRAULIC VALVE
LIFTER REMOVER
(SLIDE HAMMER TYPE)

30 DRIVEN GEAR REMOVER

5-6-94
BS0366A4A



SECTION 6A4B

4.3 AND 5.7 LITER V8 ENGINE UNIT REPAIR RPO L99 - VIN W RPO LT1 - VIN P

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require replacement after removal. General Motors also will call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplement coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

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6A4B-2 4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P

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GENERAL DESCRIPTION

CONSTRUCTION

Figures 1 through 4

Engine Block

The engine block is made of cast iron and has eight cylinders arranged in a "V" shape with four cylinders in each bank. It is a one piece casting with the cylinders encircled by coolant jackets.

Cylinder Heads

The cylinder heads are cast iron. Valve guides and hardened valve seats are integral. Spark plugs are located between the intake and exhaust ports.

Crankshaft

The crankshaft is made of cast nodular iron. It is supported by five crankshaft bearings that are retained by bearing caps which are machined with the block for proper alignment and clearances. The bearing caps are retained by two bolts each. The number five bearing at the rear of the engine assembly is the end thrust bearing. Four connecting rod journals (two rods per journal) are spaced 90 degrees apart. Pushed onto the front of the crankshaft is the crankshaft position sensor reluctor ring. The reluctor ring has four lugs used for crankshaft timing and is constructed of powdered metal. The reluctor ring has a slight interference fit onto the crankshaft and an internal keyway for correct positioning.

Piston and Connecting Rod Assemblies

The pistons are cast aluminum that use two compression rings and one oil control ring assembly. The piston is a low-friction, lightweight design with a flat top and barrel-shaped skirt. The piston pins are chromium steel. They have a floating fit in the piston and are retained by a press fit in the connecting rod assembly. The connecting rod assemblies are made out of forged powdered metal. They are machined with the rod cap installed for proper clearances and alignment.

Camshaft

A steel camshaft is supported by five bearings pressed into the engine block. The timing sprocket mounted to the front of the camshaft is driven by the crankshaft sprocket through a camshaft timing chain.

The camshaft sprocket also has spur gear teeth which drive a geared shaft assembly to operate the water pump.

A spiral gear machined into the camshaft near the rear journal drives a shaft assembly which operates the oil pump.

A pin on the camshaft mates with the distributor driveshaft. This provides net build timing, meaning the ignition timing does not have to be adjusted.

Valve Train

The valve train is a ball pivot type. Motion is transmitted from the camshaft through hydraulic roller valve lifter and tubular valve pushrods to the valve rocker arms. The valve rocker arm pivots on a ball to open the valve. The hydraulic valve lifters keep all parts of the valve train in constant contact.

The valve rocker arm ball is retained on the valve rocker arm stud with a locking nut. The valve rocker arm stud is pressed into the cylinder head.

Intake Manifold

The intake manifold is a one-piece cast aluminum unit. The intake manifold has exhaust gas recirculation and crankcase vent passages cast into it. Coolant crossover passages have been eliminated.

Exhaust Manifolds

The two cast-iron exhaust manifolds direct exhaust gases from the combustion chambers to the exhaust system. The exhaust manifolds each have a port for air injection system pipe fittings.

LUBRICATION

Figures 5 through 7

Engine lubrication is supplied by a gear-type oil pump. The oil pump is driven by an intermediate

shaft. The intermediate shaft is connected to a driveshaft assembly which is driven by the camshaft. The oil pump gears rotate and draw oil from the oil pan sump through an oil pump screen and pipe. The oil is pressurized as it passes through the oil pump and sent through engine block oil galleries.

Contained within the oil pump is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed to the oil filter where harmful contaminants are removed. A bypass valve is also incorporated into the oil filter. The bypass allows oil to bypass the filter and flow to the engine assembly if the filter becomes clogged.

The oil is then pumped to the main oil gallery which is drilled through the length of the engine block just above the camshaft. At the rear of the engine block, oil also flows into the right and left valve lifter oil galleries. From the main oil gallery, oil is pumped downward to the camshaft bearings, then to the crankshaft bearings. The crankshaft bearing upper inserts are grooved to align with oil passages drilled from the crankshaft bearing journal to the connecting rod journal. After lubricating the connecting rod bearings, the cylinder walls, rings and piston pins are lubricated by oil which is "slung" from the connecting rod bearing journals due to the rotation of the crankshaft. This oil then returns to the oil pan sump. Oil that has entered the left and right valve lifter oil galleries pressurizes the hydraulic valve lifters and is then pumped up through the valve pushrods to lubricate the valve rocker arms and valve stems.

Oil returning to the oil pan from the cylinder heads and the front camshaft bearing, lubricates the camshaft timing chain and crankshaft and camshaft sprockets.

DISASSEMBLY

When beginning the engine assembly unit repair, the belt tensioner, power steering pump, air injection pump, generator, A/C compressor, and generator and A/C compressor brackets should already be removed. For removal procedures, refer to the specific section in the service manual for each component.

ENGINE FLYWHEEL

Figure 8

Remove or Disconnect

1. Engine flywheel bolts.
2. Engine flywheel.

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan drain plug and allow oil to drain.
2. Oil filter.
3. Knock sensor and block drain plug and allow coolant to drain.

INTAKE MANIFOLD

Figures 9 and 10

Remove or Disconnect

1. Fuel pressure regulator vacuum tube.
2. Evaporative emission canister purge valve vacuum hose.
3. Fuel rail bolts and air cleaner resonator bracket.
4. Fuel injectors and fuel rail from the intake manifold.
5. Exhaust gas recirculation (EGR) and distributor vacuum harness and crankcase vent hoses.
6. EGR vacuum control solenoid and bracket.
7. Move wiring harness out of area.
8. Disconnect distributor wiring harness, if necessary.
9. EGR valve nuts, EGR valve, and gasket.
10. EGR valve pipe bolt (229), nut (14), pipe (12), and gasket (22).
11. Accelerator cable bracket bolts and bracket.
12. Manifold absolute pressure (MAP) sensor bolts and MAP sensor.
13. Throttle body bolts, throttle body, and gasket.
14. Intake manifold bolts and studs.
15. Intake manifold and gaskets.

EXHAUST MANIFOLDS

Figures 10 and 11

Right Exhaust Manifold

Remove or Disconnect

1. Right cylinder bank spark plug wire harness from spark plugs and supports.
2. Oil level indicator tube bolt.
3. Oil level indicator and tube.
4. Right exhaust manifold air injection pipe (15) and check valve (11).
5. Right exhaust manifold studs (20), bolts (21), and spacers (245).
6. Right heat shields, exhaust manifold (19), and gasket (18).

Left Exhaust Manifold

Remove or Disconnect

1. Left exhaust manifold secondary air injection pipe (15) and check valve (11).
2. Left cylinder bank spark plug wire harness from spark plugs and supports.
3. Left exhaust manifold bolts (21) and spacers (245).
4. Left heat shields, exhaust manifold, and gasket (17).

6A4B-4 4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P

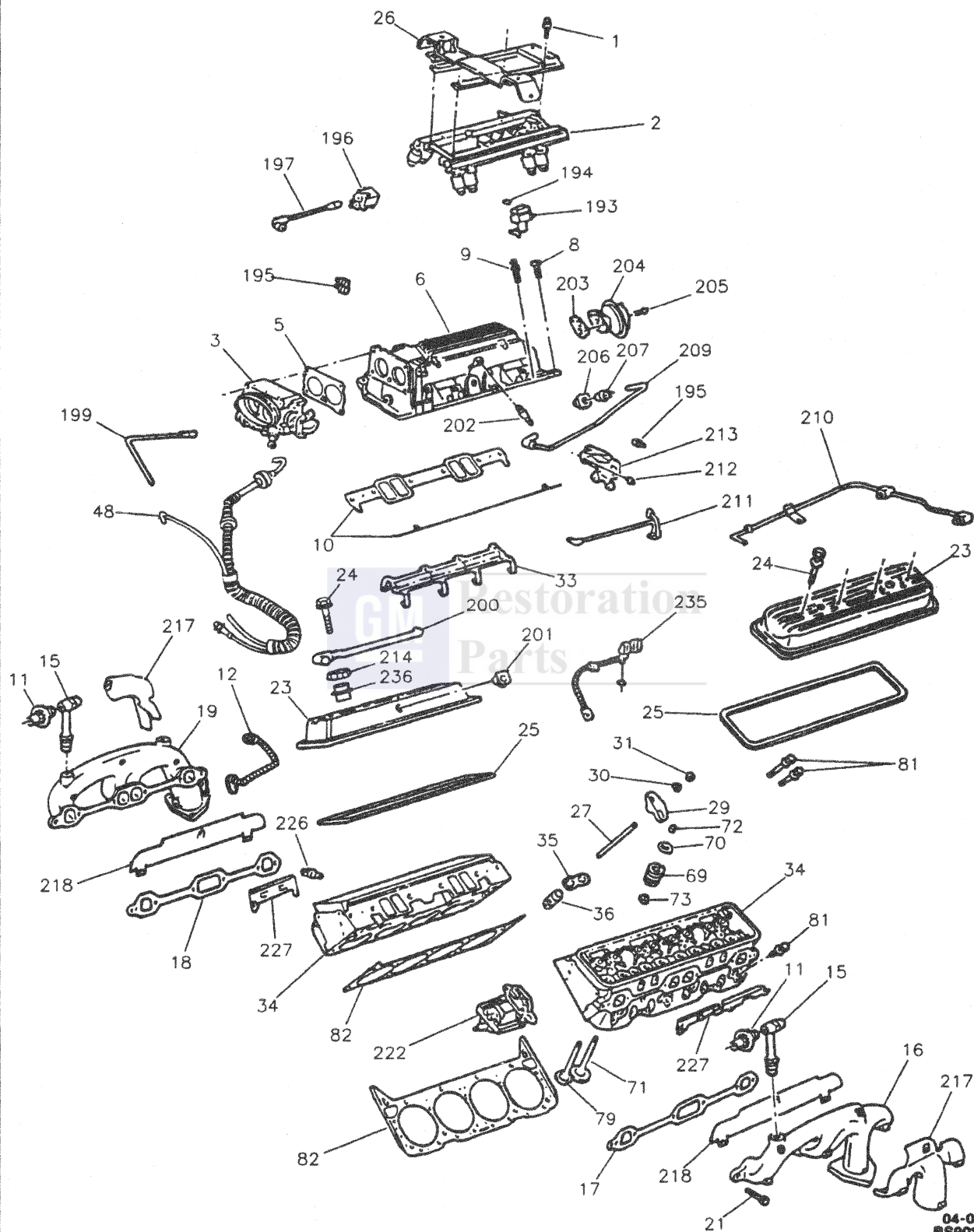


Figure 1 - Upper Engine Assembly

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1 BOLT/SCREW, FUEL INJECTOR FUEL RAIL	79 VALVE, EXHAUST
2 RAIL, MULTIPOINT FUEL INJECTION	81 BOLT/SCREW, CYLINDER HEAD
3 BODY, THROTTLE	82 GASKET, CYLINDER HEAD
5 GASKET, THROTTLE BODY	193 SOLENOID, EGR CONTROL VALVE RELAY
6 MANIFOLD, INTAKE	194 NUT, EGR CONTROL VALVE RELAY
8 BOLT/SCREW, INTAKE MANIFOLD	195 FITTING, INTAKE MANIFOLD VACUUM
9 STUD, INTAKE MANIFOLD	196 VALVE, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID
10 GASKET, INTAKE MANIFOLD	197 HOSE, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE
11 VALVE, SECONDARY AIR INJECTION	199 PIPE, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE
12 PIPE, EGR VALVE	200 HOSE, CRANKCASE VENT
15 PIPE, SECONDARY AIR INJECTION	201 GROMMET, CRANKCASE VENT HOSE
16 MANIFOLD, EXHAUST	202 FITTING, POWER BRAKE BOOSTER VACUUM TUBE
17 GASKET, EXHAUST MANIFOLD	203 GASKET, EGR VALVE
18 GASKET, EXHAUST MANIFOLD	204 VALVE, EGR
19 MANIFOLD, EXHAUST	205 BOLT/SCREW, EGR VALVE
21 BOLT/SCREW, EXHAUST MANIFOLD	206 GROMMET, CRANKCASE VENT VALVE
23 COVER, VALVE ROCKER ARM	207 VALVE, CRANKCASE VENT
24 BOLT/SCREW, VALVE ROCKER ARM COVER	209 HOSE, CRANKCASE VENT VALVE
25 GASKET, VALVE ROCKER ARM COVER	210 PIPE, ENGINE COOLANT AIR BLEED
27 PUSHROD, VALVE	211 HARNESS, EGR VALVE VACUUM
29 ARM, VALVE ROCKER	212 BOLT/SCREW, ACCELERATOR CONTROL CABLE BRACKET
30 BALL, VALVE ROCKER ARM	213 BRACKET, ACCELERATOR CONTROL CABLE
31 NUT, VALVE ROCKER ARM	214 CAP, OIL FILL
33 RETAINER, VALVE LIFTER GUIDE	217 SHIELD, EXHAUST MANIFOLD HEAT OUTER
34 HEAD, CYLINDER	218 SHIELD, EXHAUST MANIFOLD HEAT INNER
35 GUIDE, VALVE LIFTER	222 COIL, IGNITION
36 LIFTER, VALVE	226 SPARK PLUG
48 HARNESS, DISTRIBUTOR VACUUM	227 SUPPORT, SPARK PLUG WIRE
69 SPRING, VALVE	235 HARNESS, IGNITION DISTRIBUTOR WIRING
70 CAP, VALVE SPRING	236 TUBE, OIL FILL
71 VALVE, INTAKE	
72 KEY, VALVE STEM	
73 SEAL, VALVE STEM OIL	

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Figure 2 - Upper Engine Assembly - Legend

VALVE ROCKER ARM COVERS**Figure 12****Right Valve Rocker Arm Cover****Remove or Disconnect**

1. Right valve rocker arm cover bolts.
2. Right valve rocker arm cover and gasket.

Left Valve Rocker Arm Cover**Remove or Disconnect**

1. Left valve rocker arm cover bolts.
2. Left valve rocker arm cover and gasket.

VALVE ROCKER ARMS AND VALVE PUSHRODS**Figure 13 and 14****Remove or Disconnect**

1. Valve rocker arm nuts (2) and balls (1).
 2. Valve rocker arms (3) and valve pushrods (4).
- Place valve rocker arms (3), valve rocker arm balls (1), and valve pushrods (4) in a rack so that they can be reinstalled in same locations from which they were removed.

VALVE LIFTERS**Figures 15, 16, and 17****Tool Required:**

- J 3049-A Valve Lifter Removal (Plier Type)
- J 9290-01 Valve Lifter Removal (Slide Hammer Type)

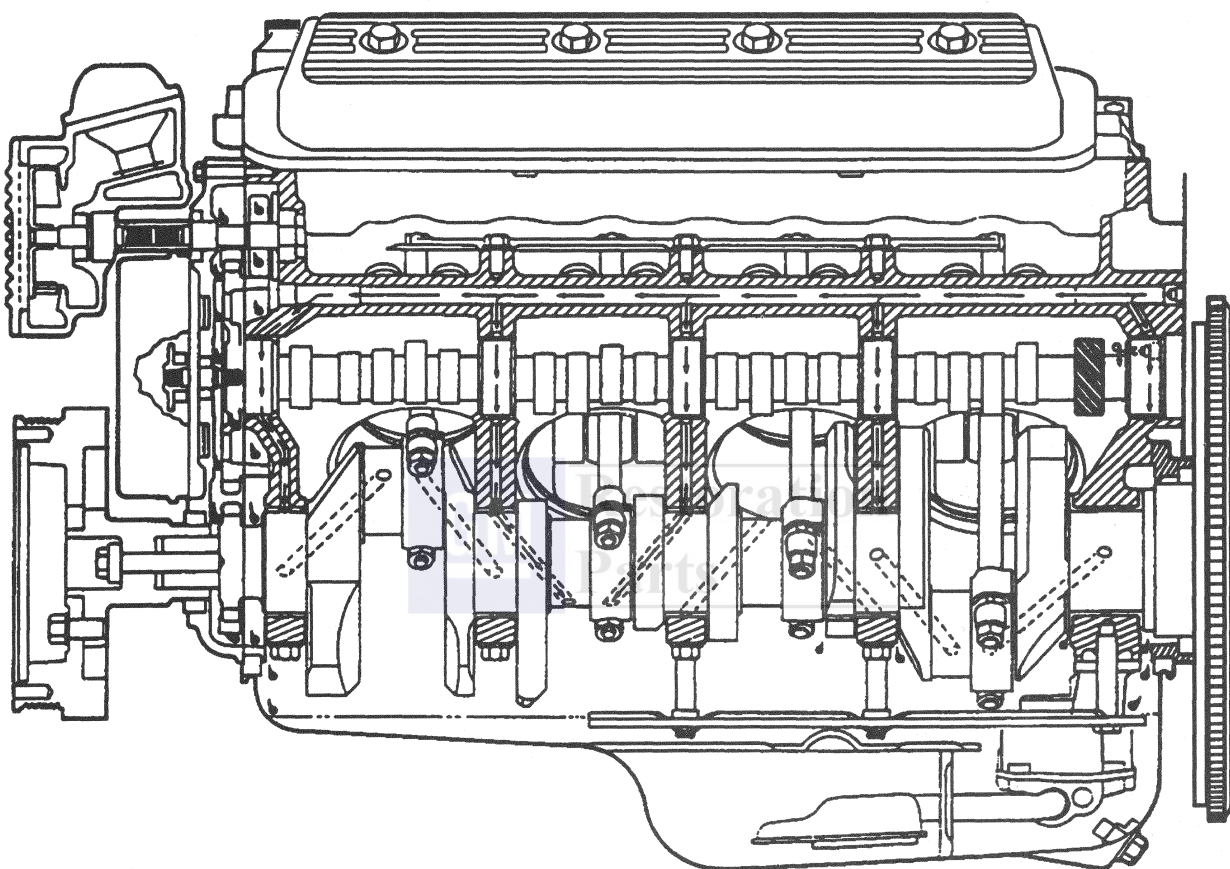
This diagram is an exploded view of a 1984-1985 Honda Civic 1.6L engine and transmission assembly. It shows the following components and their callout numbers:

- Engine Block and Cylinder Head:** 160, 162, 161, 74, 191, 170, 171, 144, 142, 143, 165, 168, 172, 167, 68, 100, 99, 101, 102, 103, 104, 105, 106.
- Intake Manifold and Air Filter:** 154, 156, 158, 157, 159, 160, 162, 161, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200.
- Timing Belt and Pulleys:** 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200.
- Valvetrain and Camshaft:** 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200.
- Transmission and Drivetrain:** 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200.
- Other Components:** 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200.

Figure 3 - Lower Engine Assembly

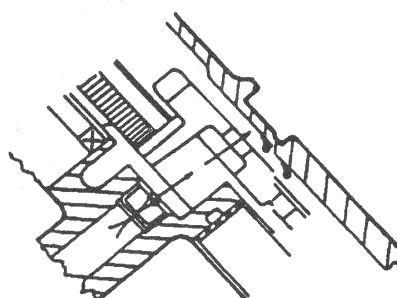
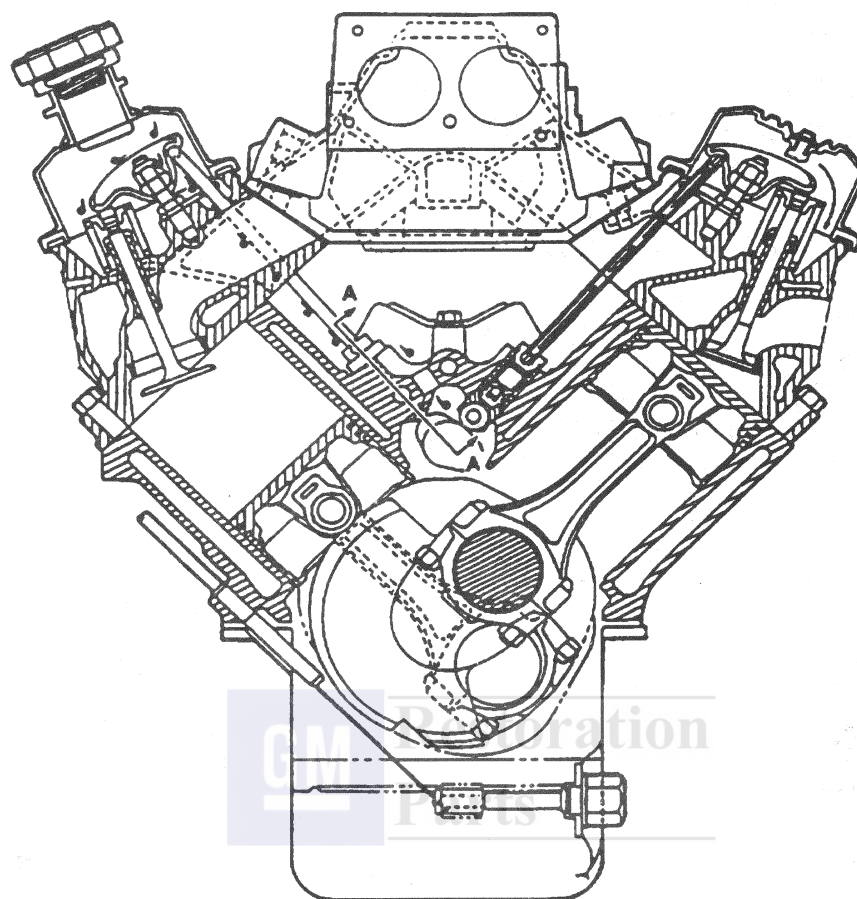
37. PUMP, WATER	117. STUD, CRANKSHAFT BEARING CAP
38. GASKET, WATER PUMP	118. PUMP, OIL
39. COUPLING, WATER PUMP DRIVESHAFT	119. DEFLECTOR, OIL
40. BOLT/SCREW, SECONDARY AIR INJECTION PUMP BRACKET	120. BOLT/SCREW, OIL PUMP
41. BRACKET, SECONDARY AIR INJECTION PUMP	121. BRACKET, GENERATOR, AIR CONDITIONING COMPRESSOR AND POWER STEERING PUMP
42. BALANCER, CRANKSHAFT	127. BOLT/SCREW, WATER PUMP
43. BOLT/SCREW, CRANKSHAFT BALANCER HUB	128. STUD, WATER PUMP
44. WASHER, CRANKSHAFT BALANCER HUB	129. BOLT/SCREW, WATER PUMP
45. HUB, CRANKSHAFT BALANCER	130. BRACKET, COOLANT FAN PULLEY (H.D. ONLY)
46. BOLT/SCREW, CRANKSHAFT BALANCER	131. STUD, COOLING FAN PULLEY BRACKET
49. DISTRIBUTOR	132. NUT, COOLING FAN PULLEY BRACKET
50. COVER, ENGINE FRONT	137. FLYWHEEL, ENGINE
51. GASKET, ENGINE FRONT COVER	138. BOLT/SCREW, ENGINE FLYWHEEL
52. BOLT/SCREW, ENGINE FRONT COVER	139. PIN, CRANKSHAFT REAR OIL SEAL HOUSING LOCATOR
53. REINFORCEMENT, OIL PAN	142. ADAPTOR, OIL FILTER
54. OIL PAN	143. BOLT/SCREW, OIL FILTER ADAPTOR
55. GASKET, OIL PAN	144. FILTER, OIL
56. BOLT/SCREW, CAMSHAFT SPROCKET	154. HARNESS, SPARK PLUG WIRE
57. SPROCKET, CAMSHAFT	156. SEAL, WATER PUMP DRIVESHAFT OIL
58. BOLT/SCREW, CAMSHAFT RETAINER	157. SEAL, WATER PUMP DRIVESHAFT OIL
59. RETAINER, CAMSHAFT	158. SEAL, DISTRIBUTOR OIL
60. CAMSHAFT	159. SEAL, CRANKSHAFT FRONT OIL
61. CHAIN, CAMSHAFT TIMING	160. INDICATOR, OIL LEVEL
62. SPROCKET, CRANKSHAFT	161. TUBE, OIL LEVEL INDICATOR
63. DRIVESHAFT, WATER PUMP	162. NUT, OIL LEVEL INDICATOR TUBE
64. BOLT/SCREW, WATER PUMP DRIVESHAFT	165. SENSOR, FUEL PUMP SWITCH AND ENGINE OIL PRESSURE GAGE INDICATOR
65. DRIVESHAFT, OIL PUMP	167. PLUG, ENGINE OIL GALLERY
66. BOLT/SCREW, OIL PUMP DRIVE SHAFT	168. PIN, FLYWHEEL HOUSING LOCATOR
67. BLOCK, ENGINE	170. PLUG, ENGINE BLOCK CORE HOLE
68. PLUG, CAMSHAFT REAR BEARING HOLE	171. SENSOR, KNOCK
74. PIN, ENGINE FRONT COVER LOCATOR	172. PLUG, OIL FILTER ADAPTER HOLE
77. WEIGHT, CRANKSHAFT BALANCER	174. BEARING, CAMSHAFT
84. BOLT/SCREW, OIL PAN	176. STUD, CRANKSHAFT REAR OIL SEAL HOUSING
89. DRIVESHAFT, OIL PUMP	177. SEAL, CRANKSHAFT REAR OIL
95. RETAINER, OIL PUMP DRIVESHAFT	178. SENSOR, ENGINE OIL LEVEL
98. CRANKSHAFT	179. PIN, OIL PUMP LOCATOR
99. CAP, CONNECTING ROD	180. KEY, CRANKSHAFT BALANCER
100. NUT, CONNECTING ROD	181. CLIP, TRANSMISSION OIL COOLER PIPE
101. BEARING, CONNECTING ROD	183. NUT, CRANKSHAFT OIL DEFLECTOR
102. BOLT/SCREW, CONNECTING ROD	184. SHIM, STARTER MOTOR
103. PISTON	185. MOTOR, STARTER
104. ROD, CONNECTING	186. BOLT/SCREW, STARTER MOTOR
105. PIN, PISTON	187. STUD, STARTER MOTOR
106. RING, PISTON	188. GASKET, OIL PAN DRAIN PLUG
107. CAP, CRANKSHAFT BEARING	189. PLUG, OIL PAN DRAIN
108. BOLT/SCREW, CRANKSHAFT BEARING CAP	190. BRACKET, ENGINE WIRING HARNESS
109. CAP, CRANKSHAFT BEARING	191. PLUG, ENGINE BLOCK OIL GALLERY
110. BEARING, CRANKSHAFT	223. HARNESS, IGNITION COIL WIRE
111. BEARING, CRANKSHAFT	240. SENSOR, CRANKSHAFT POSITION
112. STUD, CRANKSHAFT REAR OIL SEAL HOUSING	241. BOLT/SCREW, CRANKSHAFT POSITION SENSOR
113. GASKET, CRANKSHAFT REAR OIL SEAL HOUSING	242. RING, CRANKSHAFT POSITION SENSOR RELUCTOR
114. HOUSING, CRANKSHAFT REAR OIL SEAL	
115. NUT, CRANKSHAFT REAR OIL SEAL HOUSING	
116. BOLT/SCREW, CRANKSHAFT REAR OIL SEAL HOUSING	

Figure 4 - Lower Engine Assembly - Legend



SS9056A48

Figure 5 - Engine Assembly Lubrication - Left Side View



SECTION A-A

FS9066A3B

Figure 6 - Engine Assembly Lubrication - Front View

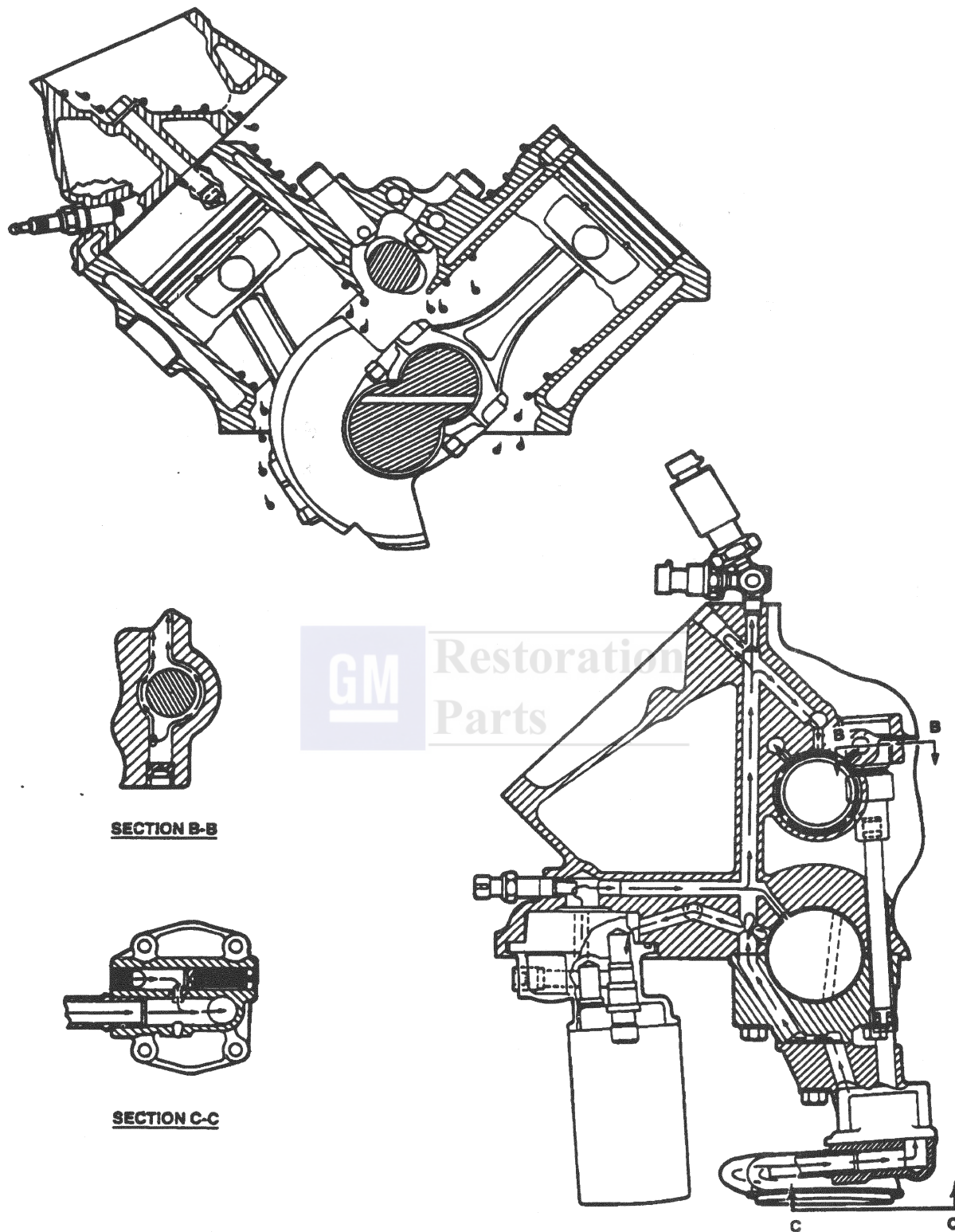


Figure 7 - Engine Assembly Lubrication - Rear Views

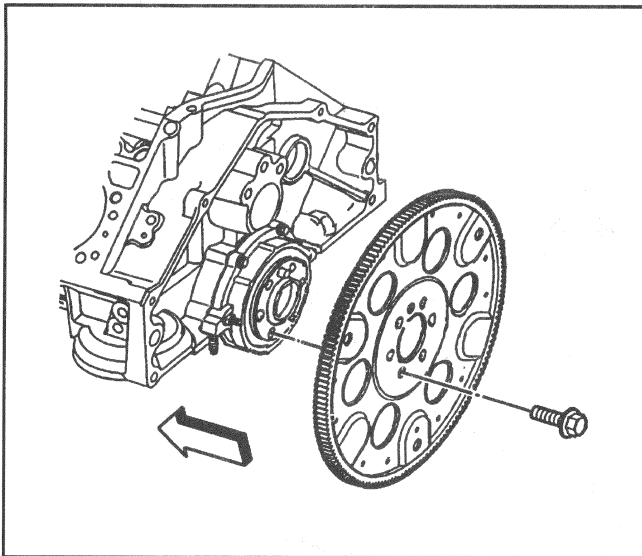


Figure 8 - Engine Flywheel

Remove or Disconnect

1. Valve lifter guide retainer bolts and valve lifter guide retainer.
2. Valve lifter guides and valve lifters.
 - Some valve lifters may be stuck in their bores because of gum or varnish deposits. These valve lifters can be removed using J 3049 or J 9290-01.

WATER PUMP

Figures 18 and 19

Remove or Disconnect

1. Mechanical fan pulley bracket nuts and bracket, if equipped.
2. Air injection pump bracket bolts and bracket.
3. Water pump bolts.

Important

- A. Keep ignition wires connected to distributor until the water pump (37) is removed.
- B. Make sure coolant is drained.
4. Water pump (37), coupling (39), and gaskets (38).

CRANKSHAFT BALANCER AND HUB

Figures 20 and 21

Tool Required:
J 39046 Crankshaft Hub Removal and Installation

Remove or Disconnect

1. Crankshaft balancer bolts and balancer.
2. Crankshaft balancer hub bolt and washer.
3. Crankshaft balancer hub using J 39046.

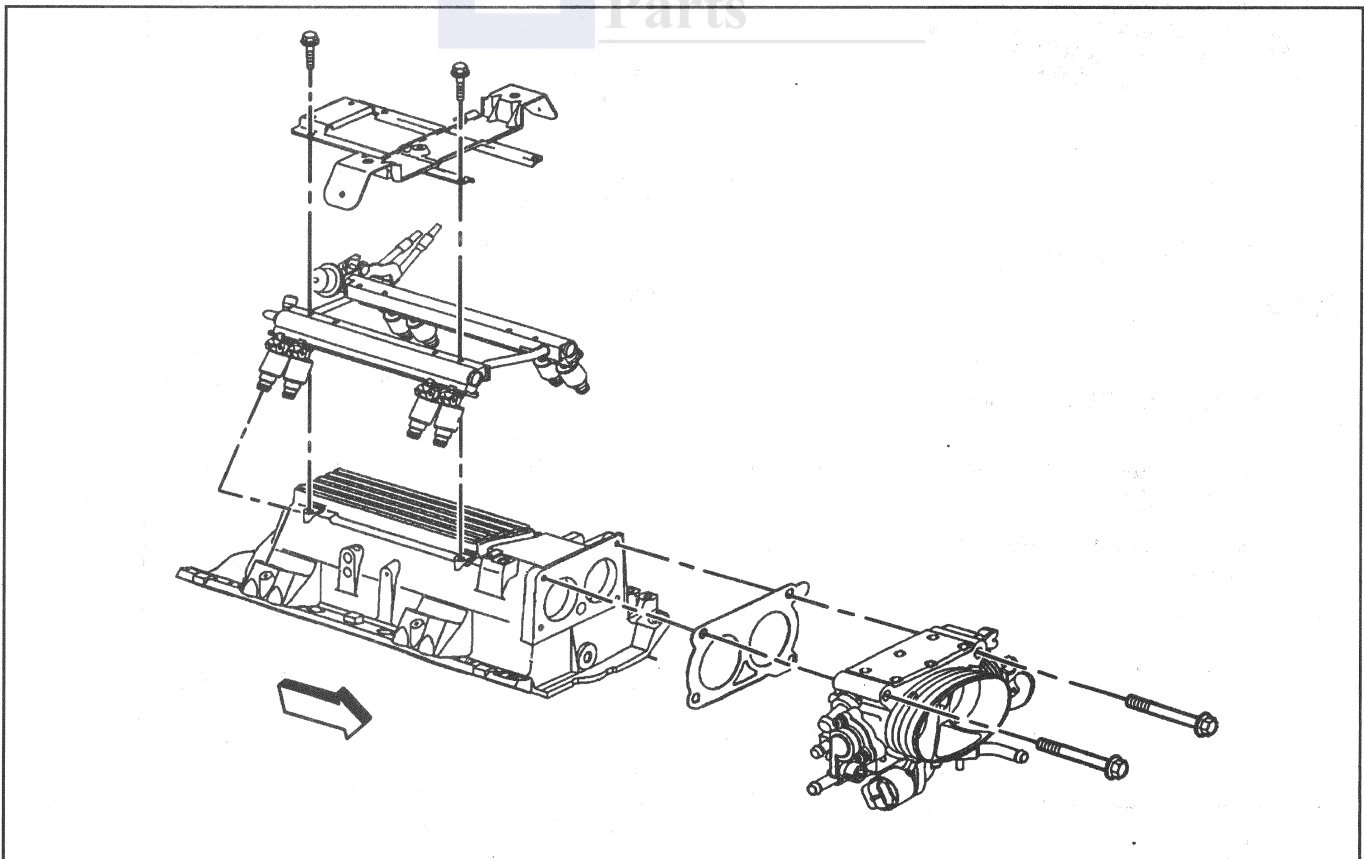


Figure 9 - Intake Manifold, Fuel Rail, Throttle Body, and Air Cleaner Resonator Bracket

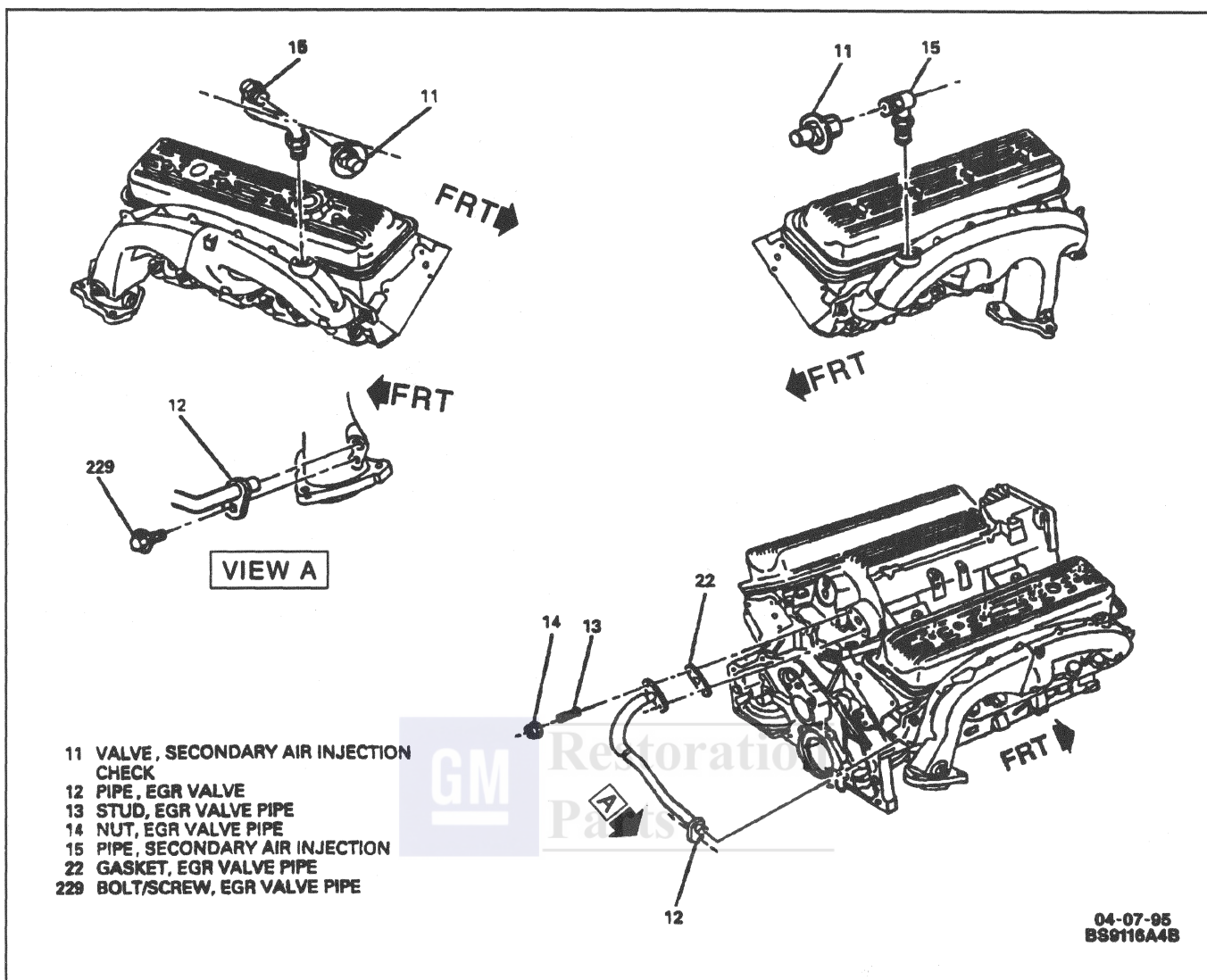


Figure 10 - Secondary AIR Injection and EGR Pipe

DISTRIBUTOR

Figure 22



Remove or Disconnect

1. Spark plug and ignition harnesses from ignition coil and spark plugs.
 - Do not remove wires from distributor unless necessary.
2. Distributor vacuum harness.



Important

- Do not allow foreign material to enter open vacuum lines.
 - Cap ends as necessary.
3. Distributor bolts (47) and distributor (49).

OIL PAN

Figures 23 and 24



Remove or Disconnect

1. Oil level sensor.
 - Oil level sensor must be removed to prevent it from being damaged as oil pan is removed.
2. Oil pan bolts, nuts, and studs.
3. Oil pan, reinforcements, and gasket.
4. Oil filter adapter bolts and washers.
5. Oil filter adapter and gasket.

CRANKSHAFT POSITION SENSOR

Figure 25



Remove or Disconnect

1. Bolt from engine front cover.
2. Sensor from engine front cover.

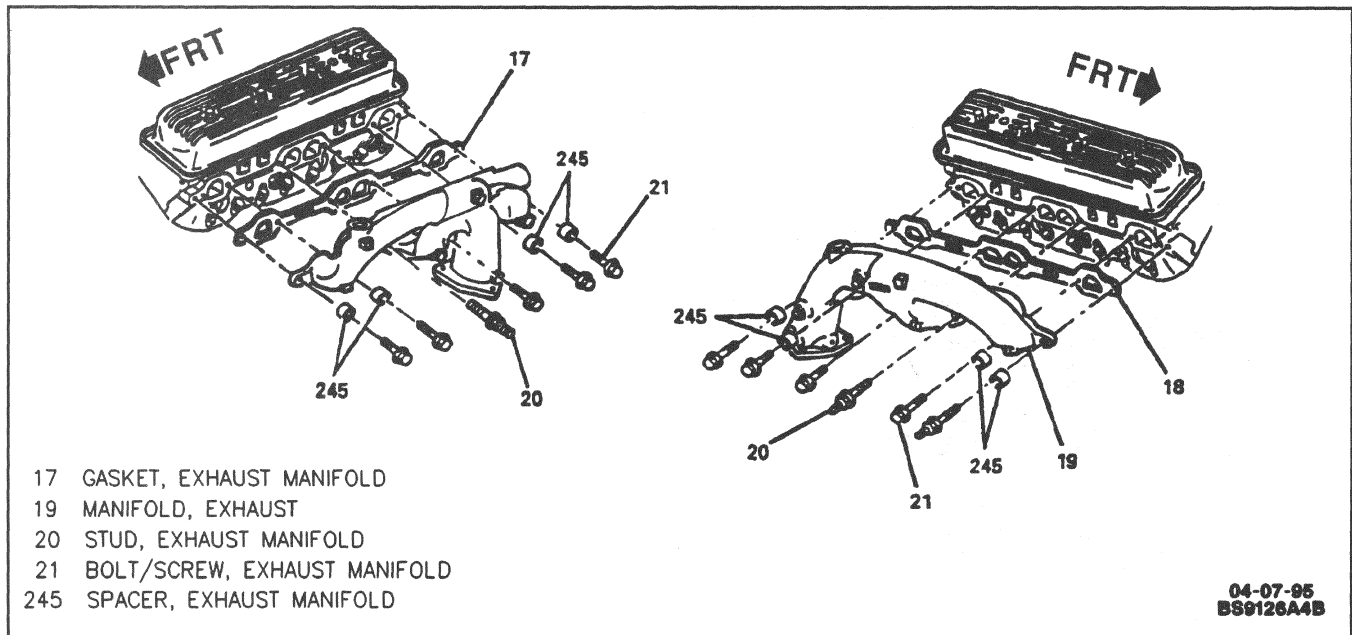


Figure 11 - Exhaust Manifolds

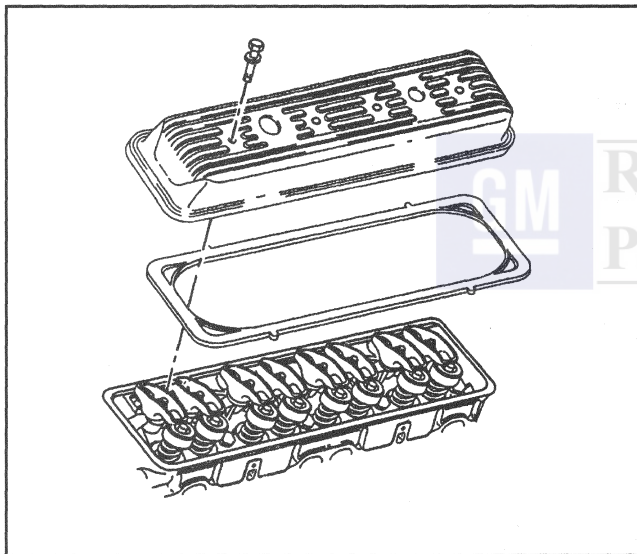


Figure 12 - Valve Rocker Arm Cover

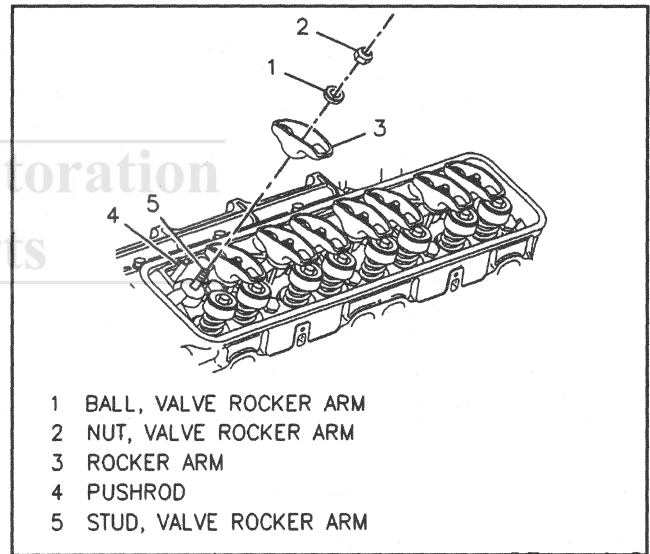


Figure 13 - Valve Rocker Arm, Ball, and Nut

ENGINE FRONT COVER

Figure 26

Remove or Disconnect

1. Engine front cover bolts (5).
2. Engine front cover (4) and gasket (1).

CRANKSHAFT POSITION SENSOR RELUCTOR RING

Figure 27

Remove or Disconnect

1. Reluctor ring from crankshaft.
2. Key, if necessary.

CAMSHAFT TIMING CHAIN, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 28, 29, and 30

Tools Required:

- J 39243-1 Water Pump Driveshaft Assembly Removal
- J 39243-2 Water Pump Driveshaft Assembly Removal
- J 5825-A Crankshaft Sprocket Removal

Remove or Disconnect

1. Camshaft sprocket bolts (56).

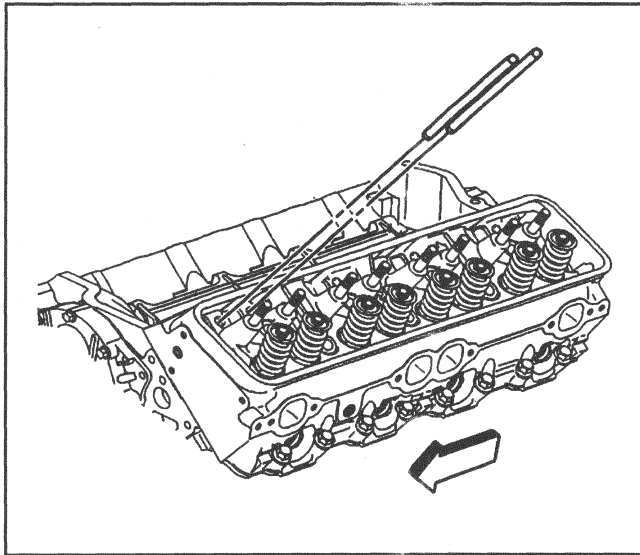


Figure 14 - Valve Pushrods

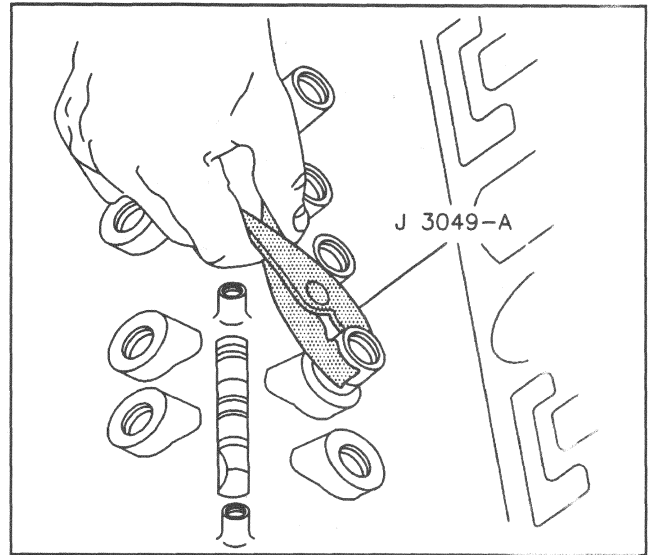


Figure 16 - Removing Valve Lifters

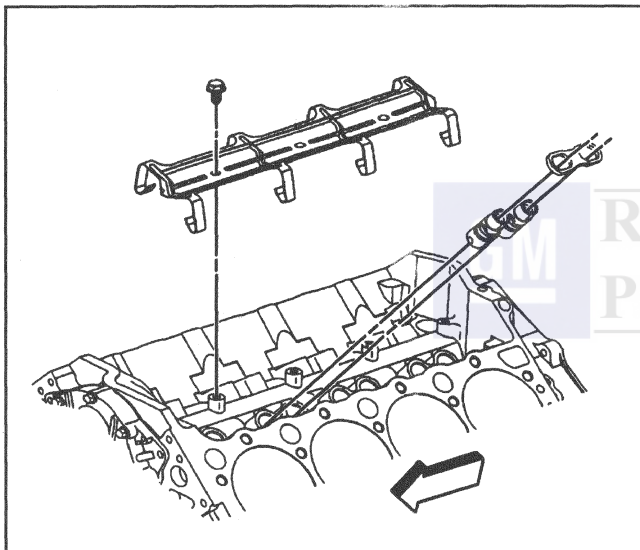


Figure 15 - Valve Lifters, Valve Lifter Guide, and Valve Lifter Guide Retainer

NOTICE: To prevent damage to piston or valves, do not turn the crankshaft after the camshaft timing chain has been removed.

2. Camshaft sprocket (57) and camshaft timing chain (61).
3. Water pump driveshaft bolts (64) and driveshaft assembly (63) using J 39243-1 and J 39243-2.
4. Crankshaft sprocket (62) using J 5825-A.
5. Key, if necessary.

CAMSHAFT

Figures 31 and 32

1. Oil pump driveshaft assembly bolt and oil pump driveshaft assembly.
2. Camshaft retainer bolts and retainer.

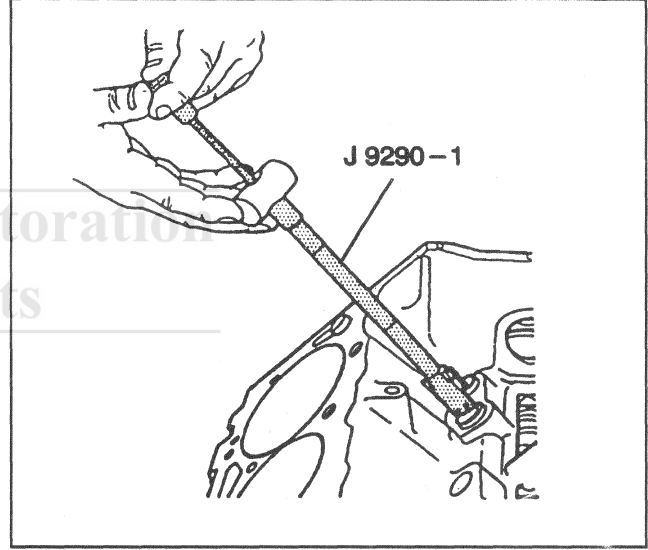


Figure 17 - Removing Valve Lifters

NOTICE: All camshaft journals are the same diameter so care must be used in removing the camshaft to avoid damage to the bearings.

3. Camshaft.
 - A. Install three 5/16 - 18 x 4.0 in. bolts in camshaft front bolt holes.
 - B. Carefully rotate and pull camshaft out of bearings.

CYLINDER HEAD

Figures 33 and 34



Remove or Disconnect

1. Engine coolant air bleed pipe bolts and pipe.
 - Use a backup wrench on pipe fitting when removing bolts.
2. Generator bracket bolts and bracket from right cylinder head.

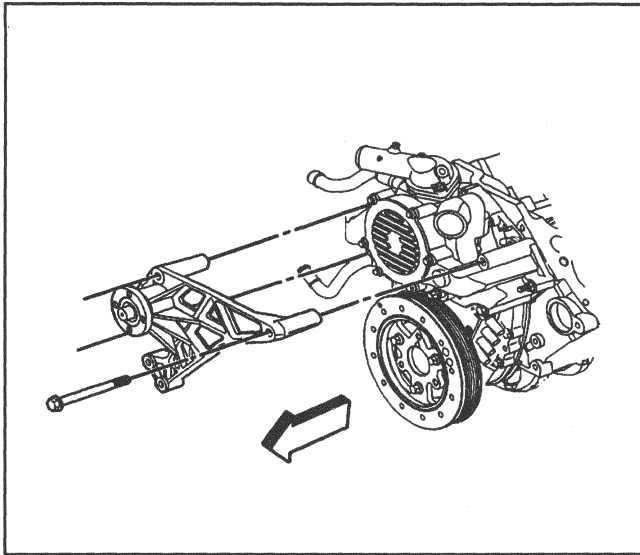


Figure 18 - Mechanical Fan Bracket

3. Cylinder head bolts.

NOTICE: After removal, place the cylinder head on two wood blocks to prevent damage.

4. Cylinder head and gasket.

5. Ignition coil studs, coil and bracket from cylinder head.

OIL PUMP

Figure 35

Remove or Disconnect

1. Crankshaft oil deflector nuts.
2. Bolt attaching oil pump to rear crankshaft bearing cap.
3. Crankshaft oil deflector, oil pump, retainer, and driveshaft.

PISTON AND CONNECTING ROD ASSEMBLY

Figures 36 and 37

Tool Required:

J 5239 Connecting Rod Bolt Guide Set

Remove or Disconnect

1. Ring ridge.
 - A. Turn crankshaft until piston is at bottom of its stroke.
 - B. Place a cloth on top of piston.
 - C. Use a ridge reamer to remove cylinder ring ridge.
 - D. Turn crankshaft so piston is at top of its stroke.
 - E. Remove cloth and cutting debris.

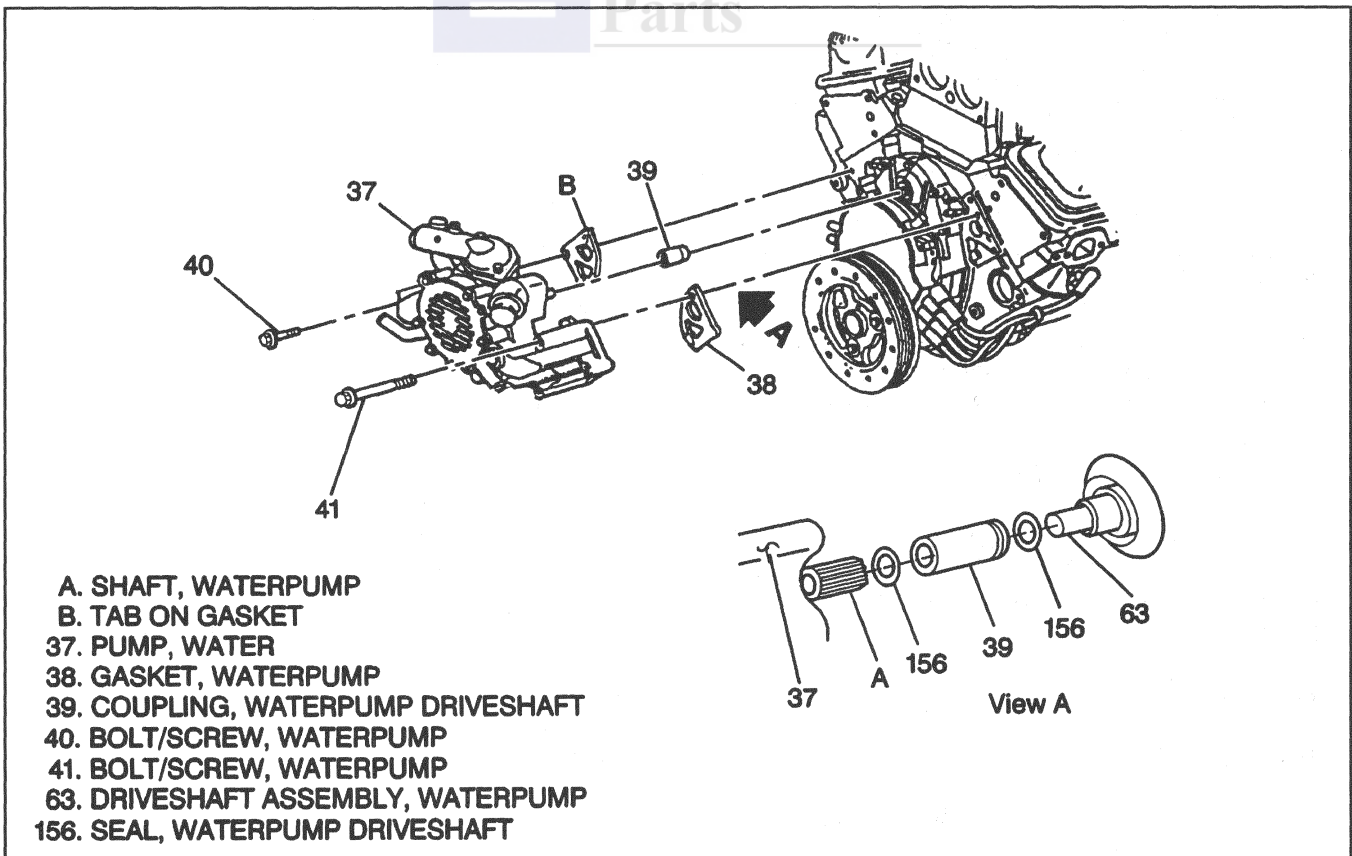


Figure 19 - Water Pump

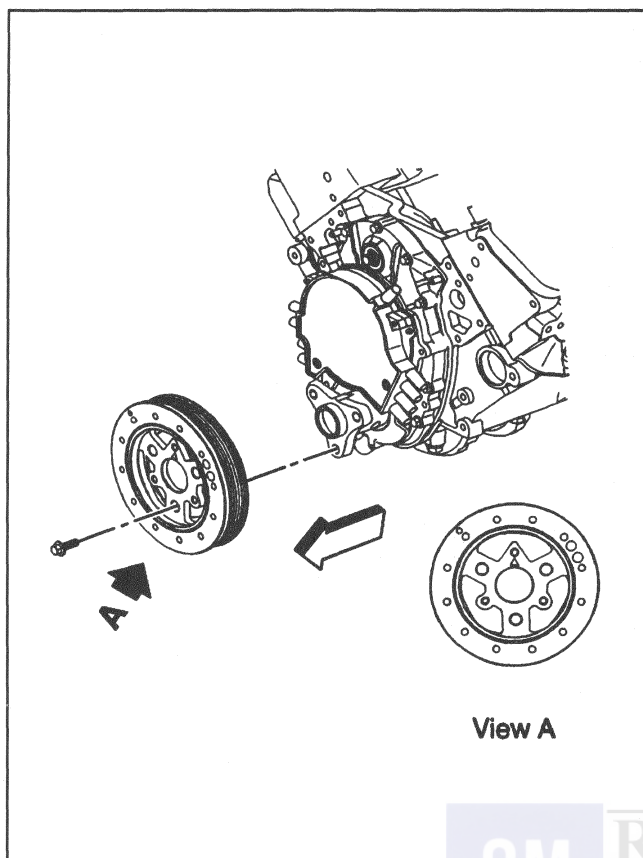


Figure 20 - Crankshaft Balancer and Hub

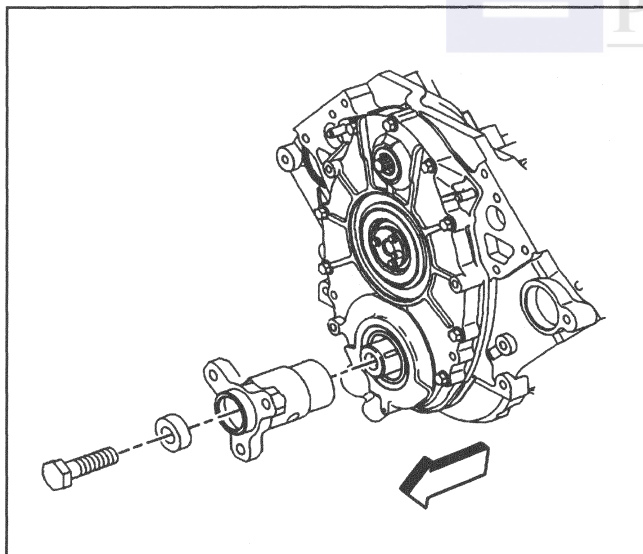


Figure 21 - Crankshaft Balancer Hub, Bolt, and Washer

! Important

- Place matchmarks or numbers on connecting rods and connecting rod caps. Connecting rod caps must be assembled to their original connecting rods.
2. Connecting rod nuts.

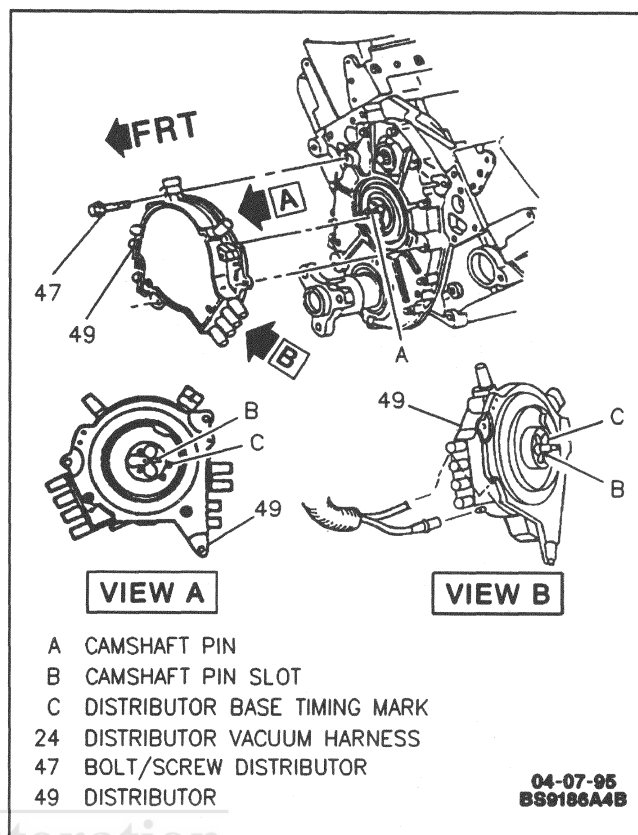


Figure 22 - Distributor

3. Connecting rod cap and bearings.
 - If re-using, keep bearings with their original connecting rod and connecting rod cap.
 - Wipe oil from bearings and crankpins.
4. Connecting rod and piston out of top of engine block using J H5239.

CRANKSHAFT REAR OIL SEAL HOUSING AND CRANKSHAFT

Figures 38, 39, and 40

↔ Remove or Disconnect

1. Crankshaft rear oil seal housing nuts and bolts.
2. Crankshaft rear oil seal housing, rear oil seal, and rear oil seal housing gasket.
3. Crankshaft rear oil seal from crankshaft rear oil seal housing.
4. Crankshaft bearing cap bolts and studs.
5. Crankshaft bearing caps.
6. Crankshaft.
7. Crankshaft bearings from engine block.
8. Crankshaft bearings from crankshaft bearing caps.

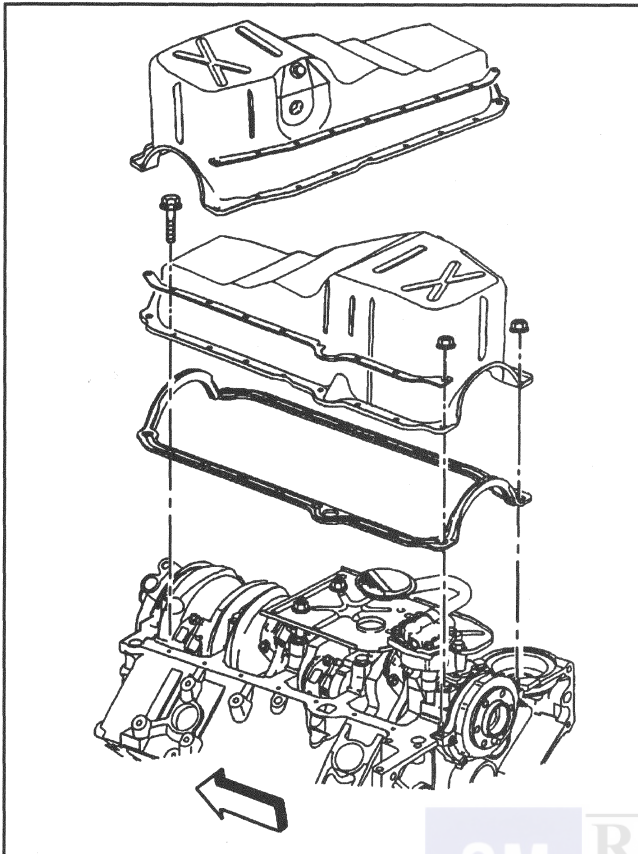


Figure 23 - Oil Pan, Reinforcements, and Gasket

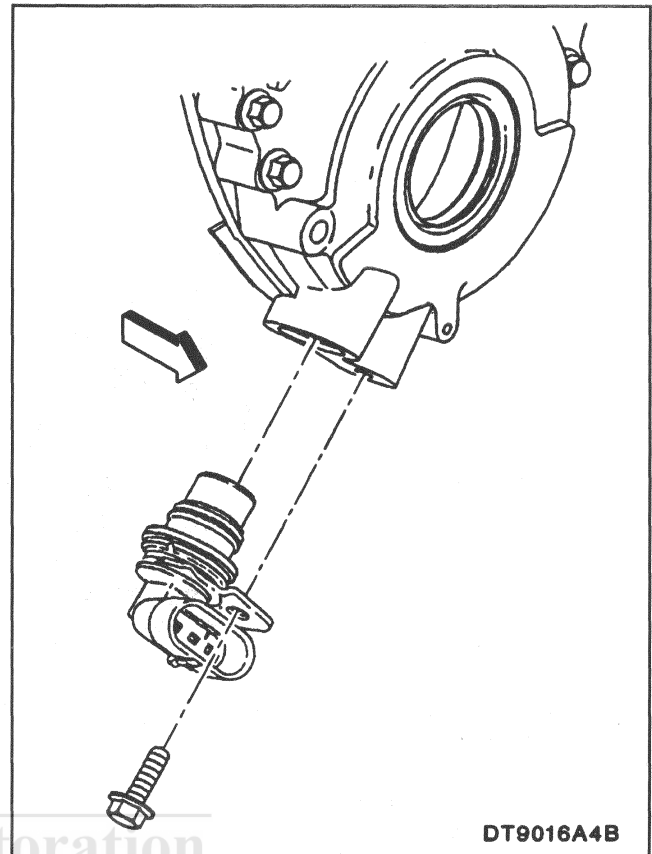


Figure 25 - Crankshaft Position Sensor

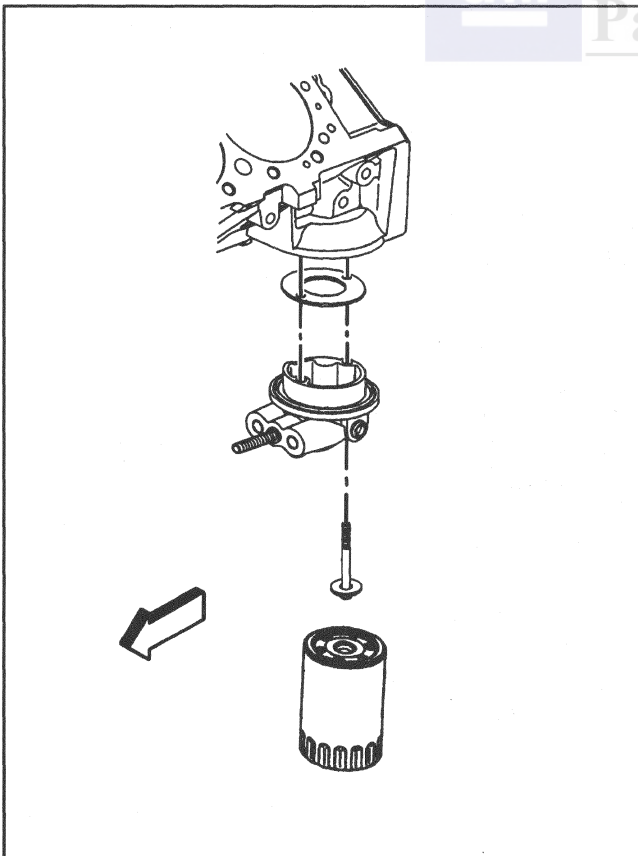


Figure 24 - Oil Cooler Adapter, Seals, and Oil Filter

CAMSHAFT BEARINGS

Figures 41 and 42

Tool Required:

J 6098-01 Camshaft Bearing Removal and Installation



Remove or Disconnect

1. Camshaft rear bearing hole plug.
2. Inner camshaft bearings using J 6098-01.
 - A. With nut and thrust washer installed to end of puller screw threads, index pilot in camshaft front bearing and install puller screw through pilot and bearing to be removed.
 - B. Install bearing tool with shoulder toward bearing. Make sure that enough threads are engaged.
 - C. Using two wrenches, hold puller screw while turning nut to draw bearing out of bore.
 - When bearing has been pulled from bore, remove bearing tool and bearing from puller screw.
 - D. Repeat above steps for remaining inner camshaft bearings.
 - Index pilot in rear camshaft bearing to remove rear inner bearing.
3. Front and rear camshaft bearings using J 6098-01.
 - A. Assemble bearing tool to driver handle.
 - B. Drive front and rear bearings out, toward center of engine block.

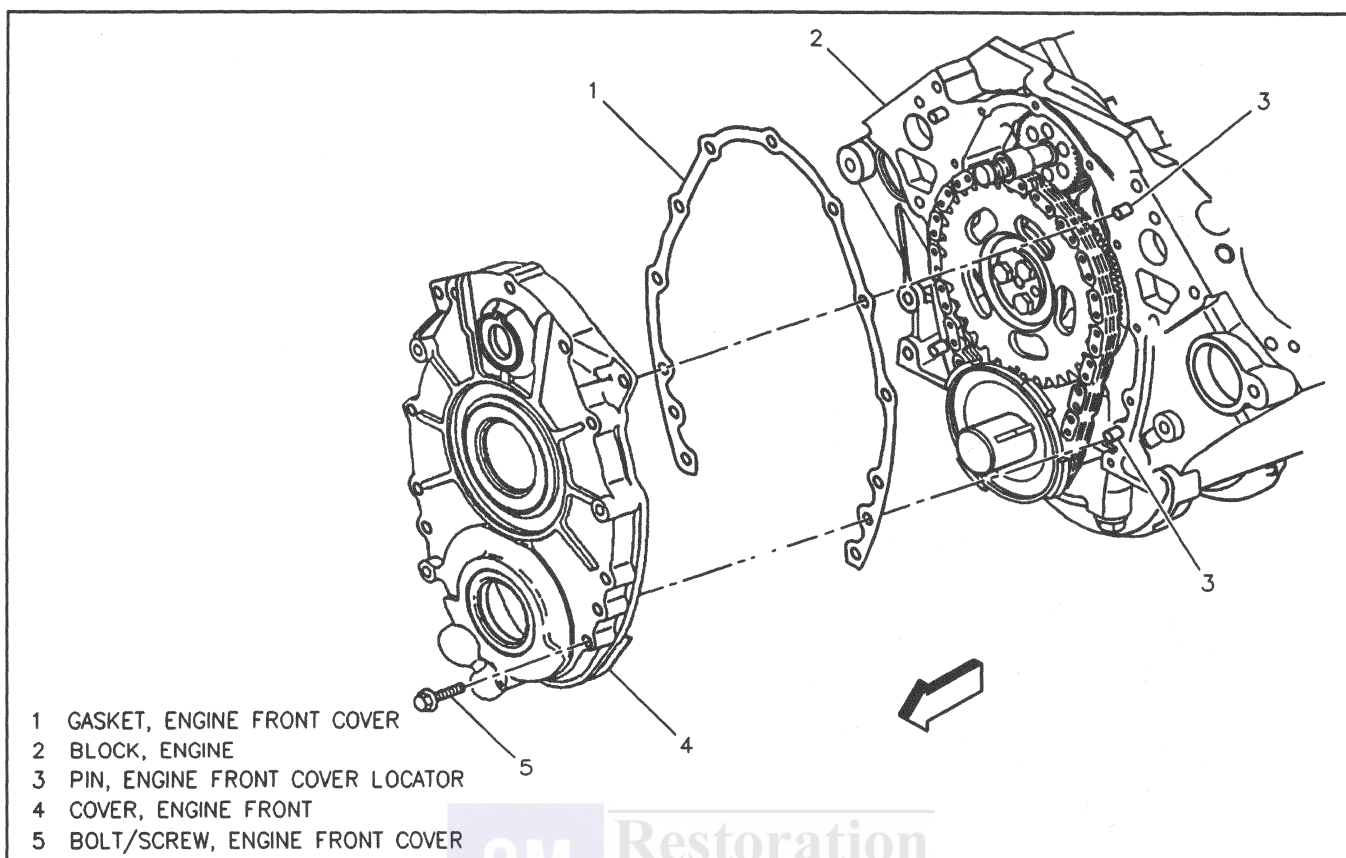


Figure 26 - Engine Front Cover

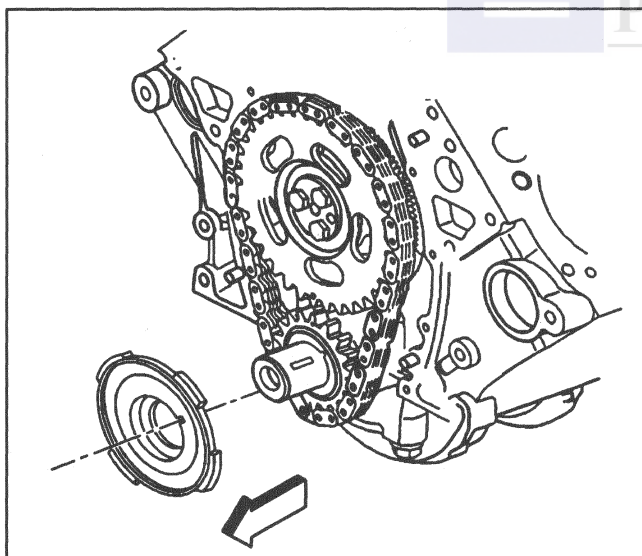


Figure 27 - Crankshaft Position Sensor Reluctor Ring

CLEANING, INSPECTION AND REPAIR

ENGINE BLOCK

Figures 43 and 44

Remove or Disconnect

1. Engine block core plugs.
2. Front and rear oil gallery plugs.
3. Fuel pump/oil pressure switch.

Clean

- Engine block in solvent.
- Gasket surfaces.
- Coolant passages.
- Oil passages.

Inspect

- For cracks in cylinder walls, coolant jacket, valve lifter bores and crankshaft bearing webs.

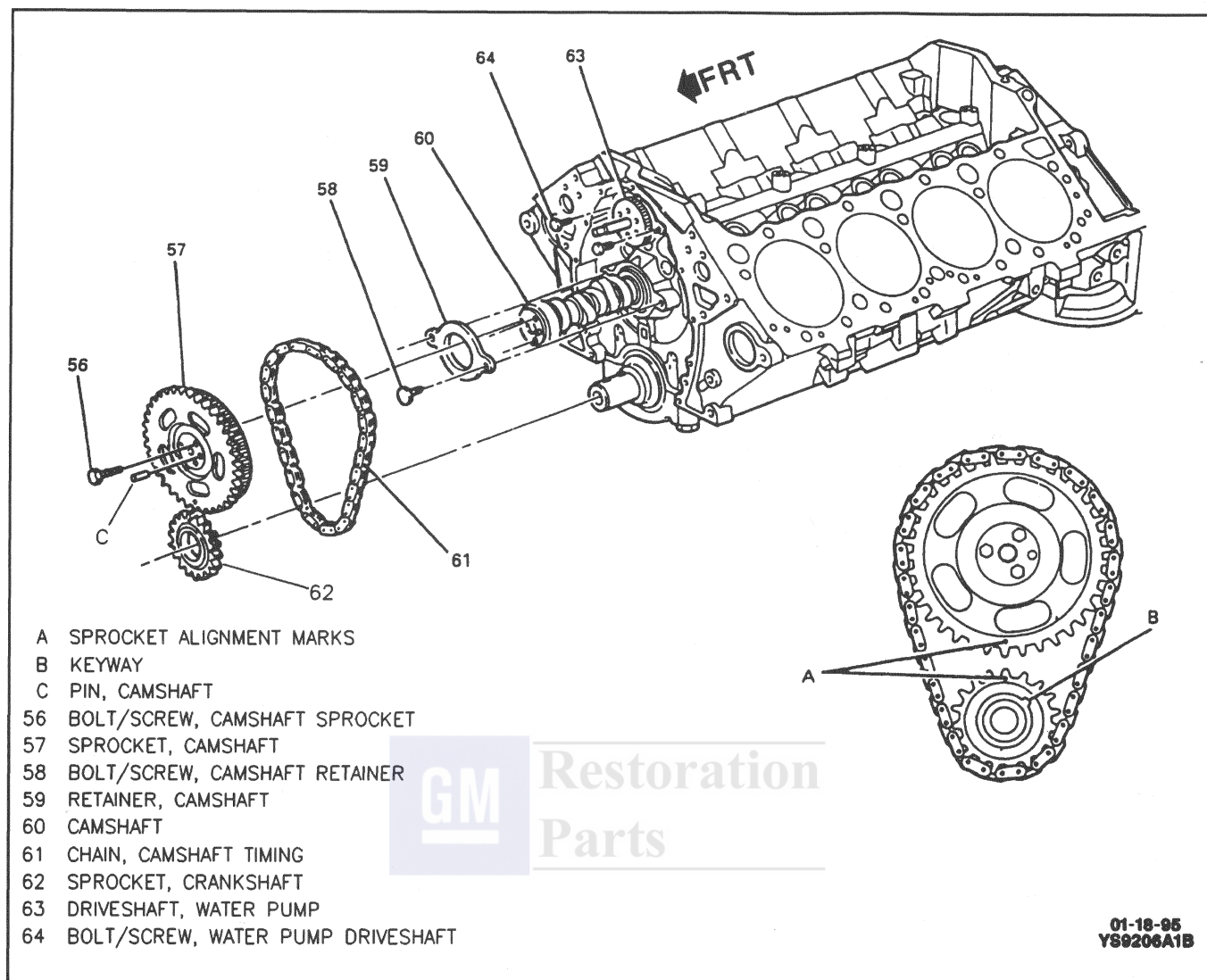


Figure 28 - Camshaft, Sprockets, and Water Pump Driveshaft Assembly



Measure

- Cylinder bores for taper, out-of-round, or excessive ring ridge at top of ring travel. Use a dial indicator. Compare measurements to "Specifications" in this section.
- Cylinders with less than 0.025 mm (0.0010 in.) of wear or taper may be reconditioned with a hone.
- Cylinders with more than 0.025 mm (0.0010 in.) of wear or taper must be bored and honed to smallest oversize piston that will permit complete resurfacing of all cylinders.

Boring

1. Draw a flat file across top of engine block several times to remove any burrs or gasket material. If engine block surface is not completely smooth and flat, boring bar may be tilted which would result in cylinder having an incorrect angle to crankshaft.

2. Measure piston to be installed 11.5 mm (0.45 in.) from bottom of piston skirt and at right angles to piston pin.
3. Bore cylinder to same diameter as piston.
4. Hone cylinder as outlined below to provide specified clearance.

- Follow instructions provided by manufacturer of boring equipment being used.

NOTICE: Handle pistons with care. Do not attempt to force them into the cylinder. The pistons may be easily distorted.

Honing

1. Follow instructions provided by manufacturer of honing equipment being used.
2. Occasionally during honing operation:
 - A. Clean cylinder bore.
 - B. Measure cylinder bore for proper piston fit.

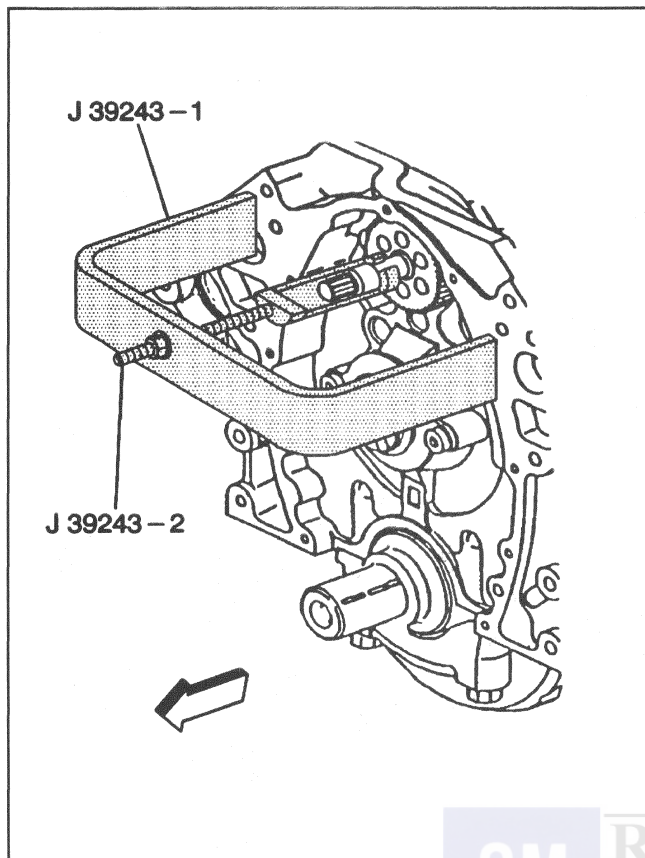


Figure 29 - Water Pump Driveshaft Assembly Removal

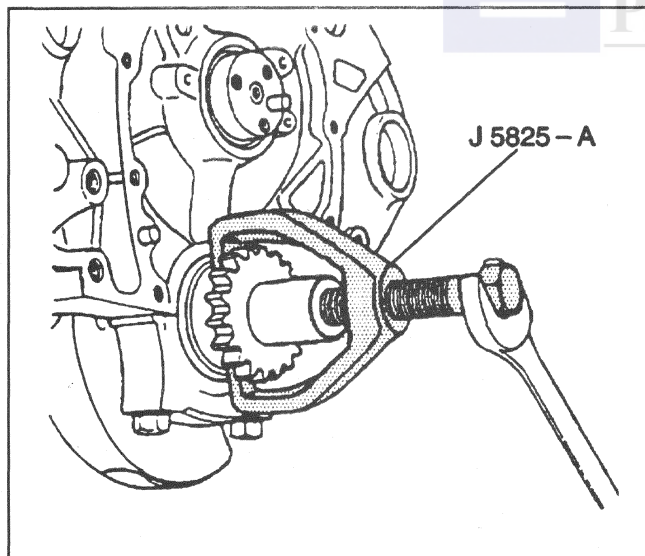


Figure 30 - Crankshaft Sprocket Removal

3. Finish operation with a 45 to 65 degree cross-hatch pattern on cylinder walls.

- Finish marks should be clean but not sharp, free from imbedded particles and torn or faded metal.

4. Place a permanent mark on each piston to match it to its proper cylinder.

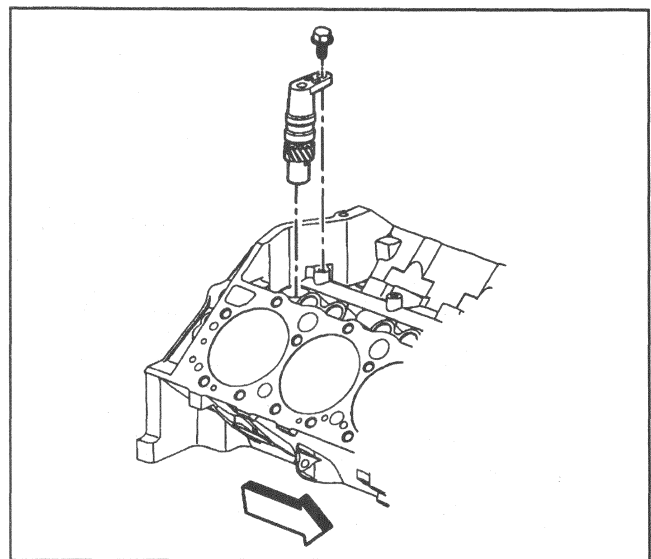


Figure 31 - Oil Pump Driveshaft Assembly

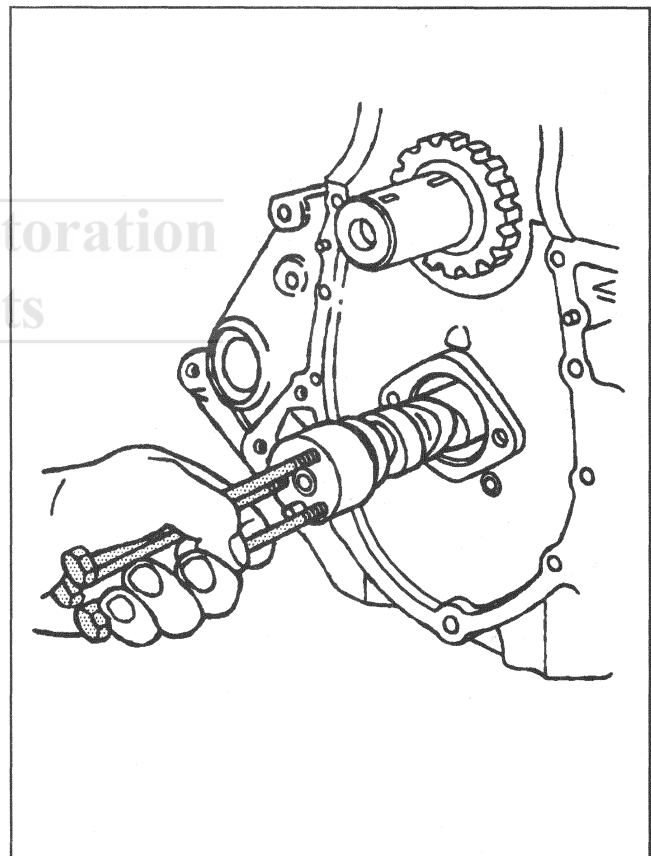


Figure 32 - Removing the Camshaft



Clean

- Cylinder bores and block with hot water and detergent using a stiff bristle brush. Rinse thoroughly and dry with a clean cloth.
- Any abrasive material left in cylinder bores will cause rapid wear of piston rings, bearings, and other engine assembly parts.

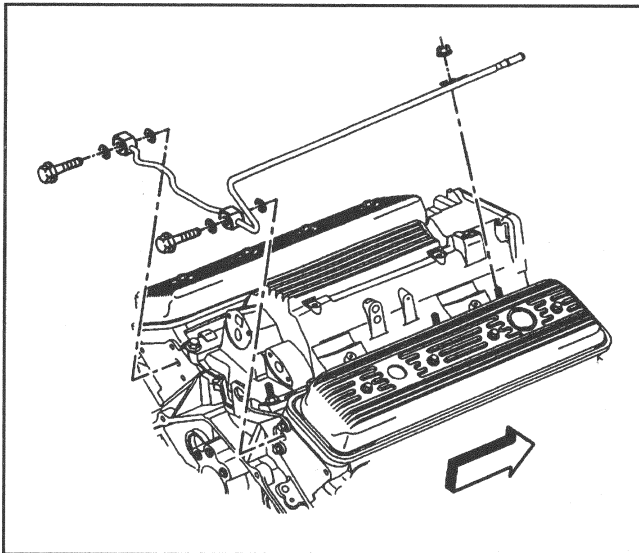


Figure 33 - Engine Coolant Air Bleed Pipe

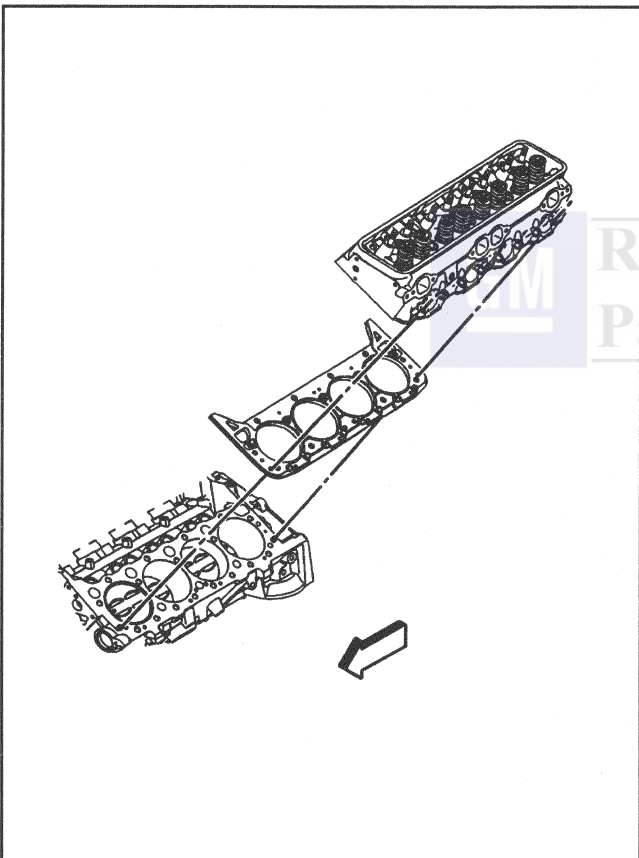


Figure 34 - Cylinder Head and Gasket

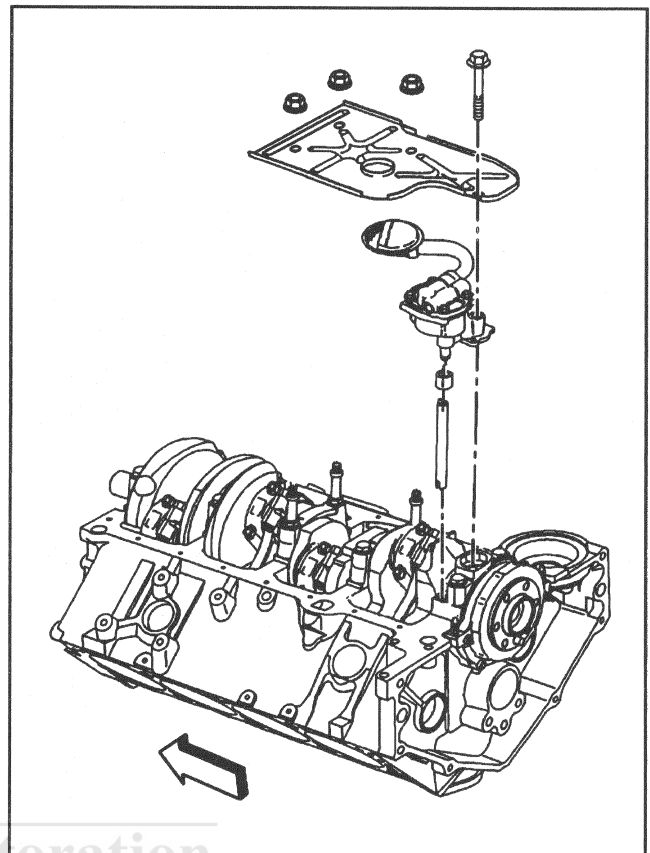


Figure 35 - Oil Pump, Crankshaft Oil Deflector, Driveshaft, and Retainer

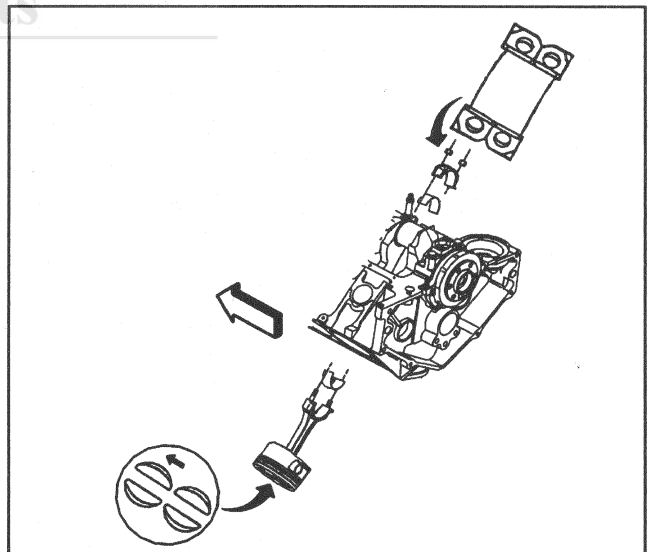


Figure 36 - Piston and Connecting Rod Assembly

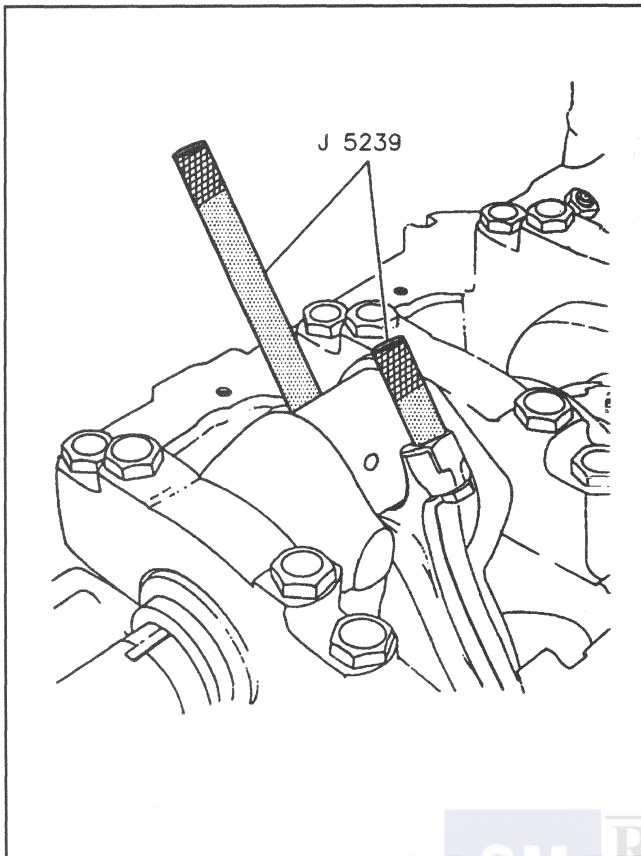


Figure 37 - Connecting Rod Guide Tool

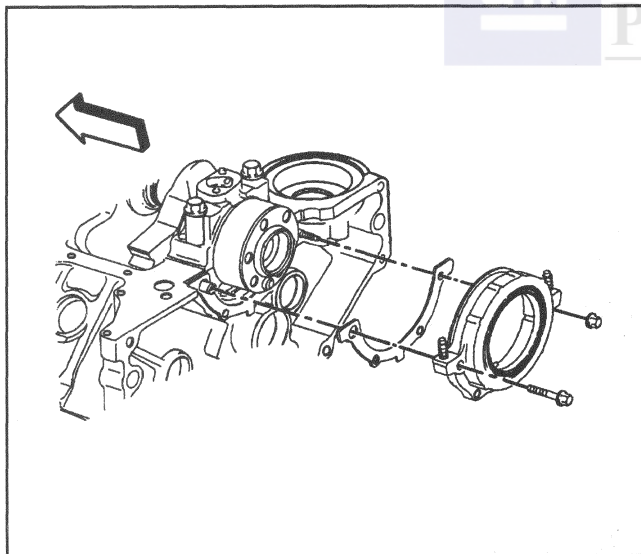


Figure 38 - Crankshaft Rear Oil Seal Housing, Housing Gasket, and Rear Oil Seal

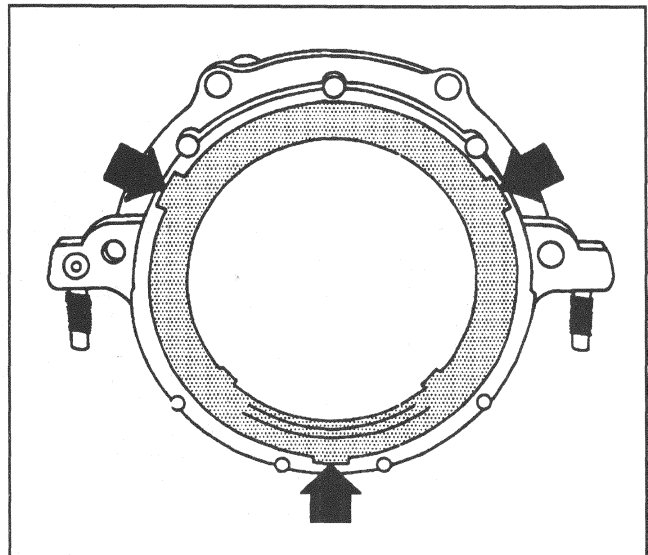


Figure 39 - Crankshaft Rear Oil Seal Removal

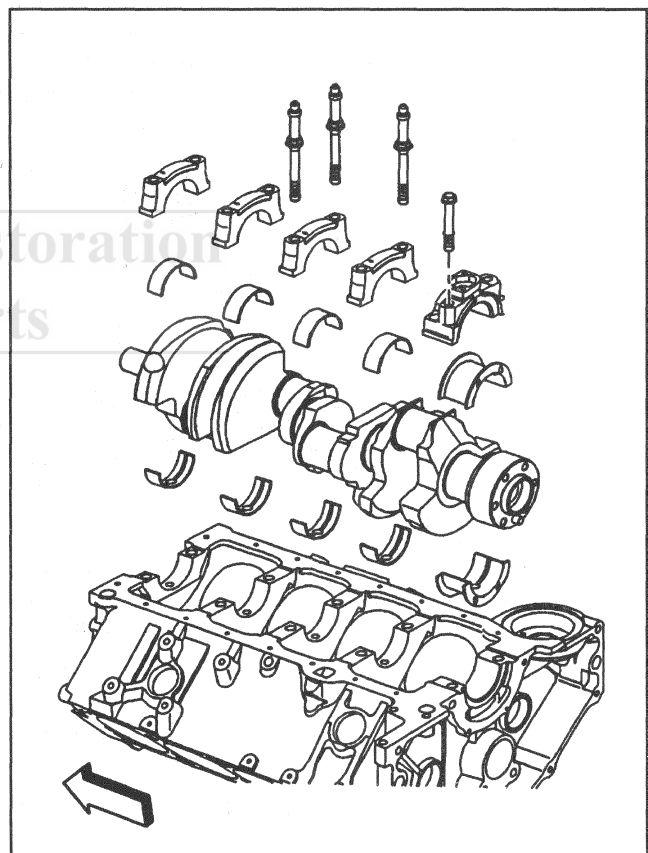


Figure 40 - Crankshaft, Crankshaft Bearings, and Crankshaft Bearing Caps

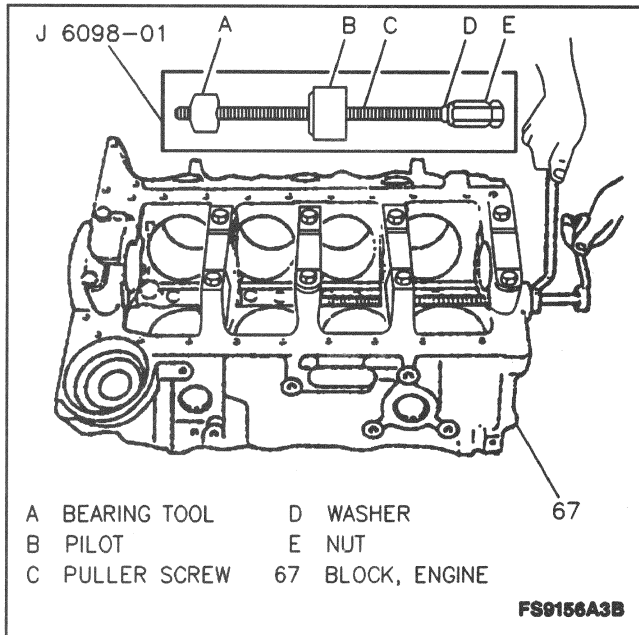


Figure 41 - Camshaft Inner Bearing Removal

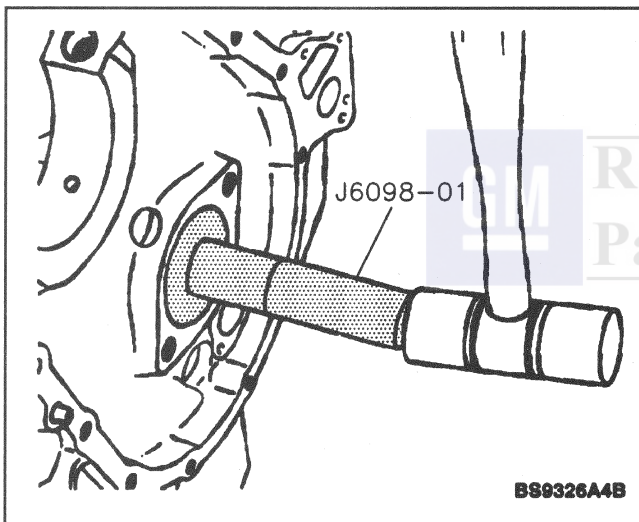


Figure 42 - Camshaft Outer Bearing Removal

- Do not use kerosene or gasoline for cleaning.
- After cleaning, swab cylinder bores with light engine oil and a clean cloth. Then wipe them out with a clean dry cloth.

CRANKSHAFT BEARING FIT

Figure 45

If replacing rear crankshaft bearing, check for correct part number. Some rear crankshaft bearings are 0.20 mm (0.008 in.) wider than standard. Crankshaft will be identified by "0.008" stamped on rear counterweight.

It is necessary to measure clearance of each crankshaft bearing to determine proper sizes. Factory installed crankshaft bearings may not be same size for each journal.

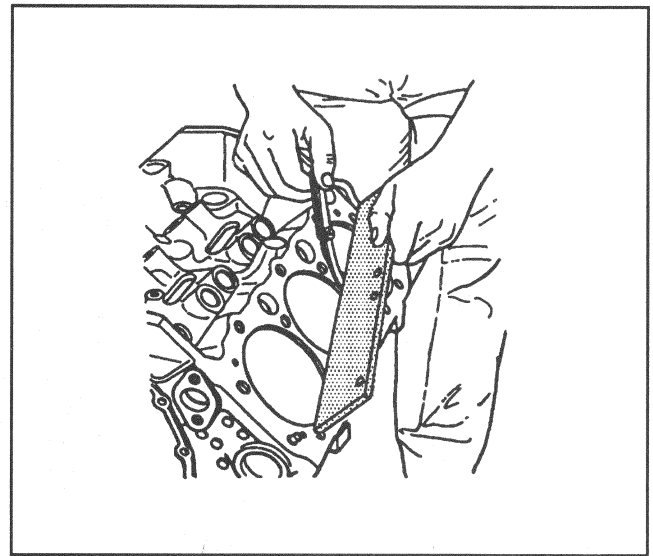


Figure 43 - Checking Block Surface For Flatness

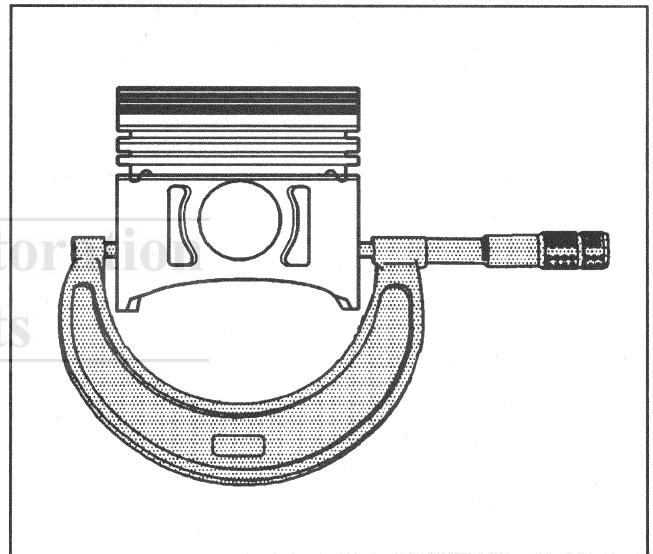


Figure 44 - Measuring the Piston



Inspect

- Lower half of crankshaft bearing.
 - If lower half is worn or damaged, both upper and lower half should be replaced.
 - If lower half is suitable for use, upper half will also be suitable for use.



Measure

- Crankshaft bearing clearance using gaging plastic.
 - Place a piece of gaging plastic full width of crankshaft bearing onto journal.
 - Measure all five bearing clearances at same time.



Important

- Do not rotate crankshaft while gaging plastic is between journal and crankshaft bearing.

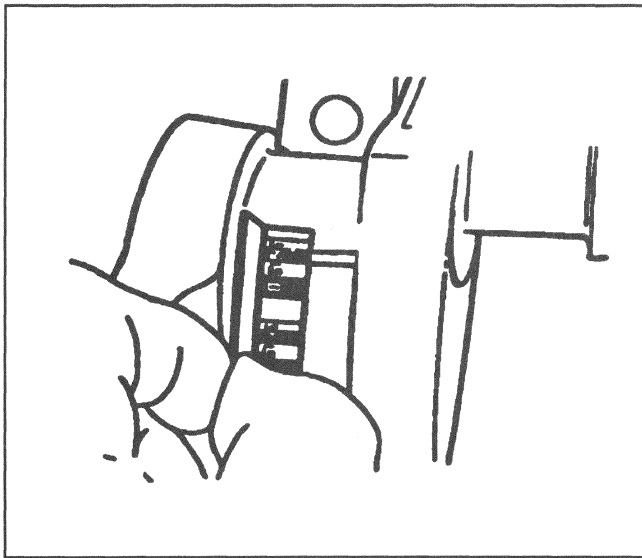


Figure 45 - Plastic-gage

- C. Install crankshaft bearing caps with arrows pointing toward front of engine block.
- D. Install bearing cap bolts and studs.

Tighten

- Crankshaft bearing cap bolts and studs to 105 N.m (77 lb. ft.).
- E. Remove crankshaft bearing cap bolts, studs, crankshaft bearing caps.
- F. Measure gaging plastic at its widest using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.
 - If gaging plastic shows an irregularity in journal exceeding 0.025 mm (0.0010 in.), measure journal with a micrometer.
 - If clearance is greater than specified, select an undersize bearing and re-measure clearance. Always replace both upper and lower crankshaft bearings as a unit.

- If clearance cannot be brought to specifications using a standard undersize bearing, regrind crankshaft for use with next undersize bearing.

CRANKSHAFT

Figures 46 and 47



Clean

- Crankshaft in solvent and dry it with compressed air.



Measure

- Crankpins for out-of-round, taper, or undersize with a micrometer. Refer to "Specifications" in this section.
- Crankshaft run-out at front and rear intermediate journals with a dial indicator. Support crankshaft front and rear journals on V-blocks. Refer to "Specifications" in this section.
- Replace or recondition crankshaft if measurements are not within specifications.

PISTON AND CONNECTING ROD ASSEMBLY

Figures 48 through 54

Tool Required:

J 24086-C Piston Pin Removal and Installation Set



Disassemble

1. Piston rings from piston.
2. Piston pin from piston and connecting rod using J 24086-C.

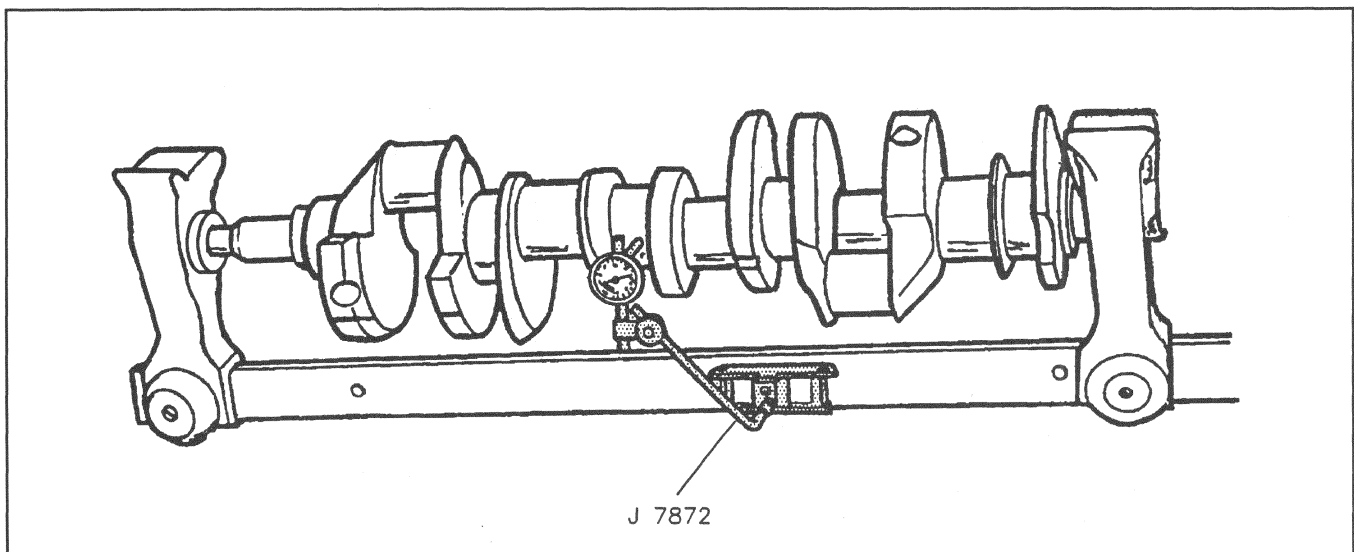


Figure 46 - Measuring Crankshaft Runout

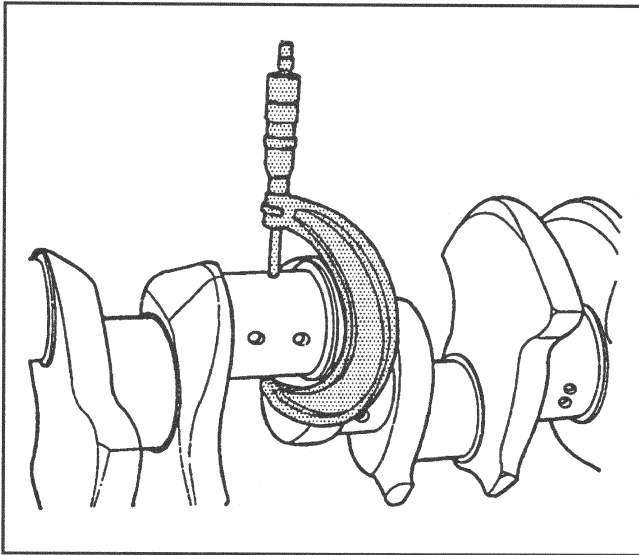


Figure 47 - Measuring Crankshaft Journals

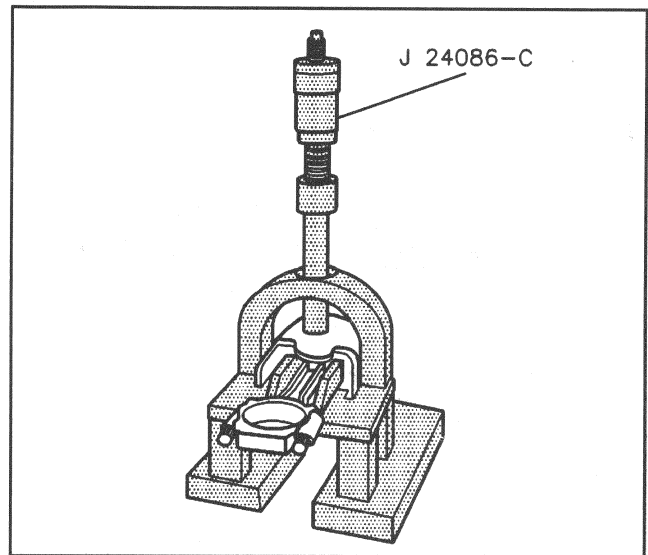


Figure 49 - Removing the Piston Pin

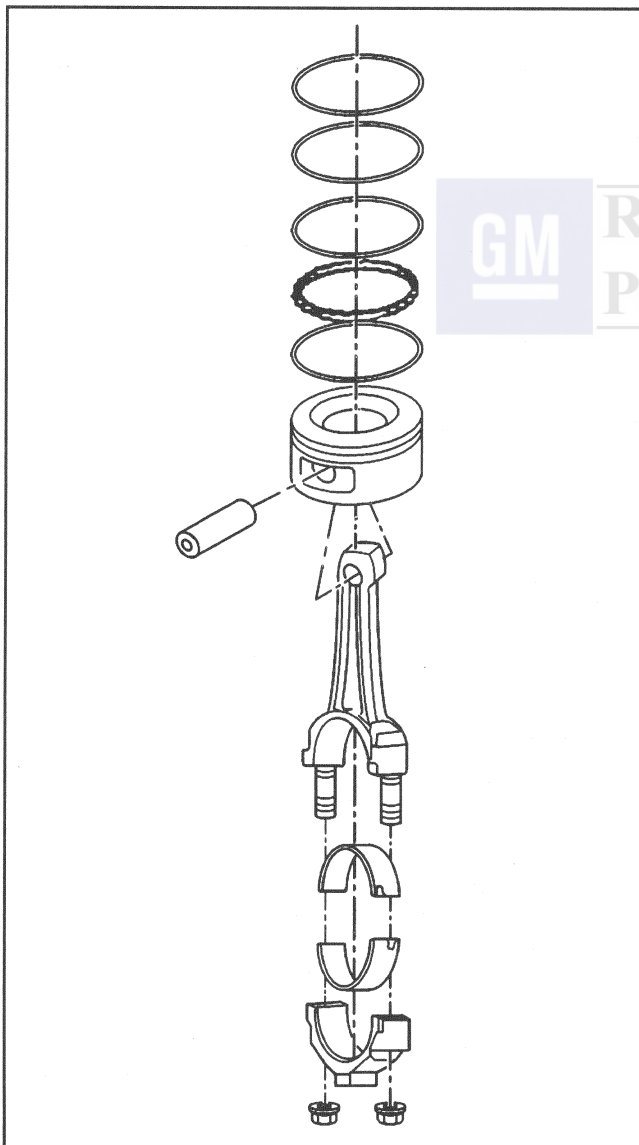


Figure 48 - Piston and Connecting Rod Components



Clean

1. Connecting rod in cleaning solvent.
2. Dry connecting rod with compressed air. Do not wire brush any part of piston.
3. Varnish from piston skirts and pins with cleaning solvent.
4. Piston ring grooves with groove cleaner.
5. Piston oil ring holes and slots.



Inspect

- Connecting rod for twisting, nicks and cracks. Replace any damaged connecting rods.
- Piston for:
 - Cracked ring lands, skirts, or pin bosses.
 - Grooves for nicks or burrs that may cause binding.
 - Warped or worn ring lands.
 - Scuffed or damaged skirts.
 - Eroded areas at top of piston.
 - Worn piston bores and piston pins.
 - Replace pistons that are damaged or show signs of excessive wear.



Measure

1. Piston pin bore-to-piston pin clearance.
 - A. Piston pin bores and piston pins must be free of varnish or scuffing when being measured.
 - B. Use a micrometer to measure piston pin and an inside micrometer to measure piston pin bore.
 - C. If clearance is in excess of 0.025 mm (0.0010 in.), piston and piston pin should be replaced. Piston and piston pin are matched and are not serviced separately.
2. Piston compression ring end gap.

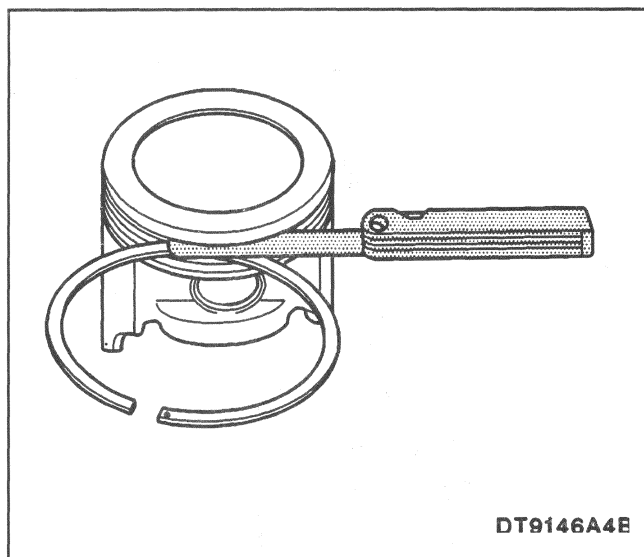


Figure 50 - Measuring Piston Ring Side Clearance

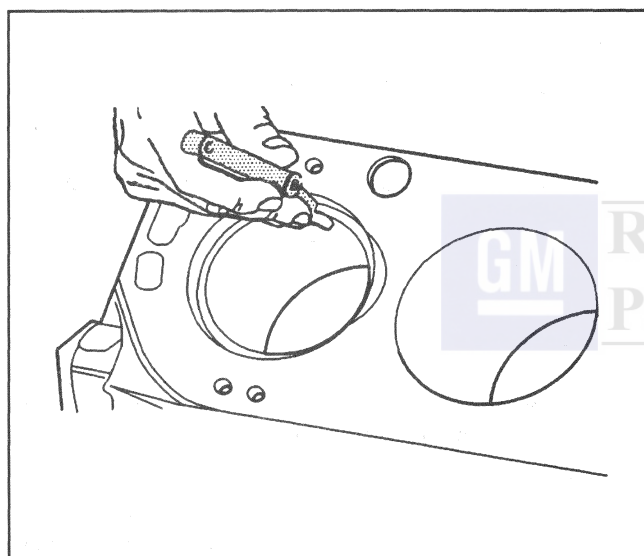


Figure 51 - Measuring Piston Ring End Gap

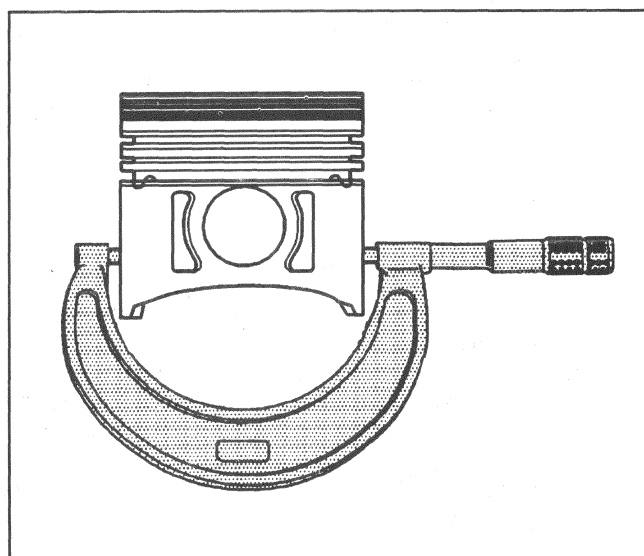


Figure 52 - Measuring Piston Diameter

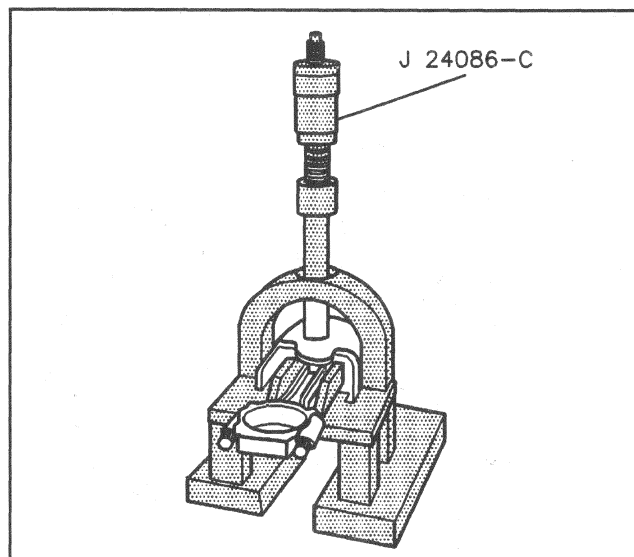


Figure 53 - Installing Piston Pin

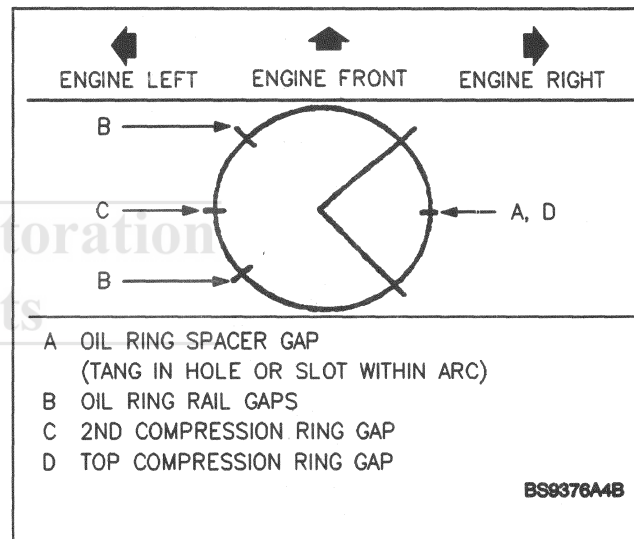


Figure 54 - Piston Ring Gap Locations

! Important

- Fit each compression ring to cylinder in which it will be used.
 - A. Place compression ring into cylinder bore.
 - B. Push compression ring into cylinder bore to approximately 6.5 mm (0.25 in.) above ring travel. Ring must be square to cylinder wall.
 - C. Measure end gap with a feeler gage. Refer to "Specifications" in this section for acceptable end gaps.
 - D. If end gap exceeds specifications, select another size ring set.
- 3. Piston ring side clearance.
 - A. Roll piston ring entirely around its ring groove on piston.
 - B. If any binding is caused by ring groove, dress groove with a fine cut file.
 - C. If any binding is caused by a distorted piston ring, replace piston ring.

- D. Measure side clearance of piston ring and groove with a feeler gage. For acceptable side clearances, refer to "Specifications" in this section.
- E. If side clearance is too small, try another piston ring.
- 4. Piston-to-cylinder bore clearance to determine suitability of a used piston. Measure piston-to-cylinder bore clearance as follows:
 - A. Measure cylinder bore diameter at a point 64 mm (2.5 in.) from top of cylinder bore using a bore gage.
 - B. Measure piston 11.5 mm (0.45 in.) from bottom of skirt at right angles to piston pin using a caliper or micrometer.
 - C. Subtract piston diameter from cylinder bore diameter. This will indicate piston-to-bore clearance.
 - D. Compare measurements to "Specifications" in this section.
 - E. If clearance exceeds specifications, subtract size of new piston from cylinder bore diameter previously measured.
 - F. If clearance with new piston is within specifications, mark that piston to cylinder to which it is to be installed.
 - G. If clearance is within specifications, used piston may be reinstalled.



Assemble



Important

- When assembling piston and connecting rod, stamped arrow on piston must point to front of engine block. The flange on connecting rod must face toward front of piston on left hand assembly and face toward rear of piston on right hand assembly.

NOTICE: After J 24086-C installer bottoms on support assembly, do not exceed 34 475 kPa (5000 psi) or the tool may be damaged.

1. Piston and connecting rod.
 - A. Lubricate piston pin holes in both piston and connecting rod assembly.
 - B. Press piston pin into piston and connecting rod using J 24086-C.



Inspect

- For freedom of movement of piston on piston pin.
- 2. Piston rings onto piston.
 - Marked side of piston rings must face toward top of piston. Locate piston ring gaps as shown (Figure 54).
 - A. Install oil ring spacer in groove.
 - B. Hold spacer ends together and install lower oil ring rail with gap properly located.

- C. Install upper oil ring rail with gap properly located.
- D. Flex oil ring assembly to make sure rings are free.
- E. Install lower compression ring with gap properly located.
- F. Install upper compression ring with gap properly located.

CONNECTING ROD BEARINGS

Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.025 mm (0.001 in.) and 0.05 mm (0.002 in.) undersize for use with new and used standard size crankshaft, and in 0.25 mm (0.010 in.) and 0.5 mm (0.020 in.) undersize for use with reconditioned crankshaft.

When removing a connecting rod cap, you may find a 0.25 mm (0.010 in.) undersize bearing. These are used in manufacturing for selective fitting.



Inspect

- Bearings for excessive wear or damage.



Measure

1. Crankpin for out-of-round and taper with a micrometer. Refer measurements to "Specifications" in this section.
 - If not within specifications, replace or recondition crankshaft.
 - If installing new bearings, determine new bearing size from maximum crankpin diameter.
2. Bearing clearances using gaging plastic.
 - A. Place a piece of gaging plastic full width of bearing, (parallel to crankshaft) onto crankpin.
 - Plastic gage should be positioned in middle of bearing. Bearing is thickest in center and bearing clearance must be measured at this location.
 - B. Install connecting rod cap with bearing onto connecting rod.
 - C. Install connecting rod nuts.



Tighten

- Connecting rod nuts, evenly, to 27 N·m (20 lb. ft.) plus an additional 55 degrees.



Important

- Do not turn crankshaft with gaging plastic installed or accuracy of measurement will be affected.
- D. Remove connecting rod nuts and cap.
- E. Measure gaging plastic at its widest using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.

- F. If clearance is greater than specified, select an undersize bearing and re-measure clearance.
- G. If clearance cannot be brought to specifications, regrind crankpin. If crankpin is already at maximum undersize, replace crankshaft.

OIL PUMP

Figures 55 and 56

Tool Required:

J 21882 Oil Pump Screen Installation

Disassemble

- Oil pump cover bolts (5) and oil pump cover (4).
 - Matchmark gear teeth for assembly.
- Driven gear (7), drive gear (7), driveshaft (9), and retainer (8), from oil pump housing (10).
- Oil pressure relief valve pin (1), relief valve (3), and spring (2).
- Oil pump screen (6) from oil pump housing (10), if replacement is necessary.
 - Mount oil pump housing (10) in a soft-jaw vise and extract oil pump screen (6).
 - Oil pump screen (6) is serviced as a unit. Do not disturb pipe on screen.

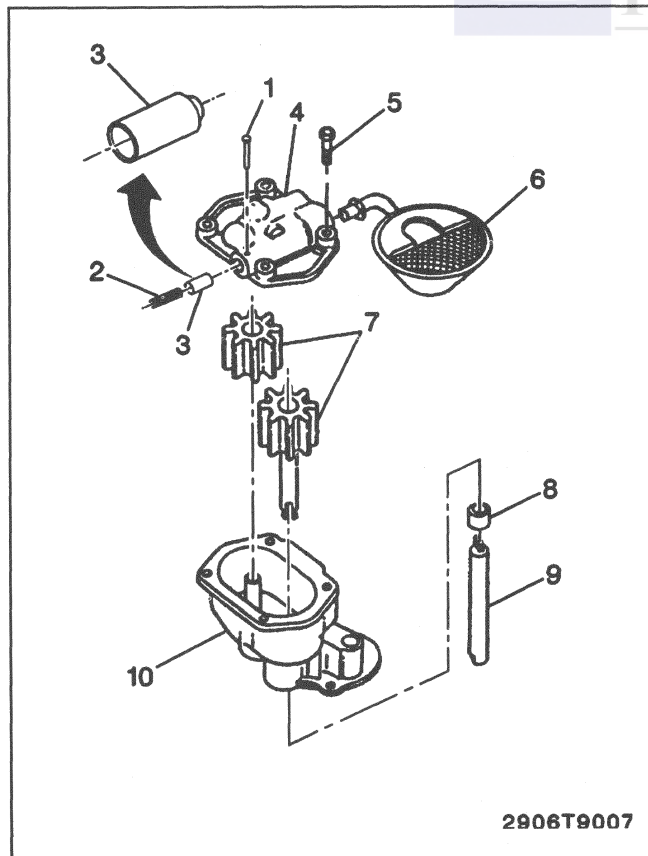


Figure 55 - Oil Pump Components

Clean

- All parts in cleaning solvent.
- Dry parts with compressed air.

Inspect

- Oil pump housing (10) and cover (4) for cracks, scoring, casting imperfections, and damaged threads.
- Drive gear shaft. If loose in oil pump housing (10), replace oil pump.
- Pressure relief valve (3) for scoring and sticking. — Burrs may be removed with a fine oil stone.
- Relief valve spring (2) for loss of tension.
- Oil pump screen (6) for broken wire mesh or looseness.
 - If pipe is loose or has been removed from screen, oil pump screen (6) must be replaced.
- Gears for chipping, galling, and wear.
- Drive gear (7) and driveshaft (9) for looseness and wear.

Important

— If wear is noted, replace entire oil pump.

Assemble

Important

- Be careful not to twist, shear, or collapse oil pump screen (6) while installing it to oil pump housing.
- A new oil pump screen (6), if previously disassembled, to oil pump housing (10).
 - Mount oil pump housing (10) in a soft-jaw vise.
 - Apply sealer to end of pipe.
 - Tap oil pump screen into place using J 21882 and a plastic-faced hammer.

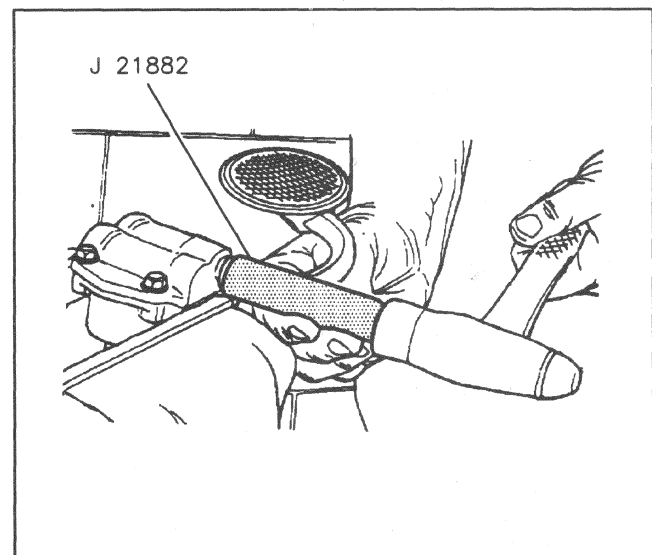


Figure 56 - Installing the Oil Pump Screen

**Important**

- Replace the pressure relief valve spring when reusing the oil pump.
- 2. Relief valve (3), spring (2), and pin (1).
- 3. Drive gear (7), driveshaft (9), and retainer (8) to oil pump housing (10).
- 4. Driven gear (7) to oil pump housing (10) with smooth side of gear toward oil pump cover (4).
- 5. Oil pump cover (4).
- 6. Oil pump cover bolts (5).

**Tighten**

- Oil pump cover bolts to 9 N-m (80 lb. in.).

**Inspect**

- For smoothness of operation by turning oil pump driveshaft (9) by hand.

CYLINDER HEAD**Figures 57 through 66****Tools Required:**

- J 8001 Dial Indicator Set
- J 9666 Valve Spring Tester
- J 8062 Valve Spring Compressor
- J 8358 Carbon Removing Brush

**Disassemble**

1. Spark plugs from cylinder head.
2. Compress valve springs (69) using J 8062.
3. Valve stem keys (72).
4. Cap (70) from valve.
5. Valve spring (69).
6. Valve seal (73).
7. Valve (71).

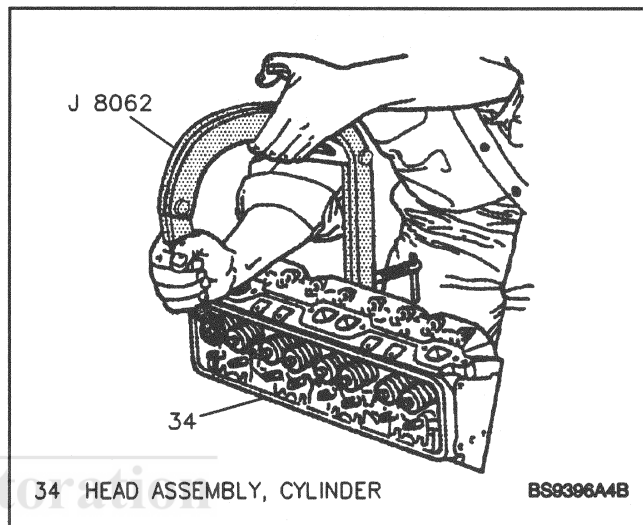
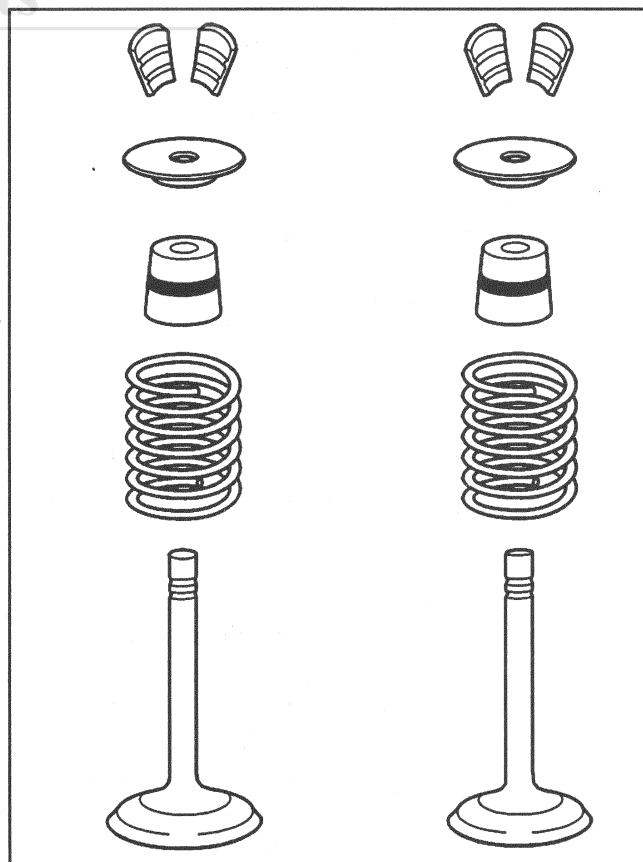
- Place valves in rack in proper sequence so they can be assembled in their original order.

**Clean**

1. Carbon from combustion chambers and valve parts using J 8358.
 - Be careful not to scuff chamber
2. Valve guides.
3. Carbon and sludge from valve pushrods and valve rocker arms.
4. Valve stems and heads on buffing wheel.
5. Cylinder head and engine block gasket surfaces.
6. Bolt hole threads in cylinder head and engine block.

**Inspect**

1. Cylinder head for cracks in exhaust ports, combustion chambers, or external cracks to water chamber.
2. Valves for burned heads, cracked faces, or damaged stems.
3. Valve springs for squareness.

**Figure 57 - Compressing Valve Spring****Figure 58 - Valve and Components**

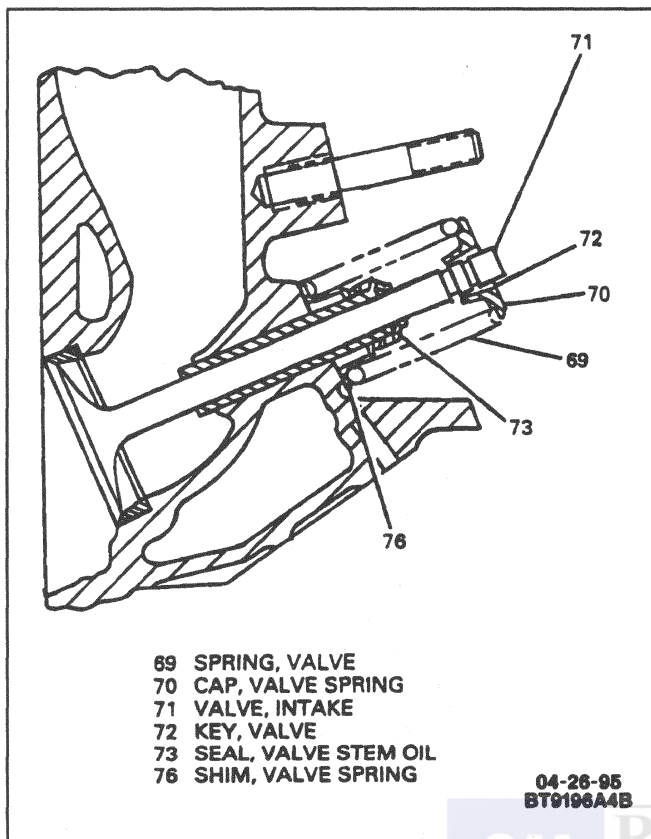


Figure 59 - Valve and Components

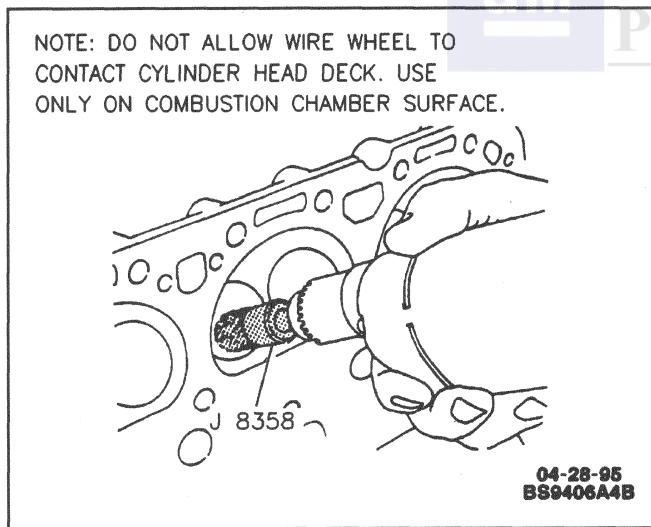


Figure 60 - Cleaning Combustion Chamber



Measure

1. Valve spring tension using J 9666.
 - If spring tension is less than 340 N (76 lb.) at 43.2 mm (1.70 in.), replace spring (69).
2. Valve stem-to-bore clearance.
 - A. Excessive valve stem-to-bore clearance will cause excessive oil consumption and may cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of valve and disturb engine assembly smoothness.

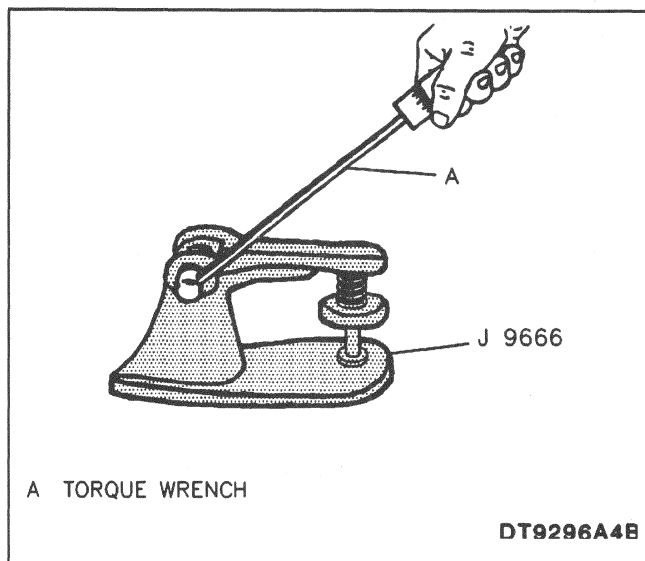


Figure 61 - Checking Valve Spring Tension

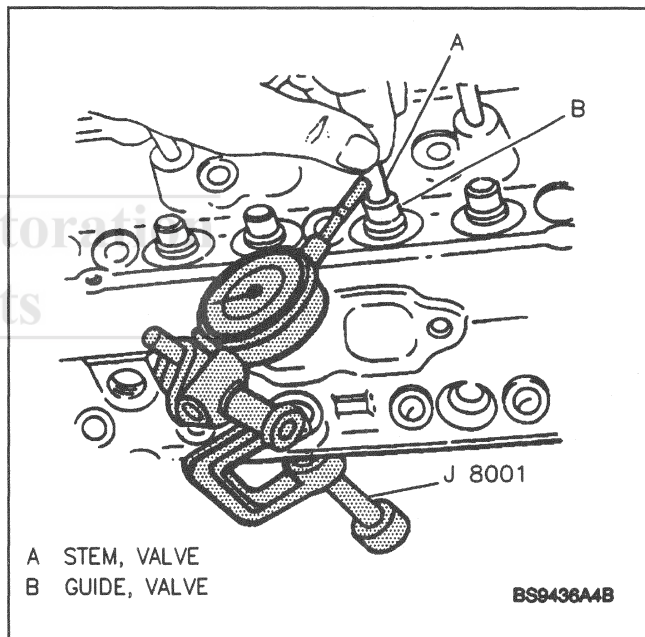


Figure 62 - Measuring Valve Stem Clearance

- B. Clamp J 8001 on exhaust port side of cylinder head.
- C. Locate indicator so movement of valve stem from side to side (crosswise to cylinder head) will cause a direct movement of indicator stem. Indicator stem must contact side of valve stem just above valve guide.
- D. Drop valve head about 1.6 mm (0.0064 in.) off valve seat.
- E. Move stem of valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves. Refer to "Specifications" in this section.
- F. Service valves are available in standard 0.076 mm (0.003 in.) and 0.038 mm (0.015 in.), 0.76 mm (0.030 in.) oversize.

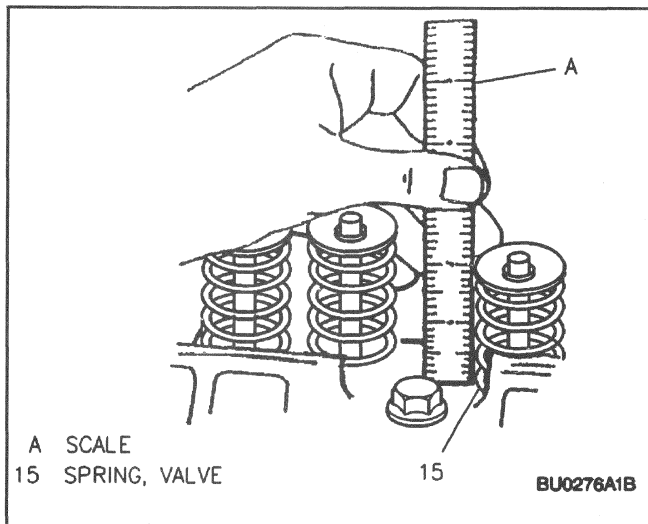


Figure 63 - Measuring Valve Spring Installation Height

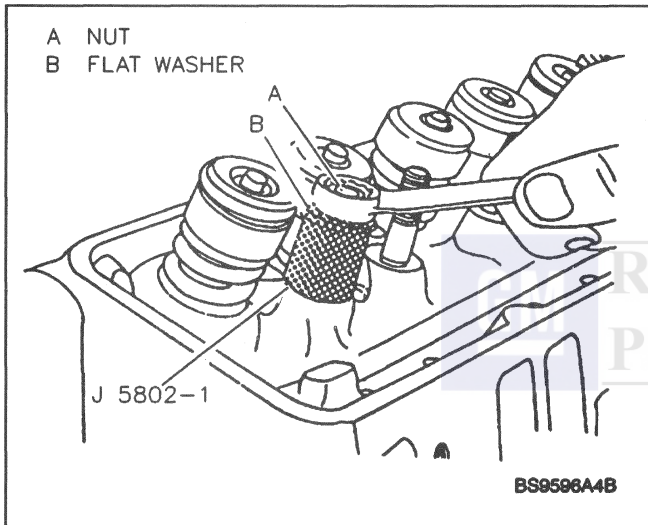


Figure 64 - Removing the Valve Rocker Arm Stud

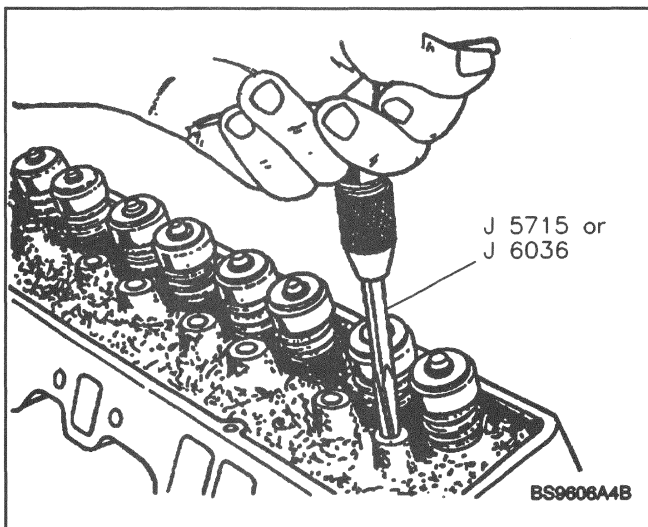


Figure 65 - Reaming the Stud Bore

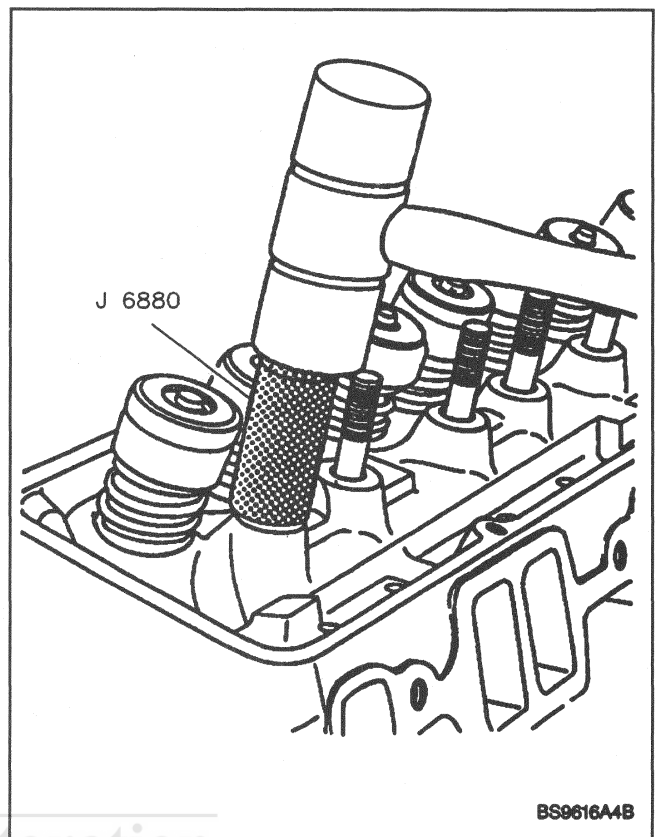


Figure 66 - Installing the Valve Rocker Arm Stud

Recondition

1. Valves with oversize stems are available as outlined above. Ream valve guide bores for oversize valves as necessary.
2. Reconditioning valve seats is very important. Valve seat reconditioning must be done after reaming valve guide bores or installing new valve guides.
 - Seating of valves must be perfect for engine assembly to deliver optimum power and performance.
 - Another important factor is cooling of valve heads. Good contact between each valve and its seat in cylinder head is necessary to insure that heat in valve head will be properly carried away.
 - Several different types of equipment are available for reconditioning valve seats. Recommendations of manufacturer of equipment being used should be carefully followed to attain proper results.
 - Regardless of what type of equipment is used, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in guide. Valve seats should be concentric to within 0.05 mm (0.002 in.) total indicator reading.

3. Valves that are pitted can be refaced to proper angle, insuring correct relation between head and stem, on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. If edge of valve head is less than 0.79 mm (0.031 in.) thick after grinding, replace valve.

- Several different types of equipment are available for refacing valves. Recommendation of manufacturer of equipment being used should be carefully followed to attain proper results.



Assemble

1. Valve (71) into proper port.
2. Valve seal (73) lightly against cylinder head.
3. Valve spring (69).
4. Cap (70) on valve stem.
5. Compress valve spring (69) using J 8062.
6. Valve stem keys (72).
 - A. Use grease to hold keys (72) in place while disconnecting J 8062.
 - B. Make sure keys (72) seat properly in upper groove of valve stem.
 - C. Tap end of stem with a plastic-faced hammer to seat keys (72), if necessary.
7. Remaining valves.



Measure

- Valve spring installed height from valve spring seat to locating surface on cap.
 - If installed height exceeds 44.2 mm (1.74 in.), install valve seat spring shim approximately 1.6 mm (0.0625 in.) thick.
 - Do not shim valve spring to obtain a less than specified installed height.

ROCKER ARM STUD REPLACEMENT

Figures 64, 65, and 66

Tools Required:

- J 5802-01 Valve Rocker Arm Stud Removal
- J 5715 Reamer (0.0762 mm (0.003 in.) oversize) or
- J 6036 Reamer (0.3302 mm (0.013 in.) oversize)
- J 6880 Valve Rocker Arm Stud Installation

Valve rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced. New studs are available in 0.0762 mm (0.003 in.) and 0.3302 mm (0.013 in.) oversize.

1. Place J 5802-01 over the stud to be removed. Install a nut and flat washer. Remove the stud by turning the nut.
2. Ream the hole to the proper size for the replacement oversize stud. Use J 5715 for 0.0762 mm (0.003 in.) oversize studs, J 6036 for 0.3302 mm (0.013 in.) oversize studs.

3. Coat lower end (press-fit area) of stud with hypoid axle lubricant. Drive the stud into place with a hammer and J 6880. Stud is installed to proper depth when the tool bottoms on the cylinder head.

CAMSHAFT

Figures 67 and 68

Tool Required:

J 7872 Magnetic Base Indicator Set



Measure

1. Camshaft journals with micrometer.
 - If journals are more than 0.025 mm (0.0010 in.) out-of-round, replace camshaft.
2. Camshaft runout using J 7872.
 - Mount camshaft in V-blocks or between centers. Using J 7872, check intermediate camshaft journal. If runout exceeds 0.065 mm (0.0026 in.), camshaft is excessively bent and should be replaced.

CRANKSHAFT POSITION SENSOR RELUCTOR RING



Inspect

- Crankshaft position sensor reluctor ring for knicks, scratches, or damage to the lugs.
- Crankshaft position sensor reluctor ring for worn keyway.

CAMSHAFT TIMING CHAIN, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY



Inspect

- Camshaft and crankshaft sprockets and water pump driveshaft assembly for wear.

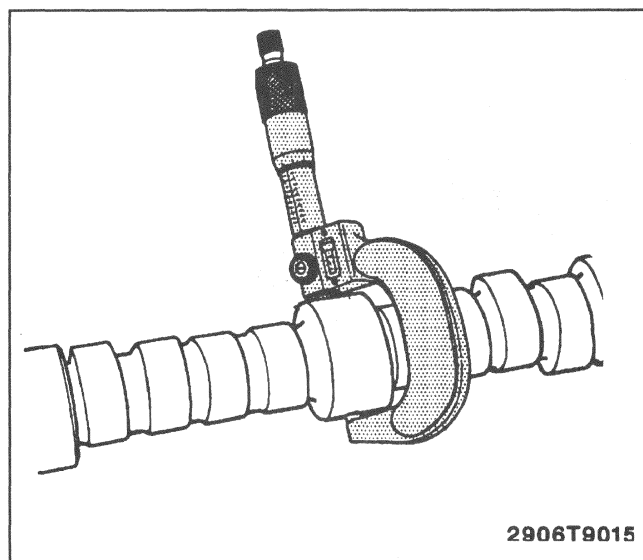


Figure 67 - Measuring Camshaft Journals

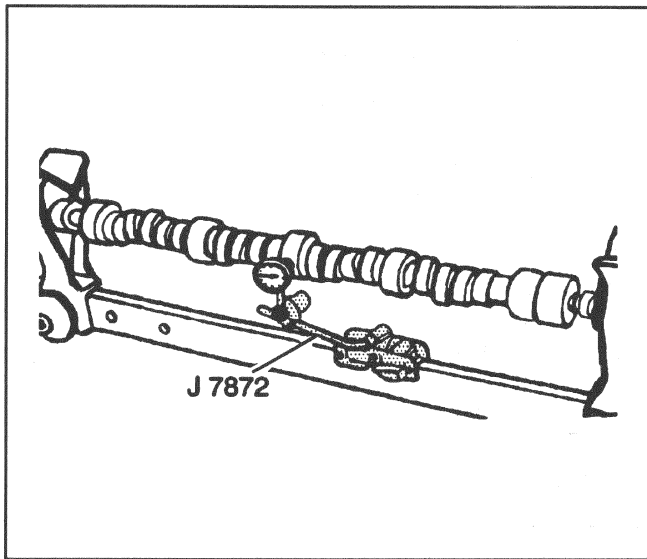


Figure 68 - Measuring Camshaft Runout

- One edge of teeth worn or teeth no longer concentric.
- Valley between teeth worn.
- Key and crankshaft keyway for wear.
- Camshaft timing chain for binding.

ENGINE FRONT COVER



Clean

- Engine front cover for damage to seals, gasket surfaces, and crankshaft position sensor bore.



Inspect

- Engine front cover for damage to seals or gasket surface.

ENGINE FRONT COVER OIL SEALS

Tools Required:

- J 35468 Engine Front Cover Alignment and Oil Seal Installation
- J 39937 Engine Front Cover Distributor Shaft Oil Seal Installation
- J 39088 Engine Front Cover Water Pump Driveshaft Assembly Oil Seal Installation



Remove or Disconnect

- Engine front cover oil seals for crankshaft, distributor shaft, and water pump driveshaft assembly.



Install or Connect

1. Crankshaft hub oil seal using J 35468.
2. Distributor driveshaft oil seal using J 39937.
3. Water pump driveshaft oil seal using J 39088.

OIL PAN



Clean

- Oil pan in solvent. Remove all sludge and varnish.
- Gasket surfaces.



Inspect

- Gasket flanges for bending or damage.
- Oil pan for rock damage or cracks.
- Crankshaft oil deflector for lack of fit.
- Oil pan drain plug opening for stripped threads.

WATER PUMP

Tool Required:

- J 39089 Water Pump Driveshaft Assembly O-Ring Seal Installation



Clean

- Water pump and engine block gasket surfaces.



Inspect

- O-ring seals on water pump driveshaft assembly and water pump shaft. Replace seals, if necessary using J 39089.

VALVE LIFTERS



Inspect

- Valve lifter body for wear and scuffing. Also inspect bore in engine block for scuffing.
- Valve lifter roller for:
 - Binding or roughness.
 - Excessive looseness in roller bearings.
 - Flat spots.
 - Pitting.
- Valve lifter pushrod seat and valve pushrod end for wear or scoring.

VALVE ROCKER ARMS AND VALVE PUSHRODS



Inspect

- Valve rocker arms and balls at their mating surfaces. These surfaces should be smooth and free of scoring or other damage.
- Valve rocker arm valve pushrod sockets and valve stem mating surfaces. These surfaces should be smooth with no scoring or exceptional wear.
- Valve pushrods for scored ends or bends.

VALVE ROCKER ARM COVERS



Clean

- Valve rocker arm cover and cylinder head gasket surfaces.

Inspect

- Gasket flanges for damage.
- Rubber grommets for deterioration.

INTAKE MANIFOLD

Clean

- Intake manifold bolts and studs.
- All intake manifold sealing surfaces.
- Remove old RTV from intake.

ASSEMBLY

ENGINE BLOCK

Install or Connect

1. Engine block core plugs.
2. Front and rear oil gallery plugs.
3. Oil filter adapter, with new adapter seal.
4. Oil filter adapter bolts and washers.
5. Fuel pump/oil pressure switch.
6. Knock sensor and drain plug.

Tighten

- Rear engine block oil gallery plugs to 20 N·m (15 lb. ft.).
- Knock sensors to 20 N·m (15 lb. ft.).
- Engine block coolant drain plug to 20 N·m (15 lb. ft.).
- Oil filter adapter bolts to 25 N·m (18 lb. ft.).
- Oil filter to 21 N·m (15 lb. ft.).
- Fuel pump/oil pressure switch to 12 N·m (106 lb. in.).

CAMSHAFT BEARINGS

Figures 69, 70, and 71

Tool Required:

J 6098-01 Camshaft Bearing Removal and Installation

Outer front and rear camshaft bearings must be installed first. These bearings serve as guides for tool pilot, and help center inner bearings during installation process.

Important

- Align camshaft bearing oil holes properly during installation.
- Number one (front) camshaft bearing oil holes must be positioned so that they are at 1 o'clock and 5 o'clock positions.

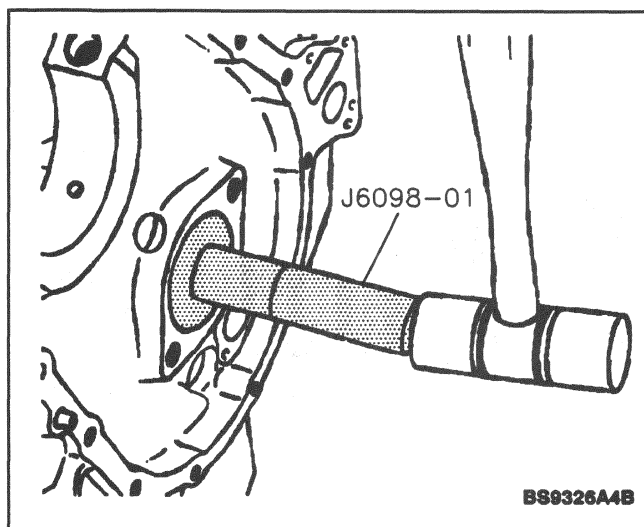


Figure 69 - Installing Camshaft Outer Bearings

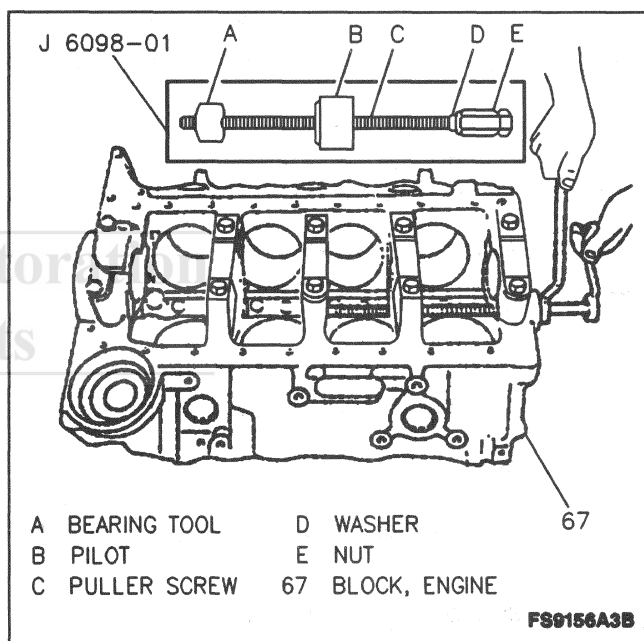


Figure 70 - Installing Camshaft Inner Bearings

- Number two through number four inner camshaft bearing oil holes must be positioned at 5 o'clock toward left side of engine block and even with bottom of cylinder bore.
- Number five (rear) camshaft bearing oil hole must be positioned at 12 o'clock.

Install or Connect

1. Front and rear camshaft bearings using J 6098-01.
 - A. Assemble bearing tool to driver handle.
 - B. Align oil holes as outlined above.
 - C. Drive front and rear bearings in, toward center of engine block.
2. Inner camshaft bearings using J 6098-01.
 - A. With nut and thrust washer assembled to end of puller screw threads, index pilot in camshaft front bearing and install puller screw through pilot.

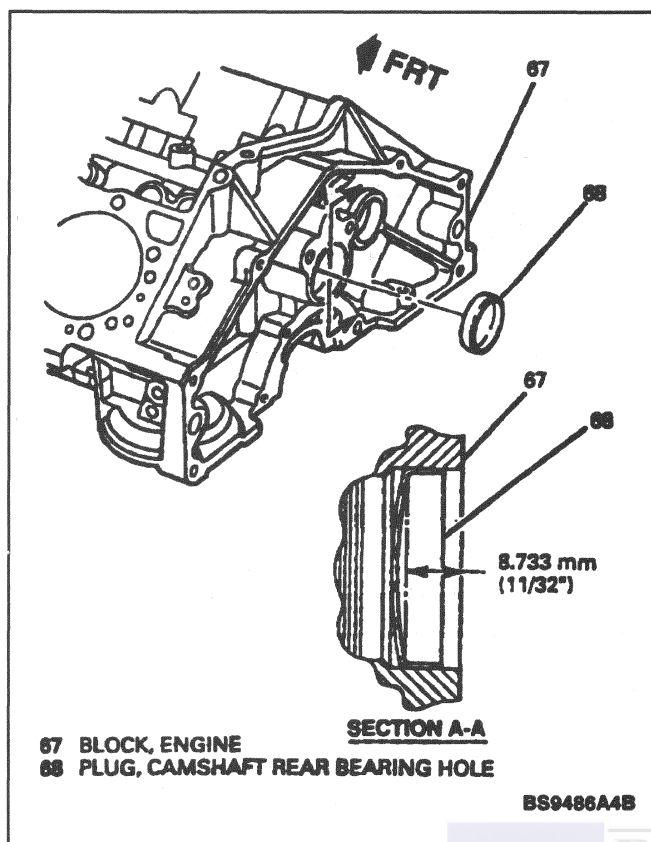


Figure 71 - Camshaft Rear Bearing Hole Plug

- B. Index camshaft bearing in bore, aligning oil hole as outlined above.
- C. Install puller screw through bearing bore and bearing to be installed and assemble bearing tool to puller screw with shoulder toward bearing. Make sure that enough threads are engaged.
- D. Using two wrenches, hold puller screw while turning nut to draw bearing into bore.
 - When bearing has been pulled into bore, remove bearing tool and puller screw and check alignment of bearing oil hole to bore oil hole.
- E. Repeat above steps for remaining inner camshaft bearings.
 - Index pilot in rear camshaft bearing to install rear inner bearing.
3. New camshaft rear bearing hole plug (68).
 - A. Coat plug outside diameter with GM P/N 1052080 sealant, or equivalent.
 - B. Install camshaft rear bearing hole plug (68) as shown (Figure 71).

CRANKSHAFT

Figures 72 and 73



Install or Connect

1. Crankshaft bearings into engine block and crankshaft bearing caps.
 - Coat crankshaft bearings with oil.

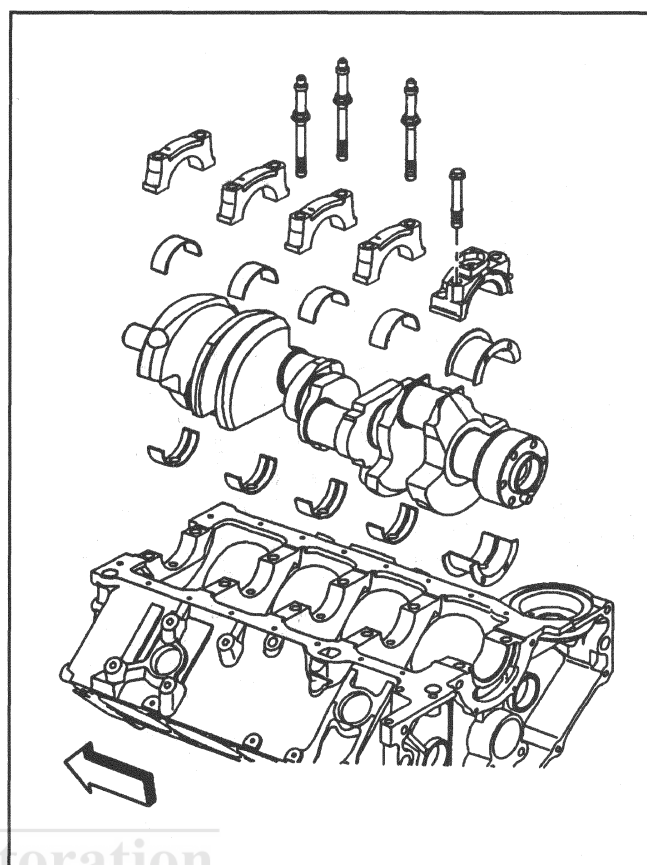


Figure 72 - Crankshaft, Crankshaft Bearings, and Crankshaft Bearing Caps

2. Crankshaft.
3. Crankshaft bearing caps with assembled crankshaft bearings. Cap directional arrows must point toward front of engine block.
4. Crankshaft bearing cap bolts and studs.
 - With crankshaft, crankshaft bearings, crankshaft bearing caps installed, and bolts and studs started, thrust crankshaft rearward to set and align bearing caps. Then thrust crankshaft forward to align rear faces of rear crankshaft bearings.



Tighten

- Crankshaft bearing cap bolts and studs to 105 N·m (77 lb. ft.).



Measure

- Crankshaft end play using a dial indicator or feeler gage. Refer to "Specifications" in this section.
 - If using a feeler gage, measure between front of rear crankshaft bearing cap and crankshaft thrust surface.

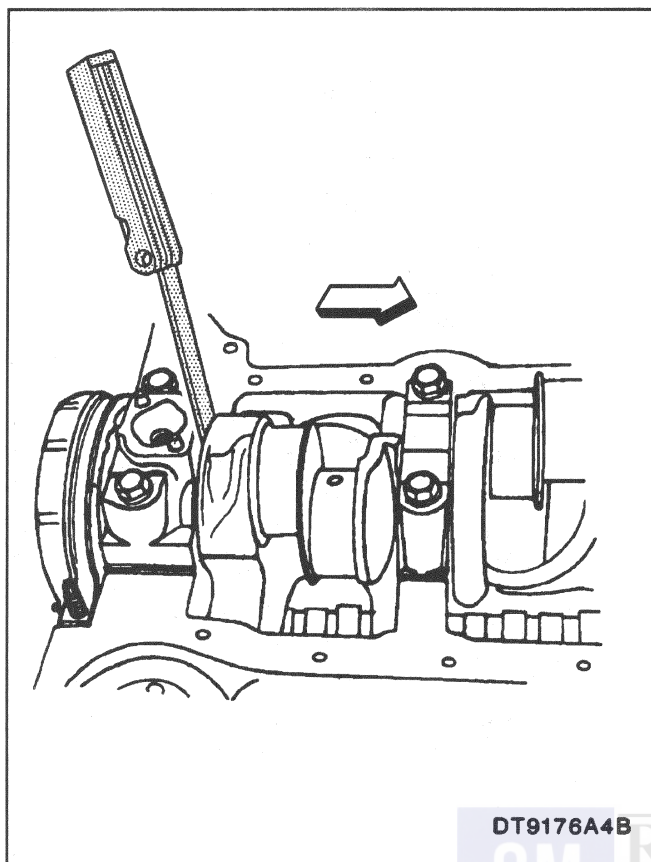


Figure 73 - Checking Crankshaft End Play

CRANKSHAFT REAR OIL SEAL HOUSING

Figure 74



Clean

- Gasket surfaces.



Install or Connect

1. New gasket and crankshaft rear oil seal housing on studs.



Important

- Always use new crankshaft rear oil seal and new crankshaft rear oil seal housing gasket during installation of crankshaft rear oil seal housing.
 - It is not necessary to use any type of sealant to hold gasket in place.
2. Crankshaft rear oil seal housing nuts and bolts.



Tighten

- Crankshaft rear oil seal housing nuts and bolts to 15 N·m (11 lb. ft.).

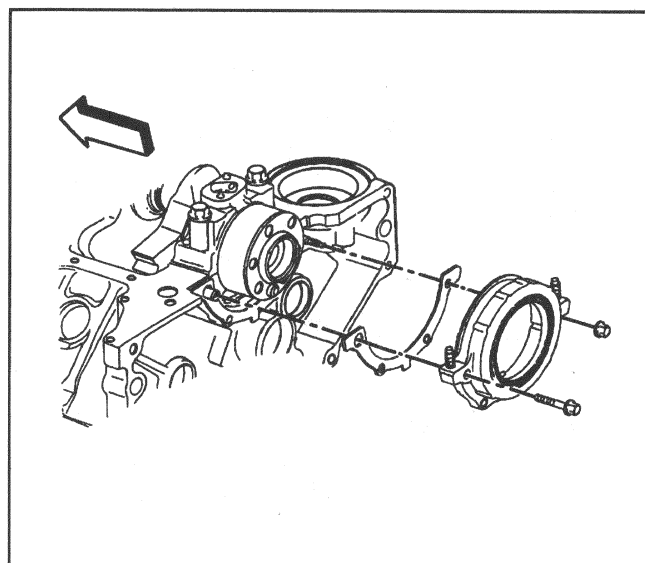


Figure 74 - Crankshaft Rear Oil Seal Housing

CRANKSHAFT REAR OIL SEAL

Figure 75

Tool Required:
J 35621 Crankshaft Rear Oil Seal
Installation



Install or Connect

1. Coat new oil seal entirely with clean engine oil.
2. Oil seal onto J 35621.

NOTICE: Crankshaft sealing surface and chamfer must be free of nicks and burrs to prevent damage to the lip of the seal.

3. J 35621 onto rear of crankshaft. Tighten screws snugly to ensure seal will be installed squarely over crankshaft.
4. Crankshaft rear oil seal to crankshaft and crankshaft rear oil seal housing.
- Tighten wing nut on J 35621 until it bottoms.
5. Remove J 35621 from crankshaft rear oil seal housing.

PISTON AND CONNECTING ROD ASSEMBLY

Figures 76, 77, and 78

Tools Required:
J 8037 Piston Ring Compressor
J 5239 Connecting Rod Bolt Guide Set



Install or Connect

1. Coat piston, piston rings, cylinder bore, and bearing surfaces with engine oil.

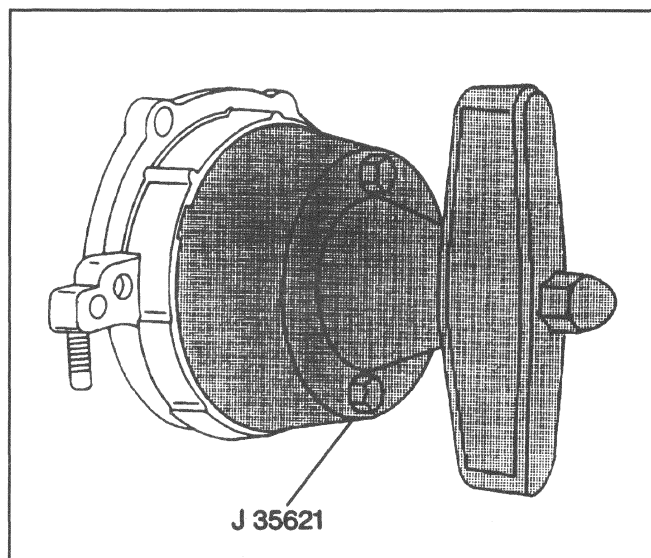


Figure 75 - Crankshaft Rear Oil Seal Installation Tool

2. Piston with stamped arrow facing forward and connecting rod assembly into its matched bore. Use J 8037 and J 5239 and lightly tap top of piston with wooden hammer handle.
 - Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.
 - Guide connecting rod assembly using J 5239.
3. Remove J 5239.

CONNECTING ROD BEARINGS

Figure 79



Install or Connect

1. Coat inside surface of bearings with engine oil.



Important

- When assembled, flanges on connecting rod and cap should face to front in left bank and to rear in right bank.
2. Connecting rod cap and bearings.
 3. Connecting rod nuts.



Tighten

- Connecting rod nuts, evenly, to 27 N·m (20 lb. ft.) plus an additional 55 degrees.



Measure

1. When all connecting rod bearings have been installed, tap each connecting rod lightly parallel to crankpin to make sure they have clearance.
2. Side clearance between connecting rod caps using a feeler gage or dial indicator.
 - Rod side clearance should be 0.16 to 0.35 mm (0.006 to 0.014 in.).

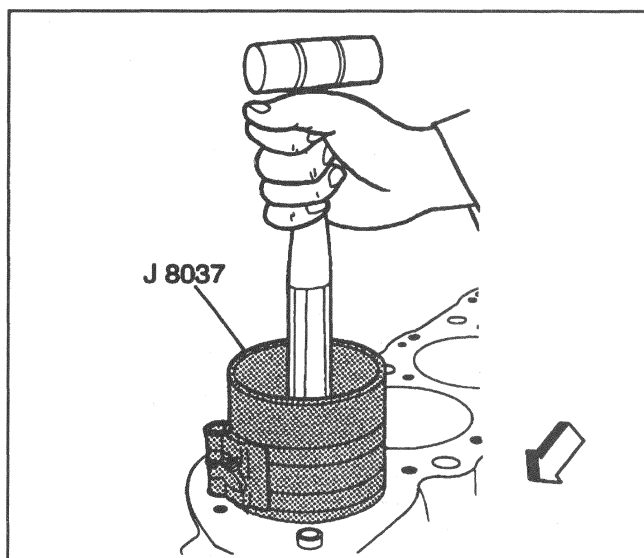


Figure 76 - Installing the Piston

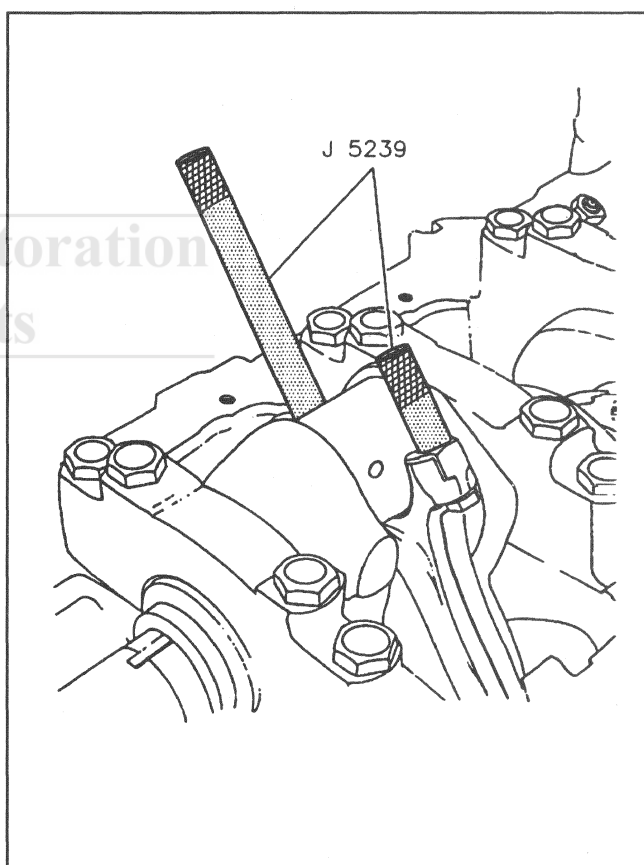


Figure 77 - Connecting Rod Guide Tool

OIL PUMP

Figure 80



Install or Connect

1. Oil pump, driveshaft, and retainer.
 - Align slot on end of driveshaft with drive tang on oil pump shaft.

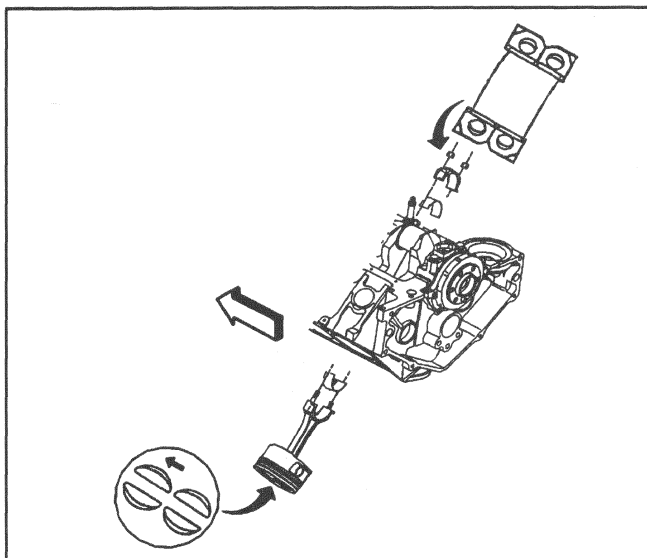


Figure 78 - Installing the Piston and Connecting Rod Assembly

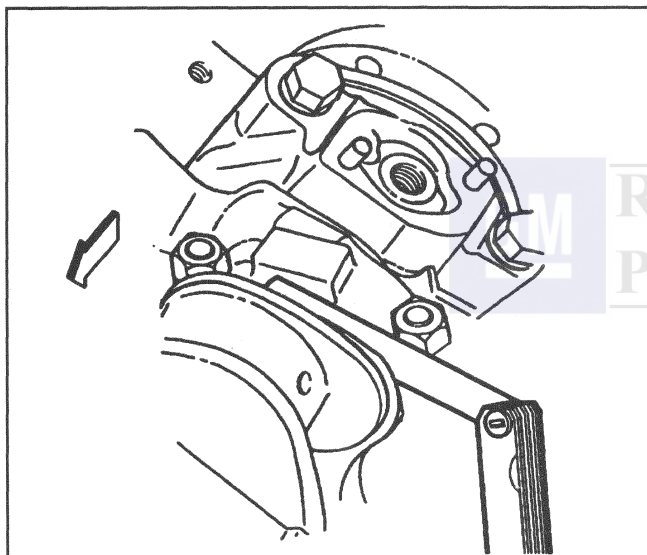


Figure 79 - Measuring Connecting Rod Side Clearance

2. Crankshaft oil deflector.
3. Bolt attaching oil pump to rear crankshaft bearing cap.
4. Crankshaft oil deflector nuts.



Tighten

- Oil pump bolt to 90 N.m (66 lb. ft.).
- Crankshaft oil deflector nuts to 40 N.m (30 lb. ft.).

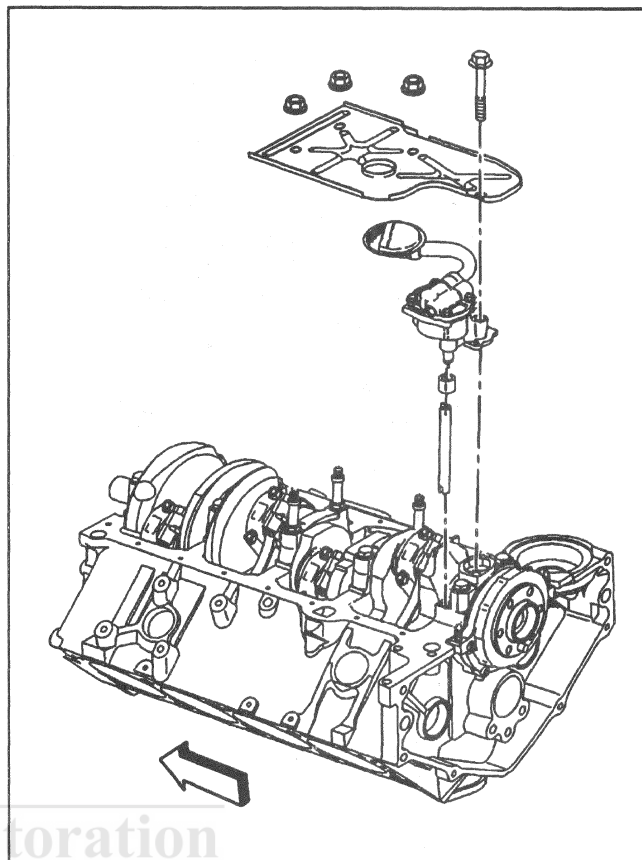


Figure 80 - Oil Pump, Crankshaft Oil Deflector, Driveshaft, and Retainer

CYLINDER HEAD

Figures 81 and 82

Tools Required:
J 36660 Torque Angle Meter



Install or Connect

1. New cylinder head gasket.
2. Gasket over locating pins, with yellow side of tab on outboard side facing up.
3. Cylinder head over locating pins and gasket.
 - Coat threads of cylinder head bolts with sealing compound GM P/N 1052080 or equivalent.
4. Cylinder head bolts finger tight.



Tighten

- Cylinder head bolts in sequence first pass to 30 N.m (22 lb. ft.) (Figure 82).
- Cylinder head bolts in sequence second pass using J 36660 to:
 - Short bolts (3,4,7,8,11,12,15,16) 55 degrees.
 - Medium bolts (14,17) 65 degrees.
 - Long bolts (1, 2, 5, 6, 9, 10, 13) 75 degrees.

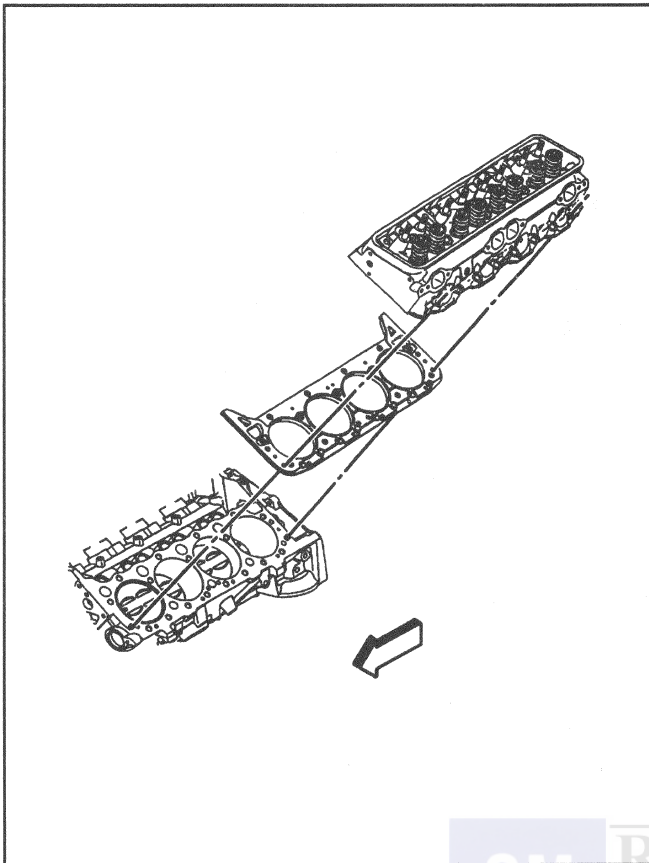


Figure 81 - Cylinder Head and Gasket

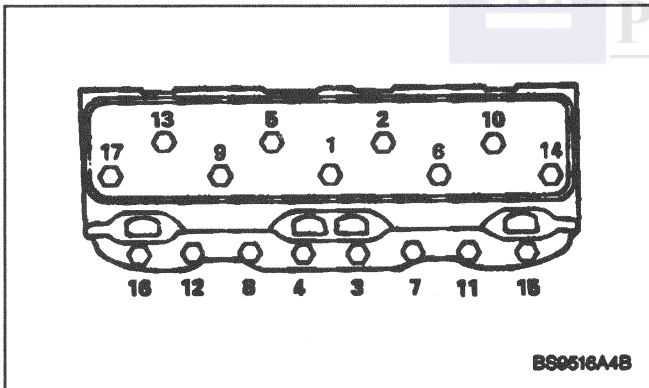


Figure 82 - Cylinder Head Tightening Sequence

5. Spark plugs.

6. Engine coolant air bleed pipe and bolts.



Tighten

- Spark plugs to:
 - Spark plugs (cylinder head - new) 30 N.m (22 lb. ft.)
 - Spark plugs (cylinder head - all subsequent installations) 20 N.m (15 lb. ft.)
- Engine coolant air bleed pipe bolts to 40 N.m (30 lb. ft.).
 - Use backup wrench on pipe fittings when installing bolts.

CAMSHAFT

Figures 83 and 84

When installing new camshaft, coat camshaft lobes and journals with engine oil.

When installing a new camshaft, inspect all valve lifters and replace as necessary to ensure durability of camshaft lobes and valve lifter rollers.

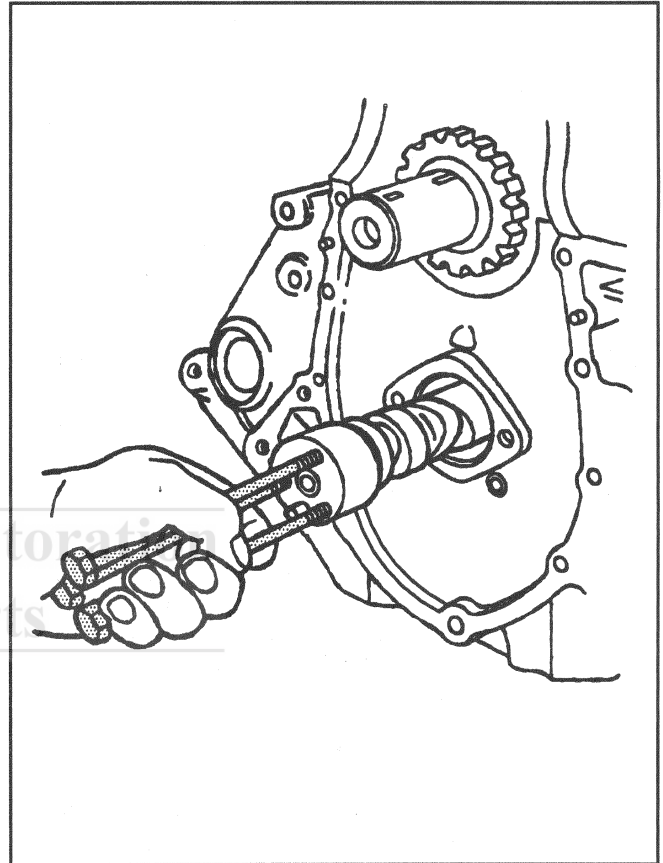


Figure 83 - Installing the Camshaft

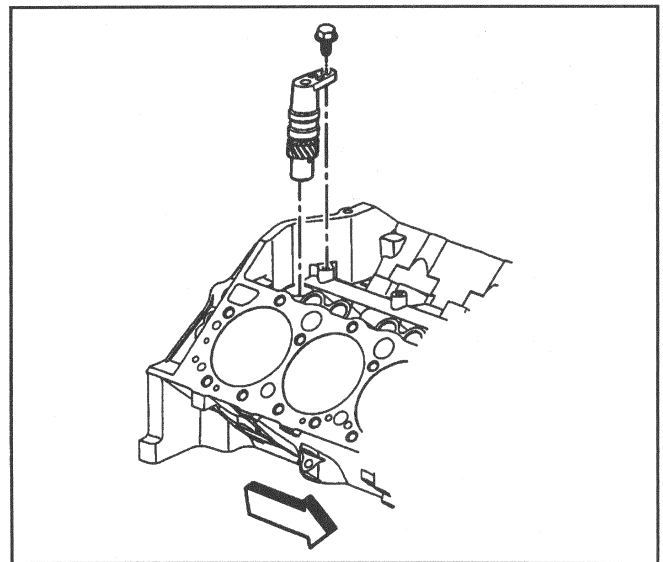


Figure 84 - Oil Pump Driveshaft Assembly

Install or Connect

1. Install three 5/16 - 18 x 4.0 in. bolts in camshaft front bolt holes.
2. Camshaft.
3. Remove the three bolts from front of camshaft.
4. Camshaft retainer and camshaft retainer bolts.

Tighten

- Camshaft retainer bolts to 12 N.m (106 lb. in.).
5. Oil pump driveshaft assembly and bolt.
 - Bolt hole "ear" must be seated on boss before tightening bolt.

Tighten

- Oil pump driveshaft bolt to 18 N.m (13 lb. ft.).

CAMSHAFT TIMING CHAIN, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 85, 86, and 87

Tools Required:

- J 5590 Crankshaft Sprocket Installation
- J 39089 Water Pump Driveshaft Assembly /Water Pump Shaft Seal Installation
- J 415465 Water Pump Driveshaft Assembly Installation

Install or Connect

1. Align key with keyway, if previously removed.
2. Crankshaft sprocket (62) using J 5590.
3. Water pump driveshaft assembly (63) using J 41546.
4. Water pump driveshaft bearing retainer bolts (64).

Tighten

- Water pump driveshaft bearing retainer bolts to 12 N.m (106 lb. in.).
5. Camshaft sprocket (57) and camshaft timing chain (61).
 - Gears must mesh, or damage to camshaft retainer could occur.
 6. Camshaft sprocket bolts (56).
 - Make sure that camshaft and crankshaft sprocket alignment marks align (Figure 87).

Tighten

- Camshaft sprocket bolts to 25 N.m (18 lb. ft.).
7. New O-ring seal to water pump driveshaft assembly (63) using J 39089.

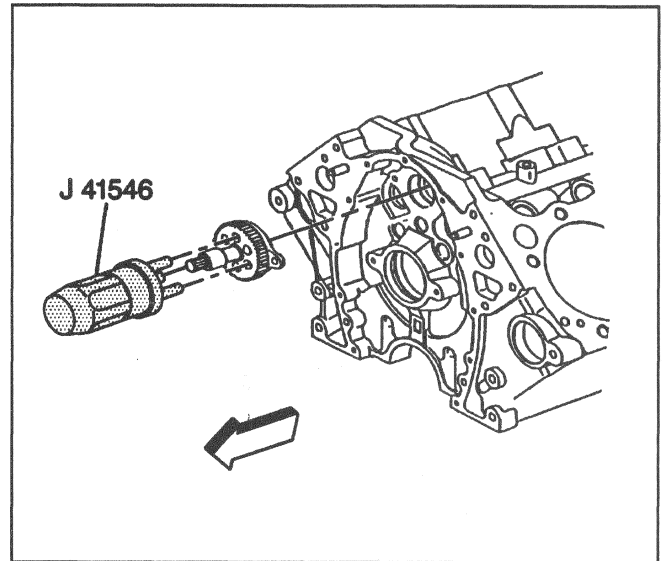


Figure 85 - Installing the Water Pump Driveshaft Assembly

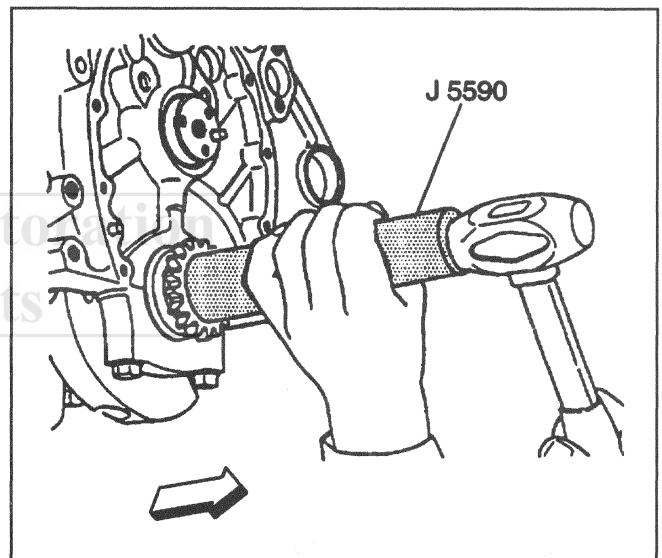


Figure 86 - Installing the Crankshaft Sprocket

CRANKSHAFT POSITION SENSOR RELUCTOR RING

Figure 88

Install or Connect

- Reluctor ring onto crankshaft.

Important

- Align the keyway on the reluctor ring with the key in the crankshaft and install the reluctor ring onto the crankshaft until the ring is completely seated against the crankshaft sprocket.

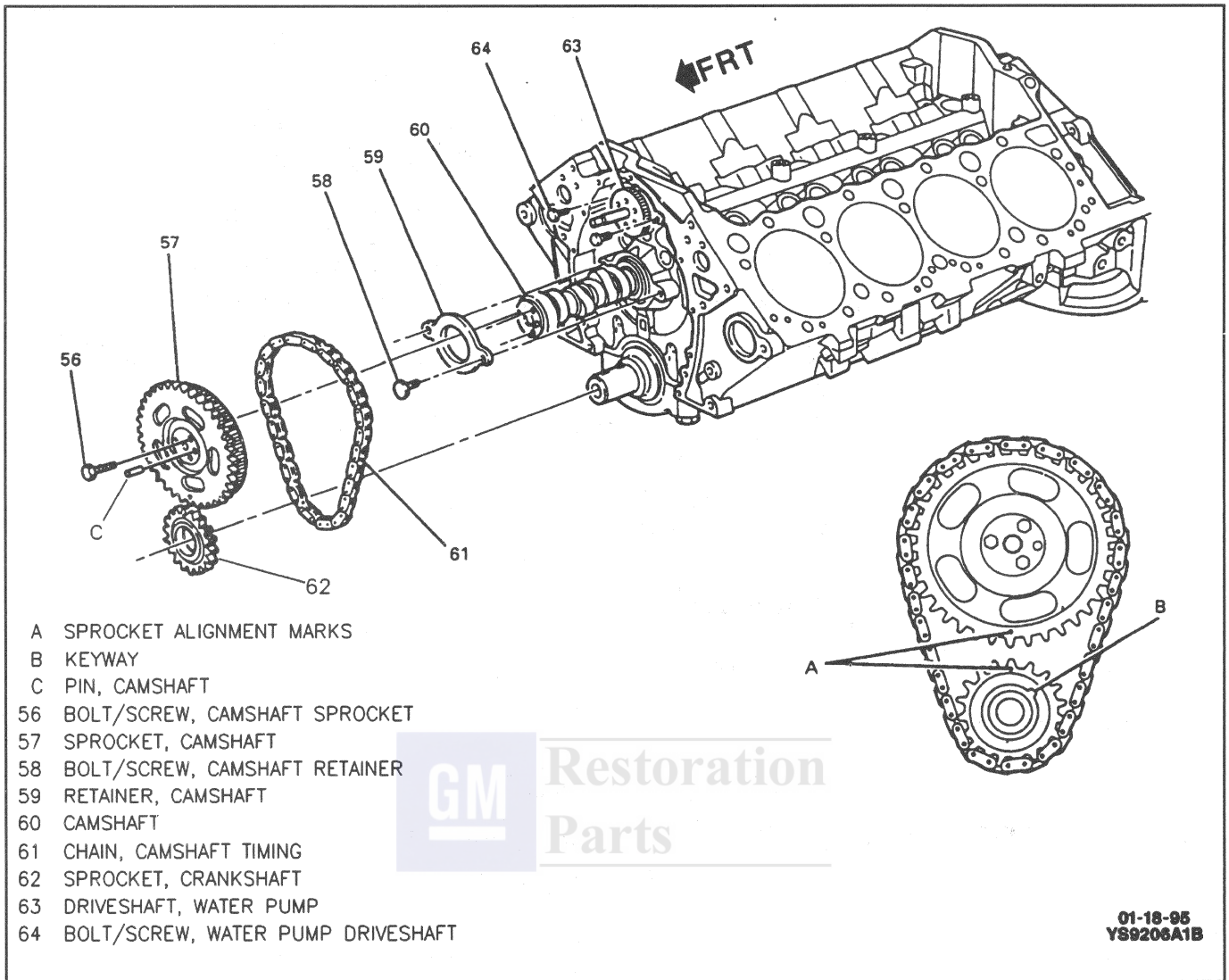


Figure 87 - Camshaft Timing Chain, Sprockets, and Water Pump Driveshaft Assembly

ENGINE FRONT COVER

Figure 89

Tool Required:
 J 39087 Water Pump Driveshaft Assembly
 Engine Front Cover Oil Seal Protector

Install or Connect

NOTICE: Be careful not to damage oil seal when installing engine front cover over water pump driveshaft assembly.

1. Gasket (1) and engine front cover (4) using J 39087 on water pump driveshaft assembly.
2. Engine front cover bolts (5).

Tighten

- Engine front cover bolts to 12 N.m (106 lb. in.).

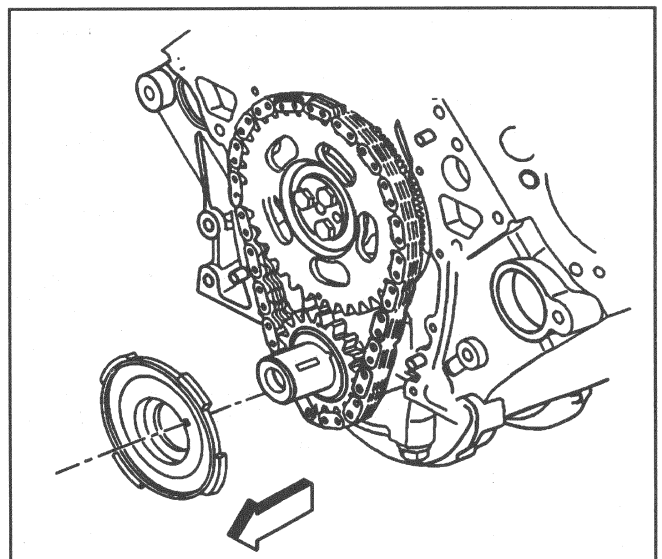


Figure 88 - Crankshaft Position Sensor Reluctor Ring

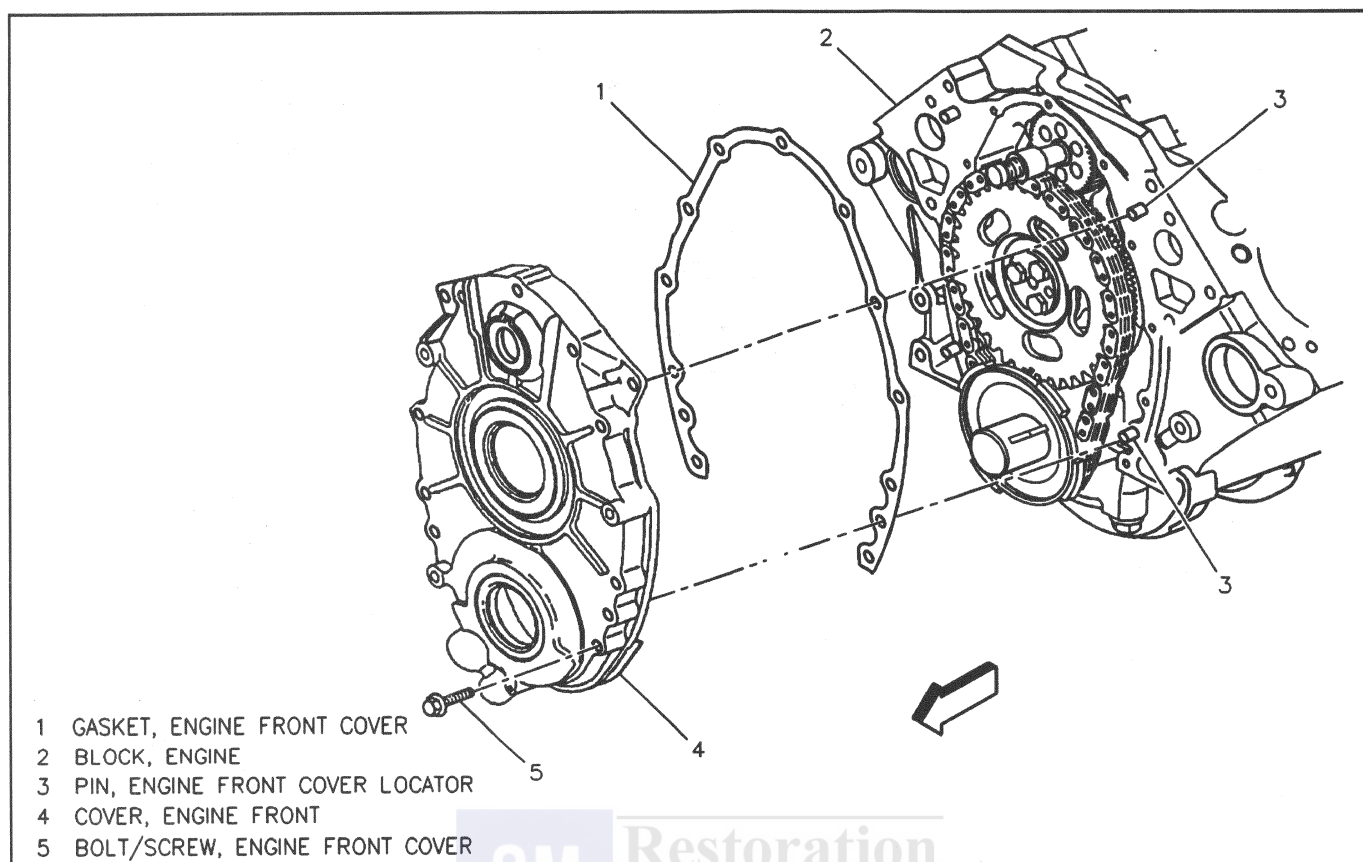


Figure 89 - Engine Front Cover

CRANKSHAFT POSITION SENSOR

Figure 90

! Important

- Do not re-use the O-ring seal on the crankshaft position sensor. Install a new O-ring seal onto the sensor.

↔ Install or Connect

1. Lubricate the O-ring seal of the sensor with clean engine oil.
2. Crankshaft position sensor into engine front cover.

! Important

- When installing the crankshaft position sensor be sure the sensor is fully seated and held stationary in the engine front cover bore. Torque the hold down bolt to the specification shown below. A sensor that is not fully seated will cock in the engine front cover and may result in erratic engine operation.

3. Bolt into cover.

⌚ Tighten

- Bolt to 12 N·m (106 lb. in.).

DISTRIBUTOR

Figure 91

! Important

- Distributor (49) is driven by a camshaft pin that mates to one slot in distributor driveshaft.
- Align distributor driveshaft slot with distributor base timing mark.
- Rotate engine crankshaft until number one piston is at top dead center (intake and exhaust valves closed). Camshaft pin will be at 9 o'clock position.

↔ Install or Connect

1. Distributor (49).

- Before inserting distributor bolts (47), make sure distributor (49) is fully seated to engine front cover. If it is difficult to seat, check alignment of distributor driveshaft slot, timing mark and camshaft pin.

2. Distributor bolts (47).

⌚ Tighten

- Distributor bolts to 12 N·m (106 lb. in.).
3. Ignition coil and bracket and studs.

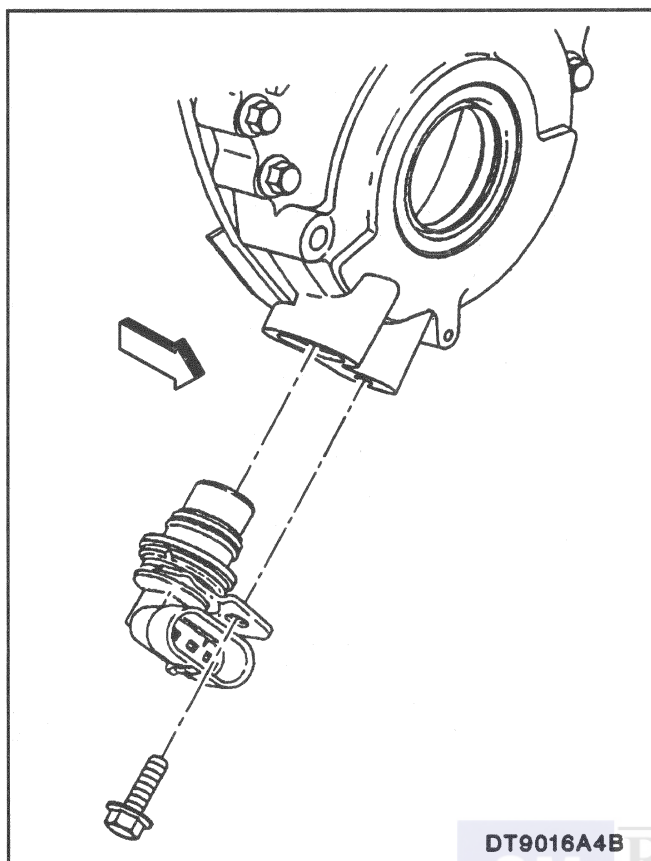


Figure 90 - Crankshaft Position Sensor

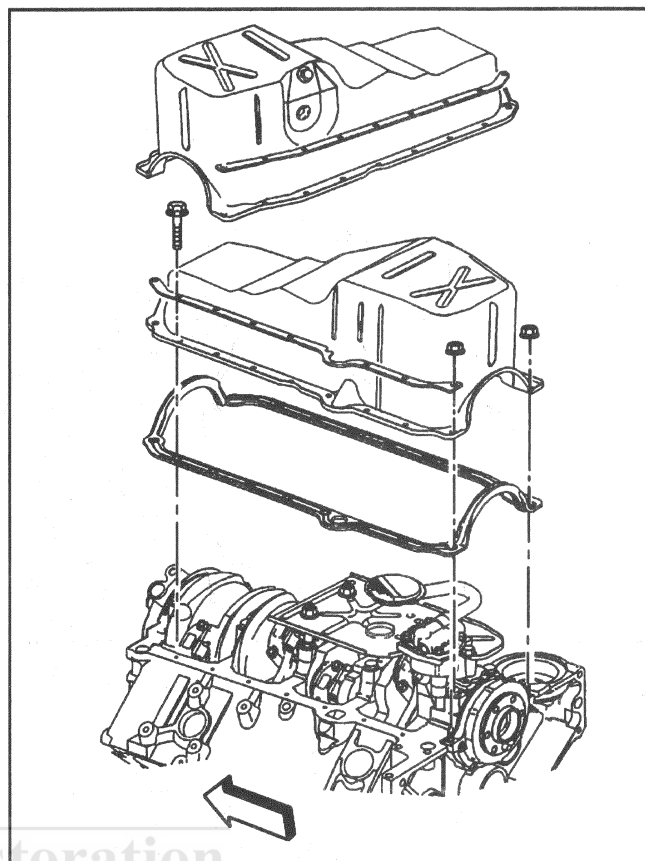


Figure 92 - Oil Pan, Reinforcements, and Gasket

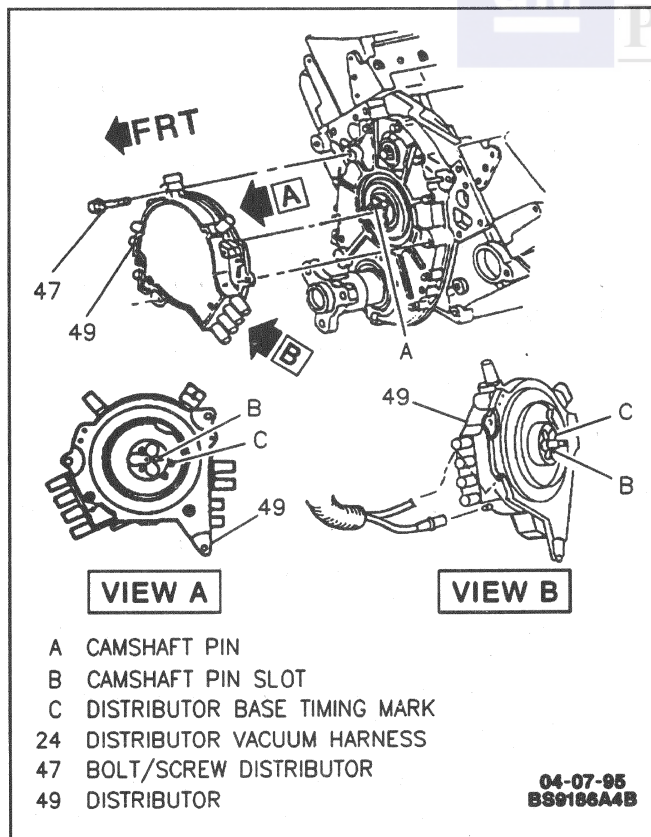


Figure 91 - Distributor



Tighten

- Ignition coil studs to 40 N·m (30 lb. ft.).
- 4. Spark plug and ignition harnesses to distributor (49), if removed, and ignition coil.
- 5. Distributor vacuum harness.

OIL PAN

Figures 92 through 95



Install or Connect

1. Apply a small amount of sealer, GM P/N 12346141 or equivalent, to engine front cover and engine block junction and to crankshaft rear oil seal housing and engine block junction. Apply sealer 25 mm (1.0 in.) in either direction of radius cavity of junctions.
2. Oil pan gasket, oil pan, and reinforcements.
3. Oil pan nuts, bolts, and studs.



Tighten

- Corner bolts or stud, and nuts to 20 N·m (15 lb. ft.).
- Remainder of bolts and studs to 12 N·m (106 lb. in.).
- 4. Oil level sensor.

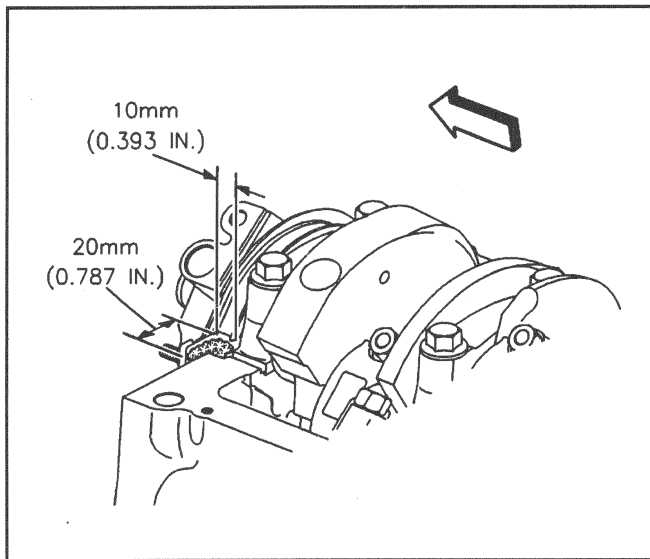


Figure 93 - Applying Sealant to Front of Engine Oil Pan Surface

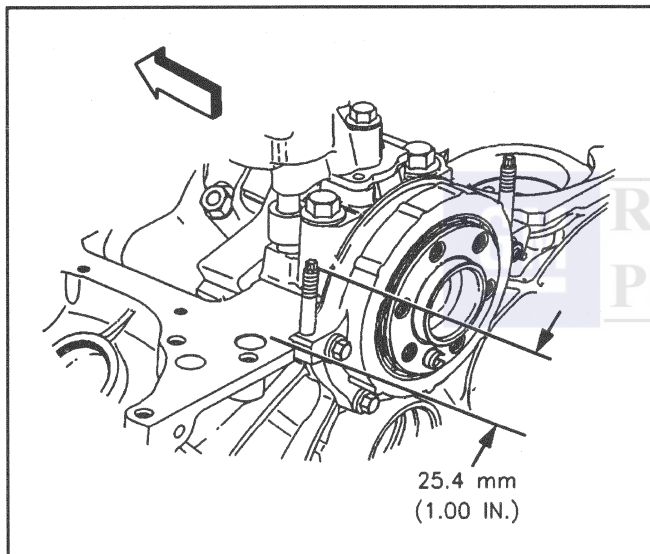


Figure 94 - Applying Sealant to Rear of Engine Oil Pan Surface



Tighten

- Oil level sensor to 35 N.m (26 lb. ft.).
- 5. Starter motor and bolts.
- 6. Oil pan drain plug and gasket.



Tighten

- Starter motor bolts to 47 N.m (35 lb. ft.).
- Oil pan drain plug to 20 N.m (15 lb. ft.).

CRANKSHAFT BALANCER AND HUB

Figure 96 and 97

Tool Required:

J 39046 Crankshaft Hub Removal and Installation

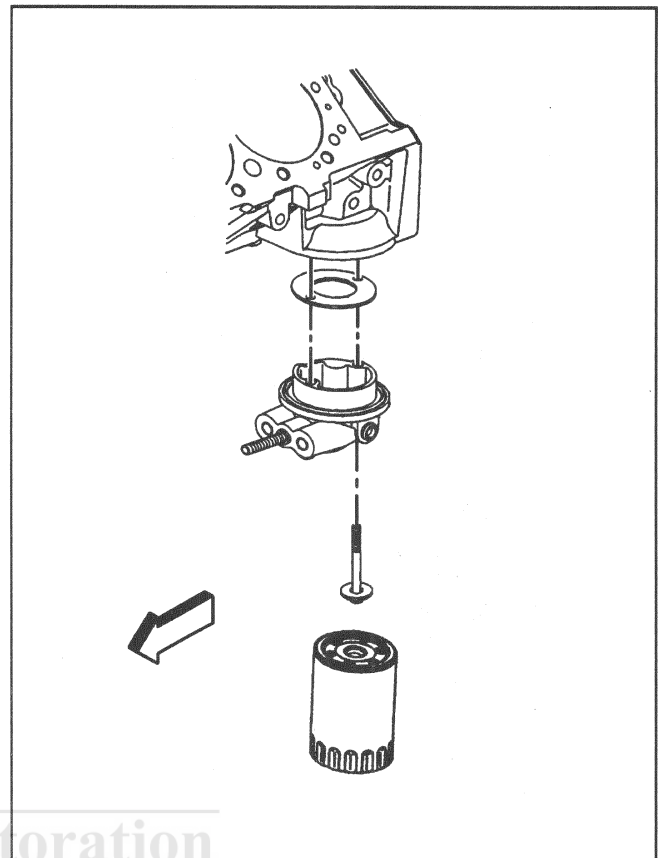


Figure 95 - Oil Cooler Adapter and Oil Filter



Install or Connect

1. Crankshaft balancer hub must be installed by following procedure:
 - A. Set number 1 piston to top dead center.
 - B. Install crankshaft balancer hub with cast arrow on hub in 12 o'clock position.
2. Crankshaft balancer hub, until completely seated against the crankshaft position sensor reluctor ring using J 39046.
3. Crankshaft balancer hub washer and bolt.
4. Crankshaft balancer and bolts.



Important

- If crankshaft balancer is replaced, new balancer weights of same size must be installed on the new balancer in same location as old balancer.
 - A. Measure depth of empty balancer weight hole. Record measurement.
 - B. Drive weights in old balancer to bottom of hole then measure depth of hole. Record measurement.
 - C. Subtract measurement of hole with weight from measurement of empty hole. Difference will be the length of balancer weight that must be installed in new balancer in the same location.

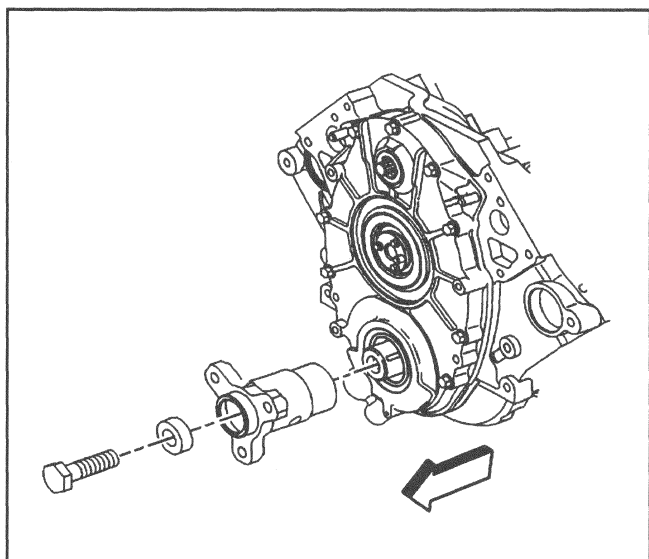


Figure 96 - Crankshaft Balancer Hub, Bolt, and Washer

Tighten

- Crankshaft balancer hub bolt to 100 N.m (75 lb. ft.).
- Crankshaft balancer bolts to 85 N.m (63 lb. ft.).

WATER PUMP

Figures 98 and 99

Install or Connect

1. Coupling (39) to water pump shaft with groove on coupling toward engine block.
 - Apply a light coat of grease to O-ring seals (156) and grease to coupling (39).
2. Position water pump (37) and gaskets (38), with tabs straight up, to engine block. Rotate coupling (39), if necessary, to align it to water pump driveshaft splines and then seat water pump.
3. Water pump bolts (40 and 41).

Tighten

- Water pump bolts to 45 N.m (35 lb. ft.).
4. Fan pulley bracket bolts and bracket, if equipped.
 5. Air injection pump bracket and bolts.

Tighten

- Fan pulley bracket bolts to 45 N.m (33 lb. ft.).
- Air injection pump bracket bolts to 40 N.m (30 lb. ft.).

VALVE LIFTERS

Figure 100

Install or Connect

1. Coat valve lifter rollers with prelube, GM P/N 1052365 or equivalent.

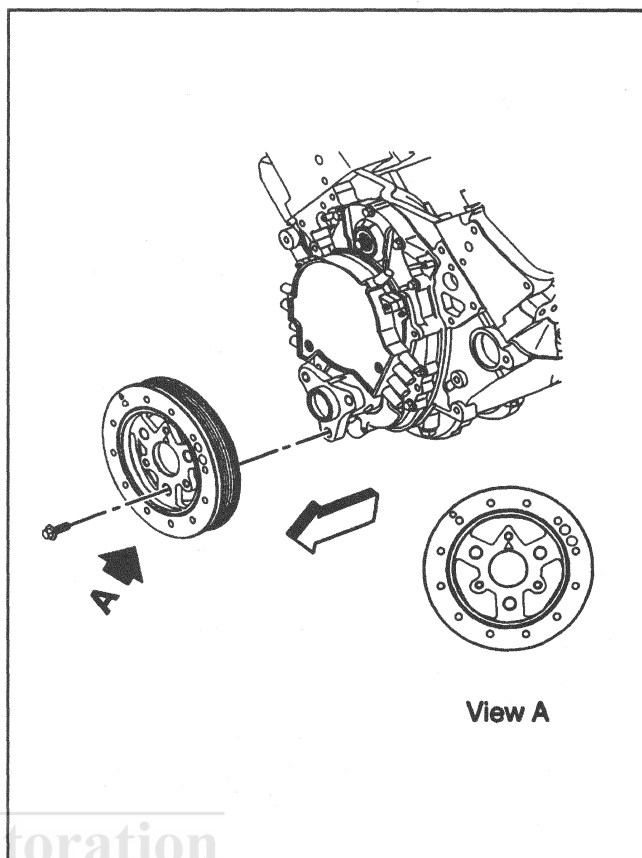


Figure 97 - Crankshaft Balancer and Hub

2. Valve lifters in same location from which they were removed.
3. Valve lifter guides, valve lifter guide retainer, and valve lifter guide retainer bolts.

Tighten

- Valve lifter guide retainer bolts to 25 N.m (18 lb. ft.).

VALVE ROCKER ARMS AND VALVE PUSHRODS

Figures 101 through 104

Tool Required:
J 8520 Cam Lobe Lift Indicator

Install or Connect

1. Coat valve rocker arm and valve rocker arm ball bearing surfaces with prelube, GM P/N 1052365 or equivalent, when installing. Keep these components and valve pushrods in same sequence to ensure their return to the original position from which they were removed.
2. Valve pushrods. Make sure valve pushrods seat in valve lifter sockets.

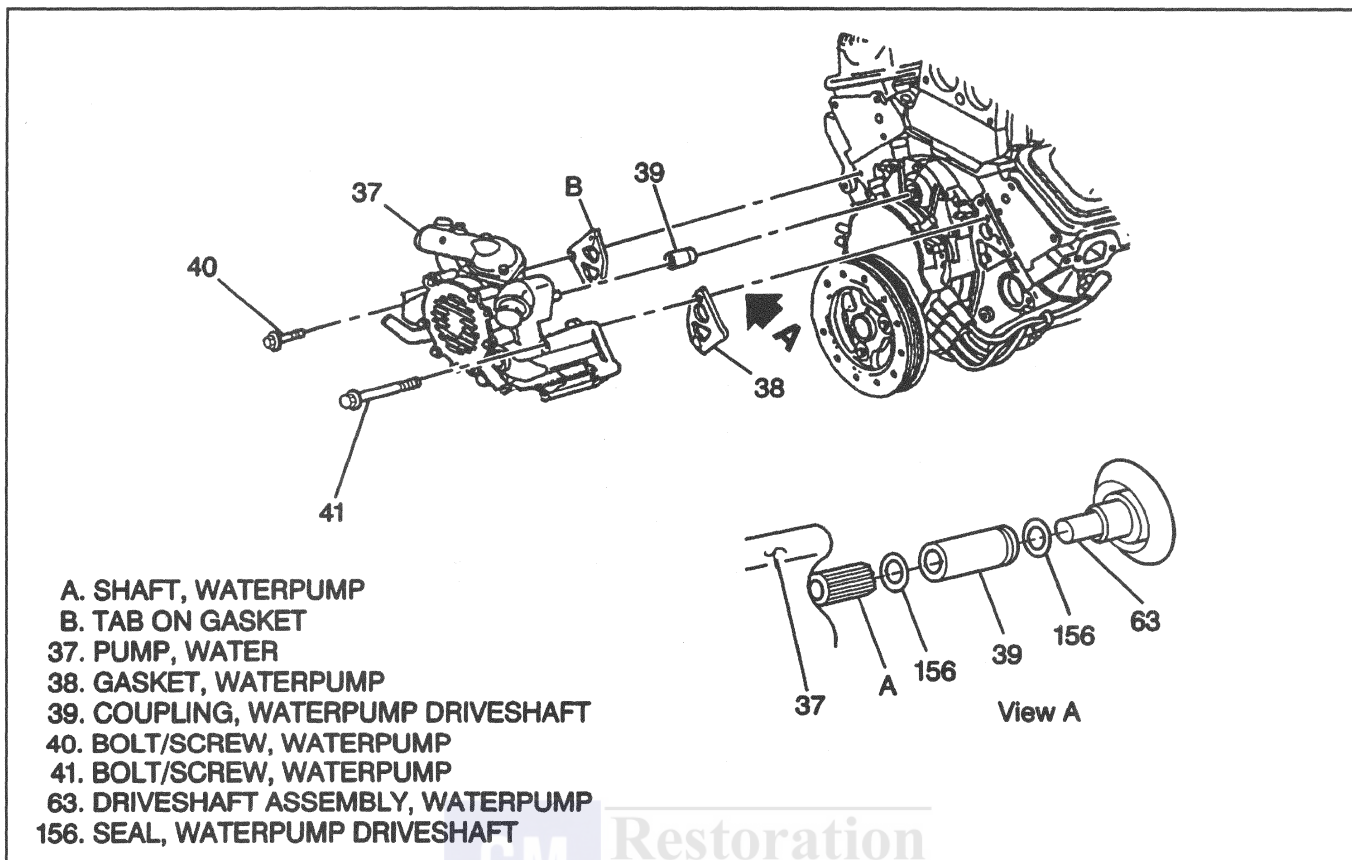


Figure 98 - Water Pump

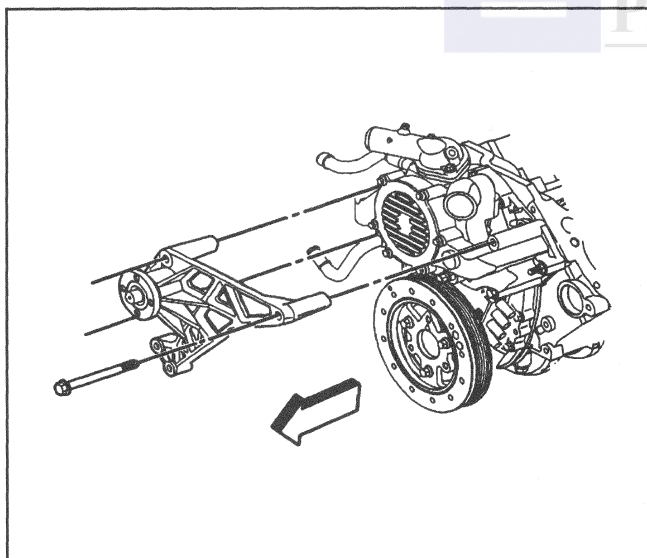


Figure 99 - Mechanical Fan Bracket



Measure

- Camshaft lobe lift.
 - A. Position J 8520 with ball socket adapter on valve pushrod. Make sure valve pushrod is in valve lifter socket.
 - B. Rotate crankshaft slowly in direction of rotation until valve lifter roller is on heel of cam lobe. At this point, valve pushrod will be in its lowest position.

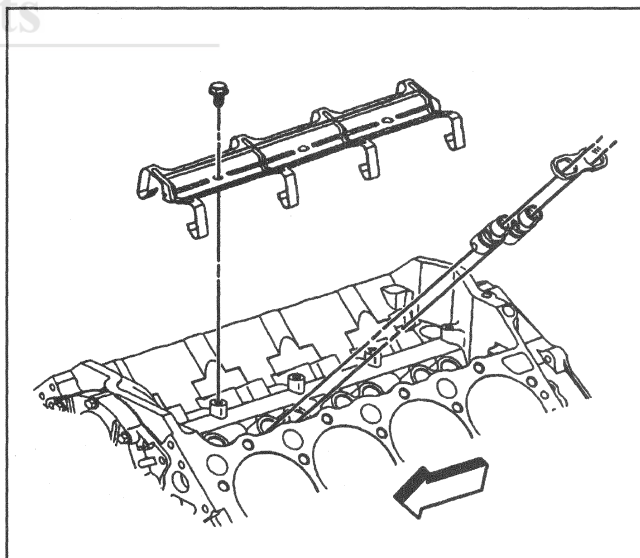


Figure 100 - Valve Lifters, Valve Lifter Guides, and Valve Lifter Retainer

- C. Set J 8520 on zero.
 - D. Rotate crankshaft slowly until valve pushrod is in fully raised position.
 - E. Compare total lift shown on J 8520 with specifications. Refer to "Specifications" in this section.
 - F. Remove J 8520.
3. Valve rocker arms (3).
 4. Valve rocker arm balls (1) and nuts (2).

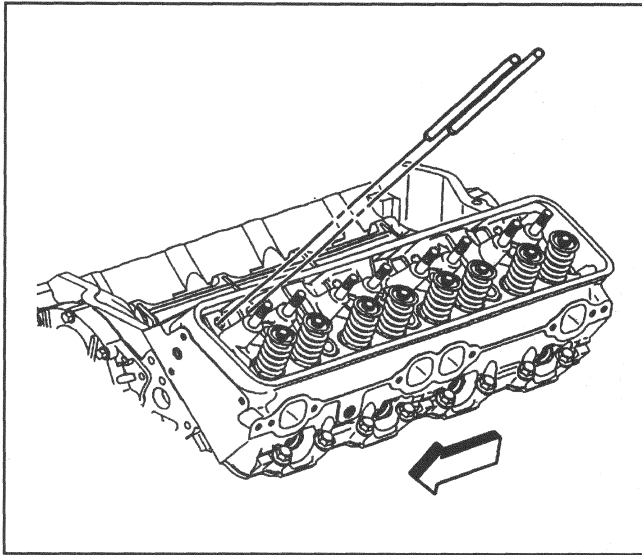


Figure 101 - Valve Pushrods

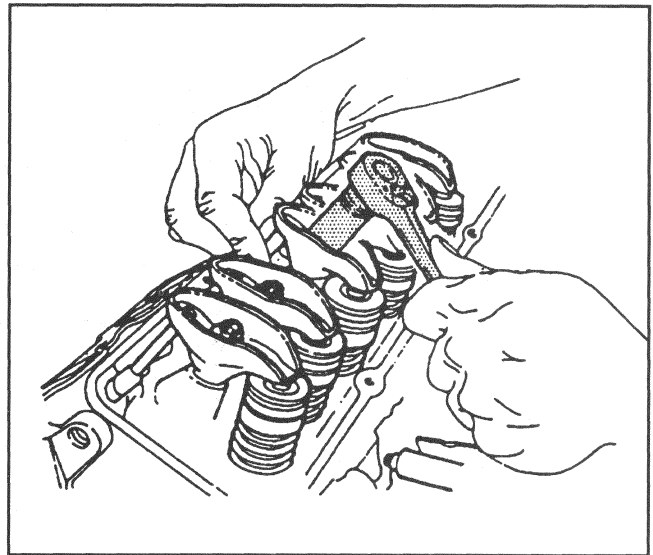


Figure 104 - Adjusting Valve Lash



Adjust

- Valve rocker arm nuts until all lash is eliminated.
 1. Turn crankshaft until cast arrow on crankshaft balancer hub is in 12 o'clock position and number 1 cylinder is in firing position (top dead center).
 - Watch number 1 cylinder valves as crankshaft balancer hub arrow approaches 12 o'clock position. If a valve moves as arrow moves to position, engine assembly is in number 6 cylinder firing position. Crankshaft must then be turned one more time to reach number 1 cylinder firing position.
 2. With engine assembly in number 1 cylinder firing position, following valves can be adjusted:
 - Exhaust 1, 3, 4, 8
 - Intake 1, 2, 5, 7
 3. Back off valve rocker arm nut (2) until lash is felt in valve pushrod (4). Then tighten valve rocker arm nut until all lash is removed. Zero lash can be felt by moving valve pushrod up and down between thumb and forefinger until there is no more movement.
 4. When all free play has been removed, tighten valve rocker arm nut (2) one additional turn (360 degrees).
 5. Turn crankshaft one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. Following valves can now be adjusted:
 - Exhaust 2, 5, 6, 7
 - Intake 3, 4, 6, 8

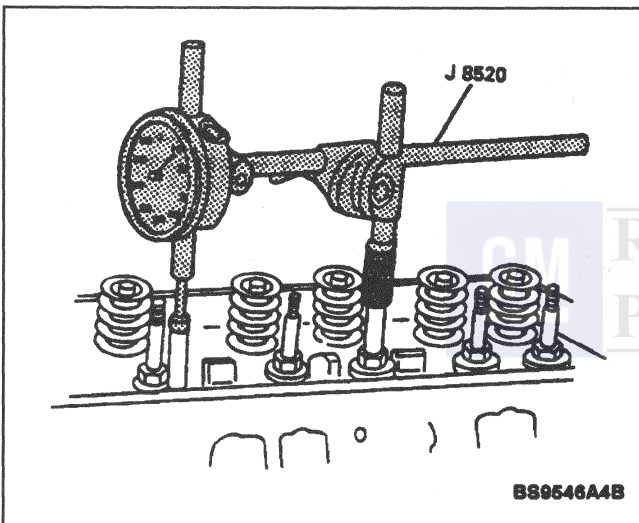
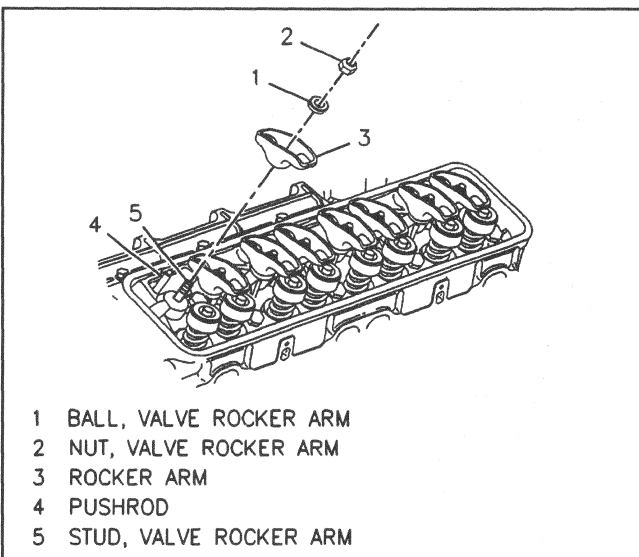


Figure 102 - Measuring Camshaft Lobe Lift



- 1 BALL, VALVE ROCKER ARM
- 2 NUT, VALVE ROCKER ARM
- 3 ROCKER ARM
- 4 PUSHROD
- 5 STUD, VALVE ROCKER ARM

Figure 103 - Valve Rocker Arm, Ball, and Nut

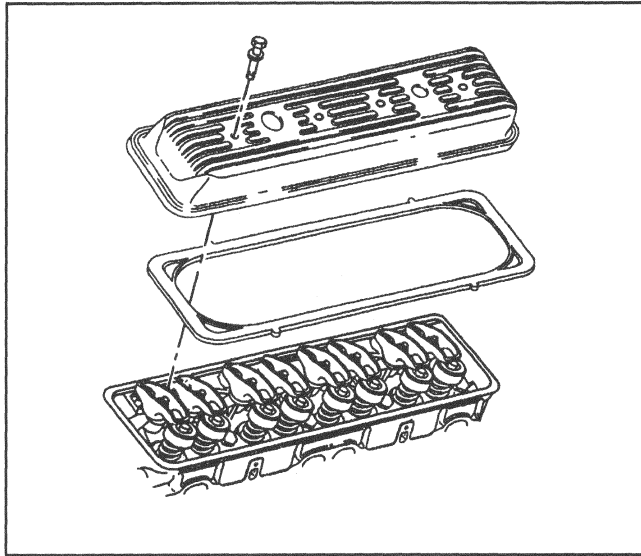


Figure 105 - Valve Rocker Arm Cover

VALVE ROCKER ARM COVERS

Figure 105

Right Valve Rocker Arm Cover



Install or Connect

1. Gasket and valve rocker arm cover.
2. Valve rocker arm cover bolts.



Tighten

- Valve rocker arm cover bolts to 12 N.m (106 lb. in.).
3. Crankcase vent hose.

Left Valve Rocker Arm Cover



Install or Connect

1. Gasket and valve rocker arm cover.
2. Valve rocker arm cover bolts.



Tighten

- Valve rocker arm cover bolts to 12 N.m (106 lb. in.).

INTAKE MANIFOLD

Figures 106 through 110



Install or Connect

1. Apply a 5 mm (0.197 in.) bead of RTV sealer, GM P/N 12346141 or equivalent, to front and rear of engine block. Extend bead 13 mm (0.5 in.) up each cylinder head to seal and retain gaskets.
2. Intake manifold with new gaskets.
3. Intake manifold bolts and studs.

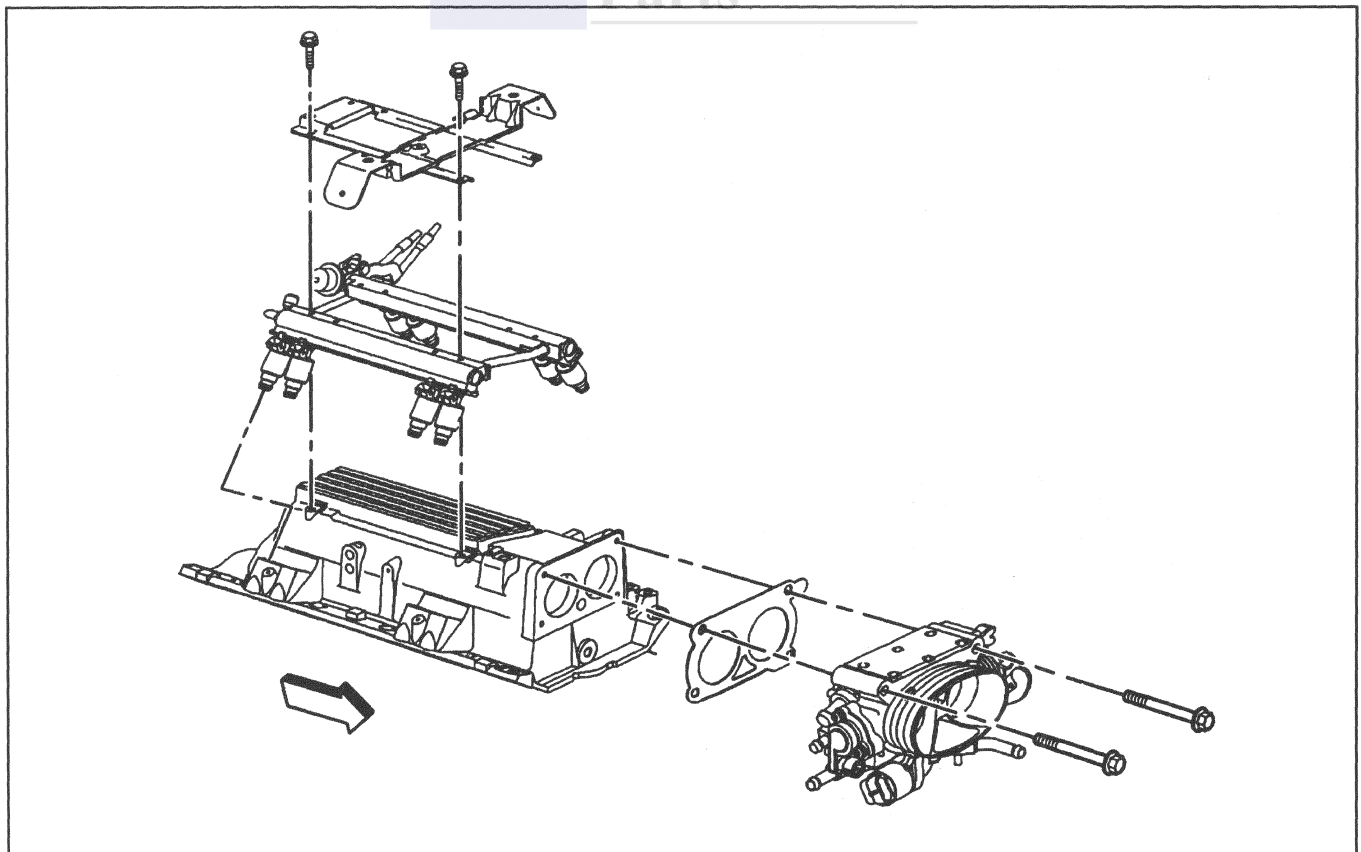


Figure 106 - Intake Manifold, Fuel Rail, Throttle Body, and Air Cleaner Resonator

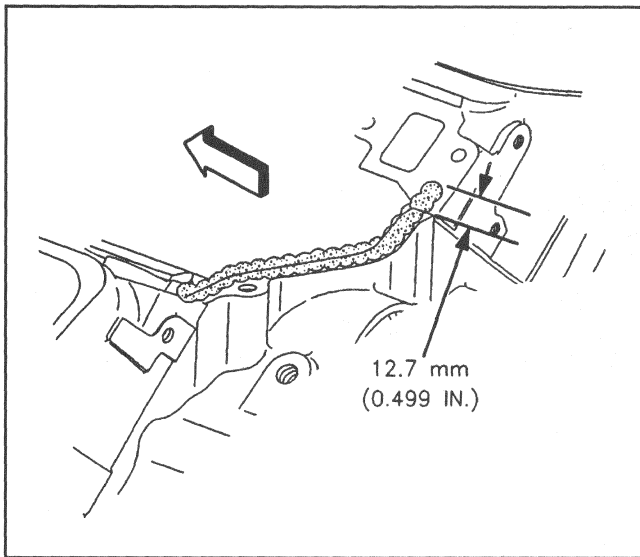


Figure 107 - Applying Sealant to the Rear of Block

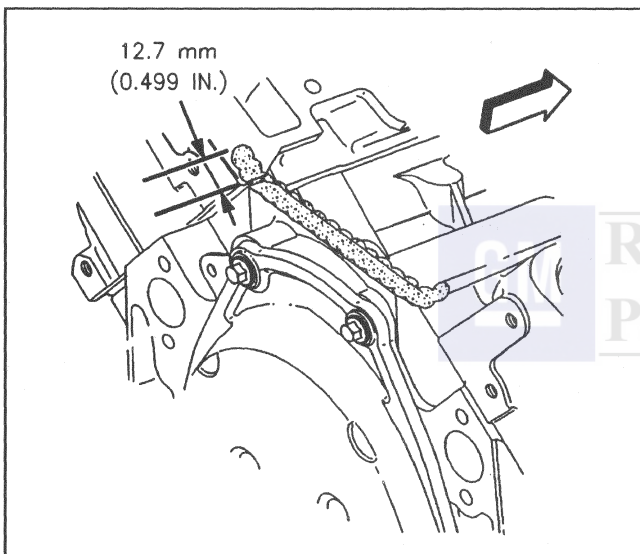


Figure 108 - Applying Sealant to the Front of Block

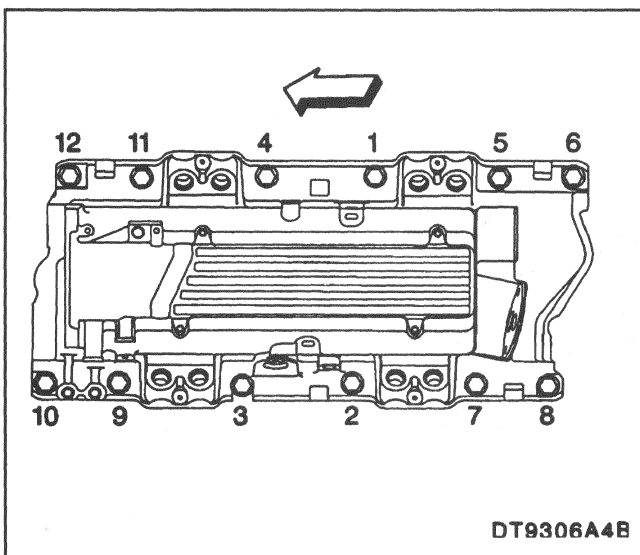


Figure 109 - Intake Manifold Tightening Sequence

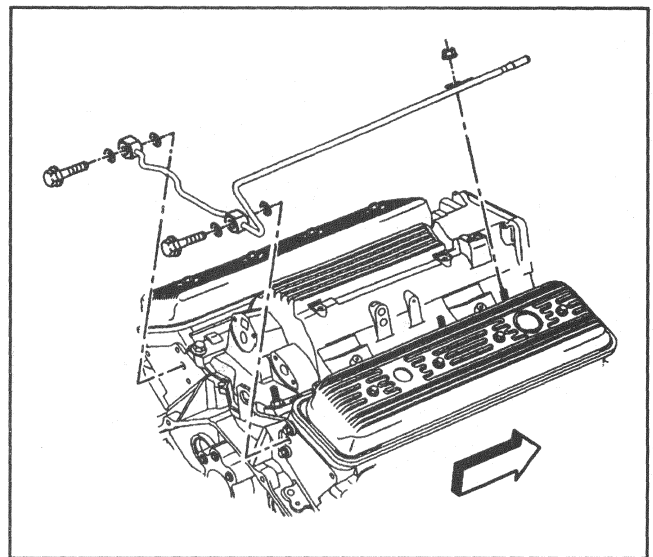


Figure 110 - Engine Coolant Air Bleed Pipe

Tighten

- Intake manifold bolts and studs in a first pass to 8 N.m (71 lb. in.) in sequence. Tighten in sequence in a second pass to final specifications of 48 N.m (35 lb. ft.) (Figure 109).

4. Throttle body, gasket and bolts.

Tighten

- Throttle body bolts to 25 N.m (18 lb. ft.).

5. Accelerator cable bracket and bolts.

6. Engine coolant air bleed pipe and bolts.

Tighten

- Accelerator control cable bracket bolts to 12 N.m (106 lb. in.).

- Engine coolant air bleed pipe bolts to 40 N.m (30 lb. ft.).

— Use a backup wrench when tightening engine coolant air bleed pipe bolts.

7. EGR valve and nuts.

8. EGR vacuum control solenoid, bracket and nut.

Tighten

- EGR valve nuts to 25 N.m (18 lb. ft.).

- EGR control valve relay nut to 25 N.m (18 lb. ft.).

9. Evaporative emission canister purge valve vacuum hose.

10. EGR and distributor vacuum harness and crankcase vent hoses.

11. Generator bracket and bolts.

Tighten

- Generator bracket bolts, in numerical sequence, to 40 N.m (30 lb. ft.).

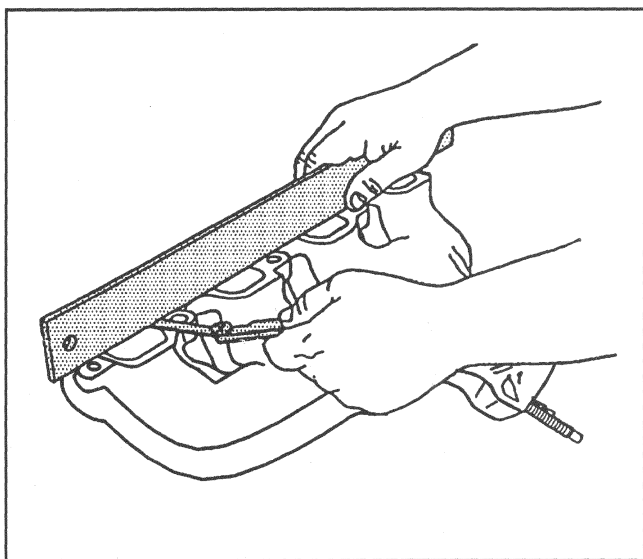


Figure 111 - Checking the Exhaust Manifold for Flatness
12. Fuel injectors with fuel rail onto intake manifold.
13. Fuel pressure regulator vacuum tube.
14. Air cleaner resonator bracket and fuel rail bolts.

Tighten

- Fuel rail bolts to 10 N.m (89 lb. in.).
- 15. Wiring harnesses if moved or disconnected.
- 16. MAP sensor and bolts.

Tighten

- MAP sensor bolts to 6 N.m (53 lb. in.).

EXHAUST MANIFOLDS

Figures 111, 112, and 113

Right Exhaust Manifold

Install or Connect

1. Exhaust manifold gasket (18), exhaust manifold (19), and heat shields.
2. Exhaust manifold studs (20), bolts (21), and spacers (245).

Tighten

- Exhaust manifold studs and bolts to 40 N.m (30 lb. ft.).
- 3. EGR valve pipe bolt (229).

Tighten

- EGR valve pipe bolt (229) to 25 N.m (18 lb. ft.).
- 4. Air injection pipe (15) and check valve (11).

Tighten

- Secondary air injection pipe fitting-to-exhaust manifold to 55 N.m (41 lb. ft.).
- 5. Apply sealer, GM P/N 1052080 or equivalent, around oil level indicator tube 13 mm (0.5 in.) below bead.
- 6. Oil level indicator, tube, and bolt to engine block.

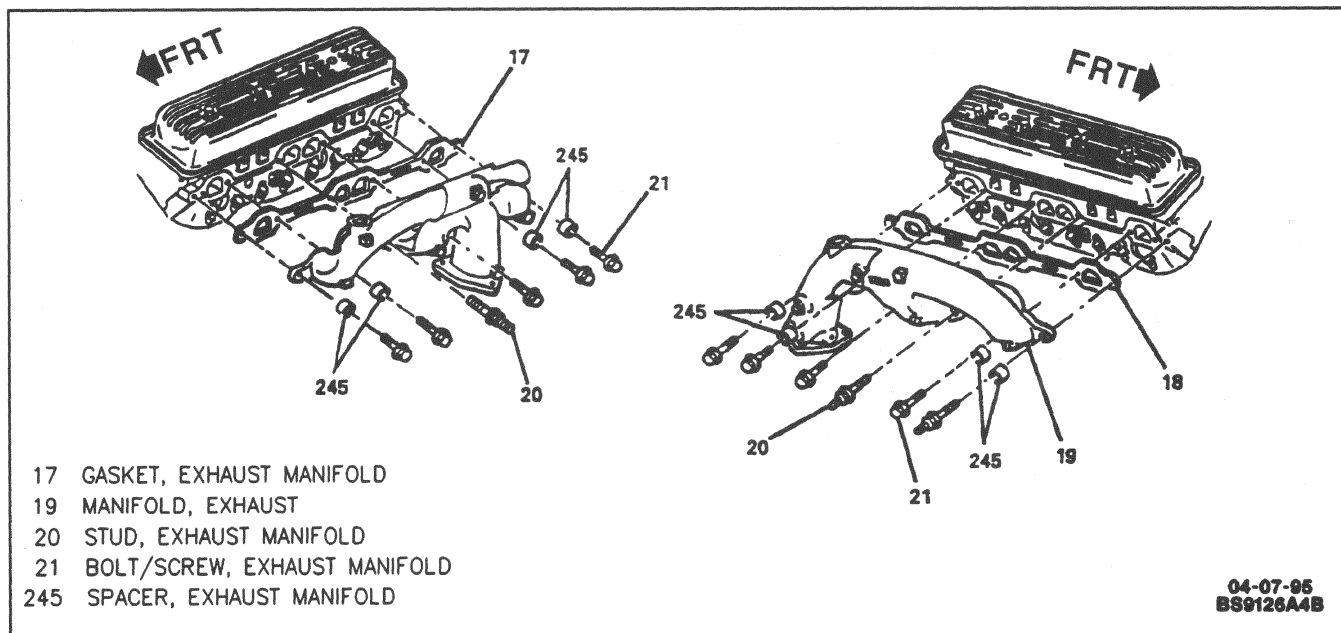


Figure 112 - Exhaust Manifolds

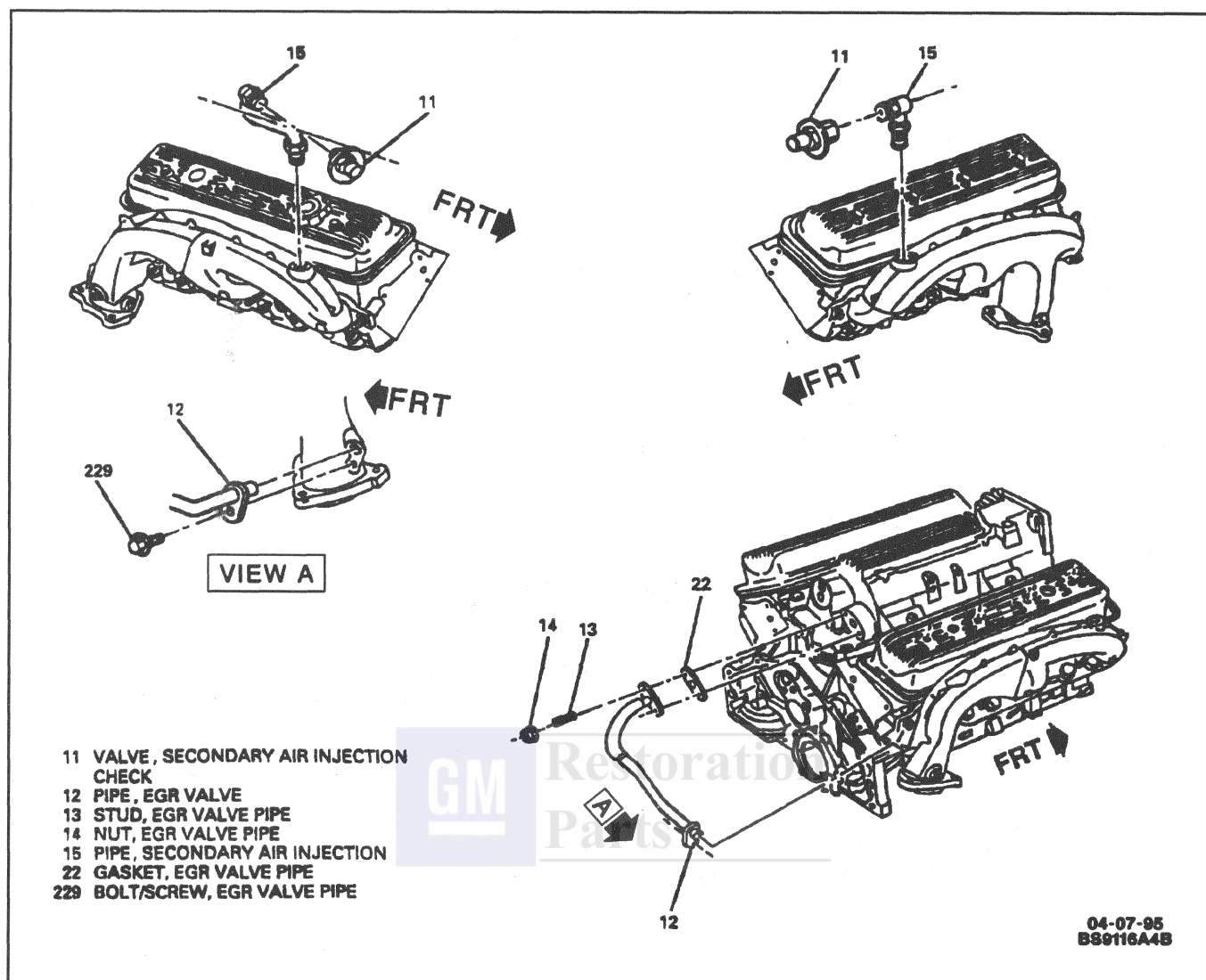


Figure 113 - Secondary AIR Injection and EGR Valve Pipes

**Tighten**

- Oil level indicator tube bolt to 12 N.m (106 lb. in.).

7. Spark plug wire harness.

Left Exhaust Manifold**Install or Connect**

1. Exhaust manifold gasket (17), exhaust manifold, and heat shields.
2. Exhaust manifold bolts (21), studs (20), and spacers (245).

**Tighten**

- Exhaust manifold bolts and studs to 40 N.m (30 lb. ft.).
3. Spark plug wire harness.
 4. Air injection pipe (15) and check valve (11).

**Tighten**

- Secondary air injection pipe fitting-to-exhaust manifold to 55 N.m (41 lb. ft.).

ENGINE FLYWHEEL*Figure 114***Install or Connect**

1. Engine flywheel to crankshaft.
 - Align locator hole to pin.
2. Engine flywheel bolts.

**Tighten**

- Engine flywheel bolts to 100 N.m (74 lb. ft.).

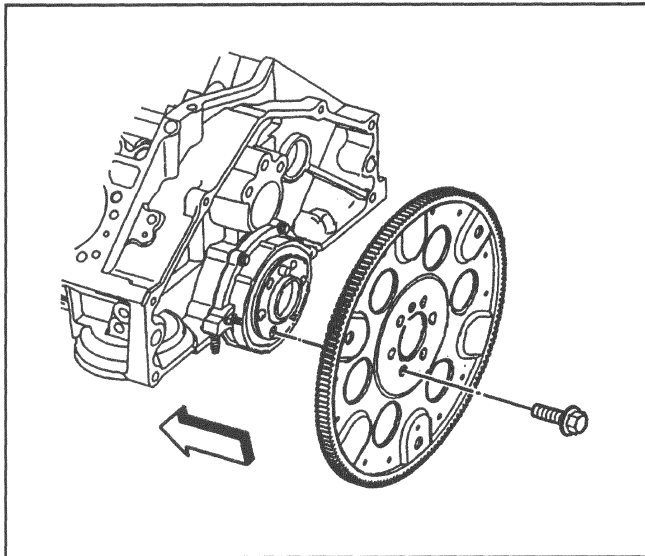


Figure 114 - Engine Flywheel

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS 4.3L/5.7L (L99/LT1)

Accelerator Control Cable Bracket Bolt.....	12 N.m (106 lb. in.)
Camshaft Retainer Bolt.....	12 N.m (106 lb. in.)
Camshaft Sprocket Bolt.....	25 N.m (18 lb. ft.)
Connecting Rod Nut.....	27 N.m (20 lb. ft.) plus an additional 55 degrees
Crankshaft Balancer Bolt.....	85 N.m (63 lb. ft.)
Crankshaft Balancer Hub Bolt.....	100 N.m (74 lb. ft.)
Crankshaft Bearing Cap Bolt and Stud.....	105 N.m (77 lb. ft.)
Crankshaft Position Sensor Bolt.....	12 N.m (106 lb. in.)
Crankshaft Rear Oil Seal Housing Nut and Bolt.....	15 N.m (11 lb. ft.)
Cylinder Head Bolt	
First Pass all Bolt in Sequence.....	30 N.m (22 lb. ft.)
Second Pass all Bolt in Sequence:	
Short Bolt.....	55 additional degrees
Medium Bolt.....	65 additional degrees
Long Bolt.....	75 additional degrees
Distributor Bolt.....	12 N.m (106 lb. in.)
EGR Vacuum Control Solenoid Nut.....	25 N.m (18 lb. ft.)
EGR Valve Nut.....	25 N.m (18 lb. ft.)
EGR Valve Pipe Bolt and Nut.....	25 N.m (18 lb. ft.)
Engine Block Coolant Drain Plug.....	20 N.m (15 lb. ft.)
Engine Block Oil Gallery Plug.....	20 N.m (15 lb. ft.)
Engine Coolant Air Bleed Pipe Bolt.....	40 N.m (30 lb. ft.)
Engine Front Cover Bolt.....	12 N.m (106 lb. in.)
Engine Oil Level Sensor.....	35 N.m (26 lb. ft.)
Exhaust Manifold Stud and Bolt.....	40 N.m (30 lb. ft.)
Fan Pulley Bracket Bolt.....	45 N.m (33 lb. ft.)
Engine Flywheel Bolt.....	100 N.m (74 lb. ft.)
Fuel Injection Fuel Rail Bolt.....	10 N.m (89 lb. in.)
Fuel Pump/Oil Pressure Switch.....	12 N.m (106 lb. in.)
Generator Bracket Bolt.....	40 N.m (30 lb. ft.)
Ignition Coil Studs.....	40 N.m (30 lb. ft.)
Intake Manifold Bolt and Stud	
First Pass.....	8 N.m (71 lb. in.)
Final Pass.....	48 N.m (35 lb. ft.)
Knock Sensor.....	20 N.m (15 lb. ft.)
MAP Sensor Bolt.....	6 N.m (53 lb. in.)
Oil Filter Adapter Bolt.....	25 N.m (18 lb. ft.)

4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P 6A4B-53

Oil Level Indicator Tube Bolt	12 N.m (106 lb. in.)
Oil Pan	
Corner Bolt and Nut or Stud	20 N.m (15 lb. ft.)
Side Rail Bolt or Stud	12 N.m (106 lb. in.)
Crankshaft Oil Deflector Nut	40 N.m (30 lb. ft.)
Oil Pan Drain Plug	20 N.m (15 lb. ft.)
Oil Pump Bolt-to-Rear Crankshaft Bearing Cap	90 N.m (66 lb. ft.)
Oil Pump Cover Bolt	9 N.m (80 lb. in.)
Oil Pump Driveshaft Bolt	18 N.m (13 lb. ft.)
Secondary Air Injection Pipe Fitting-to-Exhaust Manifold	55 N.m (41 lb. ft.)
Secondary Air Injection Pump Bracket Bolt	40 N.m (30 lb. ft.)
Spark Plugs	
Spark Plugs (cylinder head - new)	30 N.m (22 lb. ft.)
Spark Plugs (cylinder head - all subsequent installations)	20 N.m (15 lb. ft.)
Starter Motor Bolt	47 N.m (35 lb. ft.)
Throttle Body Bolt	25 N.m (18 lb. ft.)
Valve Lifter Guide Retainer Bolt	25 N.m (18 lb. ft.)
Valve Rocker Arm Cover Bolt	12 N.m (106 lb. in.)
Water Pump Bolt and Stud	45 N.m (33 lb. ft.)
Water Pump Driveshaft Bearing Retainer Bolt	12 N.m (106 lb. in.)

ENGINE ASSEMBLY SPECIFICATIONS - 4.3L (L99)

GENERAL

Type	V8
Displacement	4.3L (265 CID)
Bore	94.89 mm (3.736 in.)
Stroke	76.20 mm (3.000 in.)
Compression Ratio	9.93:1
Firing Order	1-8-4-3-6-5-7-2
Spark Plugs	
Type	AC41-943
Gap	1.24 mm (0.050)
Torque	
Spark Plugs (cylinder head - new)	30 N.m (22 lb. ft.)
Spark Plugs (cylinder head - all subsequent installations)	20 N.m (15 lb. ft.)
Oil Pressure (Minimum)	41.4 kPa (6.0 psig) at 1,000 engine rpm 124.1 kPa (18.0 psig) at 2,000 engine rpm 165.5 kPa (24.0 psig) at 4,000 engine rpm
Oil Filter Torque	21 N.m (15 lb. ft.)

CYLINDER BORE

Diameter	94.881 - 94.957 mm (3.7355 - 3.7385 in.)
Out-of-Round	
Production	0.02 mm (0.001 in.) MAX.
Service Limit	0.05 mm (0.002 in.) MAX.
Taper	
Production	
Thrust Side	0.012 mm (0.0005 in.) MAX.
Relief Side	0.025 mm (0.0010 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

PISTON

Piston Bore Clearance	
Production	0.025 - 0.068 mm (0.0010 - 0.0027 in.)
Service Limit	0.068 mm (0.0027 in.) MAX.

PISTON RINGS

Piston Compression Ring	
Groove Clearance	
Production Top	0.030 - 0.073 mm (0.0012 - 0.0029 in.)
Production 2nd	0.030 - 0.073 mm (0.0012 - 0.0029 in.)
Service Limit	0.107 mm (0.0042 in.) MAX.

6A4B-54 4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P

Gap	
Production Upper	0.25 - 0.40 mm (0.010 - 0.016 in.)
Production Lower	0.46 - 0.66 mm (0.018 - 0.026 in.)
Service Limit	0.88 mm (0.035 in.) MAX.

Piston Oil Ring

Groove Clearance	
Production	0.051 - 0.17 mm (0.002 - 0.007 in.)
Service Limit	0.20 mm (0.008 in.) MAX.

Gap	
Production	0.25 - 0.76 mm (0.010 - 0.030 in.)
Service Limit	1.65 mm (0.065 in.) MAX.

PISTON PIN

Diameter	23.545 - 23.548 mm (0.9270 - 0.9271 in.)
Clearance in Piston	
Production	0.0102 - 0.0203 mm (0.0004 - 0.0008 in.)
Service Limit	0.025 mm (0.0010 in.) MAX.
Fit In Connecting Rod	0.021 - 0.040 mm (0.0008 - 0.0016 in.) Interference

CRANKSHAFT

Crankshaft Journal

Diameter #1	62.191 - 62.207 mm (2.4485 - 2.4491 in.)
Diameter #2, #3, #4	62.191 - 62.207 mm (2.4485 - 2.4491 in.)
Diameter #5	62.191 - 62.207 mm (2.4485 - 2.4491 in.)

Taper

Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Out-of-Round

Production	0.005 mm (0.0002 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Crankshaft Bearing Clearance

Production #1	0.022 - 0.051 mm (0.0009 - 0.0020 in.)
Production #2, #3, #4	0.022 - 0.051 mm (0.0009 - 0.0020 in.)
Production #5	0.025 - 0.053 mm (0.0010 - 0.0021 in.)
Service Limit #1	0.025 - 0.051 mm (0.0010 - 0.0020 in.)
Service Limit #2, #3, #4	0.025 - 0.064 mm (0.0010 - 0.0025 in.)
Service Limit #5	0.038 - 0.076 mm (0.0015 - 0.0030 in.)

Crankshaft End Play	0.05 - 0.20 mm (0.002 - 0.008 in.)
---------------------------	------------------------------------

Crankshaft Runout (At Rear Flange)	0.038 mm (0.0015 in.)
--	-----------------------

CONNECTING ROD

Connecting Rod Journal

Diameter	53.284 - 53.334 mm (2.0978 - 2.0998 in.)
----------------	--

Taper

Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Out-of-Round

Production	0.007 mm (0.0003 in.) MAX.
Service Limit	0.025 mm (0.0010 in.) MAX.

Rod Bearing Clearance

Production	0.033 - 0.088 mm (0.0013 - 0.0035 in.)
Service Limit	0.025 - 0.076 mm (0.0010 - 0.0030 in.)

Rod Side Clearance	0.16 - 0.35 mm (0.006 - 0.014 in.)
--------------------------	------------------------------------

CAMSHAFT

Journal Diameter	47.440 - 47.490 mm (1.8677 - 1.8697 in.)
------------------------	--

End Play	0.11 - 0.30 mm (0.004 - 0.012 in.)
----------------	------------------------------------

Lobe Lift	± 0.050 mm (0.002 in.)
-----------------	------------------------

Intake	7.02 mm (0.276 in.)
--------------	---------------------

Exhaust	7.25 mm (0.285 in.)
---------------	---------------------

VALVE SYSTEM

Valve Lifter	Hydraulic
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Valve Rocker Arm Ratio	1.50:1
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Valve Lash	1 ± 1/4 turn down from zero lash
------------------	----------------------------------

4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P 6A4B-55

Face Angle.....	45 degrees
Seat Angle.....	46 degrees
Seat Runout.....	0.05 mm (0.002 in.) MAX.
Seat Width	
Intake.....	0.76 - 1.27 mm (0.030 - 0.050 in.)
Exhaust.....	1.52 - 2.03 mm (0.060 - 0.080 in.)
Stem Clearance	
Production	
Intake.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Exhaust.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Service	
Intake.....	0.093 mm (0.0037 in.) MAX.
Exhaust.....	0.119 mm (0.0047 in.) MAX.
Valve Spring	
Free Length.....	51.3 mm (2.02 in.)
Pressure	
Closed.....	338 - 374 N at 43.2 mm (76 - 84 lb. at 1.70 in.)
Open.....	832 - 903 N at 32.3 mm (187 - 203 lb. at 1.27 in.)
Installed Height	
Intake.....	44.2 mm (1.74 in.)
Exhaust.....	44.2 mm (1.74 in.)
Valve Lift	
Intake.....	10.52 mm (0.414 in.)
Exhaust.....	10.87 mm (0.428 in.)

ENGINE ASSEMBLY SPECIFICATIONS - 5.7L (LT1)

GENERAL

Type.....	V8
Displacement.....	5.7L (350 CID)
Bore.....	101.60 mm (4.000 in.)
Stroke.....	88.39 mm (3.480 in.)
Compression Ratio.....	10.4:1
Firing Order.....	1-8-4-3-6-5-7-2
Spark Plugs	
Type.....	AC41-943
Gap.....	1.24 mm (0.050)
Torque	
Spark Plugs (cylinder head - new).....	30 N.m (22 lb. ft.)
Spark Plugs (cylinder head - all subsequent installations).....	20 N.m (15 lb. ft.)
Oil Pressure (Minimum).....	41.4 kPa (6.0 psig) at 1,000 engine rpm 124.1 kPa (18.0 psig) at 2,000 engine rpm 165.5 kPa (24.0 psig) at 4,000 engine rpm
Oil Filter Torque.....	21 N.m (15 lb. ft.)

CYLINDER BORE

Diameter.....	101.618 - 101.643 mm (4.0007 - 4.0017 in.)
Out-of-Round	
Production.....	0.02 mm (0.001 in.) MAX.
Service Limit.....	0.05 mm (0.002 in.) MAX.
Taper	
Production	
Thrust Side.....	0.012 mm (0.0005 in.) MAX.
Relief Side.....	0.025 mm (0.0010 in.) MAX.
Service Limit.....	0.025 mm (0.0010 in.) MAX.

PISTON

Piston Bore Clearance	
Production.....	0.025 - 0.068 mm (0.0010 - 0.0027 in.)
Service Limit.....	0.068 mm (0.0027 in.) MAX.

PISTON RINGS

Piston Compression Ring

Groove Clearance

Production Top.....	0.050 - 0.090 mm (0.0019 - 0.0035 in.)
Production 2nd.....	0.050 - 0.090 mm (0.0019 - 0.0035 in.)
Service Limit.....	0.107 mm (0.0042 in.) MAX.

Gap

Production Upper.....	0.25 - 0.40 mm (0.010 - 0.016 in.)
Production Lower.....	0.46 - 0.66 mm (0.018 - 0.026 in.) MAX.
Service Limit.....	0.88 mm (0.035 in.) MAX.

Piston Oil Ring

Groove Clearance

Production.....	0.051 - 0.17 mm (0.002 - 0.007 in.)
Service Limit.....	0.20 mm (0.008 in.) MAX.

Gap

Production.....	0.25 - 0.76 mm (0.010 - 0.030 in.)
Service Limit.....	1.65 mm (0.065 in.) MAX.

PISTON PIN

Diameter..... 23.545 - 23.548 mm (0.9270 - 0.9271 in.)

Clearance in Piston

Production.....	0.0120 - 0.0210 mm (0.0004 - 0.0008 in.)
Service Limit.....	0.025 mm (0.0010 in.) MAX.

Fit In Connecting Rod.....0.021 - 0.040 mm (0.0008 - 0.0016 in.) Interference

CRANKSHAFT

Crankshaft Journal

Diameter #1.....	62.189 - 62.212 mm (2.4484 - 2.4493 in.)
Diameter #2, #3, #4.....	62.182 - 62.205 mm (2.4481 - 2.4490 in.)
Diameter #5.....	62.177 - 62.199 mm (2.4479 - 2.4488 in.)
Taper Production.....	0.005 mm (0.0002 in.) MAX.

Out-of-Round

Production.....	0.005 mm (0.0002 in.) MAX.
Service Limit.....	0.025 mm (0.0010 in.) MAX.

Crankshaft Bearing Clearance

Production #1.....	0.017 - 0.053 mm (0.0007 - 0.0021 in.)
Production #2, #3, #4.....	0.022 - 0.061 mm (0.0009 - 0.0024 in.)
Production #5.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Service Limit #1.....	0.025 - 0.051 mm (0.0010 - 0.0020 in.)
Service Limit #2, #3, #4.....	0.025 - 0.064 mm (0.0010 - 0.0025 in.)
Service Limit #5.....	0.038 - 0.076 mm (0.0015 - 0.0030 in.)

Crankshaft End Play..... 0.05 - 0.20 mm (0.002 - 0.008 in.)

Crankshaft Runout (At Rear Flange).....0.038 mm (0.0015 in.)

CONNECTING ROD

Connecting Rod Journal

Diameter.....	53.284 - 53.334 mm (2.0978 - 2.0998 in.)
Taper.....	0.007 mm (0.0003 in.) MAX.

Production.....	0.007 mm (0.0003 in.) MAX.
Service Limit.....	0.025 mm (0.0010 in.) MAX.

Out-of-Round

Production.....	0.007 mm (0.0003 in.) MAX.
Service Limit.....	0.025 mm (0.0010 in.) MAX.

Rod Bearing Clearance

Production.....	0.033 - 0.088 mm (0.0013 - 0.0035 in.)
Service Limit.....	0.025 - 0.076 mm (0.0010 - 0.0030 in.)

Rod Side Clearance..... 0.16 - 0.35 mm (0.006 - 0.014 in.)

CAMSHAFT

Journal Diameter..... 47.440 - 47.490 mm (1.8677 - 1.8697 in.)

End Play..... 0.11 - 0.30 mm (0.004 - 0.012 in.)

Lobe Lift.....0.050 mm (0.002 in.)

Intake.....7.02 mm (0.276 in.)

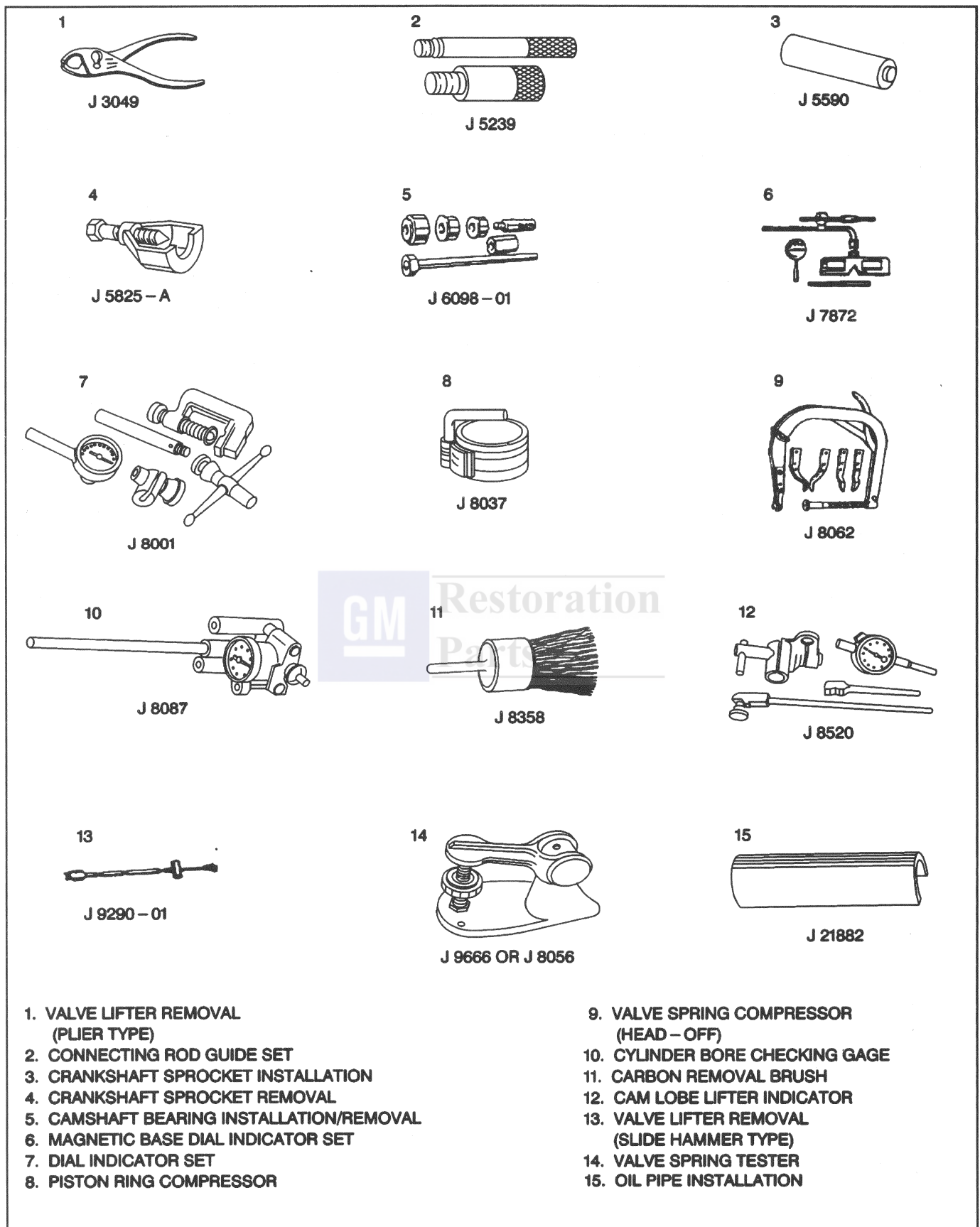
Exhaust.....7.25 mm (0.285 in.)

VALVE SYSTEM

Valve Lifter	Hydraulic
Valve Rocker Arm Ratio.....	1.50:1
Valve Lash	1 ± 1/4 turn down from zero lash
Face Angle.....	45 degrees
Seat Angle.....	46 degrees
Seat Runout.....	0.05 mm (0.002 in.) MAX.
Seat Width	
Intake.....	0.76 - 1.27 mm (0.030 - 0.050 in.)
Exhaust.....	1.52 - 2.03 mm (0.060 - 0.080 in.)
Stem Clearance	
Production	
Intake.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Exhaust.....	0.025 - 0.069 mm (0.0010 - 0.0027 in.)
Service	
Intake.....	0.093 mm (0.0037 in.) MAX.
Exhaust.....	0.119 mm (0.0047 in.) MAX.
Valve Spring	
Free Length.....	51.3 mm (2.02 in.)
Pressure	
Closed.....	338 - 374 N at 43.2 mm (76 - 84 lb. at 1.70 in.)
Open	832 - 903 N at 32.3 mm (187 - 203 lb. at 1.27 in.)
Installed Height	
Intake.....	44.2 mm (1.74 in.)
Exhaust.....	44.2 mm (1.74 in.)
Valve Lift	
Intake.....	10.52 mm (0.414 in.)
Exhaust.....	10.87 mm (0.428 in.)



6A4B-58 4.3L 5.7L ENGINE UNIT REPAIR VIN CODES W AND P



1. VALVE LIFTER REMOVAL
(PLIER TYPE)

2. CONNECTING ROD GUIDE SET

3. CRANKSHAFT SPROCKET INSTALLATION

4. CRANKSHAFT SPROCKET REMOVAL

5. CAMSHAFT BEARING INSTALLATION/REMOVAL

6. MAGNETIC BASE DIAL INDICATOR SET

7. DIAL INDICATOR SET

8. PISTON RING COMPRESSOR

9. VALVE SPRING COMPRESSOR
(HEAD - OFF)

10. CYLINDER BORE CHECKING GAGE

11. CARBON REMOVAL BRUSH

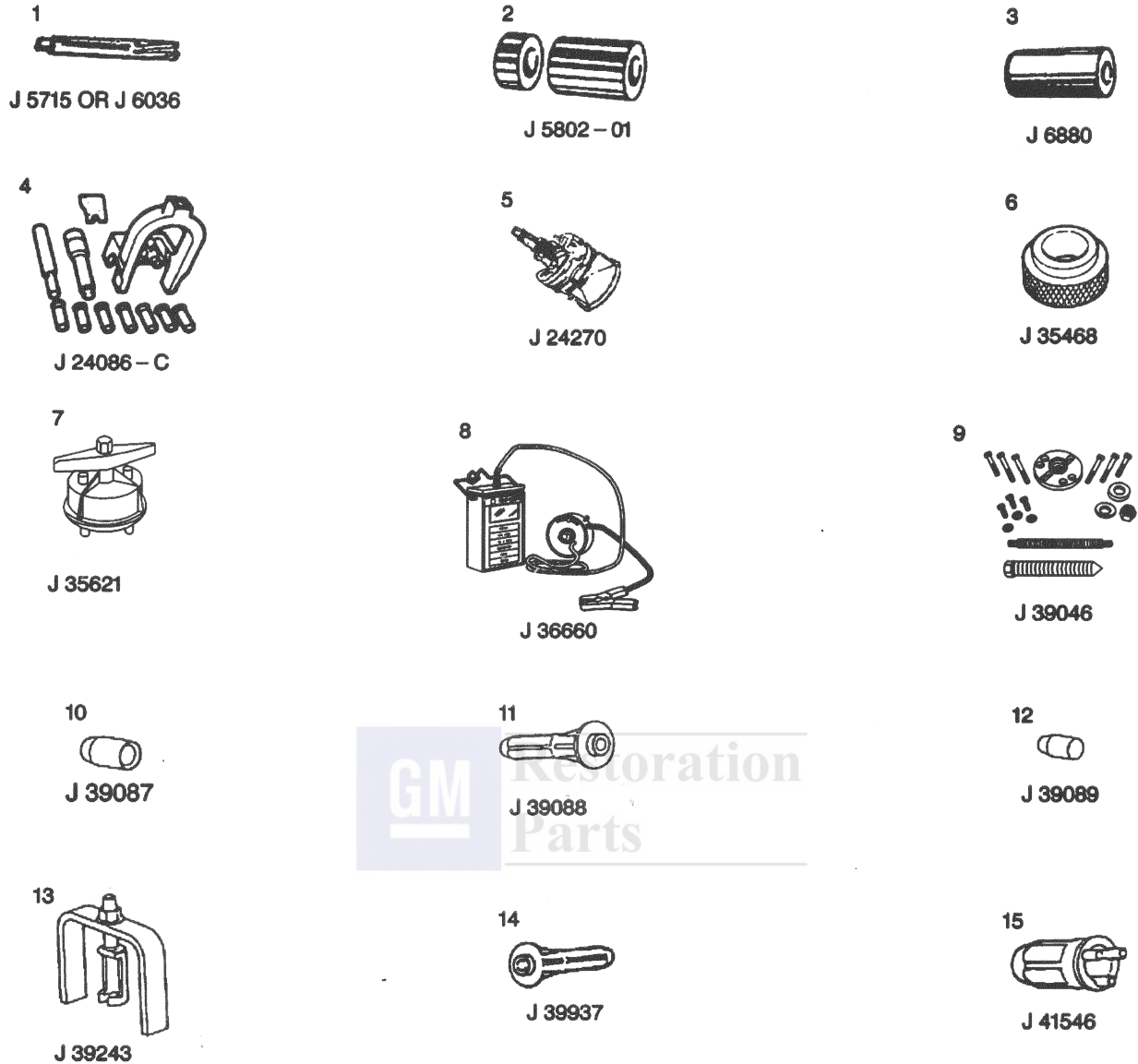
12. CAM LOBE LIFTER INDICATOR

13. VALVE LIFTER REMOVAL
(SLIDE HAMMER TYPE)

14. VALVE SPRING TESTER

15. OIL PIPE INSTALLATION

Figure 115 - Special Tools (1 of 2)



1. ROCKER STUD REAMER (0.003 IN. OVERSIZE 0.013 IN. OVERSIZE) (IRON CYLINDER HEAD)
2. ROCKER STUD REMOVAL (IRON CYLINDER HEAD)
3. ROCKER STUD INSTALLATION (IRON CYLINDER HEAD)
4. PISTON PIN REMOVAL/INSTALLATION
5. RIDGE REAMER
6. ENGINE FRONT COVER ALIGNMENT
7. CRANKSHAFT REAR OIL SEAL INSTALLATION
8. TORQUE ANGLE METER
9. CRANKSHAFT HUB REMOVAL/INSTALLATION
10. WATER PUMP DRIVESHAFT ASSEMBLY ENGINE FRONT COVER OIL SEAL PROTECTOR (L99/LT1/LT4)
11. WATER PUMP DRIVESHAFT ASSEMBLY ENGINE FRONT COVER OIL SEAL INSTALLATION (L99/LT1/LT4)
12. WATER PUMP DRIVESHAFT ASSEMBLY ENGINE FRONT COVER OIL SEAL INSTALLATION (L99/LT1/LT4)
13. WATER PUMP DRIVESHAFT ASSEMBLY REMOVAL (L99/LT1/LT4)
14. ENGINE FRONT COVER DISTRIBUTOR OIL SEAL INSTALLATION (L99/LT1/LT4)
15. WATER PUMP DRIVESHAFT ASSEMBLY INSTALLATION (L99/LT1/LT4)

Figure 116 - Special Tools (2 of 2)



SECTION 6B

COOLING AND RADIATOR

NOTICE: When adding coolant, it is important that you use GM DEX-COOL™ (orange-colored, silicate free) coolant meeting GM Specification 6277M. If silicated coolant is added to the system, premature engine, heater core, or radiator corrosion may result. In addition, the engine coolant will require change sooner - at 50,000 km (30,000 miles) or 24 months.

NOTICE: Antifreeze can be added to raise the boiling point of the coolant, but too much will affect the freezing point. Do not use a solution stronger than 70 percent antifreeze, as the freeze level rises rapidly after this point. Pure antifreeze will freeze at -22°C (-8°F).

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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6B-2 COOLING AND RADIATOR

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GENERAL DESCRIPTION

The cooling system is available in three versions. The base version consists of an aluminum core with plastic end tanks, a pressurized coolant recovery reservoir, a gear-driven engine water pump, thermostat, and two electric motor-driven fans. The right-hand end tank of the radiator contains a transmission oil cooler. The extra-capacity cooling system version (RPO VO3) has the same components except that the left-hand electric motor-driven fan has a larger size motor and the left-hand end tank of the radiator is larger to allow for an engine oil cooler provided within that end tank. The heavy-duty cooling system version (RPO VO8) has the same components as the extra-capacity cooling system except that the right-hand electric motor-driven cooling fan is replaced by a belt-driven fluid clutch controlled fan. The coolant hoses connecting the engine to the radiator on the heavy duty cooling system have metal sections for protection from the belt-driven fan blades.

Engine coolant is drawn from the suction side of the radiator through the thermostat (when open) by the water pump and circulated through internal passages in the cylinder heads and engine block. The heated coolant is then directed back to the radiator. A separate coolant flow loop is available from the water pump through hoses to the heater core and back to the water pump to provide passenger compartment heat and defrost.

The cooling system uses a pressurized coolant recovery reservoir to ensure the radiator hoses and engine coolant passages are kept completely full at all normal operating temperatures. Coolant is added to the system only at the coolant recovery reservoir, when the system is cool.

ENGINE COOLANT

This vehicle has a newly developed engine coolant. GM Goodwrench DEX-COOL™ was developed to last for 166,000 km (100,000 miles) or 5 years whichever occurs first. Follow the instructions in "Draining and Refilling Cooling System" in this section. Make sure only GM Goodwrench DEX-COOL™ (orange-colored, silicate free) is used when coolant is added or changed.

A 50/50 mixture of ethylene glycol (DEX-COOL™) and water is recommended and will provide this protection:

- Give freezing protection down to -37°C (-34°F).
- Give boiling protection up to 129°C (265°F).
- Protect against rust and corrosion.
- Help maintain the proper engine temperature.
- Allow the warning lights and gauges work to work properly.

RADIATOR

Cross-Flow Radiator Core and End Tanks

A cross-flow aluminum radiator core is used. Plastic end tanks with gaskets are secured to the core with metal clinch tabs along both core headers on the front and rear sides of the radiator. The coolant flow through the radiator is from left to right with the radiator inlet near the top of the left end tank and the radiator outlet near the bottom of the right end tank.

Transmission Oil Cooler

An oil-to-coolant transmission oil cooler is located in the right radiator end tank on all vehicles. This is an integral part of the radiator and should not be serviced separately. An additional oil-to-air transmission oil cooler is also used on all vehicles. The air-to-oil cooler is located in front and to the right of the radiator. This oil cooler is replaceable. For information on servicing the air-to-oil transmission oil cooler refer to SECTION 7A.

Engine Oil Cooler

An optional engine oil cooler is located in the left (inlet) end tank of the radiator. Engine oil cooler pipes connect the radiator to the engine block through an adapter, located between the oil filter and engine block. This system circulates the engine oil through the radiator at all times.

Coolant Drain Valve

The coolant drain valve is located at the bottom of the left end tank, facing rearward. The valve is accessible from under the vehicle.

COOLANT RECOVERY RESERVOIR FILLER CAP

A plastic pressure-vent cap is used with the coolant recovery reservoir to allow a build up of 103 kPa (15 psi) in the cooling system. This pressure raises the boiling point of engine coolant to approximately 125° C (257° F) at sea level.

CAUTION: Add coolant to the coolant recovery reservoir only when the system cools.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution. Removal of the cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. Under some conditions such as contact with hot engine parts, ethylene glycol coolant can be flammable.

The pressure-type cap contains a blow-off (pressure) valve and a vacuum (atmospheric) valve. The pressure valve is held against its seat by a heavy spring. This spring protects the cooling system by relieving pressure exceeding 103 kPa (15 psi).

To prevent the radiator, coolant recovery reservoir or hoses from collapsing caused by vacuum as the engine cools, the vacuum valve opens as the cooling system pressure drops below atmospheric pressure. As the valve opens, air is drawn into the coolant recovery reservoir equalizing the system pressure with the atmosphere.

To safely remove the cap from a cool system, rotate the cap slowly counterclockwise 1/4 turn and then stop. Allow any pressure to relieve. After all hissing stops, continue to rotate counterclockwise until the cap is removed. There is no specific orientation of the lettering on the cap versus the cap being tight. To re-tighten cap, use approximately 5 N·m (44 lb. in.) of force (hand-tighten).

COOLANT RECOVERY RESERVOIR

A "see through" plastic reservoir is connected to the cooling system at two points: 1) tee connection on inlet heater hose; and 2) throttle body heater outlet. Pressurized coolant will circulate through the reservoir from the throttle body heater outlet to the heater inlet tee connection. The reservoir is at the highest point of the cooling system. This will allow any air or vapor exceeding the pressure cap rating to exit the reservoir. When the coolant is "cold" the level should be at the "FULL COLD" line on the reservoir. An integral coolant level switch is located in the bottom of the reservoir. This switch is bonded into the reservoir and can not be removed.

ENGINE COOLANT FANS

An electric engine coolant fan aids air flow through the radiator and A/C condenser. The cooling system base version has two electric motor-driven fans mounted on the rear face of the radiator. The right fan is driven by a 150 watt motor and the left fan by a 100 watt motor. The extra-capacity cooling system version (RPO VO3) replaces the left fan motor with a 240 watt motor. The heavy-duty cooling system version (RPO VO8) replaces the right fan with an engine belt-driven fan controlled by a thermostatic fluid clutch and left fan motor with a 240 watt motor.

All electric fan motors are controlled by the powertrain control module (PCM) through relays. The PCM senses the coolant system temperature, vehicle speed and A/C high side pressure status to determine electric cooling fan operation.

FAN BLADE CLUTCH (WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

The fan blade is driven by the engine through a silicone fluid drive fan blade clutch. The silicone driving fluid allows enough slippage to limit maximum fan blade rpm. Also, the clutch eliminates overcooling, excessive noise, and power loss at high speeds.

The clutch contains a thermostatic coil which senses the temperature of the air that has been drawn through the radiator by the fan blade. When the temperature of this air is below approximately 66° C (151° F), the clutch limits fan speed to 800 to 1,400 rpm. When the temperature of this air rises above approximately 66° C (151° F), the clutch begins to allow fan speed to increase to a maximum speed of approximately 2,200 rpm. No attempt should be made to disturb the calibration of the clutch because each clutch is calibrated at the time of manufacture. Under certain temperature conditions, there is a lateral movement at the fan blade tip which should not be considered as hub or bearing failure. This condition is a design feature of the clutch which allows up to approximately 6 mm (1/4 inch) lateral movement measured at the fan blade tip.

Testing a clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise or counterclockwise motion will cause the clutch to freewheel, which is a normal condition when operated in this manner. This should not be considered a test for clutch replacement.

COOLING FAN RELAYS

The engine coolant fans (electric motor-driven) are activated by relays controlled by the powertrain control module (PCM). The PCM uses engine coolant temperature, vehicle speed, and A/C high side pressure status to determine coolant fan operation. Refer to SECTION 8A for cooling fan relay location and diagnosis.

LOW COOLANT LEVEL SWITCH

The low coolant level switch is located in the bottom of the coolant recovery reservoir. When the coolant level becomes low, the switch contacts will close (using a magnetic float) and a warning/indicator lamp in the instrument cluster will be illuminated. Refer to SECTION 8A for low engine coolant warning/indicator lamp diagnosis.

ENGINE COOLANT TEMPERATURE SWITCH

The engine coolant temperature switch activates a warning/indicator lamp in the instrument cluster if the engine temperature exceeds 126° C (250° F). Refer to SECTION 8A for engine coolant temperature switch location and diagnosis.

6B-4 COOLING AND RADIATOR

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located on the lower front section of the water pump. The sensor provides a variable input according to engine coolant temperature to the powertrain control module (PCM). Refer to SECTION 6E3 for engine coolant temperature sensor diagnosis.

ENGINE COOLANT THERMOSTAT

The engine coolant thermostat is located in a housing which is mounted on top of the water pump. The thermostat regulates the coolant flow from the radiator to the water pump. A pellet-type thermostat is used in the engine coolant inlet passage to control the flow of engine coolant to provide fast engine warm-up and to regulate engine temperatures. A wax pellet element in the thermostat expands when heated and contracts when cooled. The pellet element is connected through a piston to a valve. The valve remains closed while the engine coolant is cold, allowing full circulation of engine coolant through engine, throttle body heater and heater core. As the engine warms, the pellet element expands and the thermostat valve opens, permitting full engine coolant flow throughout all components of the cooling system.

THROTTLE BODY HEATER

Engine coolant flow is provided to the throttle body to improve cold weather driveability. Engine coolant is routed from the rear of both cylinder heads to the throttle body and then to the coolant recovery reservoir.

RADIATOR AIR SIDE BAFFLES AND DEFLECTORS

Radiator air side baffles are located on both sides of the radiator to increase air flow through the radiator. Radiator air deflectors are located at the lower sides and at the bottom of the radiator.

FAN BELT (WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

An additional belt (fan belt) is used to drive the optional mechanical cooling fan. The driving pulley which is bolted to the crankshaft balancer and the driven pulley is bolted to the fan clutch. A tensioner pulley maintains proper belt tension on the driving and driven pulleys.

CYLINDER BLOCK DRAINS

The engine cylinder block has two threaded drain holes located on either side of the engine block just above the oil pan. Knock sensors are installed in both drain holes. For more information on knock sensors, refer to SECTION 6E3-C5.

MAINTENANCE RECOMMENDATIONS

Regular maintenance of the cooling system will help keep it operating properly. Use the following procedures to check the cooling system at least once a year.

Every five years or 166 000 km (100,000 miles), whichever comes first, the cooling system should be drained and refilled. Refer to "Draining and Refilling Cooling System" in this section.

CHECKING ENGINE COOLANT

CAUTION: To avoid the danger of being burned, do not remove the coolant recovery reservoir cap while the engine and radiator are still hot. Scalding fluid and steam may be blown out under pressure. Check the engine coolant level visually in the "see-through" reservoir. The level should be at or above the "FULL COLD" mark on the tank when the engine is cold. At normal operating temperatures the engine coolant level should be above the "FULL COLD" mark on the tank.

Engine coolant should be added only to the reservoir to raise the level to the appropriate mark. Use a 50/50 mixture of high quality ethylene glycol and water for engine coolant additions.

ENGINE COOLANT CONCENTRATION

The percentage of ethylene glycol in the engine coolant should be checked periodically and when the engine coolant level is adjusted or the system is drained and refilled. This test is done by using a refractometer engine coolant tester. Refractometers test for the amount of glycol in a coolant mixture by measuring the speed of light as it passes through the fluid and are not affected by the specific gravity of the glycol. Refer to "Testing the Coolant Concentration" in this section.

HOSES AND CLAMPS INSPECTION

Inspect the condition of all hoses and clamps. Hoses should be flexible and show no signs of bulging, cracks, cuts, kinks or area of possible leaks. Inspect the brackets, supports, ties and clamps. Adjust and tighten as necessary.

PRESSURE TESTING

Test the reservoir filler cap for the proper pressure holding capacity. Refer to "Coolant Recovery Reservoir Filler Cap Pressure Test" in this section. For cooling system pressure testing, refer to "On-Vehicle Cooling System Pressure Testing" in this section.

EXTERIOR RADIATOR CLEANING

Clearing away bugs, leaves and other debris from the small air passageways of the radiator will improve the operation of the cooling system. Use compressed air to blow through the radiator from the rear towards the front of the vehicle. If compressed air is not available, water can be used by directing the water hose from the rear of the radiator.

CAUTION: Never spray water on hot radiator. The resulting steam could cause personal injury.

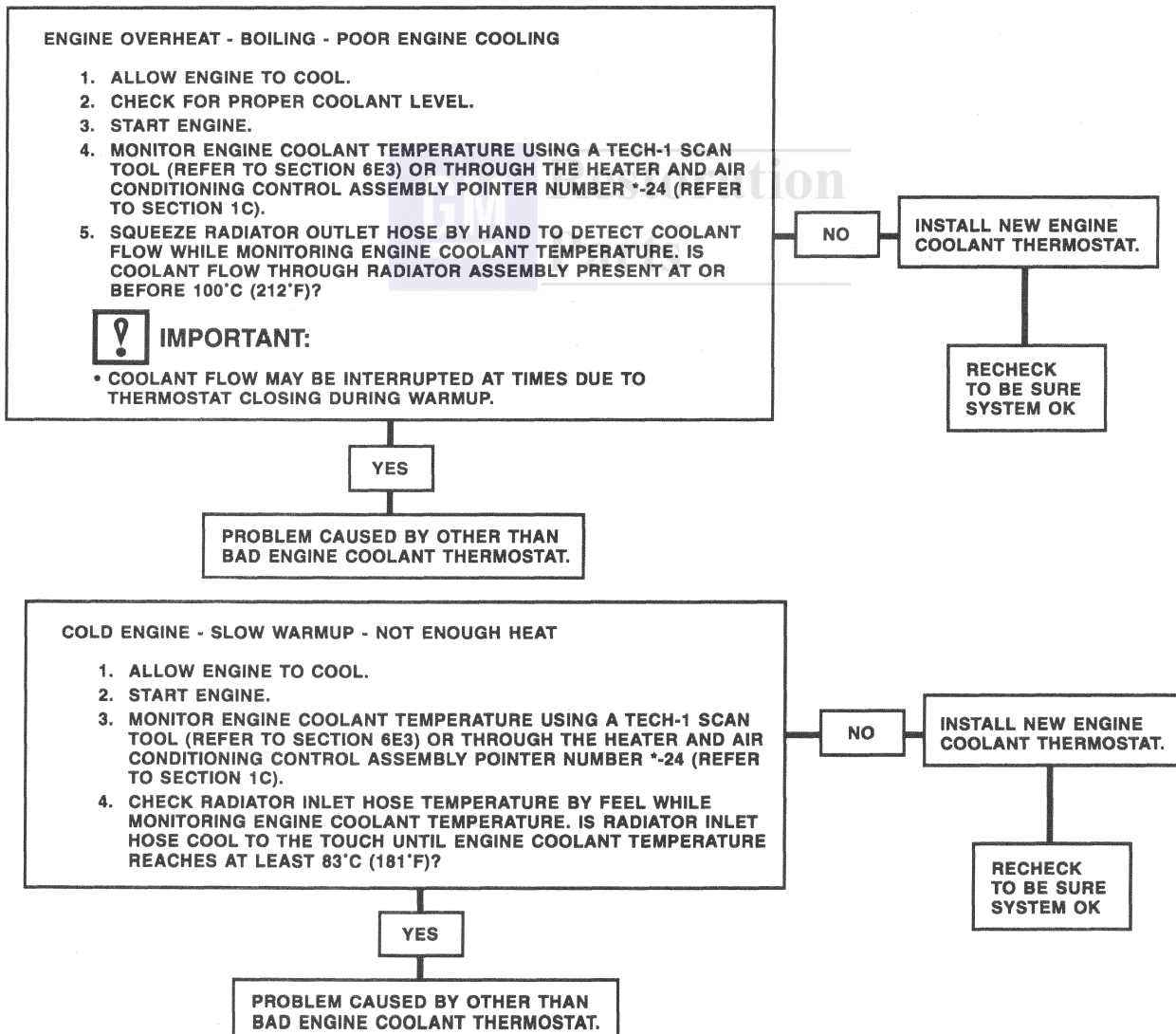
NOTICE: The radiator fins are necessary for good heat transfer and should not be brushed. Brushing may damage the fins, reducing heat transfer.

DIAGNOSIS

COOLING SYSTEM OVERHEATING

1. If overheating occurs due to prolonged idling in gear, instruct operator on driving techniques which would reduce the possibility of engine overheating:
 - Idle in "NEUTRAL" as much as possible and raise engine rpm using accelerator pedal.
2. If above does not apply, refer to diagnosis chart.

ENGINE COOLANT THERMOSTAT DIAGNOSIS



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ENGINE COOLANT THERMOSTAT TEST

The thermostat controls coolant flow into the engine (inlet side). As the thermostat opens, cold coolant from the radiator passes through the thermostat causing it to close until the thermostat again reaches normal operating temperature. This slow bleeding of cold coolant into a hot engine helps prevent thermal shock due to the sudden rush of cold coolant. The thermostat will remain open after the entire cooling system has reached normal operating temperature.



Inspect

- Engine coolant thermostat opening temperature. Refer to "Cooling System Overheating" in this section.

FAN BLADE CLUTCH (WITH RPO V08 HEAVY-DUTY COOLING SYSTEM)

1. Fan noise is usually normal if it occurs when clutch is engaged for maximum cooling or during first few minutes after start up.
2. If clutch is locked up due to an internal failure, fan noise or an excessive roar will occur continuously under all high engine speeds (2,500 rpm and up).
3. If fan blade cannot be rotated by hand or if there is a rough grating feel as fan blade is turned, clutch should be replaced.
4. An approximate 6 mm (1/4 inch) maximum lateral movement measured at fan blade tip is allowable. This is not cause for replacement.

5. Small fluid leaks which may occur in area around bearing are not cause for replacement. If leakage appears excessive, proceed to next step.
6. Clutch diagnostic procedure.
 - A. Start with a cool engine to ensure complete clutch disengagement.
 - B. If fan blade and clutch freewheel with no drag (revolve more than five times when spun by hand), clutch should be replaced.

COOLANT RECOVERY RESERVOIR FILLER CAP



Inspect

- Inner sealing surface of coolant recovery reservoir filler tube neck for damage or debris.
- Cap for damage or debris.

COOLANT RECOVERY RESERVOIR FILLER CAP PRESSURE TEST

Tools Required:

J 24460-01 Cooling System Tester

J 24460-92 Cooling System Adapter Set

1. Clean coolant recovery reservoir filler cap.
2. Install cap on male threaded adapter J 24460-194 (part of J 24460-92).
3. Attach adapter J 24460-194 to J 24460-01.
4. Pump pressure tester slowly to obtain minimum holding pressure.
 - A. If cap fails to hold 97 kPa (14 psi), replace cap.
 - B. If installing a new cap, coat cap gasket with engine coolant.

COOLING SYSTEM DIAGNOSIS

<u>CONDITION</u>	<u>POSSIBLE CAUSE</u>	<u>CORRECTION</u>
Engine overheats.	a. Loss of engine coolant. b. Loss of system pressure. c. Weak engine coolant solution. d. Loose fan belt (RPO V08 heavy duty cooling systems only). e. Obstructed radiator fins. f. Cooling system passages blocked by rust or scale. g. Water pump drive shaft broken or splines slipping. h. Kinked coolant recovery reservoir hose. i. Inoperative mechanical fan blade (RPO V08 heavy duty cooling systems only). j. Inoperative electric engine coolant fan. k. Electric engine coolant fan operating in reverse, forcing hot air from engine compartment through radiator. l. Loose, damaged, and/or missing radiator fan upper and lower shrouds, radiator air side and lower deflectors or radiator air side baffles. m. Engine coolant thermostat stuck in the closed position. n. Faulty water pump. o. Incorrect radiator. p. Incorrect or damaged fan blade/engine coolant fan. q. Exhaust system restriction (catalytic converter plugged). r. Engine oil overfill.	a. Pressure test engine cooling system. b. Perform coolant recovery reservoir filler cap pressure test. c. Test engine coolant for proper 50-50 mixture. d. Check fan belt tension. e. Remove or relocate added-on parts that block air to radiator. Clean away bugs, leaves, and other debris. f. Remove radiator. Clean or replace as necessary. Remove cylinder head and inspect, if required. g. Replace drive shaft and/or water pump. h. Re-route coolant recovery reservoir hose. i. Replace fan blade clutch. j. Refer to SECTION 6E3. k. Reverse polarity at electric engine coolant fan motor connector terminals. l. Repair or replace as required. m. Replace engine coolant thermostat. n. Replace water pump. o. Determine proper radiator for vehicle and replace radiator if necessary. p. Check for correct part number. Replace fan blade (with RPO V08 heavy duty cooling system) or engine coolant fan if required. q. Refer to SECTION 6F. r. Check engine oil level.
Loss of engine coolant.	Cooling system leaking (external or internal).	Pressure test cooling system. Refer to "On Vehicle Cooling System Pressure Testing" in this section.
Engine fails to reach normal operating temperature. Cool air from the heater.	a. Engine coolant thermostat stuck open or wrong type of engine coolant thermostat. b. Engine coolant is below the "FULL COLD" mark.	a. Install new engine coolant thermostat with correct part number. b. Add engine coolant.
Low coolant light "ON" (reservoir level correct).	Faulty low coolant sensor or circuit.	Refer to SECTION 8A.

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SERPENTINE DRIVE BELT

Routine inspection of the serpentine drive belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and are not a basis for belt replacement. For belt tensioning and replacement procedures, refer to SECTION 6A4A.

ON-VEHICLE SERVICE

DRAINING AND REFILLING COOLING SYSTEM

Figure 1

Every five years or 166 000 km (100,000 miles) whichever first occurs, the cooling system should be drained and filled using the following recommended procedures:

CAUTION: To avoid the danger of being burned, do not remove the coolant recovery reservoir filler cap while the engine and radiator are still hot. Scalding fluid and steam may be blown out under pressure.

1. Park vehicle on level surface.
2. Remove coolant recovery reservoir filler cap.
 - A. Slowly rotate cap counterclockwise about 1/4 turn and then stop.
 - B. Wait until any remaining pressure (indicated by a hissing sound) is relieved.
 - C. After all hissing ceases, continue to rotate cap counterclockwise until cap is removed.
3. Open coolant drain valve located in left-hand radiator end tank.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

4. Disconnect battery negative cable.
5. Open heater air bleed valve (36) located just above water pump on the thermostat housing.
 - Place a shop towel under the bleed valve to prevent coolant from splashing onto distributor.
6. Remove both electronic spark control (ESC) knock sensors located on both sides of engine block.
7. Allow system to drain completely.



Important

- Store used coolant in a proper fashion, i.e., in a used coolant holding tank. NEVER POUR USED COOLANT DOWN THE DRAIN! Ethylene Glycol antifreeze is a very toxic chemical; disposing of it into the sewer system or ground water is both illegal and ecologically unsound!

8. Close coolant drain valve.

9. Install ESC knock sensors.

NOTICE: Use Ethylene Glycol antifreeze meeting GM specification 6277M (silicate free) to provide required freezing and corrosion protection at least 50-percent solution, -37° C (-34° F).

10. Fill cooling system through the coolant recovery reservoir to the "FULL COLD" mark.
11. Close heater air bleed valve (36) when bubbles disappear and only coolant is visible.
12. Connect battery negative cable.



Tighten

- Bolt/screw to 6 N·m (53 lb. in.).



Important

- Block wheels, place transmission in "PARK" or "NEUTRAL" and set parking brake.

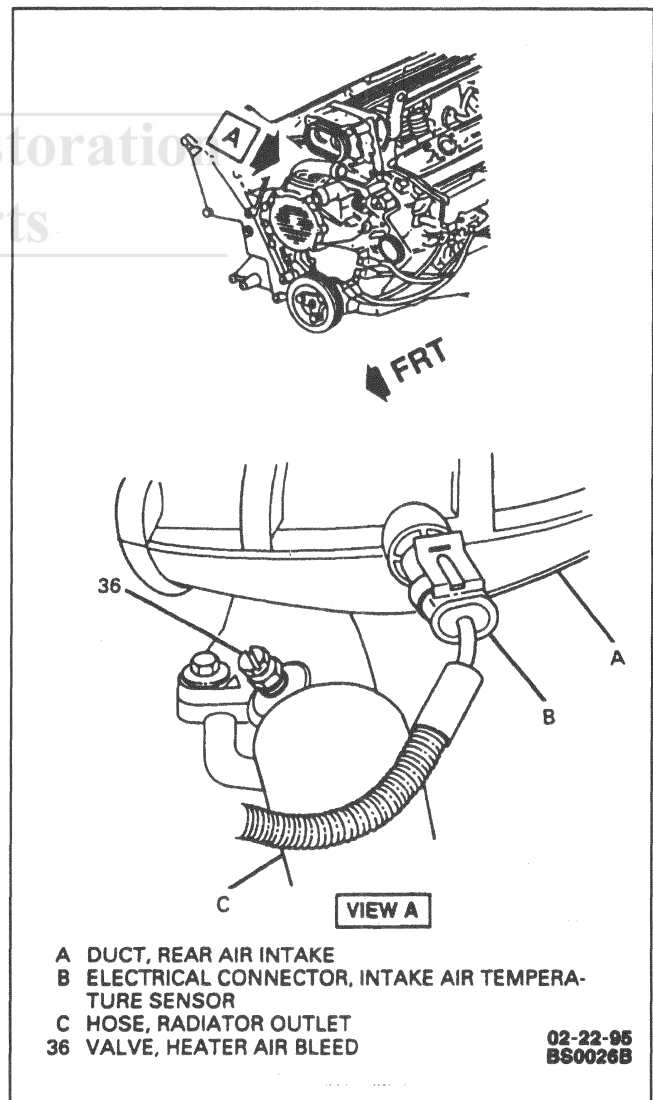


Figure 1- Heater Air Bleed Valve

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13. Run engine with the coolant recovery reservoir filler cap off until thermostat opens.
14. Open heater air bleed valve (36). When bubbles disappear and only coolant is visible, close heater air bleed valve (36).
 - Place a shop towel under the bleed valve to prevent coolant from splashing onto distributor.

CAUTION: Under some conditions, Ethylene Glycol in engine coolant is flammable. To avoid being burned when adding engine coolant, do not spill it on the exhaust system or on hot engine parts.

15. Fill cooling system through the coolant recovery reservoir until the coolant level is approximately 25 mm (1 inch) above the "FULL COLD" mark.

NOTICE: Use Ethylene Glycol antifreeze meeting GM specification 6277M (low silicate) to provide required freezing and corrosion protection - at least 50-percent solution, -37° C (-34° F).

! Important

- When refilling the engine cooling system, add two engine coolant supplement sealant pellets (GM P/N 3634621 or equivalent) and coolant antifreeze meeting GM specification 6277M.
16. Install the coolant recovery reservoir filler cap.

🔍 Inspect

- For leaks, after running engine until normal operating temperature is reached.

NOTICE: "LOW COOLANT" warning/indicator lamp may come on after this procedure. After operating vehicle so engine heats up and cools down three times, if "LOW COOLANT" warning/indicator lamp does not go out, or fails to come on at ignition check and coolant is above "FULL COLD" mark in reservoir, refer to SECTION 8A. If at any time the "HOT" warning/indicator lamp comes on, immediate action is required. Turn off engine and allow vehicle to cool. Do not remove coolant recovery reservoir cap at this time.

17. Test coolant concentration. Refer to "Testing the Coolant Concentration" in this section.

TESTING THE COOLANT CONCENTRATION

Figures 2 through 4

Tools Required:
J 23688-A or J 26568-A Coolant Tester

! Important

- Both J 23688-A and J 26568-A automatically compensate for temperature.

- Make sure eyepiece of J 23688-A or J 26568-A is totally free of solution before looking through it. Refer to Figure 2.
 - Before each use, swing plastic cover at slanted end of J 26568-A or J 23688-A exposing measuring window and bottom of plastic cover.
 - Wipe dry both prism and bottom of sample cover with tissue or clean soft cloth.
 - Close plastic cover.
1. Release tip of pump from J 23688-A or J 26568-A housing.
 - Do not remove clear plastic pump from J 23688-A or J 26568-A.

CAUTION: To avoid being burned, DO NOT remove coolant recovery reservoir cap while engine is at normal operating temperature. The cooling system will release scalding fluid and steam under pressure if cap is removed while engine and radiator are still hot. This could result in a large coolant loss and possible personal injury.

2. Remove coolant recovery reservoir cap.
3. Insert tube into coolant recovery reservoir.
 - Make sure tube is below level of coolant.
4. Press and release bulb to get sample of coolant.
5. Bend tube around J 23688-A or J 26568-A so that tip can be inserted in cover plate opening.
6. Press bulb and allow a few drops to fall onto measuring surface.

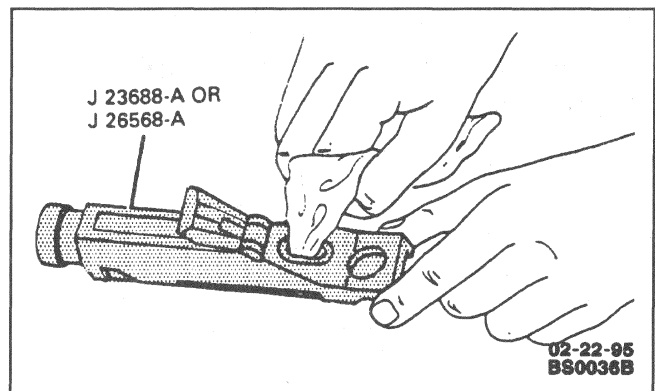


Figure 2 - Cleaning the Coolant Tester

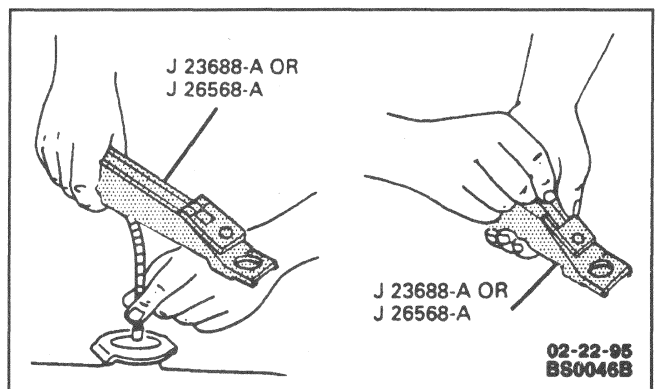


Figure 3 - Collecting the Coolant

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- Do not open plastic cover when taking readings because water evaporation can change readings.
7. Point J 23688-A or J 26568-A toward any light source and look into eyepiece.
 - Coolant protection reading is at point where dividing line between light and dark crosses scale on right.
 - Temperature scale is reversed from a standard thermometer scale. Below zero readings are on upper half of scale.
 - If readings are not clear, the measuring prism was not cleaned and dried or there was not enough fluid on measuring prism.

CALIBRATING TESTERS

J 23688-A and J 26568-A are factory calibrated and sealed and should not require adjustment. If adjustment is required, follow instructions below.

1. Make sure J 23688-A and J 26568-A is between 21° C and 29° C (70° F and 85° F).
2. Using distilled water, take a reading. If reading departs from a 0° C (32° F) reading on scale, a correction can be made by adjusting screw on bottom of J 23688-A and J 26568-A.
3. Remove sealant covering screw.

Important

- Do not remove screw from J 23688-A and J 26568-A.
4. Turn screw in direction necessary to adjust reading to 0° C (32° F) line.
 5. Reseal the screw using a silicone sealant.

ENGINE COOLANT FLUSHING AND RECYCLING

Engine Coolant Flushing

Tool Required:

Non-Aqueous Coolant Exchanger such as ProFill J 75010-KM (Available in the GM Dealer Equipment program)

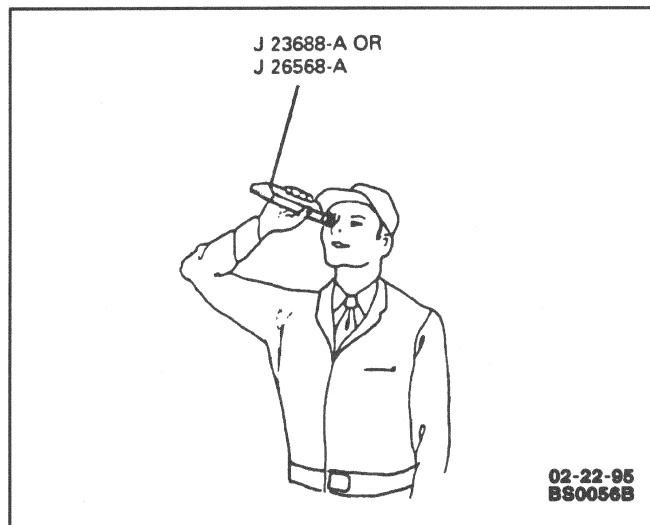


Figure 4 - Reading the Coolant Tester

If your state/local environmental enforcement group does not allow the discharge of coolant or if you do not desire to put used coolant into the environment there are various methods and equipment that can be used to flush the coolant system. If using special equipment such as a back flusher, follow the manufacturer's instructions. However, the thermostat should be removed before flushing the system.

Engine Coolant Recycling

Tool Required:

GM approved Recycling System such as Pro Clean (Available in the GM Dealer Equipment program)

As the need arises to conduct cooling system maintenance or repairs, all of the used coolant must be removed and replaced with qualified new or recycled coolant. If only the radiator is drained, up to 50 percent of the used, contaminated coolant can remain in the cooling system. Removing used coolant (from the vehicle) can be accomplished by several methods:

- Utilize waterless coolant evacuation system available in the GM Dealer Equipment program (or equivalent) which removes the used coolant and replaces it with approved new or recycled coolant.
- Utilize a GM approved coolant recycling system available in the GM Dealer Equipment program (or equivalent) which recycles the coolant on the vehicle thereby eliminating the need for evacuation.
- Recover used coolant and store in a used coolant holding tank and submit the used coolant for recycling on a regular basis.

RADIATOR LEAK TESTING

Clean the core so the damaged area is easier to find. Some radiator leaks can sometimes be detected without pressurizing the system. After filling the cooling system, inspect the radiator for leaks before proceeding with what may be an unnecessary step of pressurizing the cooling system.

ON-VEHICLE COOLING SYSTEM PRESSURE TESTING

Figure 5

Tools Required:

J 24460-01 Cooling system Tester

J 24460-92 Cooling System Adapter Set

Important

- A very slight amount of weepage may occur at the water pump vent hole during vehicle operation. Tracks of residue may occur from the lower vent hole. The water pump should be replaced only if coolant is dripping from the vent hole while the engine is in operation or while the cooling system is pressurized.

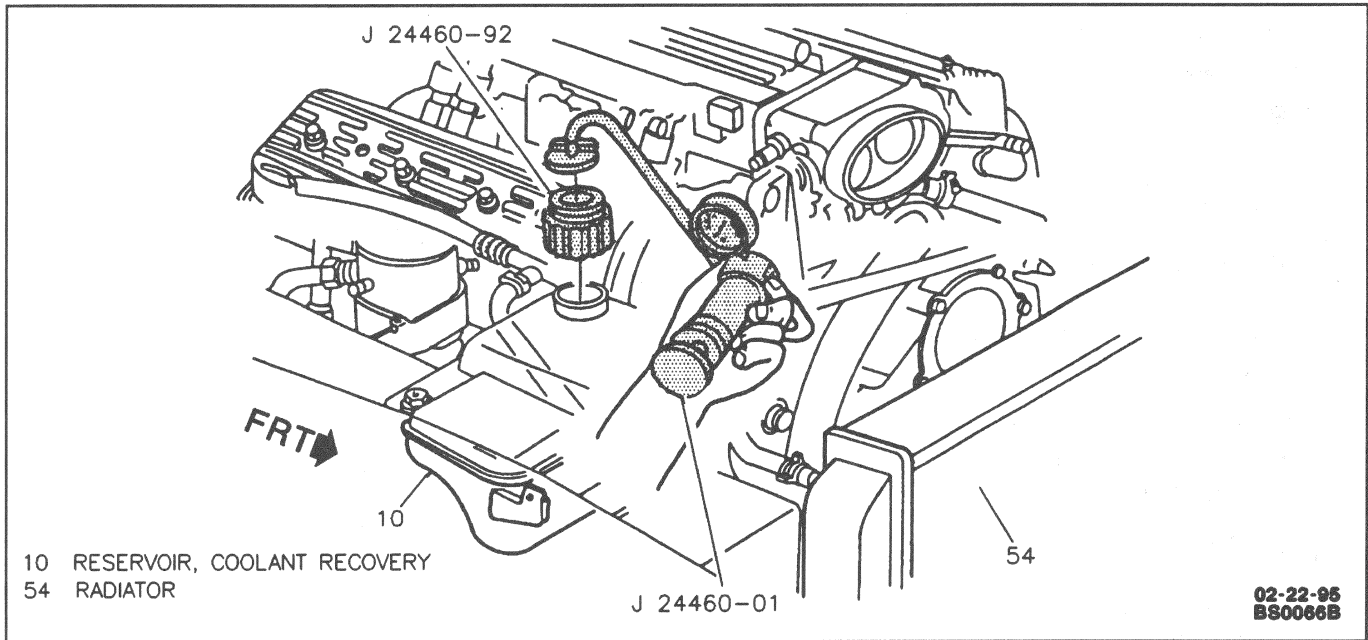


Figure 5 - Pressure Testing the Cooling System

- Minor water pump weepage and minor engine cooling system leaks may be corrected by adding two sealant pellets GM P/N 3634621 to the cooling system. Pellets should be crushed then placed inside coolant recovery reservoir.

1. Ensure that radiator hose clamps and heater hose clamps are properly positioned and secured.
2. Inspect connections for leaks. Repair as required.

CAUTION: To avoid being burned, do not remove coolant recovery reservoir cap while engine is at normal operating temperature. The cooling system will release scalding fluid and steam under pressure if radiator filler cap is removed while engine and radiator are still hot.

3. Remove coolant recovery reservoir cap.
4. Fill cooling system to the "FULL COLD" mark.
5. Attach female threaded adapter J 24460-193 (part of J 24460-92) to coolant recovery reservoir filler neck.
6. Connect system tester, such as J 24460-01 to adapter J 24460-193 already attached to the coolant recovery filler neck.
7. Pump up pressure to no more than 138 kPa (20 psi).
8. System should hold pressure for at least two minutes.
 - A. If a measurable amount of pressure drops in less than two minutes, check for leak.
 - B. Leak may be internal or external. If no visible leak is found, including heater core, engine disassembly may be required. Refer to SECTION 6A4A.

ENGINE COOLANT THERMOSTAT AND HOUSING

Figure 6

↔ Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Air resonator and intake air duct.
3. Open coolant drain valve, located in the left-hand radiator end tank, and drain engine coolant.
4. Close coolant drain valve.
5. Radiator outlet hose and clamp from thermostat housing (14).

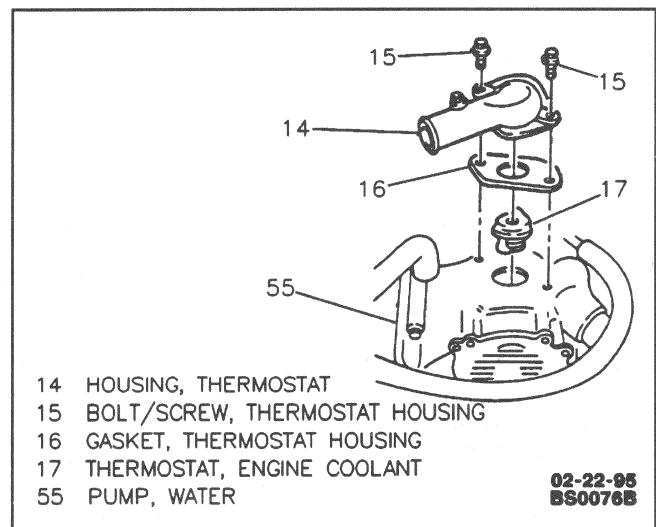


Figure 6 - Engine Coolant Thermostat and Housing

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6. Bolts/screws (15).
7. Thermostat housing (14).
8. Thermostat (17) and gasket (16).



Clean

- Gasket surfaces of thermostat housing (14) and water pump (55).



Install or Connect

NOTICE: Refer to “Notice” on page 6B-1 of this section.

1. Thermostat (17) and new gasket (16).
2. Thermostat housing (14).
3. Bolts/screws (15).



Tighten

- Bolts/screws (15) to 28 N.m (21 lb. ft.).
4. Radiator outlet hose and clamp to thermostat housing (14).
 5. Air intake duct and air resonator.
 6. Add engine coolant. Refer to “Draining and Refilling Cooling System” in this section.
 7. Battery negative cable.



Tighten

- Bolt/screw to 6 N.m (53 lb. in.).



Inspect

- For leaks before and after running engine.

COOLANT RECOVERY RESERVOIR

Figure 7



Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Electrical connector to low coolant switch (located underneath reservoir).
3. Open coolant drain valve (located in left hand radiator end tank).
4. Drain enough coolant to empty reservoir (10) and its hoses.
5. Close coolant drain valve.
6. Coolant recovery reservoir hoses.
 - Throttle body heater to reservoir hose at the reservoir (10).
 - Heater inlet tee to reservoir hose at tee.
7. Nuts (11).
8. Reservoir (10).



Clean

- Reservoir (10) with soap and water. Rinse thoroughly.



Install or Connect

NOTICE: Refer to “Notice” on page 6B-1 of this section.

1. Reservoir (10).
2. Nuts (11).

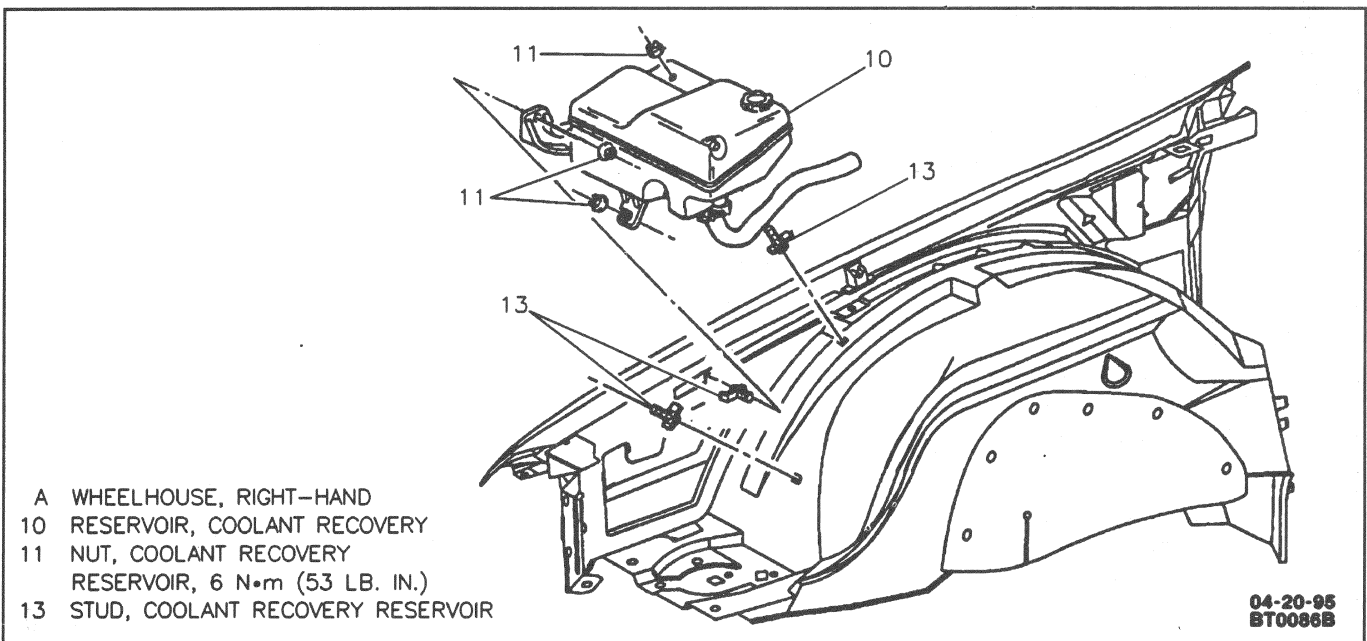


Figure 7 - Coolant Recovery Reservoir



Tighten

- Nuts (11) to 6 N.m (53 lb. in.).
- 3. Coolant recovery reservoir hoses.
- 4. Electrical connector to low coolant sensor.
- 5. Battery negative cable.
- 6. Refill cooling system. Refer to "Draining and Refilling Cooling System" in this section.

FAN BLADE (WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

Figure 8



Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Radiator fan upper shroud bolts/screws.
3. Radiator fan upper shroud.
4. Nuts (44).
5. Fan blade (45) with clutch (51).
6. Bolts/screws (52).

NOTICE: Place the clutch in an upright position after removing it. Laying it flat may result in fluid leaking from the clutch.

7. Fan blade (45).



Inspect

- For bent or cracked fan blades.
- Mating surfaces for smoothness. Remove burrs or other imperfections as necessary.

CAUTION: If a fan blade is bent or damaged in any way, no attempt should be made to repair and/or reuse the damaged part. A bent or damaged fan blade should always be replaced with a new fan blade.

CAUTION: It is essential that the fan blade remain in proper balance. Balance cannot be assured once a fan blade has been bent or damaged. A fan blade that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition.

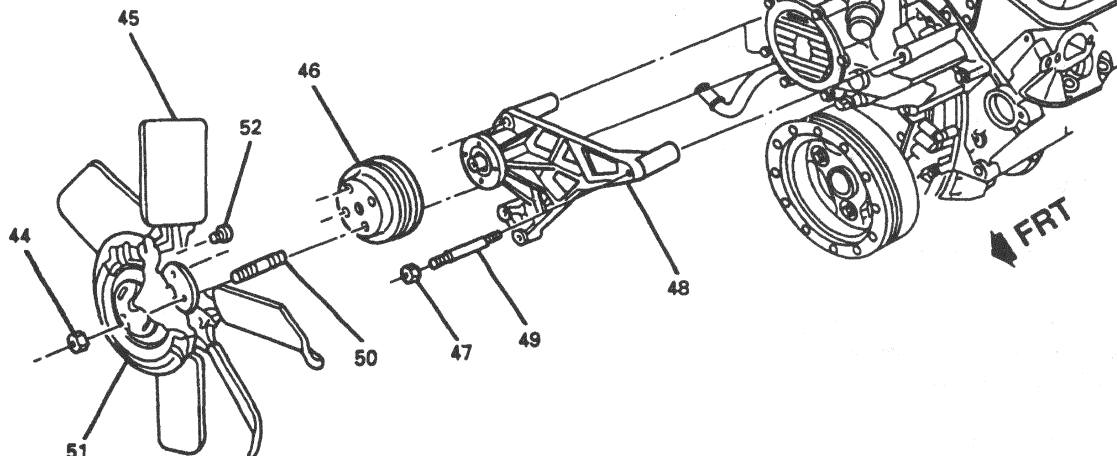


Install or Connect

NOTICE: Refer to "Notice" on page 6B-1 of this section.

1. Fan blade (45) to clutch (51).
2. Bolts/screws (52).

- 44 NUT, FAN BLADE CLUTCH
- 45 BLADE, FAN
- 46 PULLEY, FAN
- 47 NUT, COOLANT FAN PULLEY BRACKET
- 48 BRACKET, COOLANT FAN PULLEY
- 49 STUD, COOLANT FAN PULLEY BRACKET
- 50 STUD, FAN BLADE CLUTCH
- 51 CLUTCH, FAN BLADE
- 52 BOLT/SCREW, FAN BLADE CLUTCH



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Figure 8 - Fan Blade

6B-14 COOLING AND RADIATOR



Tighten

- Bolts/screws (52) to 24 N.m (18 lb. ft.).
3. Clutch (51) with fan blade (45) to bracket (48).
 4. Nuts (44).



Tighten

- Nuts (44) to 24 N.m (18 lb. ft.).
5. Radiator fan upper shroud.
 6. Radiator fan upper shroud bolts/screws.



Tighten

- Radiator fan upper shroud bolts/screws to 6 N.m (53 lb. in.).
7. Battery negative cable.

FAN BLADE CLUTCH (WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

For clutch service procedures, refer to "Fan Blade (with RPO VO8 Heavy-Duty Cooling System)" in this section.

ENGINE COOLANT FAN (ELECTRIC, WITHOUT RPO VO8 HEAVY-DUTY COOLING SYSTEM)

Figure 9



Important

- The base cooling system (without VO3 and VO8) has dual electric fans with a 150-watt fan on the right side and a 100-watt fan on the left side. The VO3 cooling system also has dual electric fans with a 240-watt fan on the left side and a 150-watt fan on the right side. The fans must be installed in their correct location or inadequate cooling may result.

CAUTION: Keep hands, tools, and clothing away from engine coolant fan to help prevent personal injury. This engine coolant fan is electric and can come on whether or not the engine is running. The engine coolant fan can start automatically in response to a temperature sensor with the ignition in the "RUN" position.



Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Electrical connectors.
3. Bolts/screws (18 and 19).
4. Fan (20, 21 or 22) from slots in radiator support.

- Note location of each fan.



Install or Connect

NOTICE: Refer to "Notice" on page 6B-1 of this section.

1. Fan (20, 21 or 22) into slots in radiator support.
 - Install at location noted during removal.
2. Bolts/screws (18 and 19).



Tighten

- Bolts/screws (18 and 19) to 6 N.m (53 lb. in.).
3. Electrical connectors.
 4. Battery negative cable.

ENGINE COOLANT FAN (ELECTRIC, WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

Figures 9 and 10

CAUTION: Keep hands, tools, and clothing away from engine coolant fan to help prevent personal injury. This engine coolant fan is electric and can come on whether or not the engine is running. The engine coolant fan can start automatically in response to a temperature sensor with the ignition in the "RUN" position.

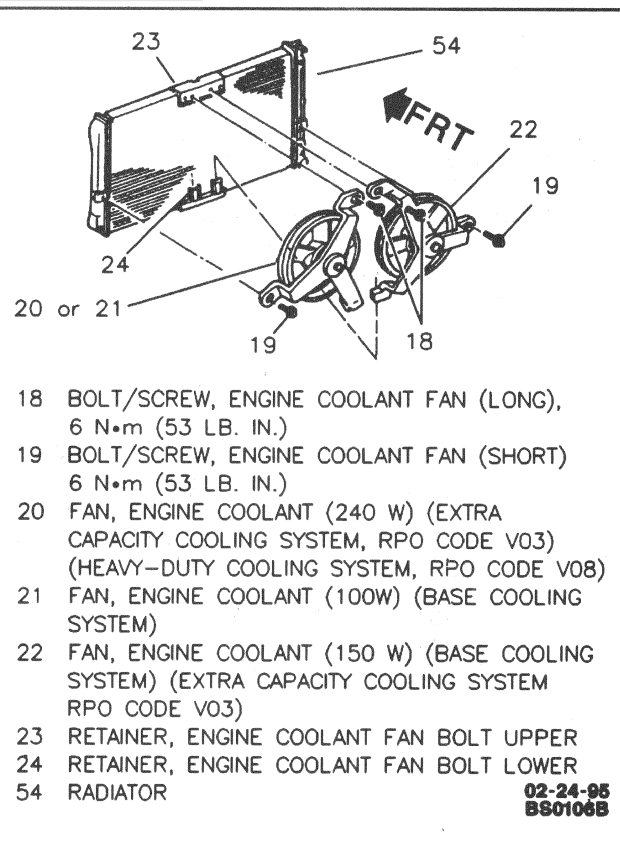


Figure 9 - Engine Coolant Fans (Electric)

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Air intake duct and resonator.
3. Bolts/screws (25 and 26).
4. Upper shroud (27).
5. Electrical connectors.
6. Bolts/screws (18 and 19).
7. Fan (20) from slot in lower retainer (24).

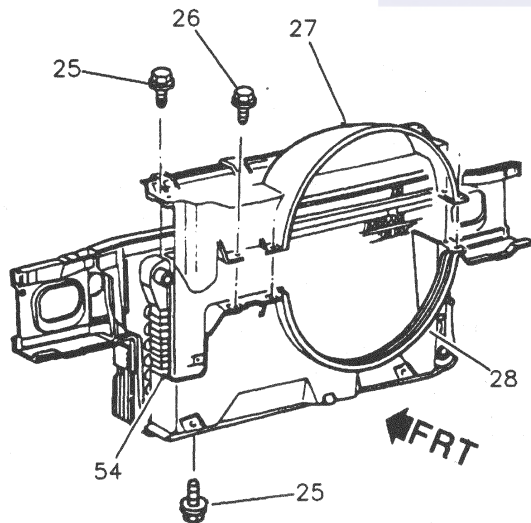
Install or Connect

NOTICE: Refer to "Notice" on page 6B-1 of this section.

1. Fan (20) into slot in lower retainer (24).
2. Bolts/screws (18 and 19).

Tighten

- Bolts/screws (18 and 19) to 6 N.m (53 lb. in.).
- 3. Electrical connectors.
- 4. Upper shroud (27).
- 5. Bolts/screws (25 and 26).



- | | |
|----|--|
| 25 | BOLT/SCREW, RADIATOR FAN SHROUD, |
| | 6 N.m (53 LB. IN.) |
| 26 | BOLT/SCREW, RADIATOR FAN UPPER SHROUD, |
| | 6 N.m (53 LB. IN.) |
| 27 | SHROUD, RADIATOR FAN UPPER |
| 28 | SHROUD, RADIATOR FAN LOWER |
| 54 | RADIATOR |

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Figure 10 - Radiator Fan Upper and Lower Shroud (with RPO VO8, Heavy-Duty Cooling System)

Tighten

- Bolts/screws (25 and 26) to 6 N.m (53 lb. in.).
- 6. Air intake duct and resonator.
- 7. Battery negative cable.

Tighten

- Bolt/screw to 6 N.m (53 lb. in.).

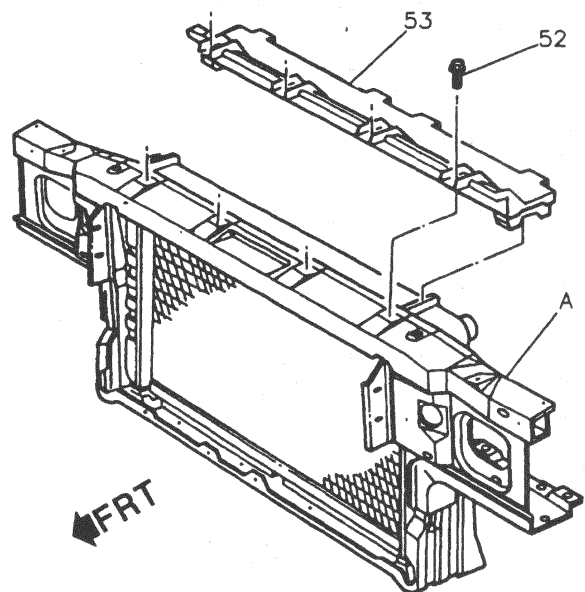
RADIATOR

Figure 11

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Air intake duct and resonator.
3. Open coolant drain valve located in left radiator end tank and drain coolant.
4. Engine coolant hoses from radiator. Refer to "Engine Coolant Hoses" in this section.
5. Engine cooling fans. Refer to "Engine Cooling Fan" in this section.



- | | |
|----|-------------------------------------|
| A | BRACKET, RADIATOR SUPPORT |
| 52 | BOLT/SCREW, RADIATOR UPPER MOUNTING |
| | PANEL, 6 N.m (53 LB. IN.) |
| 53 | PANEL, RADIATOR UPPER MOUNTING |

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Figure 11 - Radiator Upper Mounting Panel

6B-16 COOLING AND RADIATOR

6. Transmission oil cooler lower and upper pipes from radiator.
 - Plug transmission oil cooler lower and upper pipes.
7. Engine oil cooler inlet and outlet hoses from radiator, if equipped.
8. Coolant recovery reservoir hose from radiator.
9. Bolts/screws (52) and radiator upper mounting panel (53), if vehicle is not equipped with a mechanical fan.
10. Radiator.

Install or Connect

NOTICE: Refer to “Notice” on page 6B-1 of this section.

1. Radiator.
 - Make sure radiator is seated on radiator insulators.
2. Radiator upper mounting panel (53) and bolts/screws (52), if removed.

Tighten

- Bolts/screws (52) to 6 N.m (53 lb. in.).
3. Coolant recovery reservoir hose to radiator.
 4. Transmission oil cooler lower and upper pipes to radiator.

Tighten

- Transmission oil cooler lower and upper pipes to 23 N.m (17 lb. ft.).
5. Engine oil cooler inlet and outlet hoses to radiator, if equipped.

Tighten

- Engine oil cooler inlet and outlet hoses to 24 N.m (18 lb. ft.).
6. Engine cooling fans. Refer to “Engine Cooling Fan” in this section.
 7. Engine coolant hoses to radiator. Refer to “Engine Coolant Hoses” in this section.
 8. Close coolant drain valve.
 9. Battery negative cable.

Tighten

- Bolt/screw to 6 N.m (53 lb. in.).
10. Add engine coolant. Refer to “Draining and Refilling Cooling System” in this section.

Inspect

- For leaks, after running engine until normal operating temperature is reached.

RADIATOR AIR SIDE BAFFLES AND DEFLECTORS

Radiator Air Side Baffle

Figure 12

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Baffle retainers (30) and side baffle retainers (31).
3. Side baffle (29).

Install or Connect

1. Side baffle (29) to radiator support.
2. Side baffle retainers (31).
 - Attach to headlamp bracket.
3. Baffle retainers (30).
 - Attach to condenser.
4. Battery negative cable.

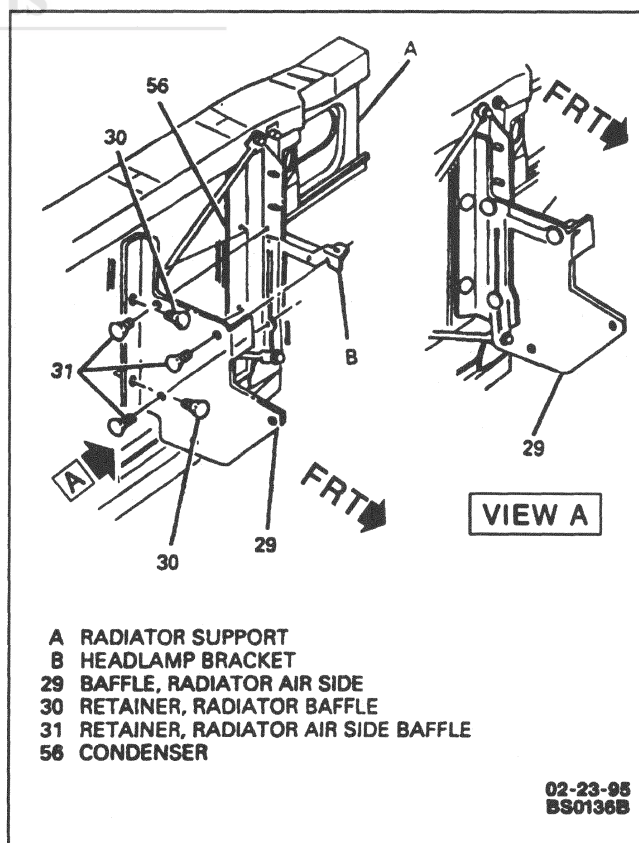


Figure 12 - Radiator Air Side Baffle (Left Hand Shown, Right Side Opposite)

Radiator Air Lower Deflector

Figure 13

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (33).
3. Lower deflector (32).

Install or Connect

NOTICE: Refer to "Notice" on page 6B-1 of this section.

1. Lower deflector (32).
2. Bolts/screws (33).

Tighten

- Bolts/screws (33) to 1.5 N·m (13 lb. in.).
3. Lower vehicle

Radiator Air Side Deflectors

Figure 14

Remove or Disconnect

1. Bolts/screws (35).
2. Side deflector (34).

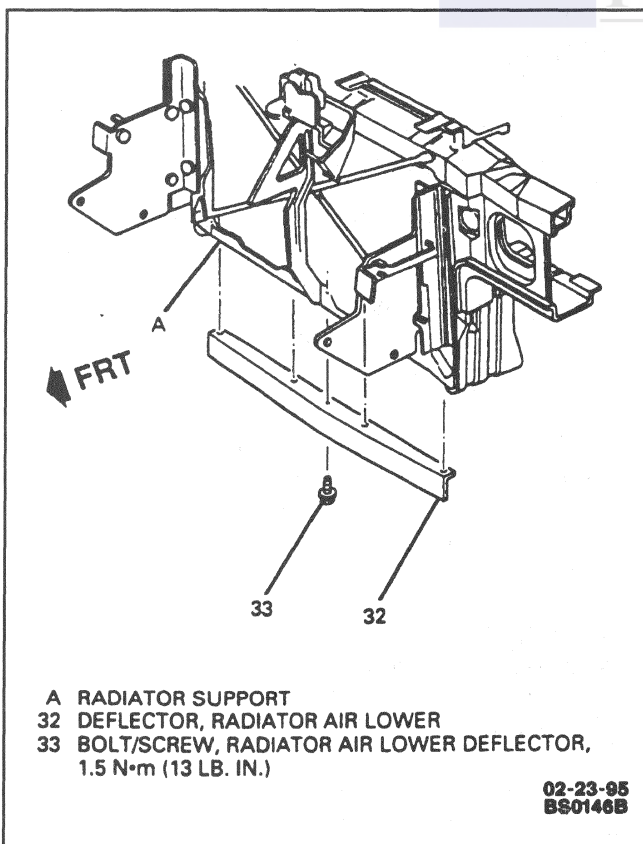


Figure 13 - Radiator Air Lower Deflector

Install or Connect

NOTICE: Refer to "Notice" on page 6B-1 of this section.

1. Side deflector (34) to wheel housing extension panel.
2. Bolts/screws (35).

Tighten

- Bolts/screws (35) to 1.9 N·m (17 lb. in.).

RADIATOR FAN UPPER AND LOWER SHROUDS (WITH RPO VO8 HEAVY-DUTY COOLING SYSTEM)

Figure 10

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Bolts/screws (25 and 26) from upper shroud (27).
3. Upper shroud (27) from lower shroud (28) and radiator support.

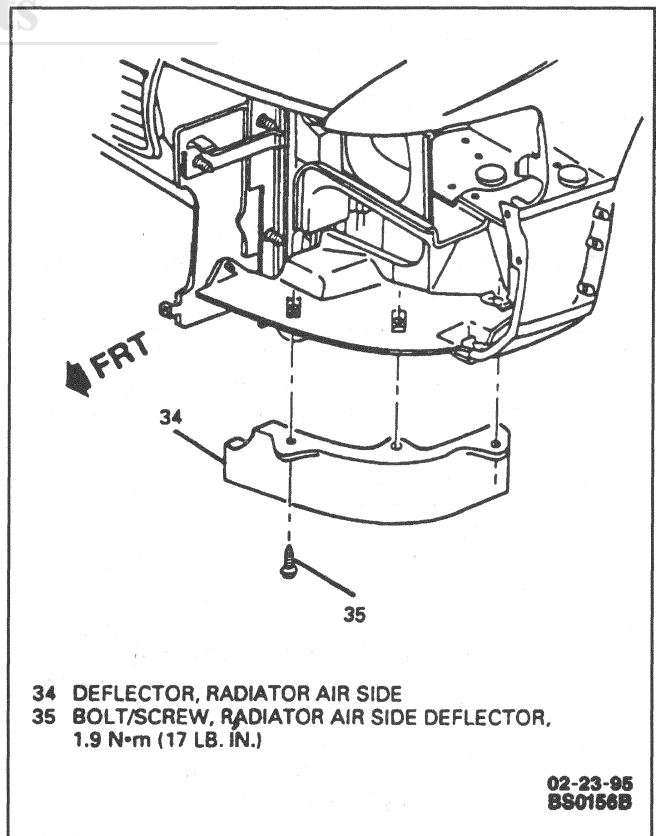


Figure 14 - Radiator Air Side Deflectors (LH Shown, RH Opposite)

6B-18 COOLING AND RADIATOR

4. Bolts/screws (25) from lower shroud (28).
5. Lower shroud (28) from radiator support.

Install or Connect

NOTICE: Refer to “Notice” on page 6B-1 of this section.

1. Lower shroud (28) to radiator support.
2. Bolts/screws (25).
3. Upper shroud (27) to lower shroud (28) and radiator support.
4. Bolts/screws (25 and 26).

Tighten

- Bolts/screws (25 and 26) to 6 N.m (53 lb. in.).
5. Battery negative cable.

Tighten

- Bolt/screw to 6 N.m (53 lb. in.).

ENGINE COOLANT HOSES

Figures 10, 11, and 15

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Drain radiator (54) so level of engine coolant is below hose being removed.
3. Air cleaner rear resonator (37).
4. Intake air temperature sensor electrical connector.
5. Loosen clamps on rear intake duct (at engine) and on air cleaner front resonator (39) at mass airflow sensor (57).
6. Rear intake duct and air cleaner front resonator (39) as a unit.
7. Radiator inlet hose (40) at radiator and water pump.
8. Radiator upper mounting panel bolts/screws (52) or radiator fan shroud bolts/screws (25).
9. Radiator upper mounting panel (53) (base cooling system and RPO V03 cooling system) or radiator fan upper shroud (27) (RPO V08 cooling system only).
10. Nuts holding radiator outlet hose bracket to air conditioning compressor studs (RPO V08 cooling system only).
11. Radiator outlet hose (41) at thermostat housing.
12. Coolant recovery reservoir front hose (42) at reservoir and throttle body tube.
13. Coolant recovery reservoir rear hose (43) at reservoir and radiator.

14. Raise and suitably support vehicle. Refer to SECTION 0A.

15. Radiator outlet hose (41) from radiator (54).

Install or Connect

NOTICE: On vehicles equipped with heavy-duty cooling option (RPO V08), do not attempt to replace the specified radiator outlet hose with an ordinary rubber hose. The proper V08 hose contains a metal section to protect it from possible damage by the engine-driven cooling fan blades.

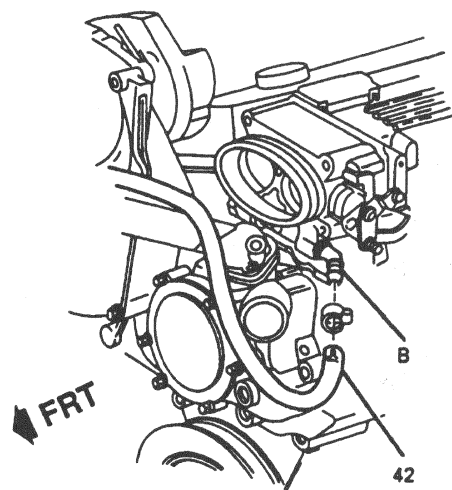
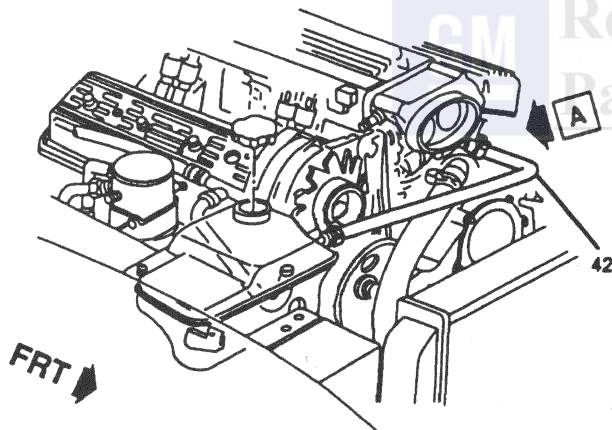
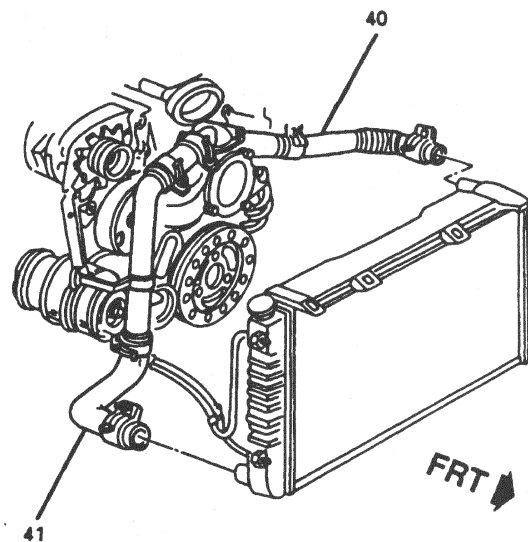
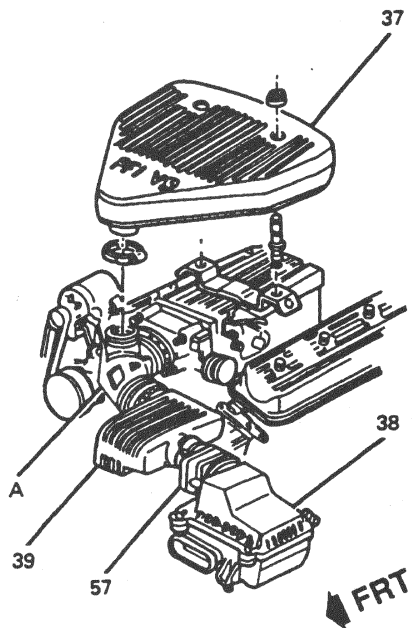
1. Radiator outlet hose (41) at radiator.
2. Lower vehicle.
3. Coolant recovery reservoir rear hose (43) at reservoir and radiator.
4. Coolant recovery reservoir front hose (42) at reservoir and throttle body tube. Make sure front hose is routed underneath rear hose.
5. Radiator outlet hose (41) at thermostat housing.

Important

- Make sure radiator outlet hose (41) is routed underneath coolant recovery reservoir front hose (42).
6. Radiator outlet hose bracket to air conditioner compressor studs (RPO V08 cooling system only).
 7. Air conditioning compressor stud nuts (RPO V08 cooling system only).

Tighten

- Air conditioning compressor stud nuts to 16 N.m (12 lb. ft.).
8. Radiator upper mounting panel (53) (base cooling system and RPO V03 cooling system) or radiator fan upper shroud (27) (RPO V08 cooling system only).
 9. Radiator upper mounting panel bolts/screws (52) or radiator fan shroud bolts/screws (25).
- ### Tighten
- Bolts/screws (52 or 25) to 6 N.m (53 lb. in.).
10. Radiator inlet hose (40) at radiator and water pump.
 11. Rear air intake duct and air cleaner front resonator (39) as a unit.
 12. Tighten clamps snugly on rear air intake duct (at engine) and on air cleaner front resonator (39) at mass airflow sensor (57).
 13. Intake air temperature sensor electrical connector.
 14. Air cleaner rear resonator (37). Insert front part of rear reservoir into top of previously installed rear air intake duct and tighten clamp snugly.
 15. Battery negative cable.



- A REAR AIR INTAKE DUCT
- B THROTTLE BODY TUBE
- 37 RESONATOR, AIR CLEANER REAR
- 38 CLEANER, AIR
- 39 RESONATOR, AIR CLEANER FRONT
- 40 HOSE, RADIATOR INLET
- 41 HOSE, RADIATOR OUTLET (HOSE SHOWN FOR RPO CODE V08 HEAVY-DUTY COOLING SYSTEM; STANDARD HOSE HAS SAME ROUTING)
- 42 HOSE, COOLANT RECOVERY RESERVOIR
- 57 MASS AIRFLOW SENSOR

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Figure 15 - Engine Coolant Hoses

6B-20 COOLING AND RADIATOR



Tighten

- Bolt/screw to 6 N.m (53 lb. in.).

16. Add engine coolant. Refer to “Draining and Refilling Cooling System” in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

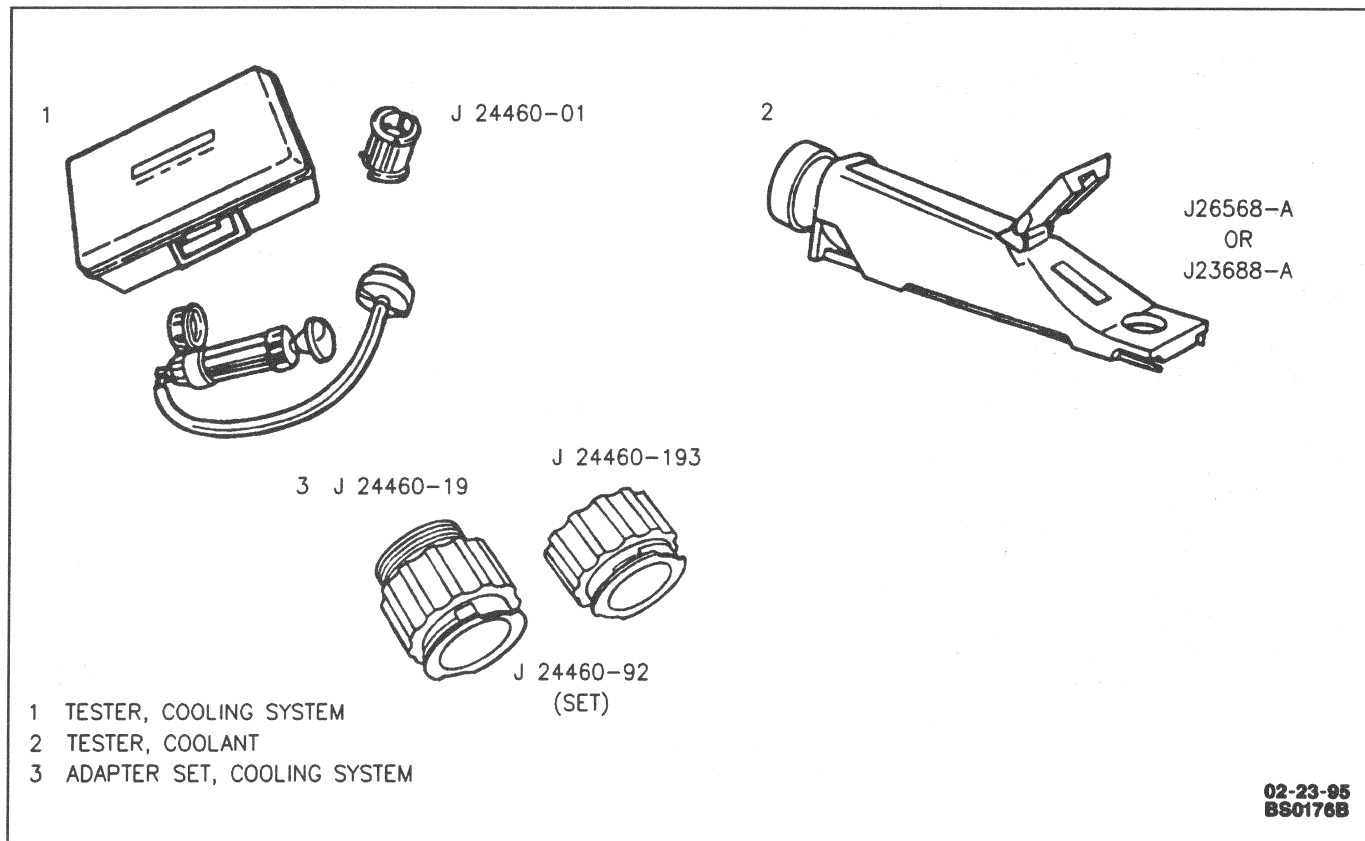
Cooling System Approximate Fluid Capacities

Without Heavy-Duty Cooling System	13.5 liters (14.3 qt.)
With Heavy-Duty Cooling System	15.9 liters (16.9 qt.)
Thermostat Opening Temperature	85° C (185° F)

FASTENER TIGHTENING SPECIFICATIONS

Coolant Recovery Reservoir Nut	6 N.m (53 lb. in.)
Engine Coolant Fan Bolt/Screw (Electric)	6 N.m (53 lb. in.)
Engine Oil Cooler Fitting Nut	27 N.m (20 lb. ft.)
Fan Blade Clutch Bolt/Screw	24 N.m (18 lb. ft.)
Fan Blade Clutch Nut	24 N.m (18 lb. ft.)
Radiator Air Lower Deflector Bolt/Screw	1.5 N.m (13 lb. in.)
Radiator Air Side Deflector Bolt/Screw	1.9nm (17 lb in)
Radiator Fan Shroud Bolt/Screw	6 N.m (53 lb. in.)
Radiator Fan Upper Shroud Bolt/Screw	6 N.m (53 lb. in.)
Radiator Upper Mounting Panel Bolt/Screw	6 N.m (53 lb. in.)
Thermostat Housing Bolt/Screw	28 N.m (21 lb. ft.)
Transmission Oil Cooler Fitting Nut	27 N.m (20 lb. ft.)

SPECIAL TOOLS



Section 6C

Engine Fuel

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

Notice: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors

will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, Do Not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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General Description

The fuel supply is stored in the fuel tank. An electric fuel pump, attached to the fuel sender assembly (inside the fuel tank) pumps fuel through an in-line filter to the fuel rail assembly. The pump is designed to provide fuel at a pressure above the regulated pressure needed by the injectors. A pressure regulator, an integral part of the fuel rail assembly, keeps fuel available to the injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate pipe. For further information on the fuel injection system, go to *Fuel Metering System* located in *Section 6E3-C2*.

Unleaded fuel must be used with all gasoline engines for proper emission control system operation. Using unleaded fuel will also decrease spark plug fouling and extend engine oil life. Leaded fuel can damage the emission control system, and its use can result in loss of emission warranty coverage.

All vehicles with gasoline engines are equipped with an evaporative emission system that minimizes the escape of fuel vapors to the atmosphere. Information on this system is found in *Section 6E3-C3*.

Fuel Tank

The fuel tank is used to store fuel for the vehicle. The tank is molded from high density polyethylene, and is located behind the rear wheels. It is held in place by two metal straps and a cross strap attached to the underbody. The tank shape includes a reservoir to maintain a constant supply of fuel around the fuel pump strainer during low fuel conditions and aggressive vehicle maneuvers.

When working on or near the fuel tank, be sure to observe important information molded on the bottom of tank.

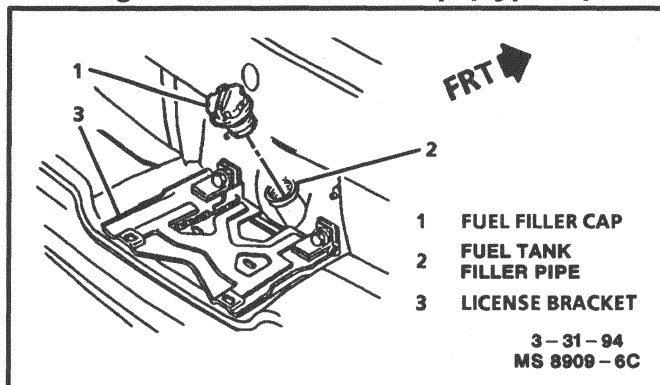
6C-2 Engine Fuel

Fuel Tank Filler Pipe

Figure 1

The fuel tank filler pipe outlet is positioned at the rear of the vehicle. To prevent refueling with leaded fuel, the fuel filler pipe has a built-in restrictor and deflector.

Figure 1 - Fuel Filler Cap (Typical)



Fuel Filler Cap

Figure 1

The fuel tank filler pipe is equipped with a threaded-type cap. The threaded part of the cap requires several turns counterclockwise to remove. A built-in torque-limiting device prevents over tightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

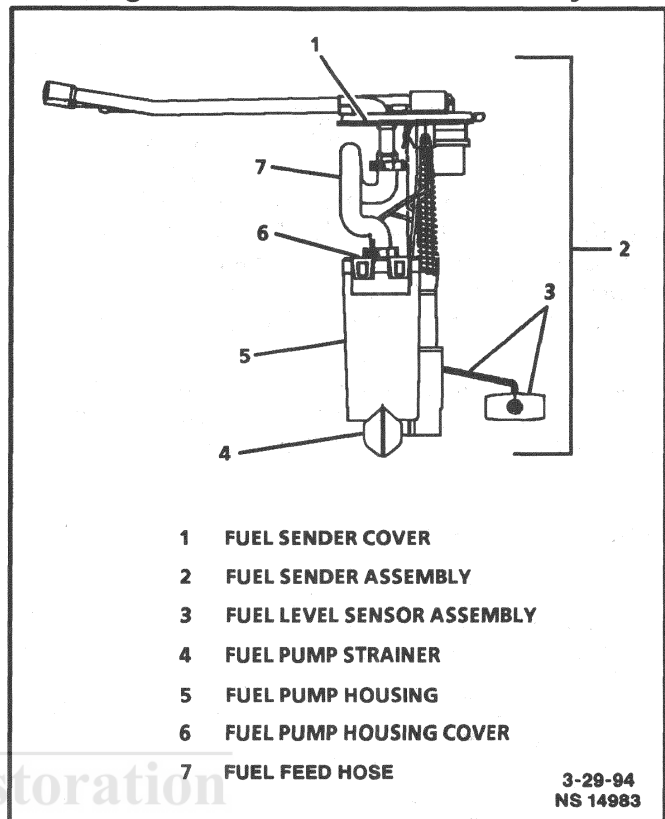
Notice: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serious malfunction of the system.

Fuel Sender Assembly

Figure 2

The fuel sender assembly is located inside the fuel tank and is attached to the top of the fuel tank. The fuel sender assembly consists of the following major components: a fuel sender, fuel pump, and a fuel pump strainer.

Figure 2 - Fuel Sender Assembly



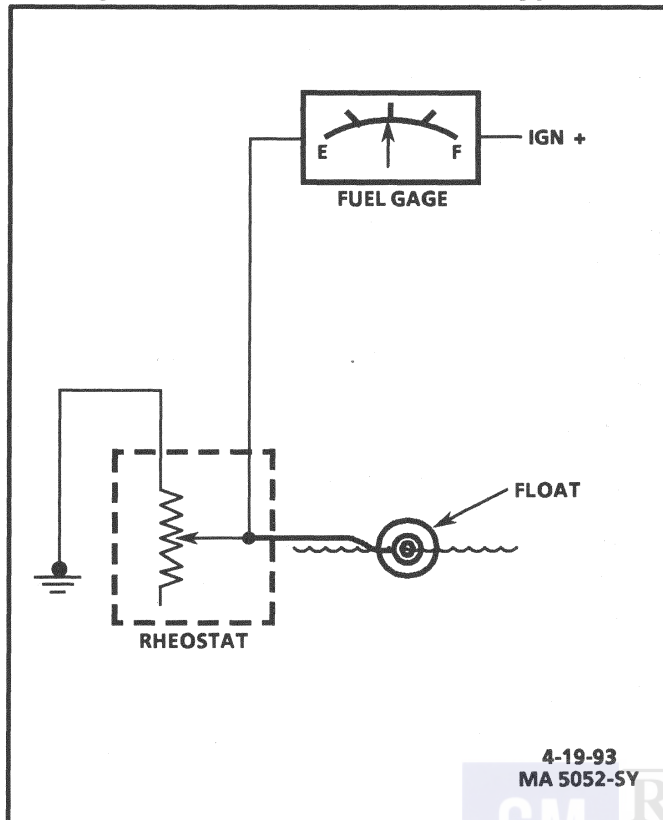
Fuel Sender

Figures 2 and 3

The fuel sender consists of the float, wire float arm, rheostat and roll-over valve. Fuel level is sensed by the position of the float and float arm which operate the 90 ohm rheostat. As the float position changes, the amount of current passing through the rheostat varies, thus changing the gauge reading on the instrument panel.

The roll-over valve is pressed into the EVAP pipe of the fuel sender and is not serviced separately. The roll-over valve prevents fuel from entering the evaporative emission canister if the vehicle rolls over by shutting "OFF" the EVAP pipe to the canister.

Figure 3 - 90 Ohm Rheostat (Typical)



Fuel Pump

Figure 2

The fuel pump is an electric medium pressure twin turbine pump which is mounted to the fuel sender assembly inside the fuel tank. The fuel is pumped to the fuel rail assembly at a specified flow and pressure by the fuel pump. Excess fuel is returned to the fuel tank by the return pipe. The fuel pump delivers a constant flow of fuel to the engine even during low fuel conditions and aggressive vehicle maneuvers.

The electric fuel pump operation is controlled by the Powertrain Control Module (PCM) through a fuel pump relay. Go to *Section 6E3-C2* and *Section 8A* of this manual for further description and a wiring diagram of the fuel pump relay.

Fuel Pump Strainer

Figure 2

A woven plastic fuel pump strainer is attached to the lower end of the fuel pump in the fuel tank. The functions of the fuel pump strainer are to filter contaminants and to wick fuel.

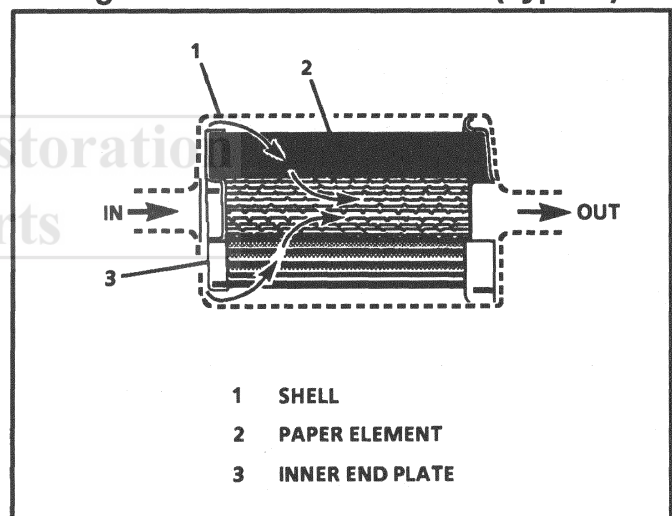
The life of the fuel pump strainer is generally considered to be that of the fuel pump. The fuel pump strainer is self-cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water. In this case the tank should be thoroughly cleaned. Go to *Fuel System Cleaning* in this section. If the fuel pump strainer is plugged, replace it with a new one.

In-Line Fuel Filter

Figure 4

A steel in-line fuel filter is used in the fuel feed pipe ahead of the fuel injection system. The filter element is made of paper, and is designed to trap particles in the fuel that may damage the injection system. The filter housing is constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. Quick-connect type fittings are used at both ends of the filter. There is no service interval for fuel filter replacement. Only replace the fuel filter if it is restricted.

Figure 4 - In-Line Fuel Filter (Typical)



MA 5050-SY

Fuel Feed and Return Pipes

Nylon Fuel Pipes

Nylon fuel pipes are designed to perform the same job as the steel or flexible fuel pipes or hoses they replace. Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There are two sizes used: 3/8" ID for the fuel feed, and 5/16" ID for the fuel return.

The fuel feed and return pipes are assembled as a harness. Retaining clips hold the pipes together and provide a means for attaching the pipes to the vehicle. Sections of the pipes that are exposed to chafing, high temperature or vibration are protected with heat resistant rubber hose and/or corrugated plastic conduit.

6C-4 Engine Fuel

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if forced into sharp bends, nylon pipes will kink and restrict fuel flow. Also, once exposed to fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Some special care should be taken when working on a vehicle with nylon fuel pipes.

CAUTION: To Reduce the Risk of Fire and Personal Injury:

- **Always cover nylon fuel pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115° C (239° F) for more than one hour, or more than 90° C (194° F) for any extended period.**
- **Take care not to nick or scratch the nylon fuel pipes. If damaged, they must be replaced.**

Quick-Connect Fittings

Quick-connect type fittings provide a simplified means of installing and connecting fuel system components. Depending on the vehicle model, there are two types of quick-connect fittings, each used at different locations in

the fuel system. Each type consists of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs or fingers hold the fittings together.

EVAP Pipes and Hoses

The EVAP pipe extends from the fuel sender assembly to the evaporative emission canister. It is made up of nylon pipe and is connected to the fuel sender assembly and the evaporative emission canister with fuel resistant rubber hoses.

CAUTION: To Reduce the Risk of Fire and Personal Injury:

- **Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115° C (239° F) for more than one hour, or more than 90° C (194° F) for any extended period.**
- **Take care not to nick or scratch the nylon vapor pipes. If damaged, they must be replaced.**

Diagnosis

Alcohol-in-Fuel

Alcohol-in-fuel can be detrimental to fuel system components and may cause driveability problems such as hesitation, lack of power, stall, no start, etc.

The problems may be due to fuel system corrosion and subsequent fuel filter plugging, deterioration of rubber components and/or air-fuel mixture leaning.

Various types and concentrations of alcohols are used in commercial fuel. Some alcohols are more detrimental to fuel system components than others. If an excessive amount of alcohol in the fuel is suspected as the cause of a driveability condition, the following procedure may be used to detect the presence of alcohol in the fuel.

Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy, or contaminated with water (as indicated by a water layer at the bottom of the sample), this procedure should not be used, and the fuel system should be cleaned. Go to *Fuel System Cleaning* in this section.

1. Using a 100 ml cylinder with 1 ml graduation marks, fill with fuel to the 90 ml mark.
2. Add 10 ml of water to bring the total fluid volume to 100 ml and install a stopper.
3. Shake vigorously for 10 to 15 seconds.
4. Carefully loosen the stopper to release pressure.
5. Close the stopper and shake vigorously again for 10 to 15 seconds.

6. Put the graduated cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer (which would now contain both alcohol and water) will be greater than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, it will indicate at least 5 percent alcohol in fuel. The actual amount of alcohol may be somewhat greater because this procedure does not extract all of the alcohol from the fuel.

Fuel Tank Leak Check

Important:

- Before attempting "Fuel Tank Leak Check" place a dry chemical (Class B) fire extinguisher near work area.
 - Before removing the fuel tank for a suspected leak, make sure fuel pipes are not leaking onto the tank. Once removed, make sure fuel is not leaking around fuel sender assembly O-ring.
 - This check requires the fuel sender assembly with O-ring to be installed.
1. Disconnect negative battery cable.
 2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
 3. Drain fuel tank. Refer to *Draining Fuel Tank*.
 4. Remove fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
 5. Cap fuel feed pipe, fuel return pipe and EVAP pipe on fuel sender assembly.
 6. Connect a piece of hose to the filler pipe nipple and plug opposite end.

7. Submerge tank in water or apply soap solution to outside of tank.
8. Apply 35 kPa (5 psi) air pressure to the vent hose on the fuel tank.

- Air bubbles appearing from fuel tank indicate a leak. Replace the fuel tank if it is leaking. Refer to *Fuel Tank and Fuel Filler Tube Replacement*.

On-Vehicle Service

Important: Before attempting any "On-Vehicle Service" place a dry chemical (Class B) fire extinguisher near work area.

Fuel System Pressure Relief

Tool Required:

J 34730-1A, Fuel Pressure Gauge

CAUTION:

- *To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.*
 - *After relieving system pressure, a small amount of fuel may be released when servicing fuel pipes or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.*
1. Ignition "OFF."
 2. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
 3. Loosen fuel filler cap to relieve tank pressure. (Do not tighten until service has been completed.)
 4. Connect J 34730-1A to fuel pressure connection. Wrap a shop towel around fitting while connecting gauge to avoid spillage.
 5. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
 6. Drain any fuel remaining in gauge into an approved container.

Servicing Quick-Connect Fittings

Figure 5

Tools Required:

J 37088-A, tool set, Fuel Line Quick-Connect Separator

Remove or Disconnect

Important:

- Relieve fuel system pressure before servicing any fuel system connection. Refer to *Fuel System Pressure Relief*.

- Slide dust covers from quick-connect fittings, if equipped.
1. Grasp both sides of fitting. Twist female connector 1/4 turn in each direction to loosen any dirt within fitting.

CAUTION: *Safety glasses must be worn when using compressed air, as flying dirt particles may cause eye injury.*

2. Using compressed air, blow dirt out of fitting.

- For plastic (Hand Releasable) Fitting -

3. Squeeze plastic retainer release tabs.
4. Pull connection apart.

-OR-

- For Metal Fitting -

3. Choose correct tool from J 37088-A tool set for size of fitting. Insert tool into female connector, then push inward to release locking tabs.
4. Pull connection apart.

Clean and Inspect

Notice: If it is necessary to remove rust or burrs from fuel pipe: use emery cloth in a radial motion with the pipe end to prevent damage to O-ring sealing surface.

- Using a clean shop towel, wipe off male pipe end.
- Inspect both ends of fitting for dirt and burrs. Clean or replace components/assemblies as required.

Install or Connect

CAUTION: *To Reduce the Risk of Fire and Personal Injury:*

Before connecting fitting, always apply a few drops of clean engine oil to the male pipe end. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

1. Apply a few drops of clean engine oil to the male pipe end.
2. Push both sides of fitting together to cause the retaining tabs/fingers to snap into place.
3. Once installed, pull on both sides of fitting to make sure connection is secure.
4. Reposition dust cover over quick-connect fitting, if equipped.

Figure 5 - Quick-Connect Fittings



Metal Collar Quick-connect Fitting



Plastic Collar Quick-connect Fitting

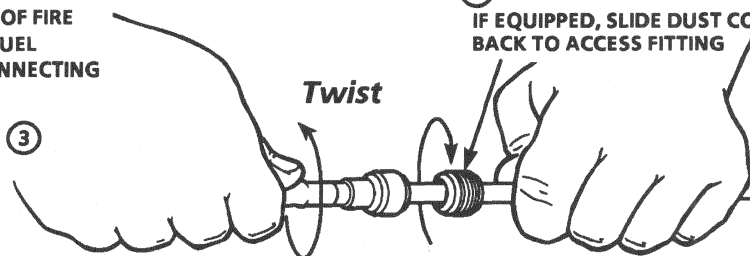
Removal

①

CAUTION: TO REDUCE THE RISK OF FIRE AND PERSONAL INJURY, RELIEVE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING FUEL PIPE FITTINGS.

②

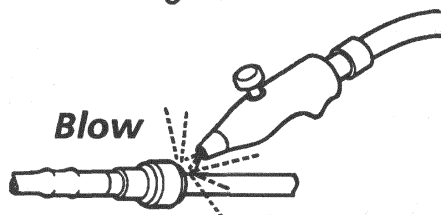
IF EQUIPPED, SLIDE DUST COVER BACK TO ACCESS FITTING



③

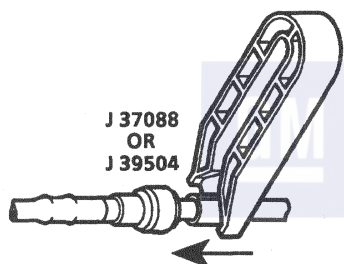
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Blow

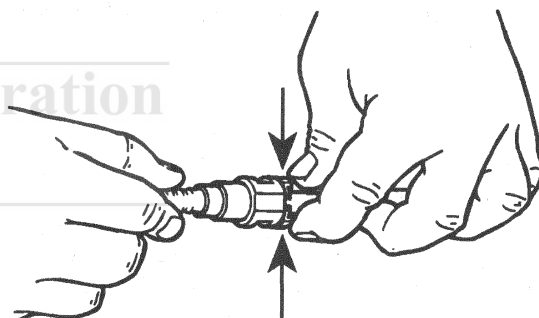


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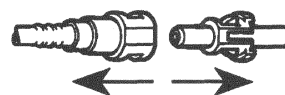
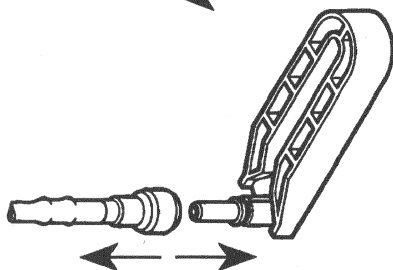
J 37088
OR
J 39504



OR

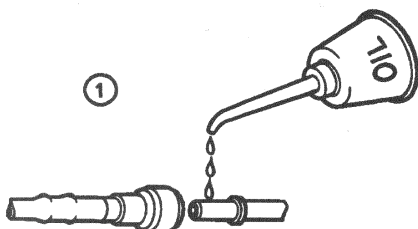


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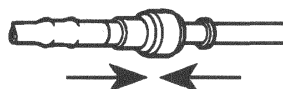


Installation

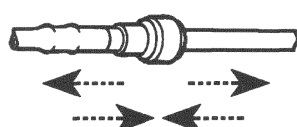
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IF EQUIPPED, REPOSITION DUST COVER AFTER SERVICE



In-Line Fuel Filter Replacement

Figure 6

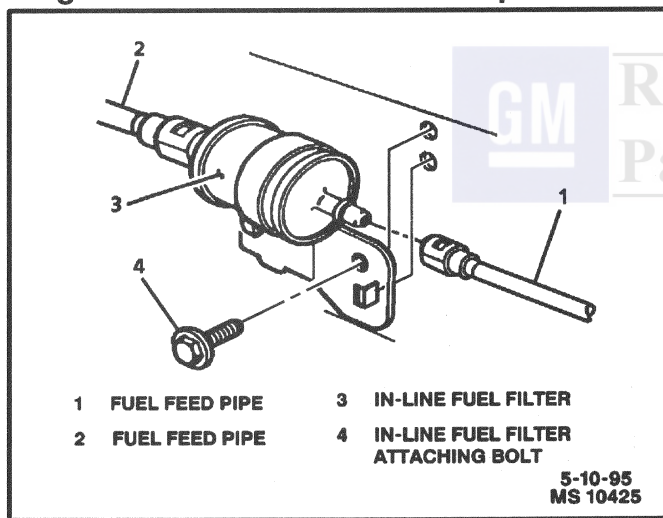
Important:

- There is no service interval for fuel filter replacement. Only replace the fuel filter if it is restricted.
- If the in-line fuel filter is restricted, the fuel tank should be inspected internally and cleaned if necessary.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Raise vehicle.
4. Fuel filter bracket attaching bolt.
5. Quick-connect fittings. Refer to *Servicing Quick-Connect Fittings*.
6. Fuel filter.

Figure 6 - In-Line Fuel Filter Replacement



Install or Connect

1. Remove protective caps from new filter.
2. New plastic connector retainers on filter inlet and outlet tubes.
 - Install in same positions as on old filter noting direction of fuel flow arrow.
3. Quick-connect fittings. Refer to *Servicing Quick-Connect Fittings*.
4. Trap in-line fuel filter over return pipe and install to frame with attaching bolt. Tighten
 - In-line fuel filter attaching bolt to 10 N•m (89 lb. in.).

5. Lower vehicle.
6. Tighten fuel filler cap.
7. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Draining Fuel Tank

CAUTION:

- **Never drain or store fuel in an open container due to the possibility of fire or explosion.**
- **When draining fuel tank, slowly insert and do not force hand operated pump device in fuel tank. Forcing pump device can cause fuel pump to be dislocated from fuel sender assembly.**
- Use a hand operated pump device to drain fuel through the fuel filler pipe. Remove fuel and install fuel filler cap.

Fuel Tank and Fuel Filler Pipe Replacement

Figures 7 through 9

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Drain fuel tank. Refer to *Draining Fuel Tank*.
4. Raise vehicle.
5. Lower fuel tank shield attaching screws and lower fuel tank shields from upper fuel tank shield.
6. Wipe EVAP hose connection at fuel sender, and then disconnect EVAP hose and clamp.
7. Wipe vent hose connection at fuel filler pipe vent pipe, and then disconnect vent hose and clamp.
8. Wipe fuel filler pipe connection at fuel tank, and then disconnect fuel filler pipe and clamp.

Notice:

- If nylon fuel feed or return pipes becomes kinked, and cannot be straightened, they must be replaced.
- Do Not attempt to repair sections of nylon fuel pipes. If damaged, replace.
- 9. Fuel feed and return pipe quick-connect fittings at fuel sender assembly. Refer to *Servicing Quick-Connect Fittings*.

Figure 7 - Fuel Tank Mounting (Typical) (1 of 2)

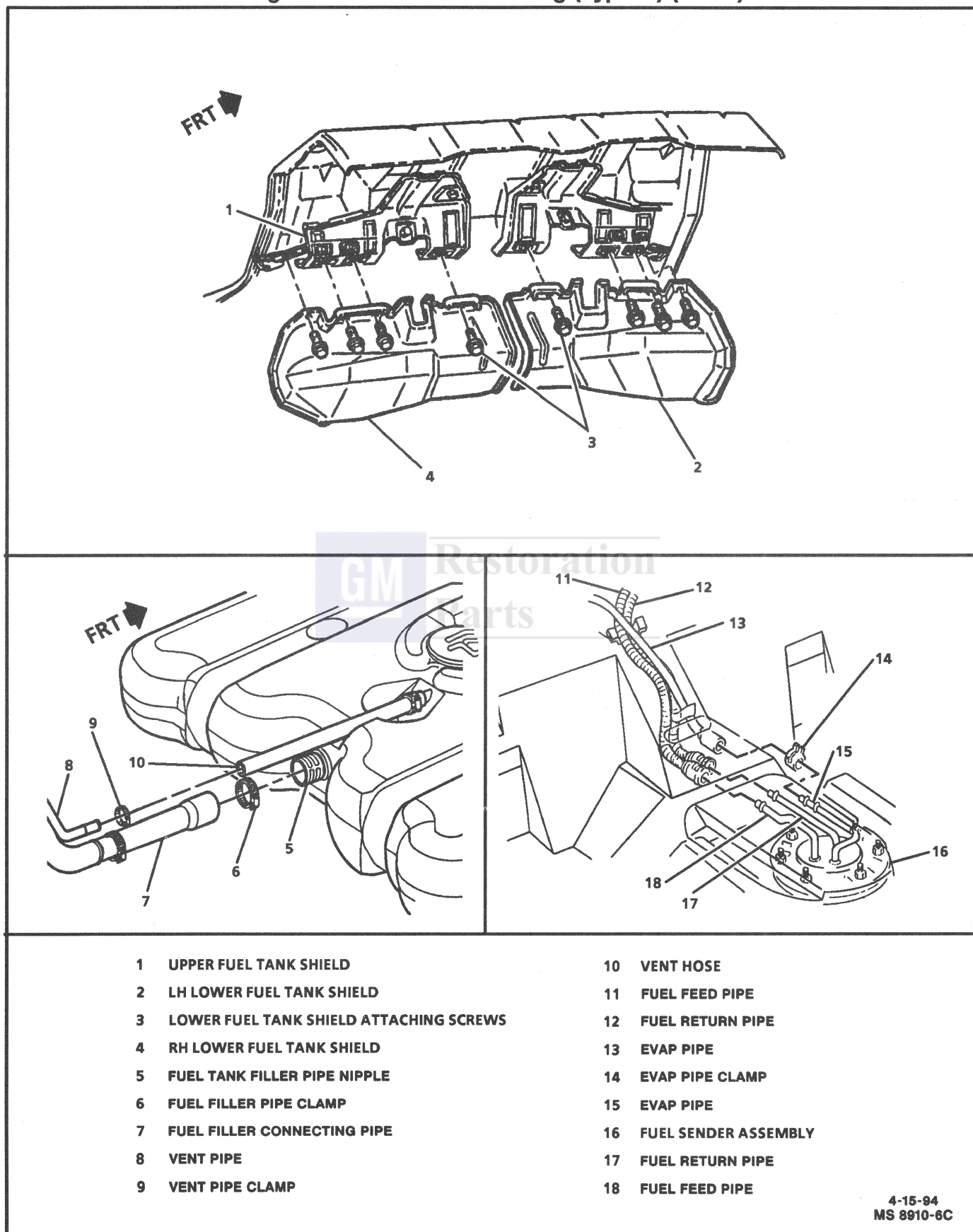
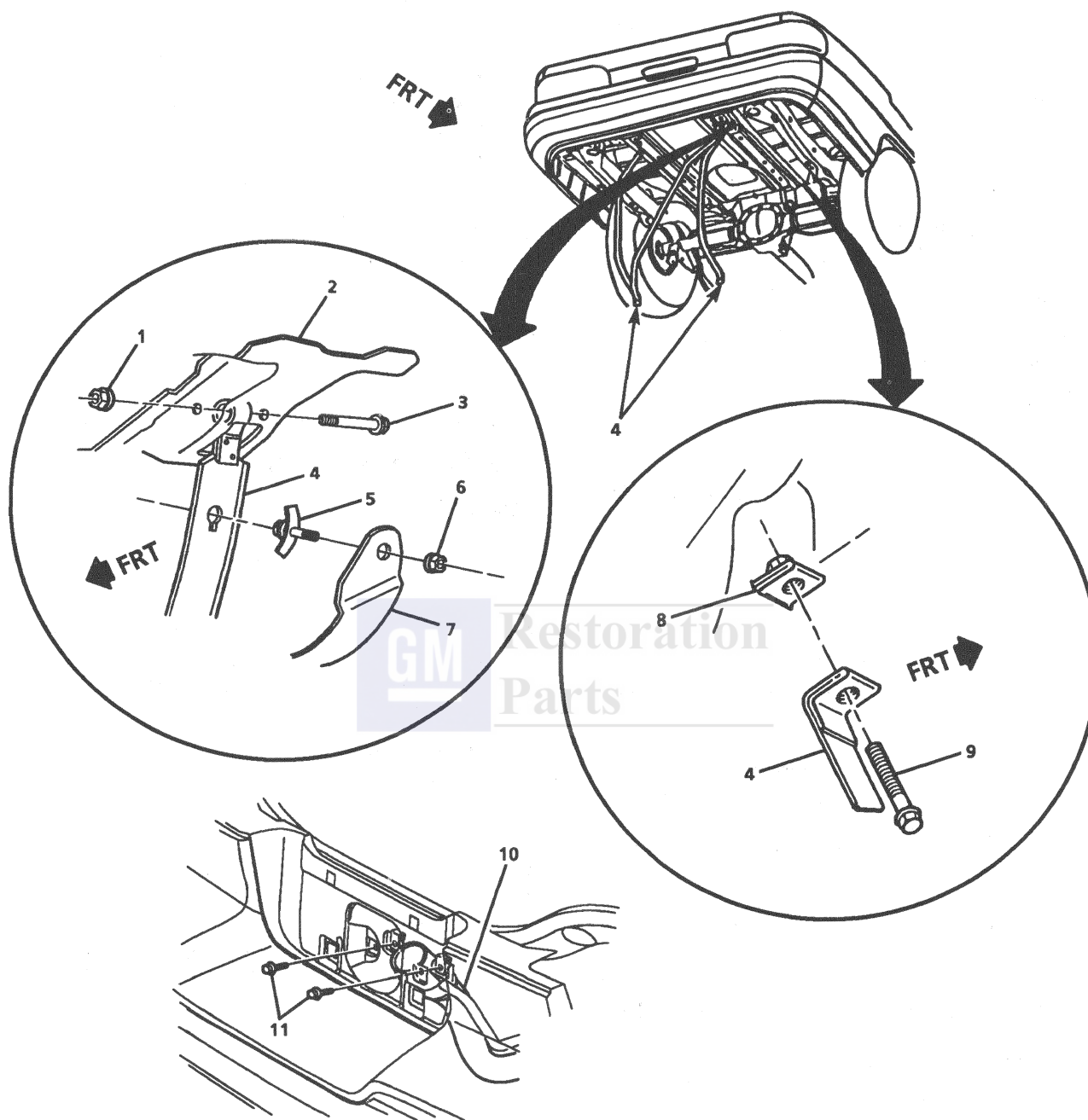


Figure 8 - Fuel Tank Mounting (Typical) (2 of 2)



- 1 REAR FUEL TANK RETAINING STRAP NUTS
- 2 UNDER BODY
- 3 REAR FUEL TANK RETAINING STRAP BOLTS
- 4 FUEL TANK RETAINING STRAPS
- 5 FUEL TANK CROSS STRAP ATTACHING SCREW
- 6 FUEL TANK CROSS STRAP ATTACHING NUT

- 7 FUEL TANK CROSS STRAP
- 8 FRONT FUEL TANK RETAINING STRAP BODY NUTS
- 9 FRONT FUEL TANK RETAINING STRAP BOLTS
- 10 FUEL FILLER PIPE
- 11 FUEL FILLER PIPE ATTACHING SCREWS

6C-10 Engine Fuel

10. Fuel sender assembly electrical connector.

Notice: Do Not bend fuel tank retaining straps, as this may damage straps.

11. With the aid of an assistant, support fuel tank and remove front fuel tank retaining strap attaching bolts and fuel tank.

- Place fuel tank in a suitable work area.

Important: Perform Step 12 only if fuel filler pipe needs to be replaced.

12. Fuel filler pipe attaching screws, ground strap (if equipped), and fuel filler pipe.

Disassemble

1. Fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.
2. Fuel tank vent hose.

Assemble

1. Fuel tank vent hose.
2. Install fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.

Install or Connect

Important: Perform Step 1 only if fuel filler pipe needs to be installed.

1. Fuel filler pipe, ground strap (if equipped), and fuel filler pipe attaching screws.
Tighten
 - Fuel filler pipe attaching screws to 6 N•m (53 lb. in.) (Except Wagon) and 1.9 N•m (17 lb. in.) (Wagon).
 - Fuel filler pipe ground strap screw to 4 N•m (35 lb. in.).
2. With the aid of an assistant, position and support fuel tank. Install fuel tank retaining strap front attaching bolts.
Tighten
 - Front fuel tank retaining strap bolts to 32 N•m (24 lb. ft.).
3. Fuel filler pipe and clamp.

4. Fuel tank vent hose and clamp.

5. EVAP hose and clamp.

6. Fuel sender assembly electrical connector.

7. Fuel feed and return pipe quick-connect fittings to fuel sender assembly. Refer to *Servicing Quick-Connect Fittings*.

8. Lower fuel tank shields on upper fuel tank shield with attaching screws.

Tighten

- Lower fuel tank shield attaching screws to 1 N•m (9 lb. in.).

9. Lower vehicle.

10. Add fuel and install fuel filler cap.

11. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Fuel Sender Assembly Replacement

Figures 9 and 10

Important: Always replace fuel sender assembly O-ring when reinstalling fuel sender assembly.

Notice: Do Not handle the fuel sender assembly by the fuel sender pipes. Due to the length of the pipes, the amount of leverage generated by handling the pipes could damage the solder joints.

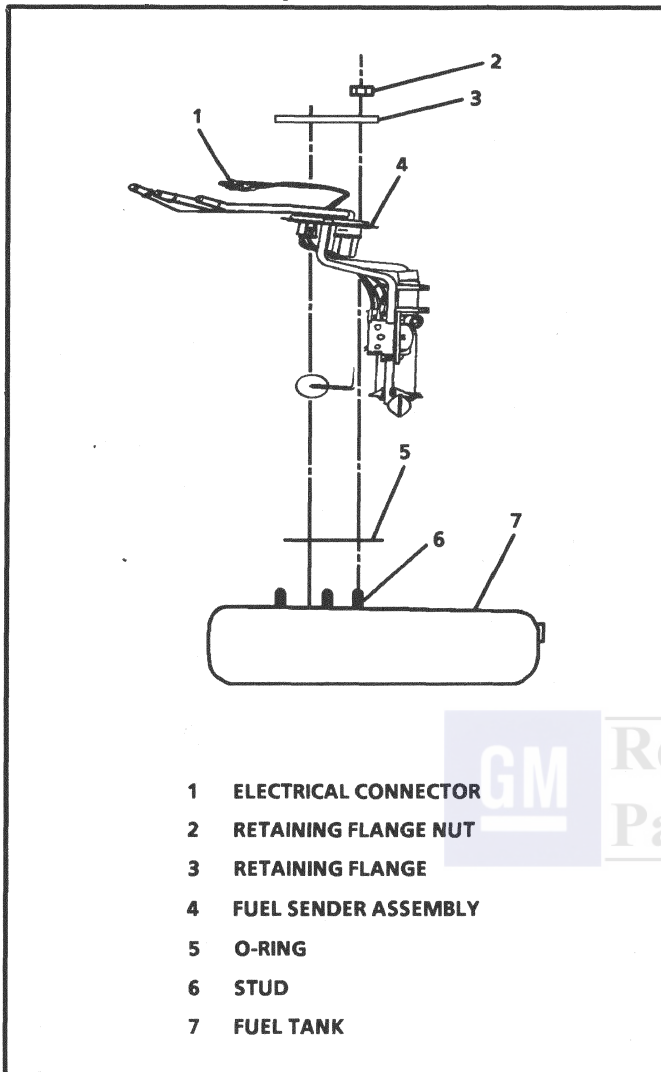
Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Drain fuel tank. Refer to *Draining Fuel Tank*.
4. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
5. Fuel sender assembly attaching nuts, retaining flange, fuel sender assembly and O-ring from fuel tank. Discard O-ring.

Clean

- Fuel sender assembly sealing surfaces.

Figure 9 - Fuel Sender Assembly Replacement



MS 8912-6C

Install or Connect

Important: Care should be taken not to fold over or twist the fuel pump strainer when installing the fuel sender assembly as this will restrict fuel flow. Also, assure that the fuel pump strainer does not block full travel of float arm.

1. Position new O-ring on fuel tank.
2. Fuel sender assembly, retaining flange and fuel sender assembly attaching nuts.
Tighten
 - Fuel sender assembly attaching nuts to 3 N•m (27 lb. in.).

3. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
4. Add fuel and install fuel filler cap.
5. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Fuel Sender Assembly Service

Figures 9 and 10

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Drain fuel tank. Refer to *Draining Fuel Tank*.
4. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
5. Fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.

Disassemble

1. Note position of fuel strainer on fuel pump.
2. Support sender with one hand and grasp strainer with other hand.
 - Rotate strainer in one direction and pull off of pump. Discard strainer after inspection.

Inspect

- Fuel pump strainer. If strainer is contaminated, it must be replaced and the fuel tank should be cleaned.
- Fuel pump inlet for dirt and debris. If found, fuel pump should be replaced.

- If fuel pump is being replaced, proceed to Step 3. -

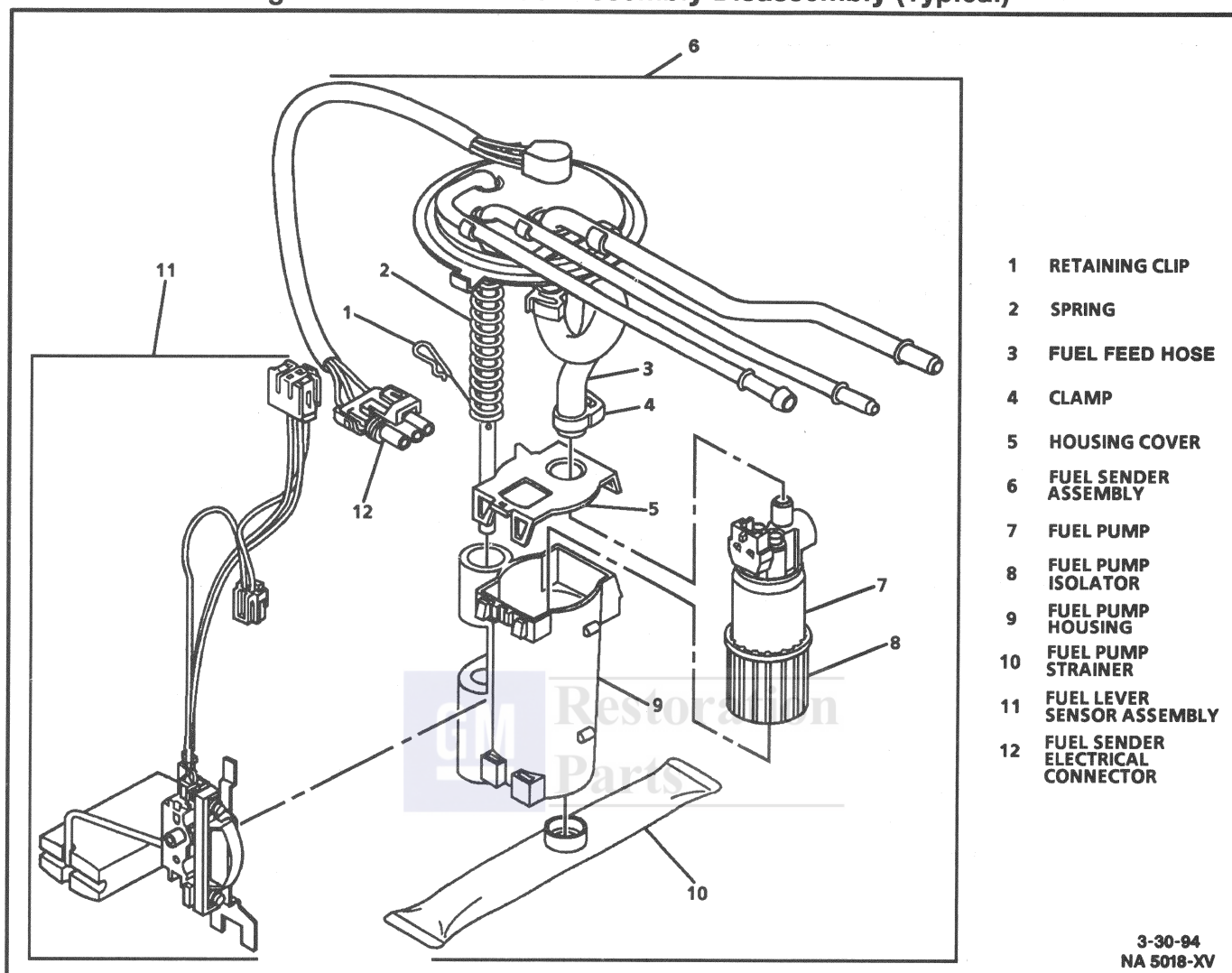
3. Loosen clamp and remove fuel feed hose from fuel pump outlet.
4. Terminal retainer.
5. Fuel pump electrical connector and electrical connector from bottom of sender cover.
6. Retainer clip from fuel return pipe.
7. Fuel pump and fuel level sensor assembly and spring from fuel sender.
8. Housing cover from fuel pump housing.
9. Fuel pump.

Notice: Do Not run fuel pump unless submerged in fuel.

- If fuel level sensor is being replaced, proceed to Step 10. -

10. Slide fuel level sensor from retainers on fuel pump housing.

Figure 10 - Fuel Sender Assembly Disassembly (Typical)



Assemble

1. Fuel level sensor to fuel pump housing.
2. Fuel pump and isolator into fuel pump housing.

Important: Small hole in the housing cover aligns over the fuel level sensor.

3. Housing cover to fuel pump housing.
4. Slide fuel pump and fuel level sensor assembly and spring onto fuel return pipe.

Important: Fuel pump and fuel level sensor assembly must be aligned directly under fuel sender cover.

5. Compress spring and install retainer clip through fuel return pipe.
6. Fuel feed hose to fuel pump outlet.
 - Tighten clamps so that 5 to 8 teeth are engaged.

7. Fuel pump electrical connector and electrical connector to bottom of sender cover.
8. Terminal retainer.

Important: Always install a new pump strainer when replacing fuel pump.

9. New pump strainer in same position as noted during disassembly.
 - Push on outer edge of strainer ferrule until fully seated.

Install or Connect

1. Fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.
2. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
3. Add fuel and install fuel filler cap.
4. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Fuel System Cleaning

Important:

- Only use oil free compressed air to blow out fuel pipes.
- If the in-line fuel filter is plugged, the fuel tank should be inspected internally and cleaned if necessary.

Fuel Tank

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Drain fuel tank. Refer to *Draining Fuel Tank*.
4. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
5. Fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.

Inspect

- Whenever the fuel tank is cleaned, the fuel pump strainer must be inspected. If strainer is contaminated, it must be replaced and the fuel pump must be inspected.
- Fuel pump inlet for dirt and debris. If found, fuel pump should be replaced.
- 6. Flush fuel tank with hot water.

Important: When flushing fuel tank, the fuel and water mixture needs to be treated as a hazardous material. The material needs to be handled in accordance with all applicable local, state, and federal laws and regulations.

7. Pour water out of fuel sender assembly opening.
 - Rock tank to be sure that removal of water from tank is complete.

Install or Connect

1. Fuel sender assembly. Refer to *Fuel Sender Assembly Replacement*.
2. Fuel tank. Refer to *Fuel Tank and Fuel Filler Pipe Replacement*.
3. Add fuel and install fuel filler cap.
4. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Fuel Feed and Return Pipes Replacement

Figures 6 and 11

Tools Required:

J 37088-A, tool set, Fuel Line Quick-Connect Separator

Notice:

- If nylon fuel feed or return pipes becomes kinked, and cannot be straightened, they must be replaced.
- Do Not attempt to repair sections of nylon fuel pipes. If damaged, replace.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure. Refer to *Fuel System Pressure Relief*.
3. Quick-connect fittings at fuel rail in engine compartment. Refer to *Servicing Quick-Connect Fittings*.
4. Fuel feed and return pipe retaining clip at brake booster.
5. Raise vehicle.
6. Quick-connect fittings at fuel filter. Refer to *Servicing Quick-Connect Fittings*.
7. Lower fuel tank shield attaching screws and lower fuel tank shields.
8. Fuel feed, return, and EVAP pipe underbody retainer.
9. Quick-connect fittings at fuel sender assembly. Refer to *Servicing Quick-Connect Fittings*.
10. Fuel feed and return pipe retaining clips and fuel feed and return pipes.
 - Note position of fuel pipes for installation.

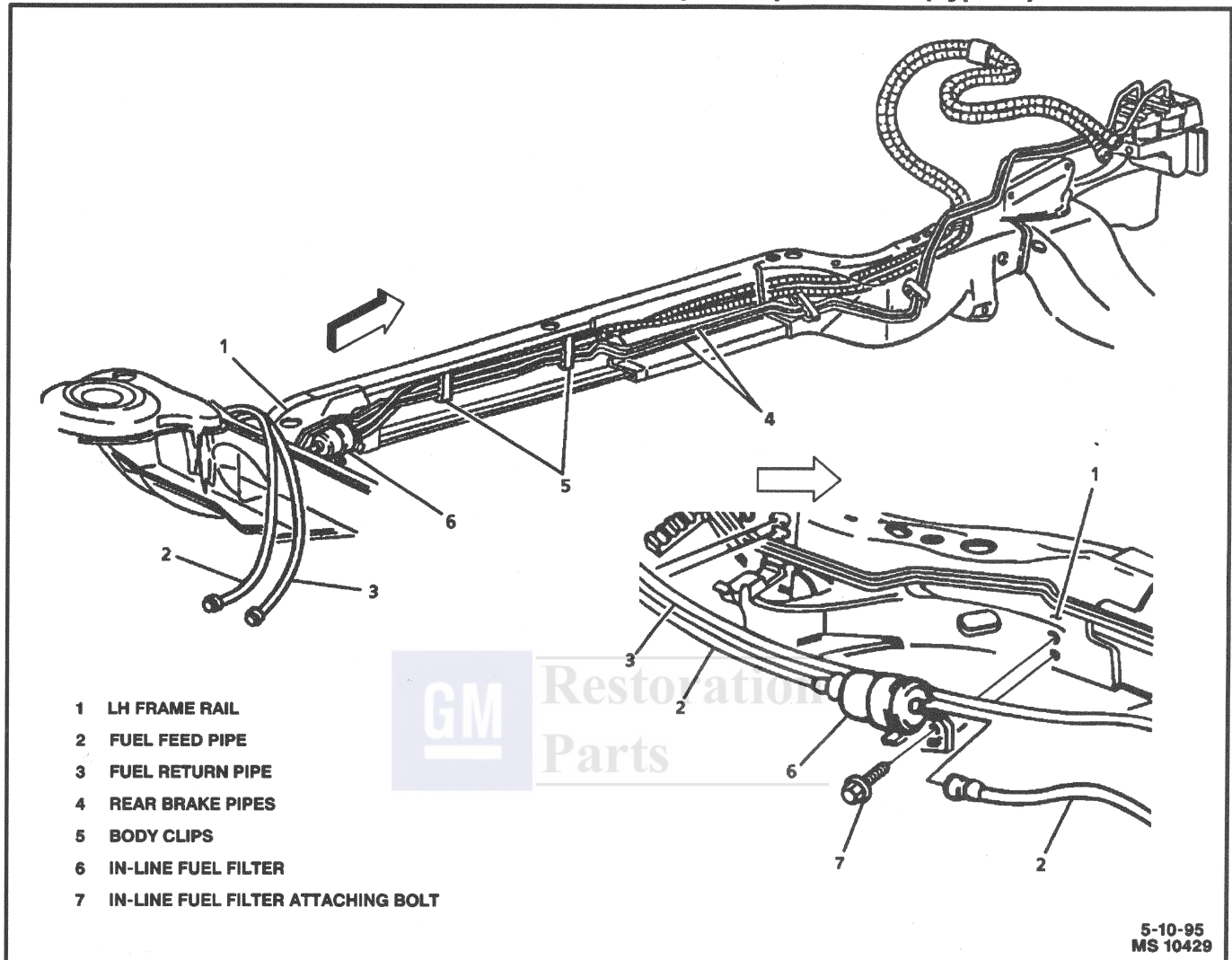
Install or Connect

CAUTION: To Reduce the Risk of Fire and Personal Injury:

- **If nylon fuel pipes are nicked, scratched or damaged during installation, they must be replaced.**
- **When installing new fuel pipes, Do Not hammer directly on the fuel harness body clips as this may damage the nylon pipes resulting in a possible fuel leak.**

1. Lower vehicle.
2. Rear ends of fuel feed and return pipes into top forward frame hole.
3. Raise vehicle.
4. Route pipes in same position as noted during disassembly.
5. Quick-connect fittings at fuel sender assembly. Refer to *Servicing Quick-Connect Fittings*.
6. Fuel feed, return, and EVAP pipe underbody retainer.

Figure 11 - Fuel Feed and Return Pipes Replacement (Typical)



7. Lower fuel tank shields and tank shield attaching screws.
Tighten
 - Lower fuel tank shield screws to 1 N•m (9 lb. in.).
8. Quick-connect fittings at fuel filter. Refer to *Servicing Quick-Connect Fittings*.
9. Close all retaining clips.
10. Lower vehicle.
11. Fuel feed and return pipe retaining clip at brake booster.
12. Quick-connect fittings at fuel rail in engine compartment. Refer to *Servicing Quick-Connect Fittings*.
13. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

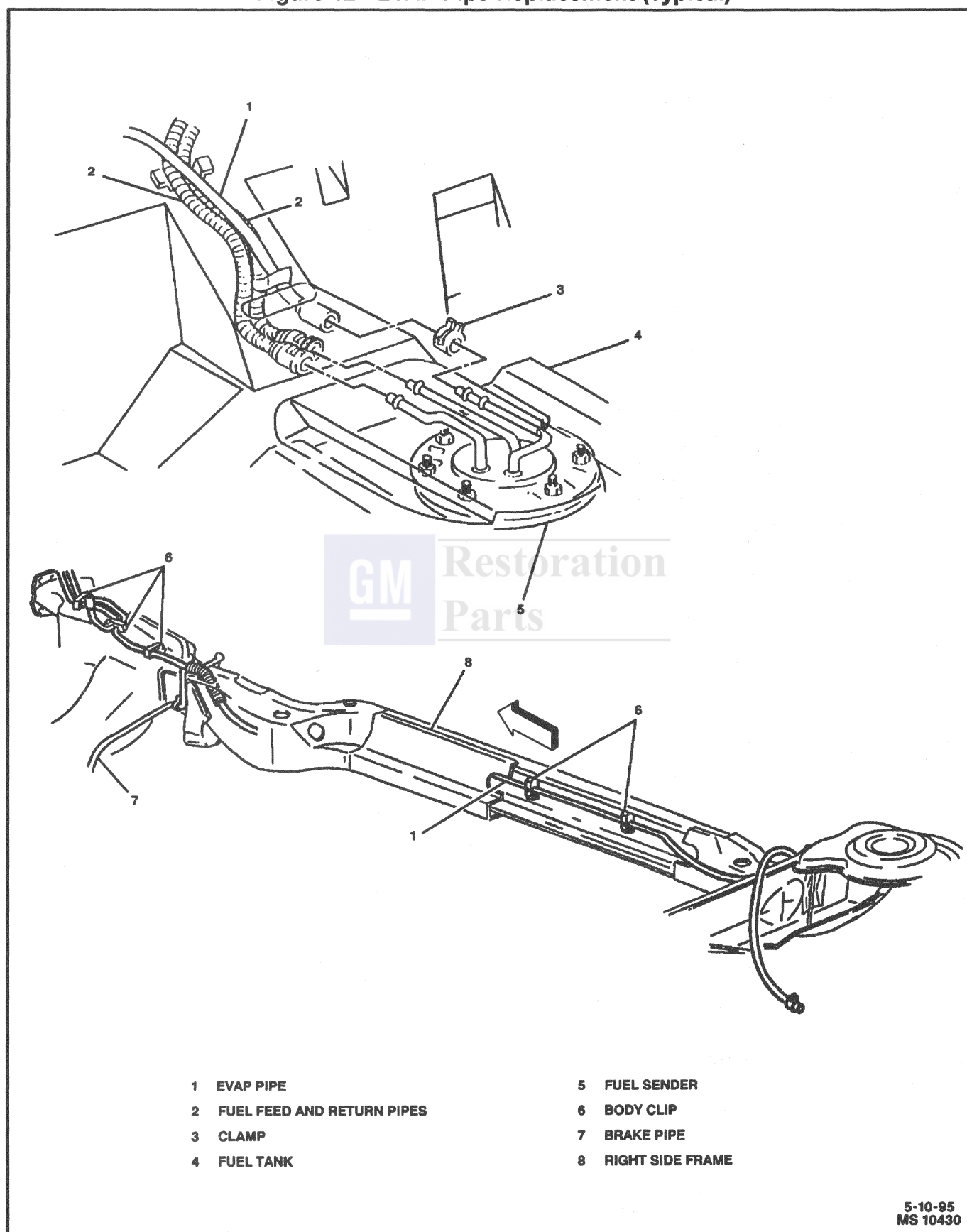
EVAP Pipe Replacement

Figure 12

Notice:

- If nylon pipes becomes kinked, and cannot be straightened, they must be replaced.
- Do Not attempt to repair sections of nylon pipes. If damaged, replace.
- When replacing EVAP pipes, always replace them with original equipment or parts that meet the GM specifications for those parts.
- When replacing EVAP hoses always replace them with original equipment or parts meeting GM specifications, use only reinforced fuel-resistant hose which is identified with the word "Fluoroelastomer" or "GM 6163-M" on the hose.

Figure 12 - EVAP Pipe Replacement (Typical)



6C-16 Engine Fuel

Remove or Disconnect

1. Raise vehicle.
2. Fuel feed, return, and EVAP pipe underbody retainer.
3. EVAP pipe clamp at fuel sender assembly.
4. EVAP pipe retaining clips.
 - Note position of EVAP pipe for installation.
5. Lower vehicle.
6. EVAP pipe hose end clamp at EVAP canister.
7. Forward pipe assembly retaining clips.

Install or Connect

1. Insert rear end of EVAP pipe into top forward frame hole. Load until formed pipe/conduit reaches into hole.
2. Forward pipe assembly retaining clips.
3. EVAP pipe hose end to EVAP canister. Secure with clamp.
4. Raise vehicle.
5. Position new EVAP pipe in same position as noted during disassembly and install retaining clips.
6. EVAP pipe clamp at fuel sender assembly.
7. Fuel feed, return, and EVAP pipe underbody retainer.
8. Lower vehicle.

Specifications

Torque Specifications

Application	Nm	Lb Ft	Lb In
Front Fuel Tank Retaining Strap Bolts	32	24	—
Fuel Filler Pipe Attaching Screws (Except Wagon)	6	—	53
Fuel Filler Pipe Attaching Screws (Wagon)	1.9	—	17
Fuel Filler Pipe Ground Strap Screw	4	—	35
Fuel Sender Assembly Attaching Nuts	3	—	27
Fuel Tank Cross Strap Attaching Nut	15	11	—
In-Line Fuel Filter Attaching Bolt	10	—	89
Lower Fuel Tank Shield Attaching Screws	1	—	9
Rear Fuel Tank Retaining Strap Nuts	25	18	—

Fuel Specifications

The fuel must meet ASTM Standard: D4814 (U.S.), CGSB 3.5-92 (Canada).

Octane Requirements

5.7L (VIN P)

4.3L (VIN W)

Minimum Octane Recommended: $87[(R+M)/2]$ (pump) octane where R= research octane number, and M= motor octane number.

Gasoline with Alcohol

Notice: Do Not spill fuel containing alcohol on the vehicle. Alcohol can cause damage to the paint finish and trim.

Methyl Tertiary-Butyl Ether (MTBE)

Fuel containing Methyl Tertiary-Butyl Ether (MTBE) may be used, providing there is no more than 15 percent MTBE by volume.

Ethanol

Fuel containing ethanol (ethyl) or grain alcohol may be used, providing that there is no more than 10 percent ethanol alcohol by volume.

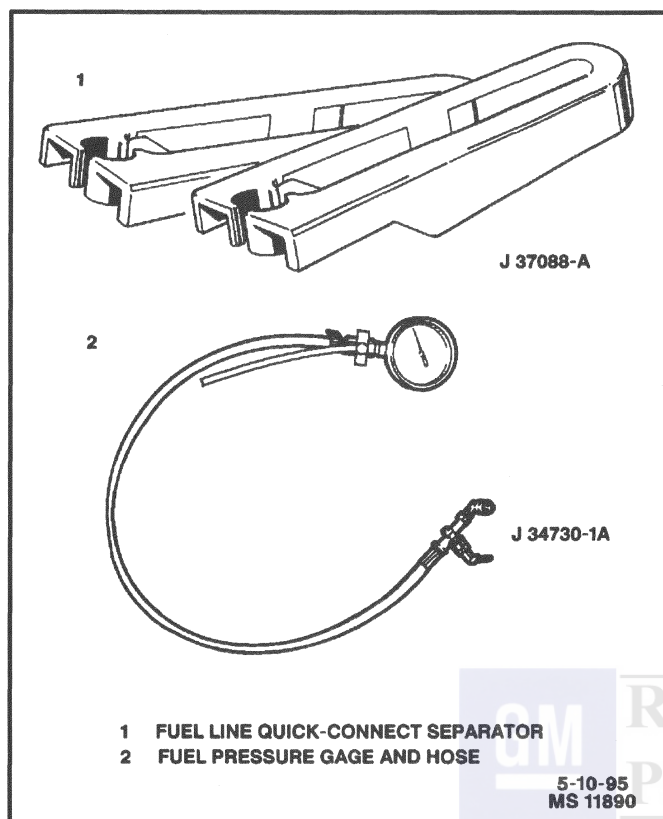
Methanol

Fuel containing methanol (methyl) or wood alcohol may be used, providing that there is no more than 5 percent methanol by volume.

Notice: Do not use fuel that contains more than 5 percent methanol. Use of a fuel (gasohol) that contains more than 5 percent of methanol can corrode metal fuel system components and damage plastic and rubber parts.

Special Tools

Figure 13 - Special Tools



Restoration
Parts



SECTION 6D1

BATTERY

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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CAUTION: All batteries generate hydrogen gas which is extremely flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery and possible severe personal injuries. Wear approved eye protection. Battery fluid is corrosive acid. Flush any contacted area with water immediately and thoroughly.

GENERAL DESCRIPTION

BATTERY

Figures 1 and 2

The maintenance-free battery is standard on all vehicles. See "SPECIFICATIONS" in this section for battery usage applications. There are no vent plugs in the cover. The battery is completely sealed except for

two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The battery has three major functions in the electrical system: first, it provides a source of energy for cranking the engine; second, it acts as a voltage stabilizer for the electrical system; and third, it provides energy for a limited time when the electrical load exceeds the output of the generator.

6D1-2 BATTERY

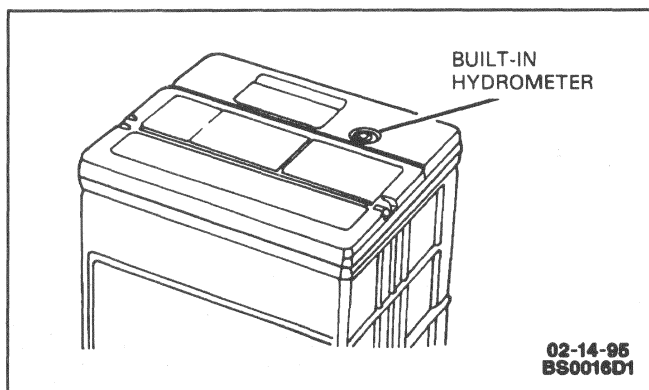


Figure 1 - Maintenance-Free Battery

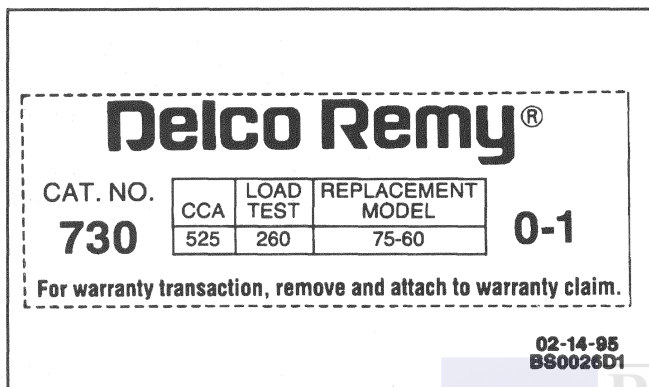


Figure 2 - Battery Label

The battery specification label contains important information for servicing the battery. This information includes test ratings and both original equipment and recommended replacement part numbers. Refer to "Specifications" at the end of this section.

BATTERY RATINGS

A battery has two ratings: (1) a reserve capacity rating and (2) a cold cranking amperage rating at -18°C (0°F). When replacing the battery, use these two ratings as a guide in selecting a replacement. For the catalog number of a replacement battery with ratings similar to the original battery, refer to "Specifications" at the end of this section.

Reserve Capacity

The "Reserve Capacity" is an estimate of the maximum length of time it is possible to travel at night (headlights "ON") with minimum electrical load and no generator output.

Expressed in minutes, it is the approximate time the fully-charged battery can support a 25-amp load without the battery terminal voltage dropping below 10.5 volts at 27°C (80°F).

Cold Cranking Amps

The cold cranking amperage (CCA) test is expressed at a battery temperature of -18°C (0°F). The current rating is the minimum amperage which must be maintained by the battery for 30 seconds, at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

COMMON CAUSES OF FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service. If the battery tests "good," but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Vehicle accessories are left on overnight.
2. Slow average driving speeds for short periods.
3. The vehicle's electrical load being more than the generator output, particularly with the addition of aftermarket equipment.
4. Conditions in the charging system such as electrical shorts, slipping serpentine belt, faulty generator, or generator voltage regulator.
5. Battery abuse, including failure to keep the battery terminals clean and tight, or loose battery hold-down. See "Battery Replacement" in this section for torque specifications.
6. Mechanical conditions in the electrical system, such as shorted or pinched wires.
7. Extended storage of vehicles.
8. Extended cranking periods due to plug fouling.
9. Incorrect interpretation of the hydrometer.
10. Insufficient ampere-hour charge rate for a discharged battery.
11. Burned out charge/generator lamp bulb causing "No Charge" condition.
12. Continuous current draw on the battery through excessive parasitic drain.

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a charged condition. As long as the green dot is visible in the hydrometer, the freezing point of the battery will be somewhere below -32°C (-25°F). The higher the state of charge, the lower the freezing point. A fully charged battery will not freeze until the temperature gets below -65°C (-85°F).

BATTERY TRAY AND HOLD-DOWN RETAINER

The battery tray and hold-down retainer should be clean and free from corrosion before installing the battery. The battery tray should be in a sound condition so that it will hold the battery securely and keep it level. Make certain there are no parts in the battery tray before installing battery. To prevent the battery from shaking in its battery tray, the hold-down retainers should be tight, but not overtight.

BATTERY PROTECTION DURING VEHICLE STORAGE

Today's vehicles have many high technology electronic devices which result in very small but continuous current drains on the batteries, commonly referred to as "parasitic loads." Vehicles that are not used for an extended period of time may develop an extremely discharged and/or permanently damaged battery resulting from parasitic loads.

Any battery discharged by parasitic loading and then allowed to stand in this condition for a period of time may not readily accept recharge. However, if properly recharged, most batteries will return to a good usable condition.

An extremely discharged battery can freeze at temperatures as high as -7°C (20°F) causing permanent damage. Permanent damage to a discharged battery can also be accelerated by high temperatures.

To prevent this condition, the battery negative cable should be disconnected on vehicles which are not going to be in service within a 30-day period, beginning from the time the vehicle is shipped. If this is not possible, batteries should be recharged periodically (every 20-45 days) until the green dot of the built-in hydrometer is visible.

BUILT-IN HYDROMETER

Figure 3

The maintenance-free battery has a built-in temperature compensated hydrometer in the top of the battery. This hydrometer is used with the following diagnostic procedure. When observing the hydrometer, make sure that the battery has a clean top. A light may be required in some poorly-lit areas. Tap the hydrometer lightly on top to dislodge any air bubbles that might cause a false indication. Under normal operation, two indications can be observed.

1. GREEN DOT VISIBLE

- Any green appearance is interpreted as a "green dot" and the battery is ready for testing.

2. DARK; GREEN DOT NOT VISIBLE

- If there is a cranking complaint, the battery should be tested as described in the "Diagnosis" in this section. The charging and electrical systems should also be checked at this time.

- Occasionally, a third condition may appear:

3. CLEAR OR LIGHT YELLOW

- This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, or excessive tipping. When finding a battery in this condition it may indicate high charging voltages caused by a faulty charging system, therefore, the charging and electrical systems may need to be checked. If a cranking complaint exists and is caused by the battery, the battery should be replaced.

DIAGNOSIS

BATTERY TESTING

Figures 3, 4 and 5

The following procedure should be used for testing batteries:

1. VISUAL INSPECTION

- Check for obvious damage, such as a cracked or broken case or cover that could permit loss of electrolyte. If obvious damage is noted,

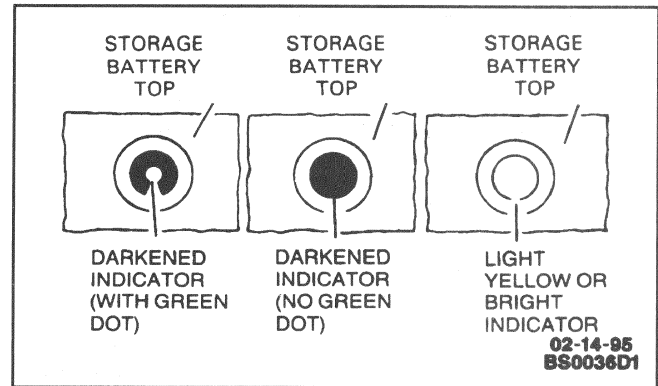


Figure 3 - Built-In Hydrometer

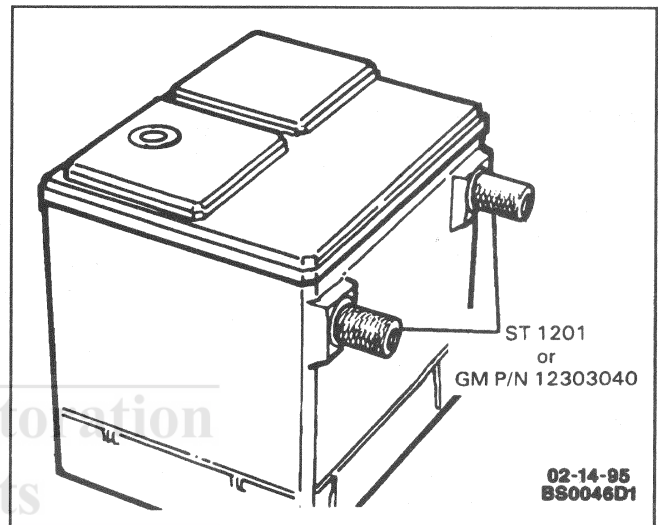


Figure 4 - Battery Side Terminal Adapters

replace the battery. Determine the cause of damage and correct as needed. If not, proceed to step 2.

2. HYDROMETER CHECK (Figure 3).

- GREEN DOT VISIBLE - Go to step 3.
- DARK; GREEN DOT NOT VISIBLE.
- Charge the battery as outlined under "Charging Procedure" in this section and proceed to step 3.

3. LOAD TEST

- Load testing requires using battery side terminal adapters to ensure good connections (Figure 4). Do not load test a frozen battery.

- Connect a voltmeter and a battery load tester across the battery terminals.
- Apply a 300-amp load for 15 seconds to remove surface charge from the battery.
- Wait 15 seconds to let the battery recover. Apply load specified on the battery label or in "Specifications" at the end of this section. Read voltage after 15 seconds, then remove load.
- If voltage does not drop below the minimum listed in Figure 5, the battery is good and should be returned to service. The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the past few hours.

6D1-4 BATTERY

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
21°C (70°F)	9.6
10°C (50°F)	9.4
0°C (32°F)	9.1
-10°C (14°F)	8.8
-18°C (0°F)	8.5
BELOW: -18°C (0°F)	8.0

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Figure 5 - Battery Voltage Drop Temperature

E. If voltage drops below the minimum listed, replace the battery.

BATTERY ELECTRICAL DRAIN

Battery electrical drain is the small amount of current required by specific control modules that is needed to retain system memory and system monitoring. Too much electrical drain, however, can cause an extremely discharged and/or permanently damaged battery. To test the battery electrical drain, refer to "Parasitic Load Test" in this section.

Parasitic Load Test

Figure 6

Tool Required:

J 38758 Parasitic Draw Test Switch

If the battery discharges while the vehicle sits for a few hours or days, the vehicle should be diagnosed for parasitic loads. Simple connection of an ammeter in series with the battery may not find the cause as the condition may not show up when power is restored unless that particular component is repeatedly cycled. Parasitic loads can be diagnosed using either of the procedures below, but use of the special tool as described in the first procedure is recommended.

NOTICE: Parasitic draw test switch should never be turned to "OFF" position with engine running or damage could occur to attached ammeter or vehicle electrical system.

1. Turn test switch knob to "OFF" position.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in Section 0A.

2. Remove battery negative cable.
3. Install parasitic draw test switch male (cable) end to negative battery terminal.
4. Install battery negative cable to female end of test switch tool.
5. Turn test switch tool knob to "ON" position.
6. Road test vehicle while activating all accessories (radio, A/C, etc.).

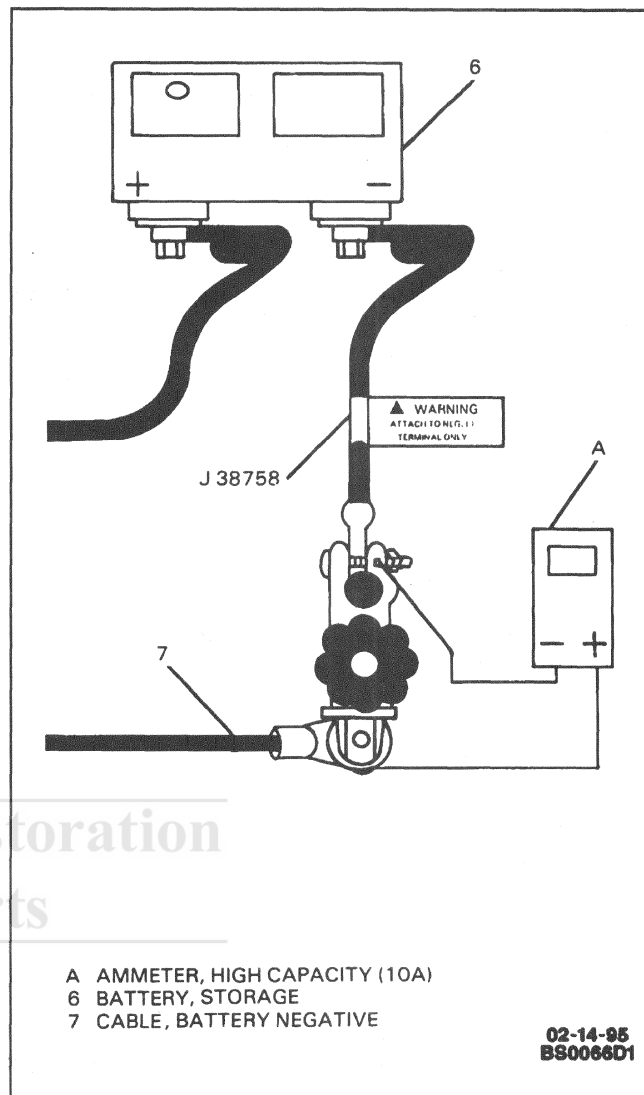


Figure 6 - Use of Parasitic Draw Test Switch

7. Turn ignition switch to "LOCKED" position and remove ignition key.
8. Disconnect underhood lamp.
9. Set ammeter to 10-amp scale and connect to terminals on test switch tool with alligator clips. Use of 10-amp scale may prevent damage to meter.
10. Turn test switch tool knob to "OFF" position to allow current to flow through ammeter.
11. Check current reading. Allow time for reading to stabilize. Electronic level control (ELC) will remain active for 6 minutes. If current reading is at or below two amps, turn test tool knob to "ON" position (to maintain continuity in electrical system) and switch to a lower scale for a more accurate reading, or install a more accurate meter, if necessary. Turn test tool knob to "OFF." If current reading is above 25 milli-amps, refer to component parasitic load chart for specific

current loads and microprocessor “time-outs” for modules in “awake” and “asleep” states. Total reading below 20 milli-amps is normal, and a reading below 25 milli-amps is acceptable. A zero reading indicates a problem with meter, scale being used, or connection.

12. If current draw is above specifications listed in component parasitic load chart, remove system maxi-fuses and circuit breakers one at a time until current draw returns to a value less than or equal to specifications listed. This should be done while monitoring ammeter so that a disruption of drain will be evident. Perform steps 10 and 11 each time a fuse is removed. Refer to SECTION 8A for specific circuit schematics. Total readings in the hundreds of milli-amps may suggest grounded wires, sticking relays, or small lamps remaining lit.

! Important

- Always turn test switch tool knob to “ON” position before removing each fuse to maintain continuity in electrical system and to avoid damaging ammeter due to accidental overloading (i.e., opening door). Do not turn switch to “OFF” while engine is running.
13. When cause of excessive current draw has been located and repaired, repeat steps 10 and 11 to verify the repair. Then turn test tool to “OFF,” remove tool, and reconnect battery negative cable to battery negative terminal.
 - Before performing a follow-up test drive, allow HVAC to calibrate itself due to disconnecting battery.

⌚ Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).

COMPONENT PARASITIC LOADS (mA)

Component	Approximate Parasitic Draw (mA)
Keyless Entry	2
Voltage Regulator in Generator	1
HVAC Control Head-C68	
Before 2.5 hour timeout	13 - 15
After 2.5 hour timeout*	5
ELC Height Sensor	
Before 6 minute timeout	400
After 6 minute timeout*	1
PCM	5-10
Radio Control Head	5
PASS-Key II® (Theft Deterrent) Module	5
*After specified timeout period elapses, component switches from “AWAKE” to “ASLEEP” mode. Total parasitic draw should not exceed 25 mA.	

Alternate Parasitic Load Test

Figures 4 and 7

The following alternate procedure may be used when testing for parasitic loads if J 38758 is not available.

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Disconnect battery negative cable.
2. Install a battery side terminal adapter, AC Delco P/N ST-120 or GM P/N 12303040 or equivalent, in negative terminal of battery (Refer to Figure 4).

3. Install other battery side terminal adapter or a 3/8-inch nut with standard threads (16 NC) on battery negative cable to assure a good electrical contact with metal face on cable for testing (add a washer behind nut if nut does not contact firmly). Yellow or black finish nuts are generally non-conductive and should not be used.
4. With all lights, accessories, and ignition switch off, connect a high capacity ammeter (at least 10 amps) from battery negative cable to side terminal adapter. This high capacity ammeter is connected to verify whether or not a high current draw is occurring at a constant rate. It is this type of high current draw which will blow the fuse in lower capacity ammeters.

6D1-6 BATTERY

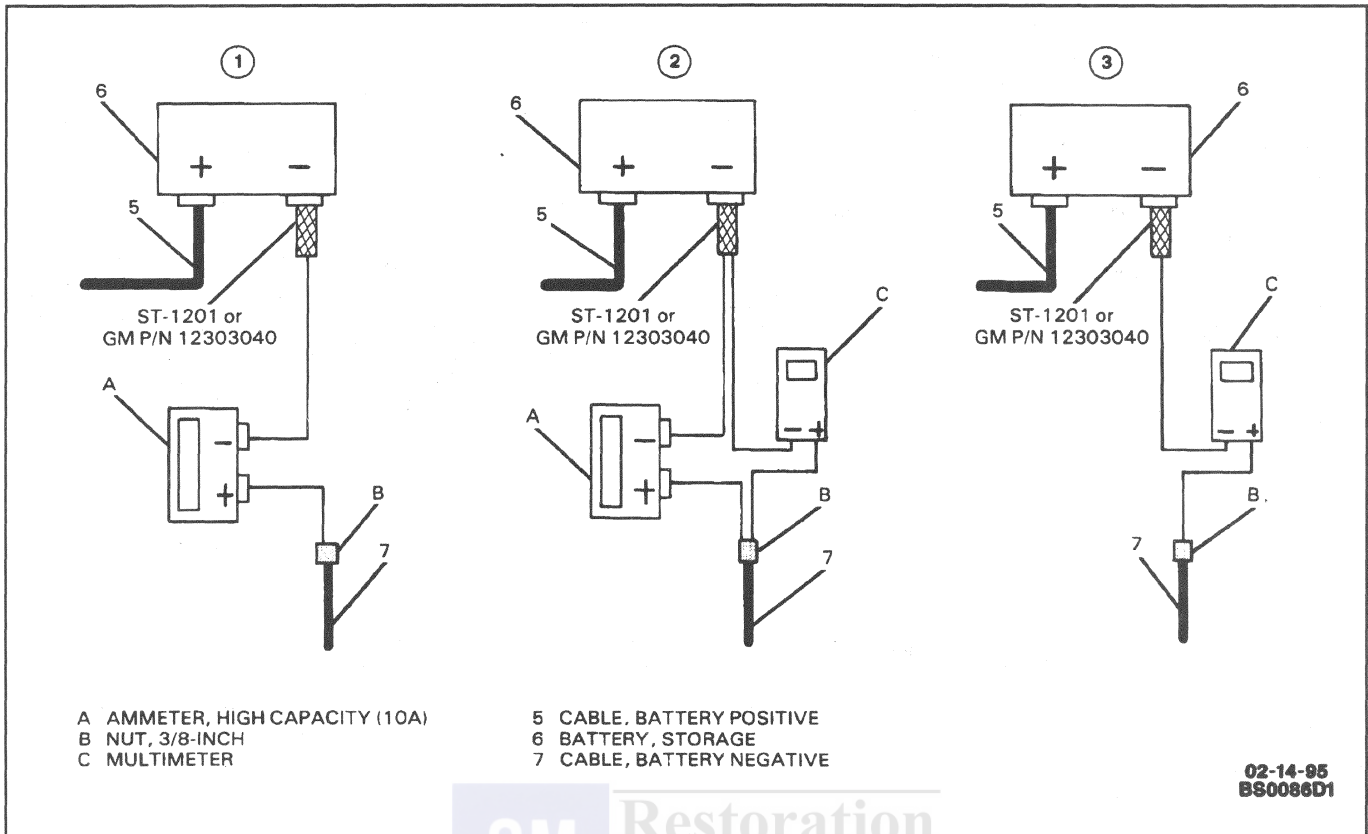


Figure 7 - Alternate Parasitic Load Diagnosis Procedure

NOTICE: If a high capacity ammeter is not available, install a section of heavy wire (preferably battery cable section) between existing battery negative cable and side terminal adapter. Allow time for initial draw to occur or check for reduced current with an inductive ammeter (current clamp) and proceed to step 5.

5. With high capacity ammeter or battery cable section still connected, connect digital multimeter, set on 300 mA dc range, in parallel with high reading ammeter.
6. Disconnect high capacity ammeter and take reading with digital multimeter. If current draw is above specifications listed in component parasitic load chart, remove system fuses and mini-breakers one at a time until current draw returns to a value less than or equal to specifications listed. This should be done while monitoring ammeter so that a disruption of drain will be evident. Refer to the "COMPONENT PARASITIC LOADS (mA)" chart in this section for approximate parasitic loads for various vehicle components. Set ammeter on maximum scale when pulling fuses to avoid damage. Refer to SECTION 8A for specific circuit schematics.
7. When cause of excessive draw has been located and repaired, repeat step 6 to verify the repair. Reconnect battery negative cable to battery negative terminal.

- Before performing a follow up test drive, allow HVAC to calibrate itself due to disconnecting battery.



Tighten

- Battery negative cable to 17 N.m (13 lb. ft.).

ON-VEHICLE SERVICE

BATTERY CHARGING

NOTICE: Always disconnect the battery negative cable when charging a battery or electronic components may be damaged.

When it is necessary to charge the battery, follow these basic rules:

1. Do not charge battery if hydrometer is clear or light yellow. Replace battery.
2. If the battery feels hot (52° C (125° F) or higher), or if electrolyte violently gasses or spews through the vent holes, discontinue charging or reduce charging rate.
3. Do not charge a battery if it seems to be frozen.

Charging Procedure

Tool Required:

AC Delco P/N ST-1201 or GM P/N 12303040

Battery Side Terminal Adapters (Pair)

1. Batteries with green hydrometer dot showing do not require charging unless they have just been discharged (such as in cranking vehicle).
2. When charging battery with side terminals, install adapter kit (AC Delco P/N ST-1201 or GM P/N 12303040 or equivalent). Refer to Figure 4.

The adapter should be snugged up against the battery terminals to keep resistance between the adapter and the battery terminal to a minimum. Recommended battery side terminal adapter torque is 15 N.m (12 lb. ft.).

3. Make sure all battery charger connections are clean and tight.
4. For best results, batteries should be charged while electrolyte and plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting battery charger.
5. Charge battery until green dot of built-in hydrometer appears. Refer to "Charging Time Required" in this section. Battery should be checked every half-hour while charging. Tap the hydrometer lightly on top to dislodge any air bubbles that might cause a false indication.
6. After charging, battery should be tested. Refer to "Diagnosis" in this section.

Charging Time Required

The time required to charge a battery will vary depending on the following factors:

- Size of Battery - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger vehicle battery.
- Temperature - A longer time will be needed to charge any battery at -18° C (0° F) than at 27° C (80° F). When a fast battery charger is connected to a cold battery the current accepted by the battery will be very low at first, then in time, the battery will accept a higher rate as the battery warms.
- Battery Charger Capacity - A battery charger which can supply only five amps will require a much longer period of charging than a battery charger that can supply 30 amps or more.
- State-Of-Charge - A completely discharged battery requires more than twice as much charge as a half-charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will also increase.

CHARGING VOLTAGE

HOURS

16.0 or more	Up to 4 Hours
14.0 - 15.9	Up to 8 Hours
13.9 or less	Up to 16 Hours

CHARGING A VERY LOW OR COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a very low or completely discharged battery, and unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with an accurate voltmeter. If below 11 volts, the charge current will be very low and it could take some time before it accepts a current in excess of a few milliamps. Such low current may be detectable on ammeters available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry which prevents charging unless the battery charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry even though battery charger leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows: If the charge current is still not measurable at the end of the above charging times, the battery should be replaced. If the charge current is measurable during the charging time, the battery is considered good and charging should be completed in the normal manner.
5. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a usable state. As a general rule of thumb, using the reserve capacity (RC) rating of the battery as the number of ampere hours of charge will usually bring the green dot into view. For reserve capacity refer to "Specifications" in this section. If battery is rated at 75 RC minutes, it would usually be completely recharged as follows: 10 ampere charge x 7 1/2 hours = 75 AH or 25 ampere charge x 3 hours = 75 AH, etc.
6. It is recommended that any battery recharged by this procedure be LOAD TESTED to establish serviceability. Refer to "Battery Testing" in this section.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

Both auxiliary battery and discharged battery assembly should be treated carefully when using jumper cables.

6D1-8 BATTERY

CAUTION: Departure from these conditions or the procedure below could result in: (1) serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or (2) damage to electronic components of either vehicle. Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive. Remove rings, watches, and other jewelry. Wear approved eye protection. Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces-battery fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the battery positive terminal (or metal in contact with it) and any other metal on the vehicle, because a short circuit could occur.

1. Set parking brake lever and place automatic transmission in "PARK." Turn "OFF" the ignition, lamps and all other electrical loads.
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.

NOTICE: Do not jump start a vehicle with charging equipment unless the equipment is specifically designed for jump starting. Using improper equipment can cause serious damage to the electrical system or electronic parts.

3. Attach the end of one jumper cable to the auxiliary battery positive terminal and the other end of the same cable to the positive terminal of the junction block. Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

CAUTION: To prevent sparking and possibly explosion of battery gases, do not connect jumper cable directly to the battery negative terminal of the dead battery.

4. Attach one end of the remaining negative cable to the auxiliary battery negative terminal, and the other end to a solid engine ground (such as the compressor bracket or power steering pump bracket) at least 46 cm (18 inches) from the battery of the vehicle being started.
5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the vehicle with the discharged battery.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must first be disconnected from the engine that was jump started.

BATTERY TRAY REPLACEMENT

Figure 8

Remove or Disconnect

1. Battery. Refer to "Battery Replacement" in this section.
2. Wheelhouse panel bolts/screws (1), battery tray nut (2), and battery tray bolt/screw (3) holding battery tray (4) to wheelhouse panel.
3. Battery tray (4).

Install or Connect

NOTICE: Refer to "Notice" on page 6D1-1 of this section.

1. Battery tray (4) to wheelhouse panel.
2. Wheelhouse panel bolts/screws (1), battery tray nut (2), and battery tray bolt/screw (3) holding battery tray (4) to wheelhouse panel.

Tighten

- Wheelhouse panel bolts/screws (1) and battery tray bolt/screw (3) to 25 N·m (18 lb. ft.).
3. Battery Refer to "Battery Replacement" in this section.

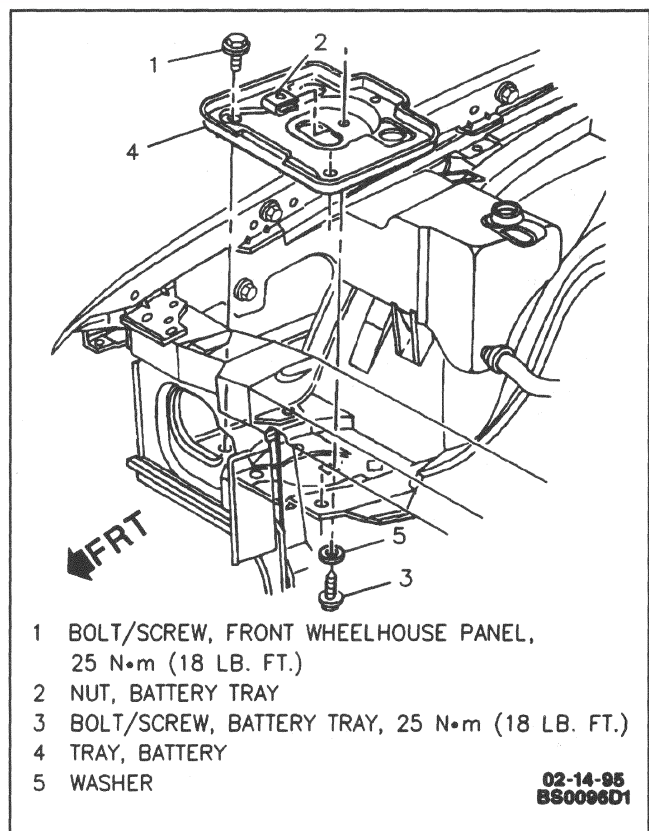


Figure 8 - Battery Tray

BATTERY REPLACEMENT

Figure 9

 Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in Section 0A.

1. Battery negative cable (7) from battery negative terminal.
2. Any brackets or braces that are in the way.
3. Battery positive cable (5) from battery positive terminal.
4. Battery holding retainer bolt/screw (8) and battery holding retainer (9).
5. Battery (6).
6. Insulator (1) from battery (6).

 Install or Connect

NOTICE: Refer to “Notice” on page 6D1-1 of this section.

1. Insulator (1) to battery (6).
2. Battery (6).
3. Battery holding retainer (9) and battery holding retainer bolt/screw (8).

 Tighten

- Battery holding retainer bolt/screw (8) to 18 N.m (13 lb. ft.).
4. Battery positive cable (5) to battery positive terminal.

 Tighten

- Battery positive cable (5) to 17 N.m (13 lb. ft.)
 - Battery negative cable (7) to 17 N.m (13 lb. ft.).
5. Any brackets or braces that were removed.
 6. Battery negative cable (7) to battery negative terminal.

BATTERY CABLE REPLACEMENT AND ROUTING

Whenever battery cables are replaced, always be certain to use a replacement battery cable that is the same type and length. Some positive cables have additional feed wires attached to them and some negative cables have additional ground straps attached. Always be certain when replacing a battery cable to route it the same as the one being replaced.

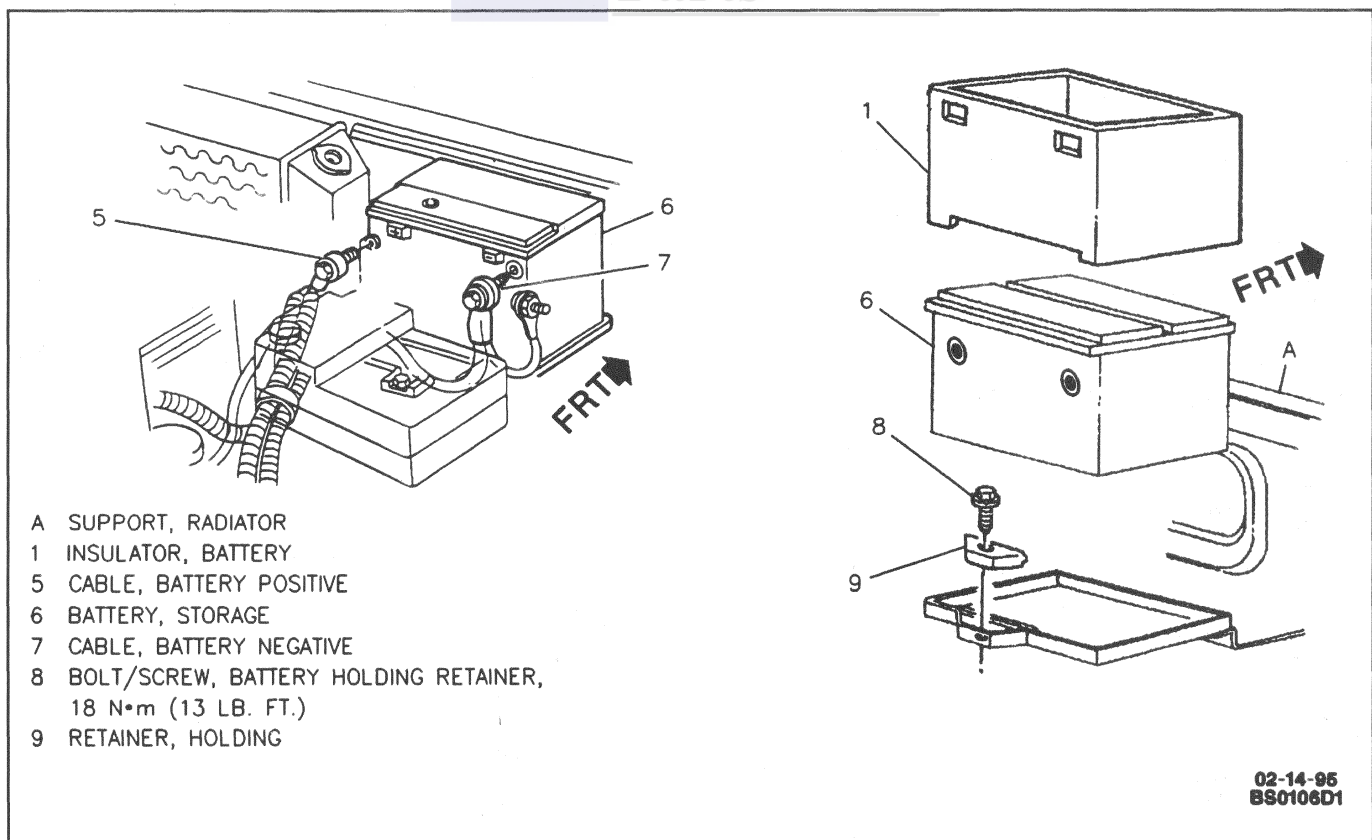


Figure 9 - Battery

6D1-10 BATTERY

Negative Cable

Figure 10

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in Section 0A.

1. Battery negative cable (7) from battery negative terminal.
2. Negative cable ground bolt/screw (11) and negative cable ground washer (10) and ground strap.
3. Generator. Refer to SECTION 6D3.
4. Nut (18), washer (13), and cable (7) from bolt/screw (12).
5. Any clamps or retainers securing negative cable (7) to body.
6. Negative cable (7) from vehicle.
 - Note routing.
 - Route as noted during removal.

Install or Connect

NOTICE: Refer to “Notice” on page 6D1-1 of this section.

1. Negative cable (7) to vehicle.

Important

- Route battery negative cable over and through generator support bracket.
2. Any clamps or retainers securing negative cable (7) to body.
 3. Negative cable (7), washer (13), and nut (18) to bolt/screw (12).

Tighten

- Nut (18) to 34 N.m (25 lb. ft.).
4. Generator. Refer to SECTION 6D3.
 5. Negative cable ground bolt/screw (11), negative cable ground washer (10) and ground strap.

Tighten

- Negative cable ground bolt/screw (11) to 4 N.m (35 lb. in.).
6. Battery negative cable (7) to battery negative terminal.

Tighten

- Battery negative cable (7) to 17 N.m (13 lb. ft.).
7. Battery negative cable (7) to battery negative terminal.

Tighten

- Battery negative cable (7) to 17 N.m (13 lb. ft.).

Positive Cable

Figure 11

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in Section 0A.

1. Battery negative cable (7) from battery negative terminal.
2. Battery positive cable (5) from battery positive terminal.
3. Generator lead nut (16) from generator.
4. Positive cable bolts/screws (17).
5. Positive cable nuts (18) and battery positive cable (5) from starter solenoid switch and electrical center.

Install or Connect

NOTICE: Refer to “Notice” on page 6D1-1 of this section.

NOTICE: Before installing battery positive cable to starter solenoid switch, be sure solenoid terminal is secure in cap by tightening terminal nut on battery cable post. If terminal is not tight in solenoid cap, the cap may be damaged during installation of battery cable and cause starter to fail later.

Tighten

- Solenoid battery terminal nut to 10 N.m (89 lb. in.).
1. Battery positive cable (5) and positive cable nuts (18) to starter solenoid switch and electrical center.

Tighten

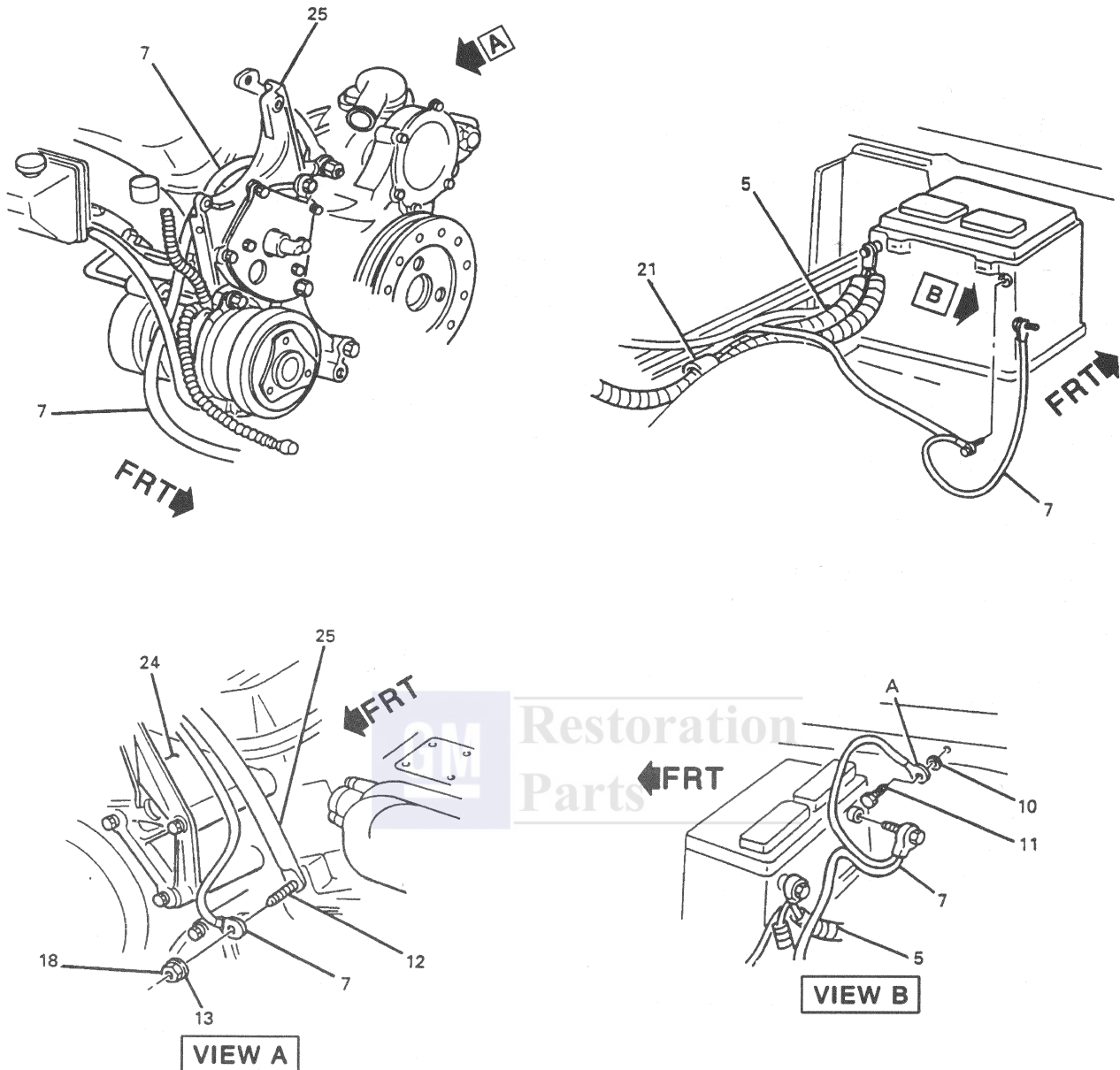
- Positive cable nuts (18) to 10 N.m (89 lb. in.).
2. Positive cable bolts/screws (17) to frame.

Tighten

- Positive cable bolts/screws (17) to 4.8 N.m (42 lb. in.).
3. Generator lead nut (16) and battery positive cable (5) to generator.

Tighten

- Generator lead nut (16)...13 N.m (115 lb. in.).



- A STRAP, GROUND
- 5 CABLE, BATTERY POSITIVE
- 7 CABLE, BATTERY NEGATIVE
- 10 WASHER, BATTERY NEGATIVE CABLE GROUND
- 11 BOLT/SCREW, BATTERY NEGATIVE CABLE GROUND, 4 N•m (35 LB. IN.)
- 12 BOLT/SCREW, BATTERY NEGATIVE CABLE, 4 N•m (35 LB. IN.)
- 13 WASHER, BATTERY NEGATIVE CABLE
- 18 NUT, BATTERY NEGATIVE CABLE, 34 N•m (25 LB. FT.)
- 21 STRAP, POSITIVE CABLE
- 24 SUPPORT BRACKET, GENERATOR
- 25 SUPPORT, GENERATOR

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Figure 10 - Battery Negative Cable

6D1-12 BATTERY

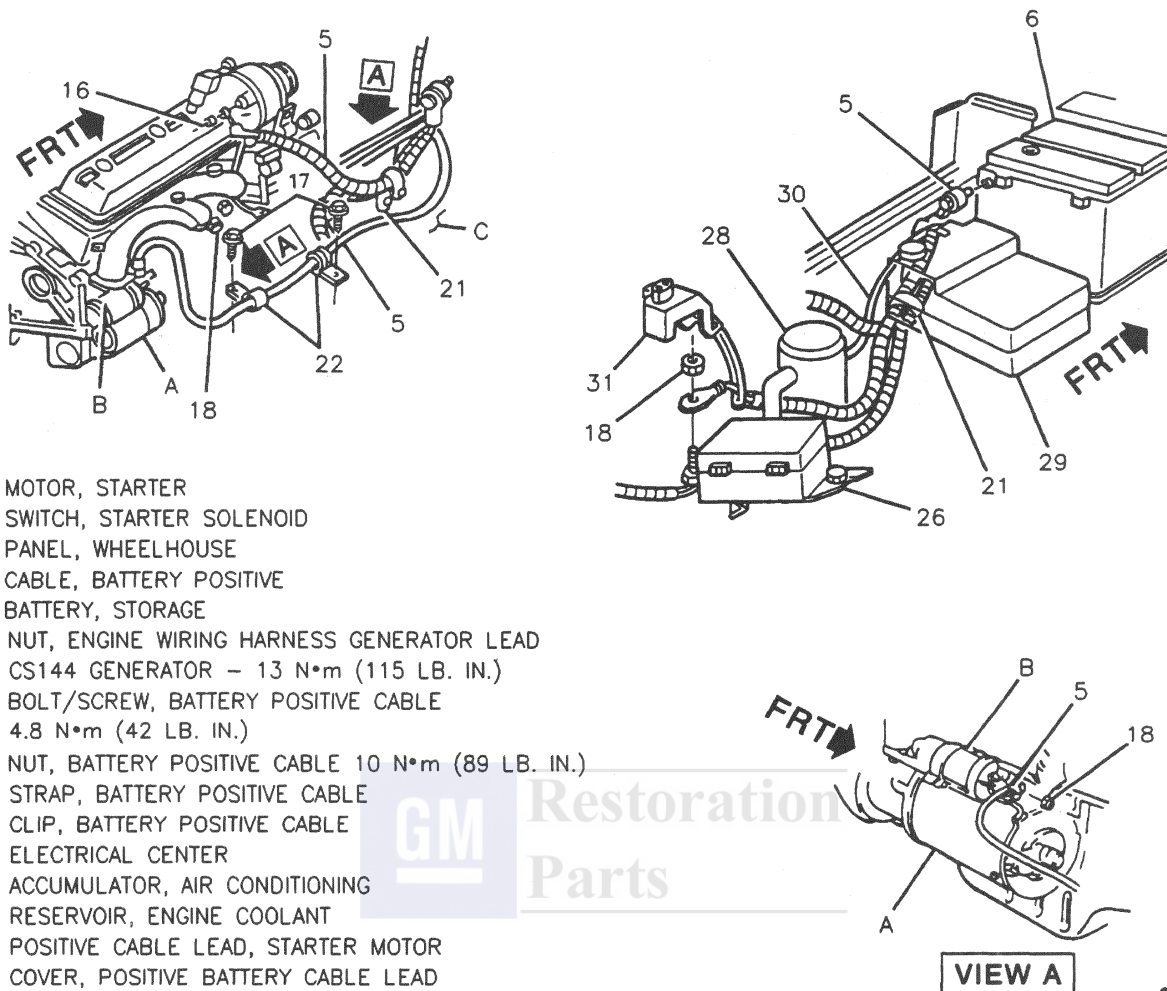


Figure 11 - Battery Positive Cable

4. Battery positive cable (5) to battery positive terminal.



Tighten

- Battery positive cable (5) to 17 N.m (13 lb. ft.).

GROUND STRAPS

Additional ground straps are used to connect the body and frame to the engine and transmission. Always connect all ground straps to ensure a good ground path to the battery from all electrical components.

CHARGING EQUIPMENT

A battery charger that is considered sufficient is usually capable of a 16-volt output. When choosing a charger, the following items should be considered essential:

1. A 16-volt minimum output.

2. To prevent overcharging, the unit should have a timer (1 to 2 hours) or a voltage regulator that would regulate a maximum of 18 volts, or have an automatic shut-off feature at full charge.
3. Ammeter or charging rate meter.
4. An automatic polarity protector. Some equipment that is available includes the AC Delco MP2101-07, Associated No. 6001, the Sun 720, or equivalent. Very few chargers have sensitive low-voltage meters, therefore, separate voltmeters may be necessary. A suitable load tester such as the Sun VAT-40 (or equivalent) is available and is a very useful tool to properly diagnose battery problems.

SPECIFICATIONS

BATTERY USAGE CHART

CATALOG NUMBER	TEST LOAD AMPS	COLD CRANKING AMPS*	RESERVE CAPACITY MINUTES*	REPLACEMENT NUMBER
514	260	525	90	75-60
744	380	770	115	78A-72
746	380	770	115	78A-72

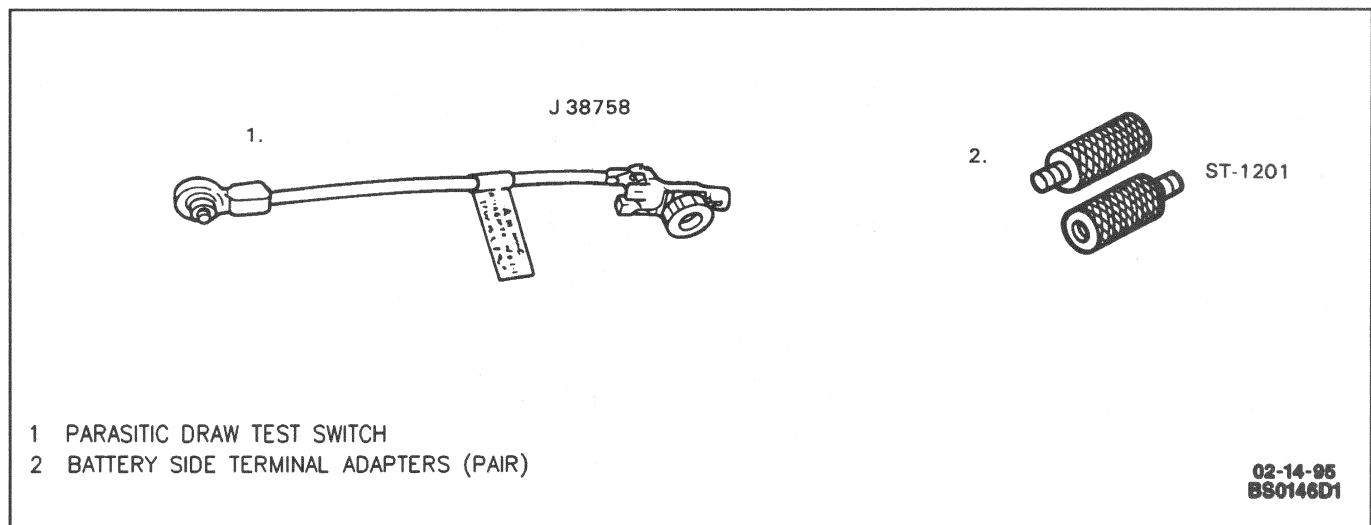
*Cold Cranking = Amperage available for 30 seconds of engine cranking at -18°C(0°F).

*Reserve Capacity = The approximate time in minutes a storage battery assembly can support a 25 amp load without the terminal voltage dropping below 10.5 volts at 27°C (80°F) in the event of a charging system failure.

FASTENER TIGHTENING SPECIFICATIONS

Battery Hold-Down Retainer Bolt/Screw	18 N.m (13 lb. ft.)
Battery Negative Cable	17 N.m (13 lb. ft.)
Battery Negative Cable Ground Bolt/Screw.....	4 N.m (35 lb. in.)
Battery Negative Cable Nut.....	34 N.m (25 lb. ft.)
Battery Positive Cable.....	17 N.m (13 lb. ft.)
Battery Positive Cable Bolt/Screw.....	4.8 N.m (42 lb. in.)
Battery Tray Bolt/Screw	25 N.m (18 lb. ft.)
Engine-to-Battery Negative Cable Bolt/Screw	4 N.m (35 lb. in.)
Engine Wiring Harness Generator Lead Nut	13 N.m (115 lb. in.)
Engine Wiring Harness Junction Block-to-Battery Positive Cable Bolt/Screw	6 N.m (53 lb. in.)
Front Wheelhouse Panel Bolt/Screw	25 N.m (18 lb. ft.)
Solenoid Battery Terminal Nut	10 N.m (89 lb. in.)
Starter Solenoid Switch-to-Battery Positive Cable Nut	10 N.m (89 lb. in.)
Storage Battery Side Terminal Adapters	15 N.m (12 lb. ft.)

SPECIAL TOOLS





SECTION 6D2

CRANKING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

GM Restoration arts CONTENTS

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6D2-2 CRANKING SYSTEM

GENERAL DESCRIPTION

STARTER USAGE

Figure 1

Three different starters are used for the 1996 models. Refer to the following chart to determine the correct starter application.

VEHICLE	ENGINE	STARTER
CAPRICE SEDAN	4.3L L99	SD-260
	5.7L LT1	PG-250
BUICK SEDAN	5.7L LT1	PG-250
CAPRICE WAGON	5.7L LT1	PG-260
BUICK WAGON	5.7L LT1	PG-260

Although the PG-250 and the PG-260 starter motors look similar, the PG-260 is lighter and uses a different solenoid, which requires a different battery positive cable, due to the terminal locator. Both PG starter motors have an anodized metal (gold colored) finish. The starter attachment and pinion-to-flywheel clearance is the same for both starters, but because of the different battery positive cable attachments, the PG starter motors are not interchangeable. The SD-260 starter motor is black and is only used on the Caprice sedan with the 4.3L L99 engine.

CRANKING CIRCUIT

The cranking circuit consists of the battery, theft deterrent relay, theft deterrent module, starter motor, ignition switch and related electrical wiring. Refer to SECTION 8A-30 for a complete electro-mechanical schematic.

STARTER MOTOR

Figure 1

When the ignition switch is moved to the start position, a start request is sent to the theft deterrent module. If correct PASS-Key II® resistance is detected and vehicle is in "PARK" or "NEUTRAL," then the theft deterrent module will energize the starter enable relay. The starter enable relay will send battery voltage to the starter solenoid switch. As the solenoid is energized, the starter shift lever moves into crank position, causing the starter drive pinion to engage the flywheel ring gear. After engagement, the starter solenoid switch will close the motor main contacts, which results in cranking of the engine. When the engine starts, the starter's overrunning clutch protects the armature from excessive speed until the switch is opened, at which time the solenoid switch plunger spring causes the pinion to disengage. To prevent excessive overrun, the ignition switch should be opened immediately when the engine starts.

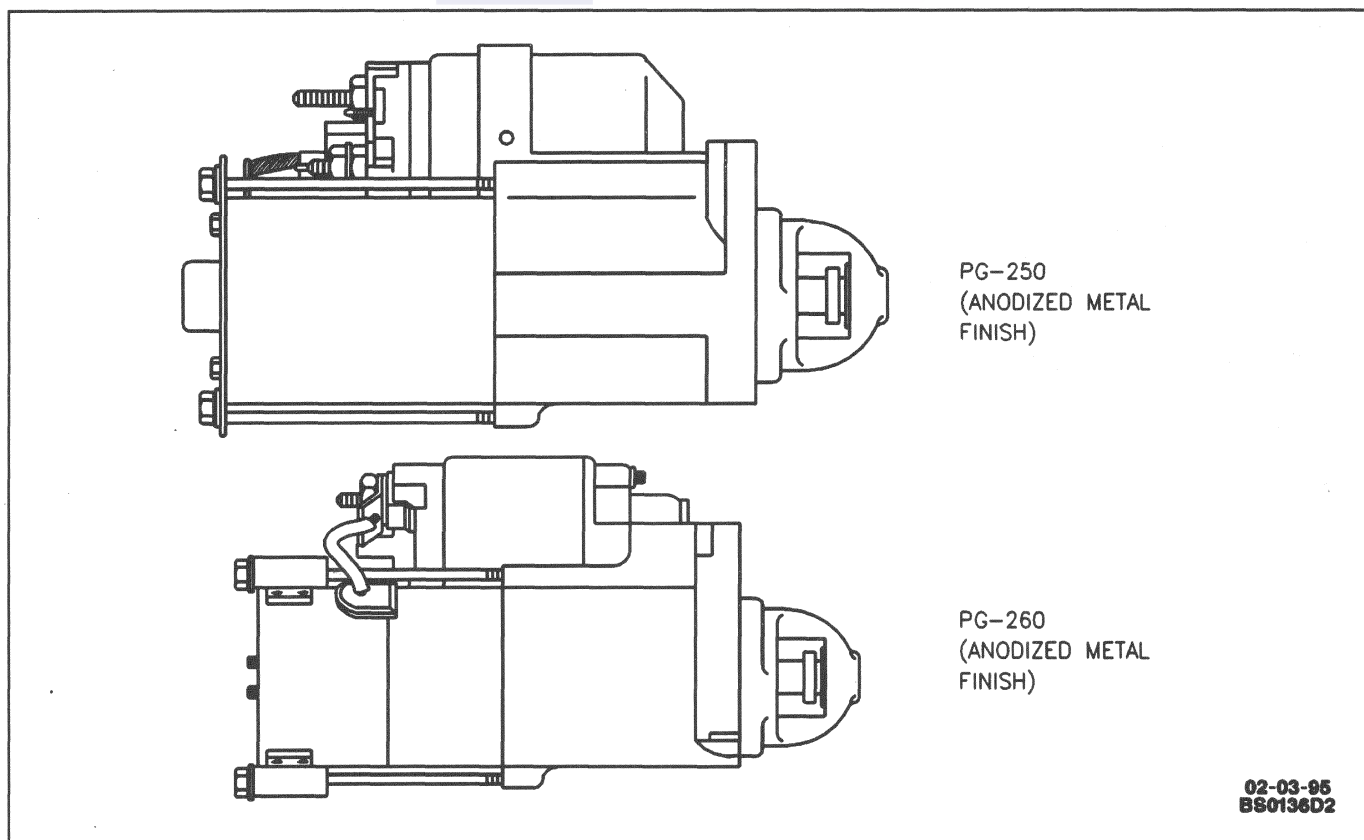


Figure 1 - Starter Motor Identification

DIAGNOSIS

NOTICE: Never operate the starter motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the starter motor.

The diagnosis in this section covers mechanical problems only such as noises. For electrical diagnosis, refer to SECTION 8A-30. If the "PASS-Key" light remains on (after a five second bulb check) while the ignition is in "RUN," then refer to SECTION 8A-133.

NOISE DIAGNOSIS

Starter motor noise could be caused by worn or damaged components, or incorrect pinion-to-flywheel clearance.

1. Raise and suitably support vehicle. Refer to SECTION 0A.



Inspect

2. Starter mounting bolts/screws for correct torque.



Tighten

- Starter mounting bolts/screws to 47 N.m (35 lb. ft.).
3. Remove transmission converter cover and inspect flywheel teeth.
 - Rotate flywheel while observing teeth. If any teeth are damaged or worn, flywheel must be replaced.



Measure

- Flywheel-to-pinion clearance.
 - A. Disconnect battery negative cable.

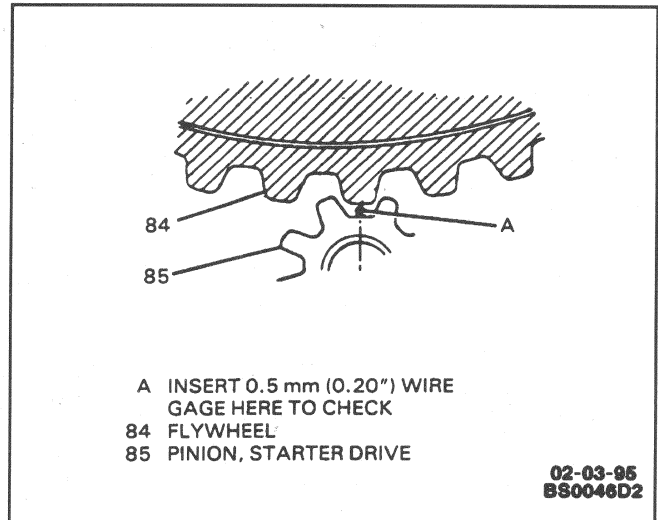


Figure 2 - Measuring Flywheel-to-Pinion Clearance

- B. Disconnect field lead from starter motor solenoid terminal "M" and tape end so it will not contact solenoid.
- C. Connect battery negative cable.
- D. Apply battery voltage to the starter solenoid terminal "S" and flash jumper terminal "M" to ground. This will engage the pinion to the flywheel.
- E. Using a wire type gage, measure the flywheel-to-pinion clearance as shown in figure 2. Clearance should be 0.5 mm (0.020 in.).
- F. Single shims installed on the outer bolt/screw are used to decrease clearance, double shims installed on both bolts/screws are used to increase clearance. Shims are not used when engine is manufactured, they are only used as a service repair to correct a noise condition.

Refer to the "Starter Motor Whine Diagnosis Chart" in this section for more information.

STARTER MOTOR WHINE DIAGNOSIS

PROBLEM	CAUSE
• HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OK.	PINION-TO-FLYWHEEL DISTANCE TOO GREAT.
• HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OK. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	PINION-TO-FLYWHEEL DISTANCE TOO SMALL.
• A LOUD "WHOOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER DRIVE PINION IS STILL HELD ENGAGED. SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER DRIVE PINION IS ENGAGED.	REPLACE STARTER DRIVE.
• A "RUMBLE," "GROWL," OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER MOTOR IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED ARMATURE. REPLACE ARMATURE.

ON-VEHICLE SERVICE

LUBRICATION

Starter motors do not require lubrication except during overhaul. When the starter motor is taken apart for any reason, lubricate only as described under "Unit Repair" in this section.

STARTER MOTOR REPLACEMENT

Figure 3

Important

- This vehicle was designed for starter mounting without shims. However if single shims (13) or double shims (14) have been added to correct a noise or engagement condition, they should be reinstalled in their original location to ensure proper pinion-to-flywheel engagement.

CAUTION: Refer to "Caution" on page 6D2-1 of this section.

Remove or Disconnect

1. Battery negative cable.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Two starter mounting bolts/screws (16 and 17) and lower starter motor (15, 18, or 19).
4. Electrical leads from starter motor (15, 18, or 19).
 - Note position of wires before disconnecting.
5. Starter motor (15, 18, or 19).

Install or Connect

NOTICE: Refer to "Notice" on page 6D2-1 of this section.

NOTICE: Before attaching electrical leads, tighten inner nuts on the solenoid terminals. If the nuts are not tight, solenoid cap may be damaged during installation of leads. Tighten inner nut of "BAT" terminal to 9 N.m (80 lb. in.) on PG-250. This does not apply to the PG-260 starter motor.

1. Electrical leads to starter motor (15, 18, or 19).

Tighten

- Starter solenoid switch "BAT" terminal outer nut to 9 N.m (80 lb. in.) on SD-260, PG-250, or PG-260.
 - Starter solenoid switch "S" terminal nut to 2.5 N.m (22 lb. in.).
2. Starter motor (15, 18, or 19) to engine.
 3. Bolts/screws (16 and 17) and shims (13 or 14), if removed.

Tighten

- Bolts/screws (16 and 17) to 47 N.m (35 lb. ft.).
4. Battery negative cable.

Tighten

- Battery negative cable to 15 N.m (11 lb. ft.).

UNIT REPAIR

Only the SD-260 and PG-250 unit repair service information is included in this section. The PG-260 starter motor should be serviced as an assembly.

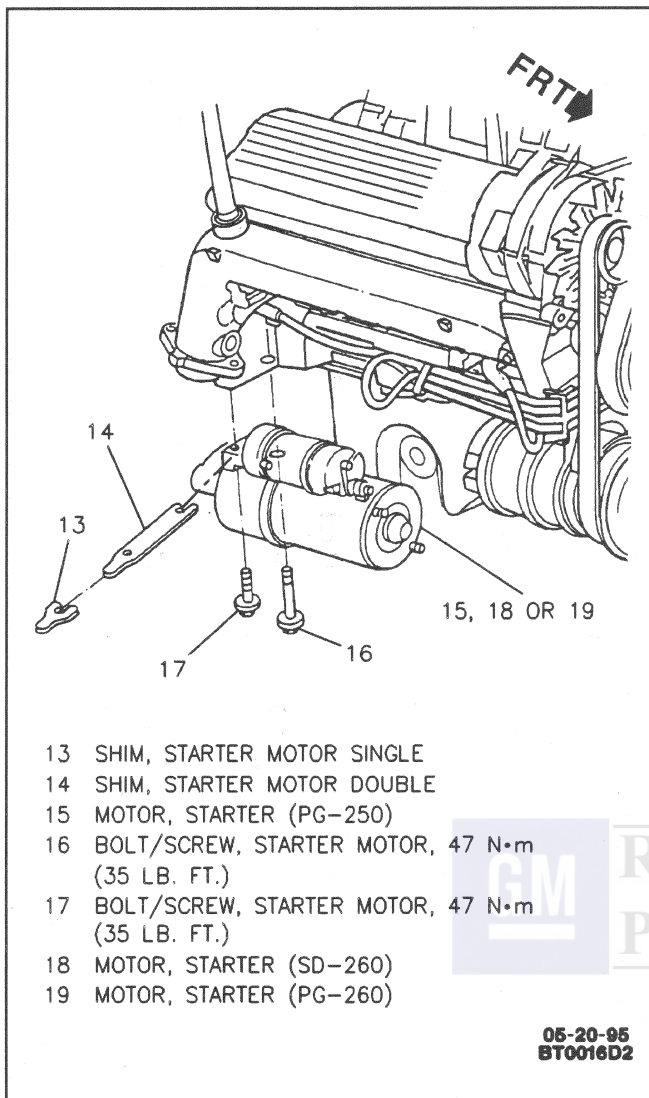


Figure 3 - Mounting Starter Motor

STARTER SOLENOID SWITCH REPLACEMENT

Figures 4 and 10

When a “no crank and no sound” starter motor condition exists, check solenoid switch (3 or 56) before disassembling starter motor. Solenoid switch (3 or 56) can be checked without removal. Refer to “Cleaning, Inspection and Testing” in this section. The solenoid switch (3) on the PG-250 starter motor is part of the starter drive housing. Refer to “PG-250 Starter Motor Disassembly” and “PG-250 Starter Motor Assembly” for replacement procedure.

NO-LOAD TEST

Figure 5

With carbon pile “OFF,” make connections as shown in Figure 5. Close the switch, adjust carbon pile to obtain 10 volts, and compare the RPM, current

and voltage readings with “Specifications” listed at the end of this section. Disconnect leads only with the switch open. Use the test results as follows:

1. Rated current draw and no-load speed indicates normal starter motor condition.
2. Low free speed and high current draw indicates:
 - Too much friction. This can be caused by tight, dirty or worn bearings, or bent armature shaft allowing armature to drag.
 - Shorted armature. This can be further checked with growler after disassembly.
 - Grounded armature or fields. Check further after disassembly.
3. Failure to operate with high current draw indicates:
 - Direct ground in terminal or fields.
 - “Frozen” bearings (this should have been determined by hand turning armature).
4. Failure to operate with no current draw indicates:
 - Open field circuit. After disassembly inspect internal connections and trace circuit with test lamp. (Refer to Figure 6).
 - Open armature coils. Inspect commutator for badly burned bars after disassembly.
 - Broken brush springs, worn brushes, high insulation between commutator bars or other causes which would prevent good contact between brushes and commutator.
5. Low no-load speed and low current draw indicates:
 - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed above under number 4.
6. High free speed and high current draw usually indicate shorted fields.
 - If shorted fields are suspected, replace field coil. Also check for shorted armature, using growler.

SD-260 STARTER MOTOR

SD-260 Starter Motor Disassembly

Figures 9 and 10



Disassemble

1. Nuts (62) and heat shield (71), if equipped, from clamp bolts/screws (63).
2. Nut (61) and field lead from solenoid switch (56).
3. Clamp bolts/screws (63) and solenoid switch (56) with clamp (66) from drive housing (54).
4. Bolts/screws (65) from starter motor.
5. Commutator end frame (49), brake washer (64), and frame kit (51) from armature (52) and drive housing (54).
6. Plug (67) from drive housing (54).
7. Armature (52) with starter drive (53), shift lever (57), plunger (68), and starter solenoid switch plunger spring (72) from drive housing (54).

6D2-6 CRANKING SYSTEM

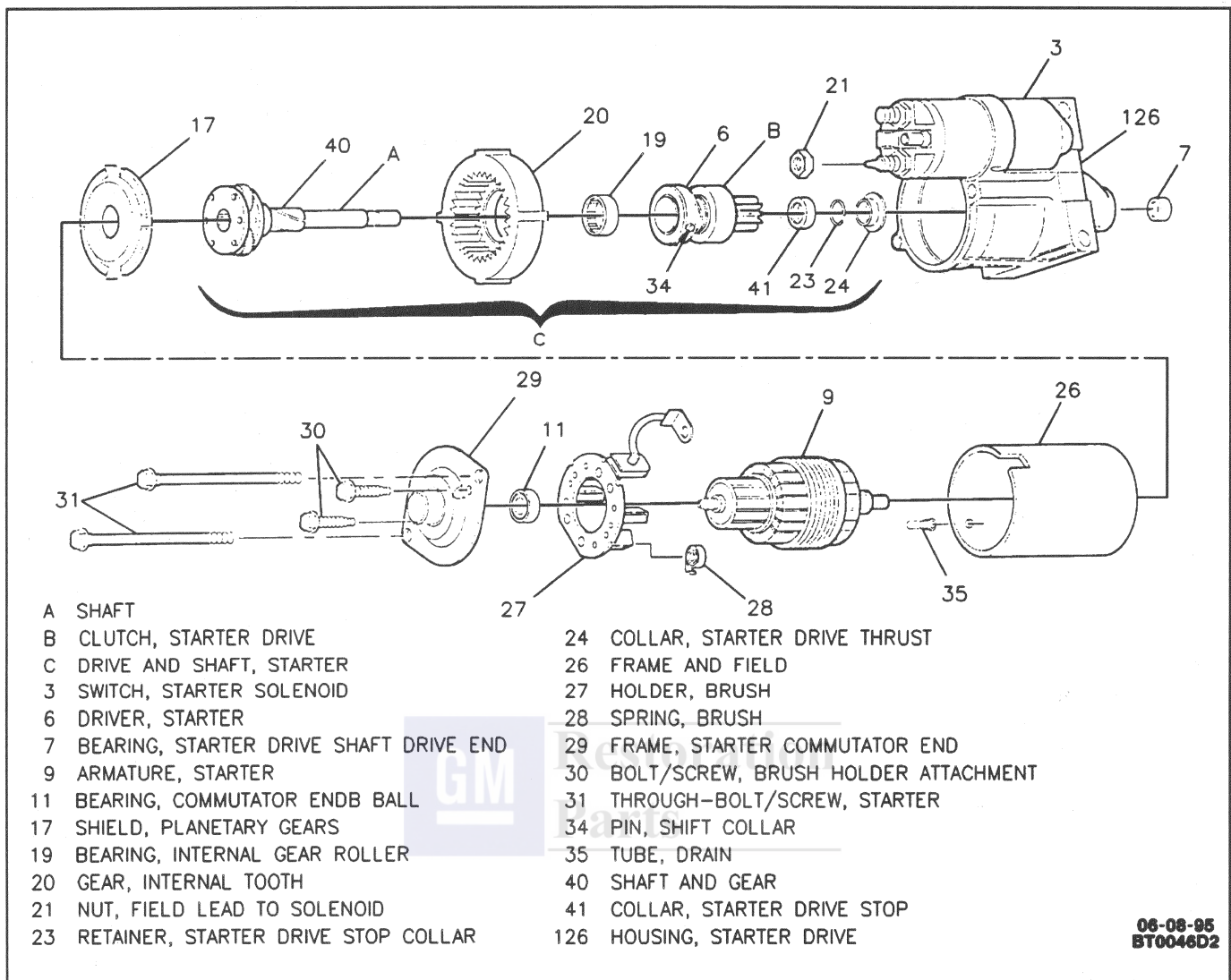


Figure 4 - PG-250 Starter Motor Disassembled View

8. Starter solenoid switch plunger spring (72) from plunger (68).
9. Plunger (68) from shift lever (57).
10. Shift lever (57) from drive housing (54) by spreading lever arms slightly to disengage.
11. Thrust collar (60) from armature shaft.
12. Retainer (59) by pushing starter drive stop collar (58) off of retainer (59) and sliding it off of armature shaft.
 - Discard retainer (59).
13. Starter drive stop collar (58) and starter drive (53) from armature shaft.

Cleaning, Inspection, and Testing (SD-260 Starter Motor)

Figures 5 through 10

NOTICE: Do not use grease dissolving solvents for cleaning the overrunning clutch or armature. Solvents dissolve the grease packed in the clutch and damage armature and field coil insulation.

1. Clean all starter motor parts. Wipe parts clean with a clean shop cloth.
2. Test starter drive (53) action. Pinion should turn freely in overrunning direction. Check pinion teeth for chipping, cracking or excessive wear. Replace starter drive (53) if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. Replace as necessary.
3. Check starter drive (53) for slipping by leaving starter drive (53) attached to armature (52). Wrap armature (52) with shop towel and clamp in vice. Using 12-point deep socket and torque wrench, put socket on pinion and turn counterclockwise. Drive should not slip with up to 68 N.m (50 ft. lb.) of applied torque. If it does, replace starter drive (53).
4. Starter drive (53) requires no lubrication; however, starter drive (53) should be wiped clean.

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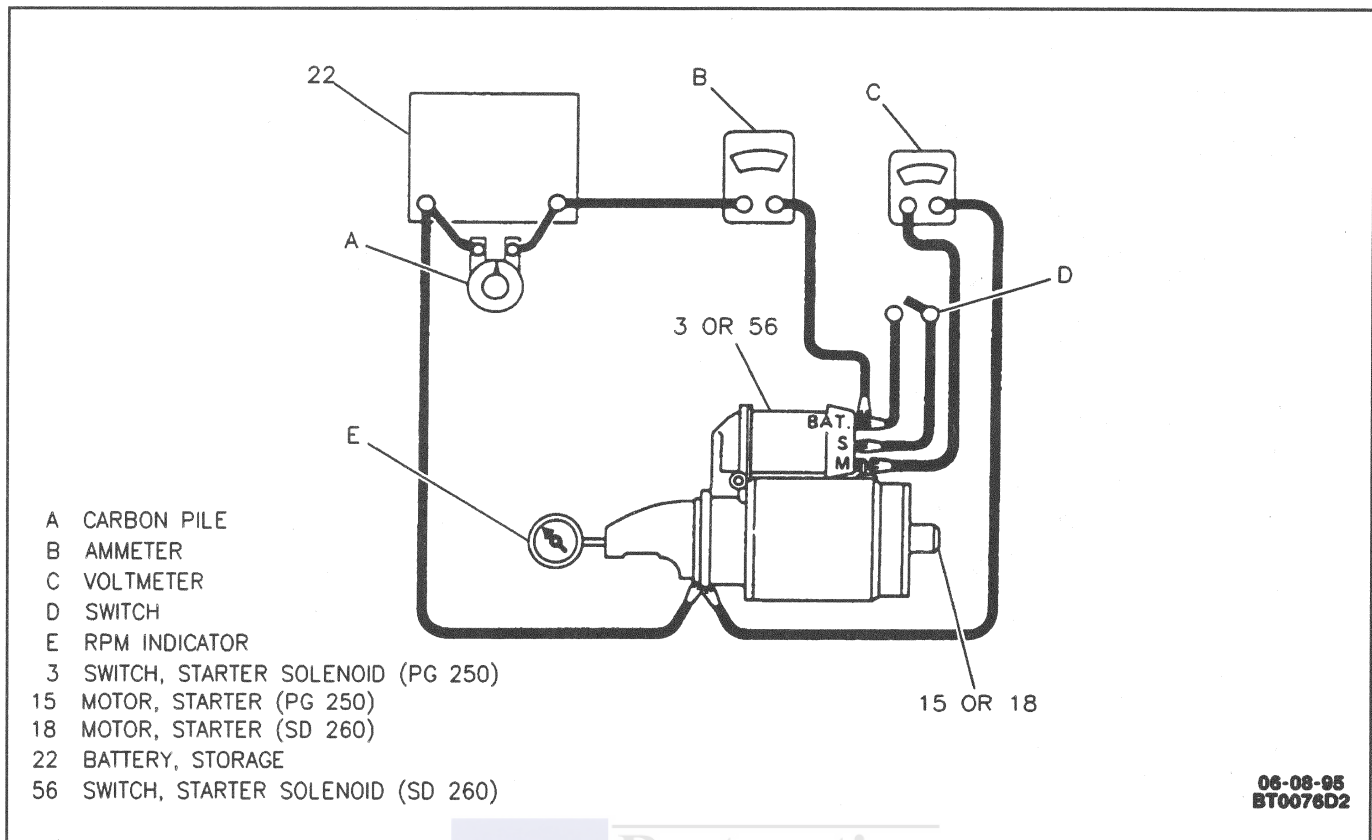


Figure 5 - No-Load Test

5. Inspect armature commutator. If commutator is dirty, clean with 400 grit polishing cloth. If commutator is rough, replace armature (52). Do not undercut or turn commutators. Inspect points where armature conductors join commutator bars to make sure they have good connection. A burned commutator bar(s) is usually evidence of poor connection.
6. Inspect brushes and brush holders. When brushes appear excessively worn when compared to new brushes they should be replaced. Make sure brush holders are clean and brushes are not binding in brush holders. Full brush surface should ride on commutator to give proper performance.
 - Check to ensure that brush springs are giving firm contact between brushes and commutator. When brush springs are distorted or discolored, they should be replaced.
 - On SD-260 starter motor, all brush and brush holder parts are part of the frame kit (51).
7. If test equipment is available:
 - A. Check armature (52) for short circuits by placing on growler and holding hacksaw blade over armature core while armature is rotated. If saw blade vibrates, armature (52) is shorted. Replace armature (52).

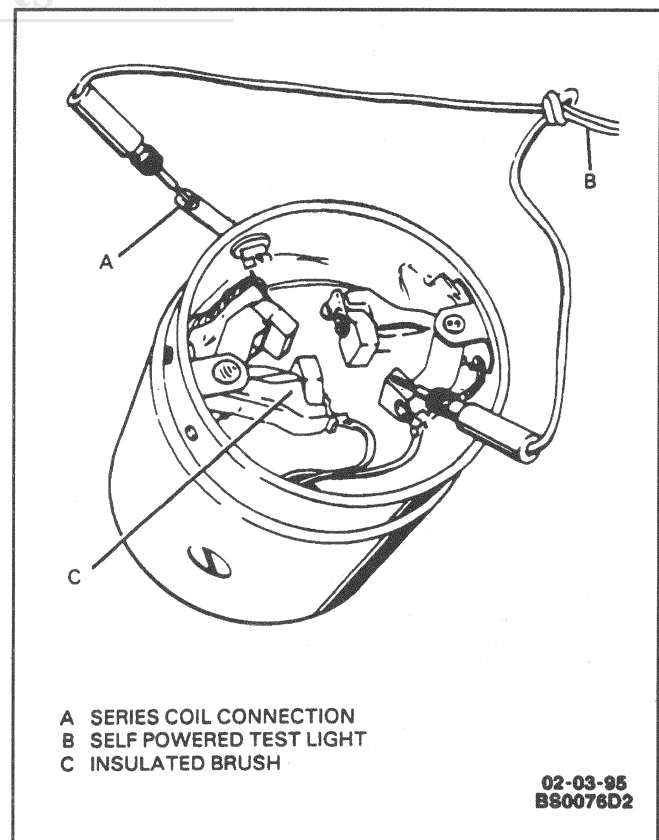


Figure 6 - Testing Series Coil for Open

6D2-8 CRANKING SYSTEM

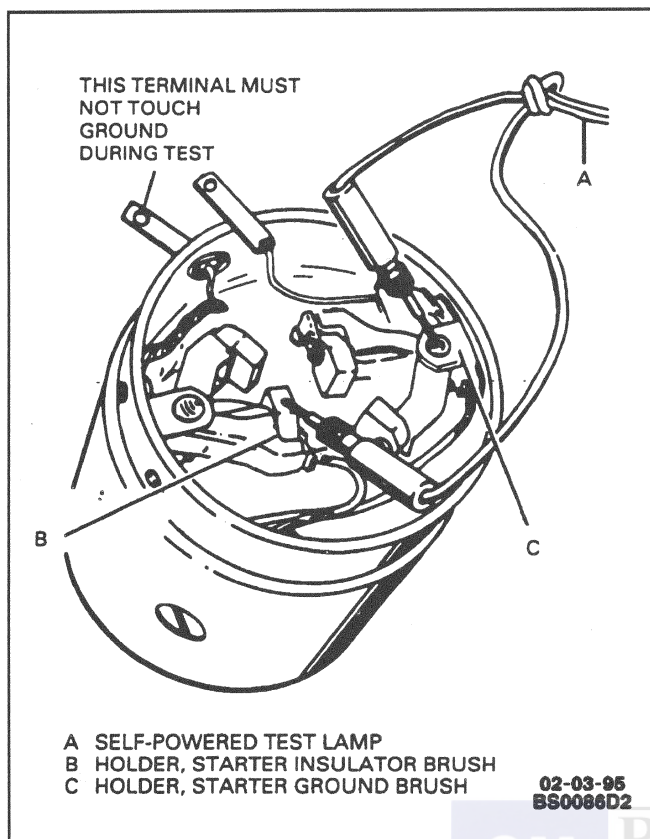


Figure 7 - Testing Series Coil for Ground

- B. On SD-260 starter motor, check field windings by using self-powered test lamp. Place one lead on field lead terminal and other lead on one insulated brush. If lamp fails to light, series coil is open and will require repair or replacement. Perform this test for each insulated brush to check brush and lead continuity (Figure 6).
- C. On SD-260 starter motor, using self-powered test lamp, place one lead on grounded brush holder and other lead on either insulated brush. If lamp lights, grounded series coil is indicated and frame kit (51) is replaced (Figure 7).

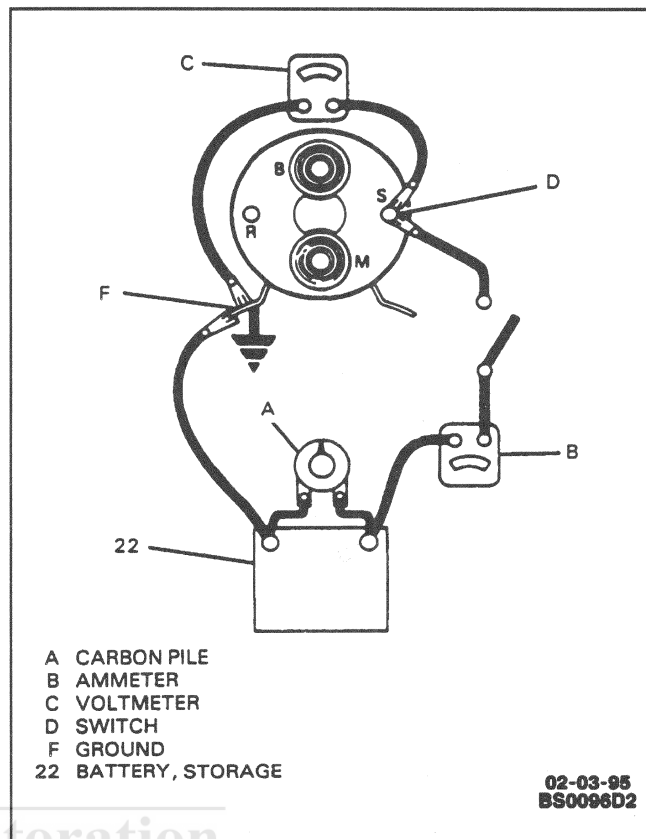


Figure 8 - Testing Solenoid Windings

- D. Check armature (52) for grounds using a self-powered test lamp. Place one lead on commutator and other lead on armature core or shaft. If lamp lights, armature (52) is grounded and must be replaced.
- E. Check current draw of solenoid windings as follows:
- If solenoid switch (56) is not removed from starter motor, field lead must be removed from "M" terminal on solenoid switch (56) before making these tests. Complete tests in minimum of time to prevent overheating of solenoid switch (56).

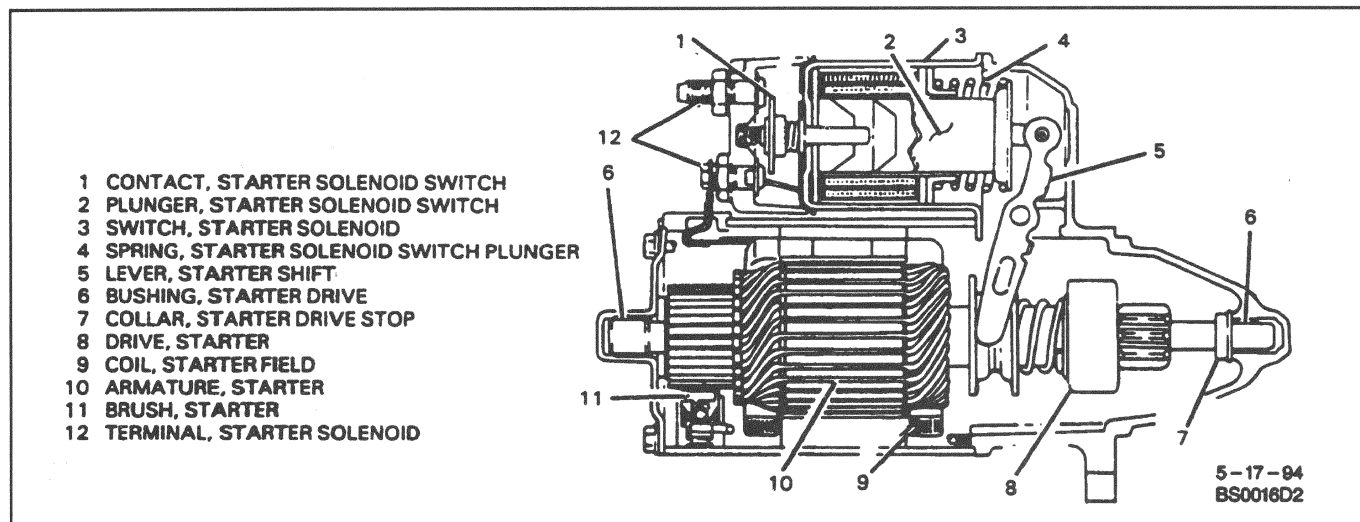
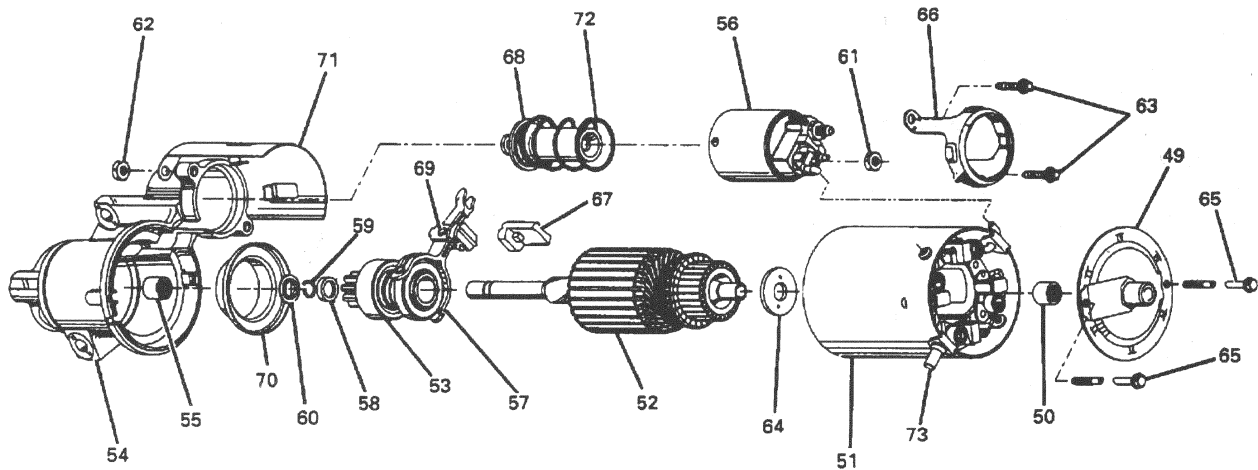


Figure 9 - SD-260 Starter Motor Cut-Away



- 49 FRAME, STARTER COMMUTATOR END
- 50 BEARING, STARTER ARMATURE COMMUTATOR END
- 51 FRAME KIT, STARTER WITH FIELD
- 52 ARMATURE, STARTER
- 53 DRIVE, STARTER
- 54 HOUSING, STARTER DRIVE
- 55 BEARING, STARTER DRIVE SHAFT DRIVE END
- 56 SWITCH, STARTER SOLENOID
- 57 LEVER, STARTER SHIFT
- 58 COLLAR, STARTER DRIVE STOP
- 59 RETAINER, STARTER DRIVE STOP COLLAR
- 60 COLLAR, STARTER DRIVE THRUST
- 61 NUT, STARTER SOLENOID SWITCH OUTER,
10 N·m (89 LB. IN.)
- 62 NUT, STARTER MOTOR HEAT SHEILD,
8 N·m (71 LB. IN.)
- 63 BOLT/SCREW, STARTER SOLENOID SWITCH CLAMP,
11 N·m (97 LB. IN.)
- 64 WASHER, STARTER ARMATURE BRAKE COMMUTATOR
END
- 65 BOLT/SCREW, COMMUTATOR END FRAME,
8.5 N·m (75 LB. IN.)
- 66 CLAMP, STARTER SOLENOID SWITCH
- 67 PLUG, STARTER SHIFT LEVER RETAINER
- 68 PLUNGER, STARTER SOLENOID SWITCH
- 69 RETAINER, STARTER SHIFT LEVER
- 70 SHIELD, STARTER DRIVE HOUSING
- 71 SHIELD, STARTER MOTOR HEAT
- 72 SPRING, STARTER SOLENOID SWITCH PLUNGER
- 73 TUBE, STARTER DRAIN

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Figure 10 - SD-260 Starter Motor Disassembled View

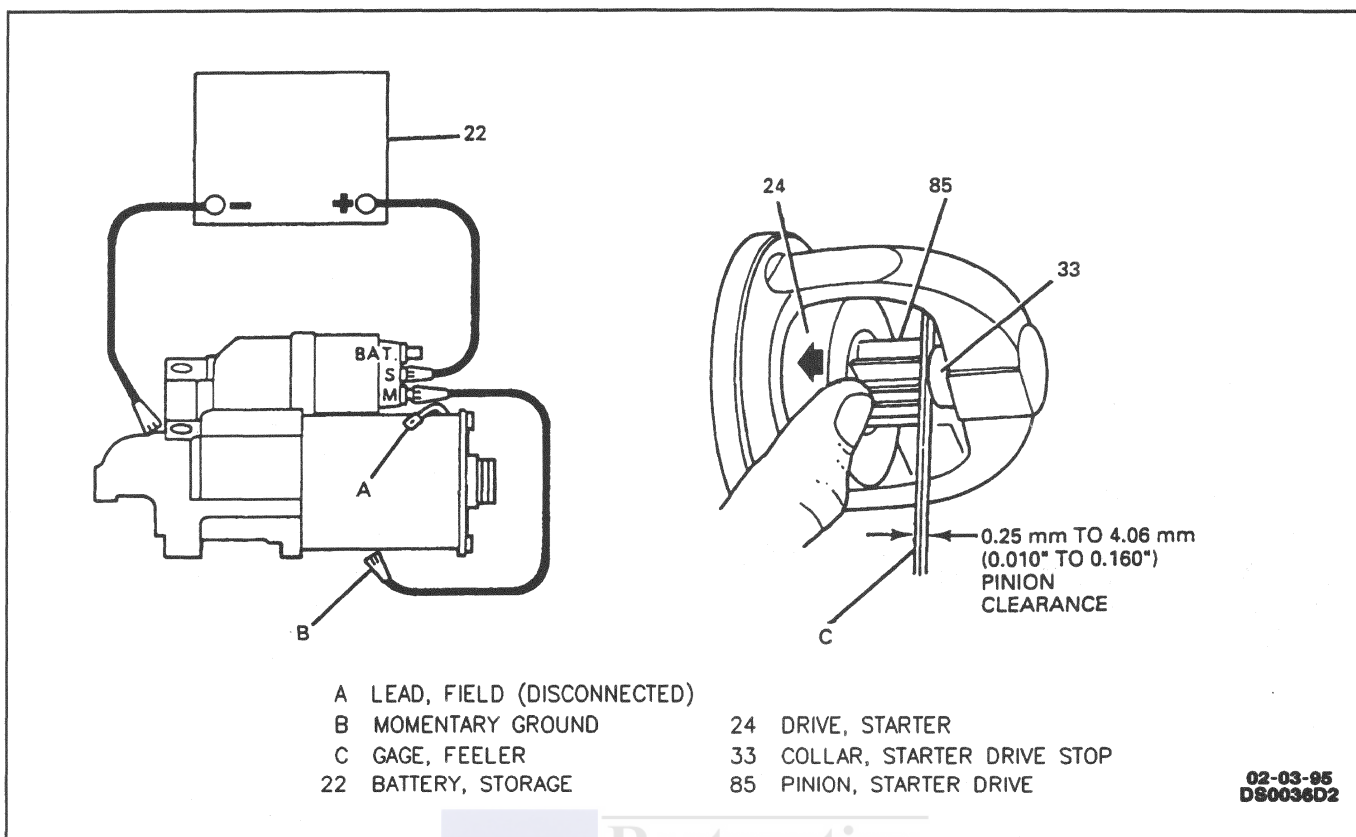


Figure 11 - Electrical Connections and Checking Pinion Clearance

- b. To check hold-in winding, connect ammeter in series with 12 volt battery and "S" terminal on solenoid switch (56). Connect voltmeter to "S" terminal and to ground. Connect carbon pile across battery. Adjust voltage to 10 volts and note ammeter reading. Reading should be 10 to 20 amperes.
- c. To check both windings, connect as for previous test. Ground solenoid "M" terminal. Adjust voltage to 10 volts and note ammeter reading. Reading should be 56 to 80 amperes.

! Important

- Current will decrease as windings heat up.
 - Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid switch (56) and the solenoid switch (56) should be replaced. No or low current draw readings that are under specifications indicate excessive resistance. A zero reading indicates an open circuit. Check connections, then replace solenoid switch (56) if necessary.
8. On SD-260 starter, solenoid switch (56) is serviced as an assembly.

Checking Pinion Clearance (SD-260 Starter Motor)

Figure 11

NOTICE: When the starter motor has been disassembled or the solenoid switch has been replaced, it is necessary to check the pinion clearance. Starter motor may not engage properly if pinion clearance is incorrect.



Measure

- Pinion Clearance as follows:

CAUTION: Keep fingers, tools, and other objects away from opening in drive housing while making electrical connections during this procedure. The strong shifting action of the solenoid switch could cause personal injury or damage as the drive pinion moves into cranking position.

- A. Secure starter motor in vise or equivalent fixture so that opening in drive housing is accessible for measurement.
- B. Disconnect field lead from solenoid switch "M" terminal and insulate it carefully.
- C. Connect one 12-volt battery lead to solenoid switch "S" terminal and the other to starter frame.

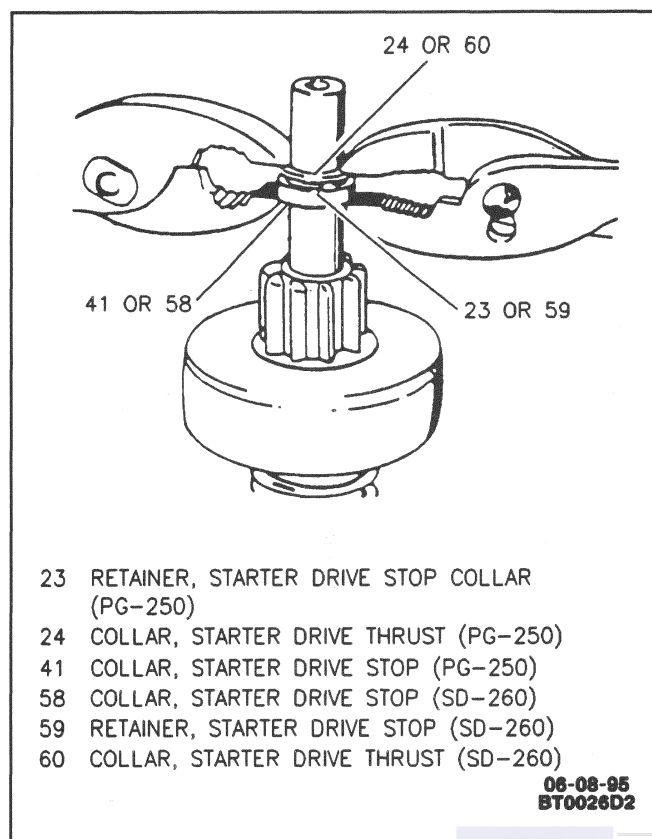


Figure 12 - Installing Pinion Stop Collar

- D. Flash jumper lead momentarily from solenoid switch "M" terminal to starter frame. This will shift pinion into cranking position and it will remain so until battery is disconnected.
- E. Push pinion back as far as possible to take up any movement, and check clearance with feeler gage. Clearance should be 0.25 mm to 4.06 mm (0.010 inch to 0.160 inch).
- F. Means for adjusting pinion clearance is not provided on starter motor. If clearance does not fall within acceptable limits, check for improper installation and replace all worn parts.
- G. Disconnect 12-volt battery leads from solenoid switch "S" terminal and starter frame.
- H. Reconnect field lead.

SD-260 Starter Motor Assembly

Figures 10, 12 and 13



Assemble

NOTICE: Refer to "Notice" on page 6D2-1 of this section.

1. Starter drive (53) onto armature shaft.
2. Starter drive stop collar (58) onto armature shaft with flat side toward starter drive (53).
3. New retainer (59) onto armature shaft and slide it down shaft until sealed in shaft groove.

4. Thrust collar (60) onto armature shaft with flange toward retainer (59).

- Use two sets of pliers and squeeze starter drive stop collar (58) and thrust collar (60) to snap starter drive stop collar (58) onto retainer (59).



Inspect

- End bearing (55). If bearing (55) has no lubrication visible or appears damaged, replace bearing (55).
 — Press bearing (55) from drive housing (54) and then press in new bearing (55) until recessed into drive housing casting as shown in figure 13. Bearing (55) is pre-lubricated and no additional lubrication is needed.
5. Shift lever (57) to starter drive (53) by spreading arms slightly.
 6. Plunger (68) to other end of shift lever (57) by snapping into place.
 7. Armature shaft into end bearing (55) while sliding lever retainer (69) into slot in drive housing (54).
 8. Plug (67) into slot in drive housing (54).
 9. Starter solenoid switch plunger spring (72) over plunger (68).
 10. Solenoid switch (56) with clamp (66) to drive housing (54).
 - Align motor terminal and solenoid switch (56) with field lead.
 11. Clamp bolts/screws (63).

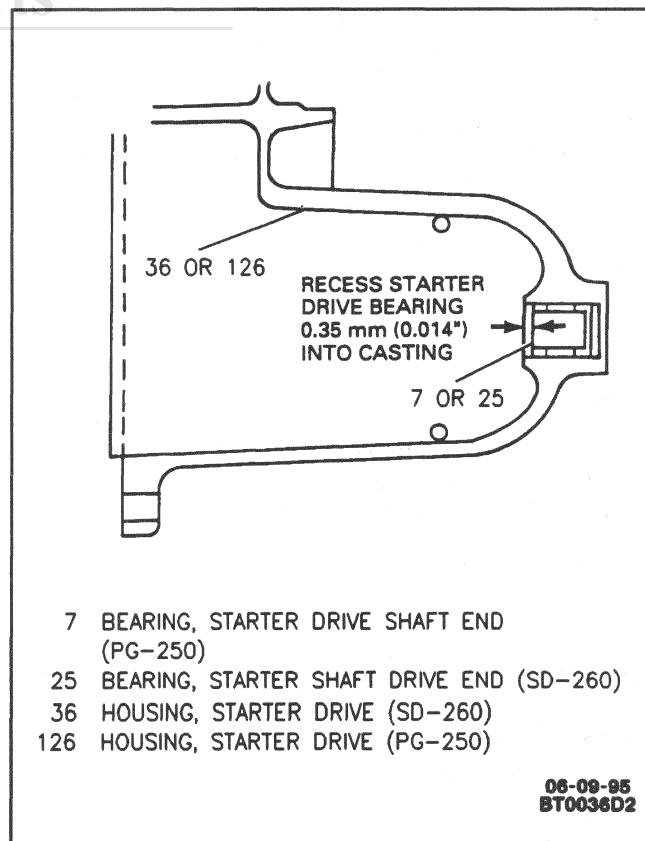


Figure 13 - Starter Drive Shaft Drive End Bearing

6D2-12 CRANKING SYSTEM



Tighten

- Clamp bolts/screws (63) to 11 N.m (97 lb. in.).



Clean

- Contact surface of frame kit brushes and armature commutator with soft cloth.

12. Frame kit (51) onto armature (52) and drive housing (54) by pushing in and holding brushes and aligning notch in frame kit (51) with locator on drive housing (54). When in place, release brushes and make sure they move freely and contact commutator.



Inspect

- Bearing (50) in commutator end frame (49). If bearing (50) has no visible lubrication or appears damaged, press in a new bearing (50) until recessed 2 mm (0.08 inch) into commutator end frame (49). Bearing (50) is pre-lubricated and no additional lubrication is needed.
13. Washer (64) onto armature shaft.
 14. Commutator end frame (49) onto armature shaft and seat into frame kit (51).
 15. Identification tag over bolt/screw hole in commutator end frame (49) with fluted end around bearing well.
 16. Bolts/screws (65) to starter motor.



Tighten

- Bolts/screws (65) to 8.5 N.m (75 ft. lb.).

NOTICE: Before attaching electrical leads, tighten inner nuts on solenoid switch terminals. If nuts are not tight, solenoid cap may be damaged during installation of leads. Tighten inner nut at "BAT" terminal to 10 N.m (89 lb. in.).

17. Nut (61) to solenoid switch (56).



Tighten

- Nut (61) to 10 N.m (89 lb. in.).

18. Heat shield (71) and nuts (62) onto protruding ends of clamp bolts/screws (63).



Tighten

- Nuts (62) to 8 N.m (71 lb. in.).

PG-250 STARTER MOTOR

PG-250 Starter Motor Disassembly

Figures 4 and 14

Tool Required:

J 28509-A Counter Gear Bearing Remover



Disassemble

1. Field lead from solenoid switch terminal by removing nut (21).
2. Through bolts/screws (31).
3. Bolts/screws (30) and end frame (29) from starter motor. Brush holder (27) and bearing (11) remain on armature.

CAUTION: Magnets on frame and field have strong attraction to armature. Keep fingers clear of pinch points to prevent personal injury.

4. Armature (9) from frame and field (26).
5. Frame and field (26) and shield (17) from housing (126).
6. Bearing (11) from armature (9), using J 28509-A. Bearing (11) is press-fit over shaft.

NOTICE: Before removing brush holder, lift each brush spring and rest against side of brush; this prevents brush damage when brush holder is pulled off of commutator. If springs are allowed to push brushes down when brushes are moved off of commutator, the brush pigtail lead may be separated from the brush.

7. Brush holder (27) from armature (9).
8. Slightly separate shaft and gear (40) and drive (6) from housing (126) and use a screwdriver to pry plastic shift lever off of pins (34).
9. Shaft and gear (40) and drive (6) from housing (126).
10. Collar (24) from shaft.
11. Slide deep socket over shaft and tap socket to drive collar (41) off of retainer (3).
12. Retainer (3), collar (41) and drive (6) from shaft.
13. Gear (20) and bearing (19) from shaft and gear (40). Bearing (19) is a press-fit into gear (20), and should only be removed if damaged.

Cleaning, Inspection, and Testing (PG-250 Starter Motor)

Figures 4 through 8



Clean

- All starter motor parts. DO NOT USE GREASE DISSOLVING SOLVENTS FOR CLEANING THE OVERRUNNING CLUTCH OR ARMATURE because the solvents dissolve grease packed in the clutch and damages the armature insulation.



Inspect

1. Drive (6) in action. Pinion should turn freely in overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace drive (6) if necessary.

Badly chipped pinion teeth can indicate chipped ring gear teeth. Replace flywheel if necessary.

- Starter drive (6) requires no lubrication, but it should be wiped clean. **Do not** clean in degreasing tank or wipe with grease dissolving solvents, as they will dissolve lubricant in drive mechanism.
- 2. Armature commutator. If commutator is dirty, clean with 400 grit polishing cloth. Remove all copper dust. If commutator is rough, armature (9) should be replaced. Do not under-cut or turn commutators.
 - Check points where armature conductors join commutator bars for good connection. A burned commutator bar is usually evidence of a poor connection.
- 3. Brushes and brush holders (27). When brushes appear excessively worn when compared to new brushes they should be replaced. Make sure brush holders are clean and brushes are not binding in brush holders (27). Full brush surface should ride on commutator to give proper performance.
 - Check to ensure that brush springs are giving firm contact between brushes and commutator. When brush springs are distorted or discolored, they should be replaced.
- 4. Armature (9) for short circuits by placing on a growler and holding a hack saw blade over armature core while armature is being rotated. If saw blade vibrates, armature is shorted.
 - Clean commutator bars and recheck armature (9) for short circuits. If saw blade still vibrates, replace armature (9).
 - Using a self powered test lamp, place one lead on commutator and other lead on armature core or shaft. If lamp lights, armature (9) is grounded and must be repaired or replaced.
- 5. Solenoid hold-in windings by connecting an ammeter and switch in series with a 12 volt battery and the "S" terminal on the solenoid switch. Connect voltmeter to "S" terminal and ground. Connect carbon pile across battery. Adjust voltage to 10 volts and note ammeter reading. PG-250 starter motor reading should be 10 to 20 amperes. Refer to figure 8 for hook up.

NOTICE: Do not allow both solenoid windings to be energized for more than 15 seconds at a time, or the pull-in winding could be damaged by overheating.

- 6. Both solenoid hold-in windings and pull-in windings by making connections as for previous test. Ground solenoid terminal "M." Adjust voltage to 10 volts and note ammeter reading. PG-250 starter motor reading should be 60 to 85 amperes.
 - Current reading will change as windings heat up.
 - Current draw readings that are over specifications indicate shorted turns or a ground in the solenoid windings. Replace solenoid switch.

- Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open. Check/repair connections when possible; otherwise, replace solenoid switch.

- 7. Solenoid switch and drive housing are serviced as an assembly.
- 8. If test equipment is available:
 - A. Check field windings by using a self-powered test lamp. Place one lead on field lead terminal and other lead on one insulated brush. If lamp fails to light, series coil is open and will require repair or replacement. Perform this test for each insulated brush to check brush and lead continuity. (Figure 6).
 - B. Using a self-powered test lamp, place one lead on grounded brush holder and other lead on either insulated brush. If lamp lights, grounded series coil is indicated and frame kit (51) must be replaced. (Figure 7).

Checking Pinion Clearance (PG-250 Starter Motor)

Figure 11

CAUTION: Keep fingers, tools and other objects away from opening when making electrical connections during this procedure. The strong shifting action of the solenoid switch could cause personal injury or damage as the pinion moves into cranking position.

- 1. Secure starter motor in vise so that opening in drive housing is accessible for measurement.
- 2. Ensure that field lead is disconnected and insulated from solenoid switch terminal.
- 3. Connect positive lead from a 12-volt power source to the solenoid switch "S" terminal. Connect negative lead from power source to a clean ground on starter motor housing. Refer to figure 9 for hook-up. This energizes hold-in coil.
- 4. Momentarily ground solenoid switch terminal "M" to starter motor housing. This energizes the solenoid switch pull-in coil and causes the pinion to move into cranking position. The pinion will stay in this position when the momentary ground is removed.
- 5. Press on drive assembly (24) just enough to take up any free play in the drive pinion as shown in figure 11. Use feeler gages to check clearance between end of pinion and collar (41). Clearance should be 0.25 to 4.06 mm (0.010 to 0.160 inch).
- 6. Disconnect negative (ground) lead from starter motor housing (pinion will retract), then disconnect positive lead from solenoid switch "S" terminal.
- 7. When clearance is outside specifications, recheck starter motor for proper assembly and for worn or damaged parts in shift mechanism and drive assembly. Replace worn parts.

6D2-14 CRANKING SYSTEM

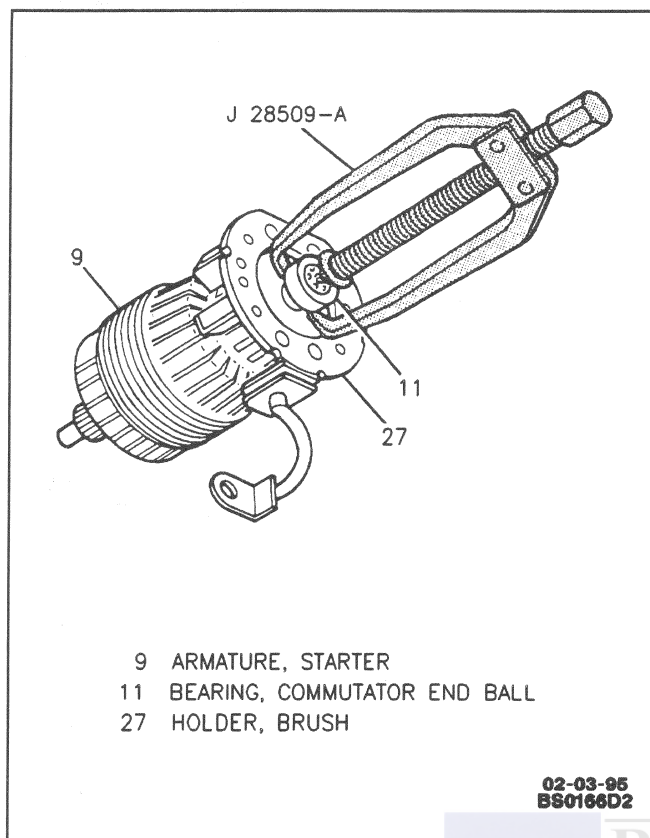


Figure 14 - Removing Commutator End Ball Bearing

PG-250 Starter Motor Assembly

Figures 4, 12, 13, 15, and 16



Inspect

- Bearing (19), bearing (7), shaft and gear (40) and bearing (11). When dry, bearing (19), and shaft and gear (40) may be lightly lubricated with GM lubricant 10497186 or equivalent. Bearings (7 and 11) are permanently lubricated, do not lubricate. If dry, replace the bearings (7 or 11). When installing bearing (7), recess into casting 0.35 mm (0.014 inch), refer to figure 13.



Assemble

NOTICE: Refer to "Notice" on page 6D2-1 of this section.

- Bearing (19) to gear (20). Press bearing to 0.35 mm (0.014 inch) below face of casting. Refer to figure 13.
- Lubricate gear (20), planetary gear of the shaft and gear (40), and the armature shaft gear teeth lightly with GM lubricant 10497186 or equivalent. Refer to figure 15.
- Gear (20) and drive assembly (6) over shaft and gear (40) with pinion away from armature (9).
- Collar (41) onto shaft.
- New retainer (3) into groove on shaft. Do not reuse old retainer (3).

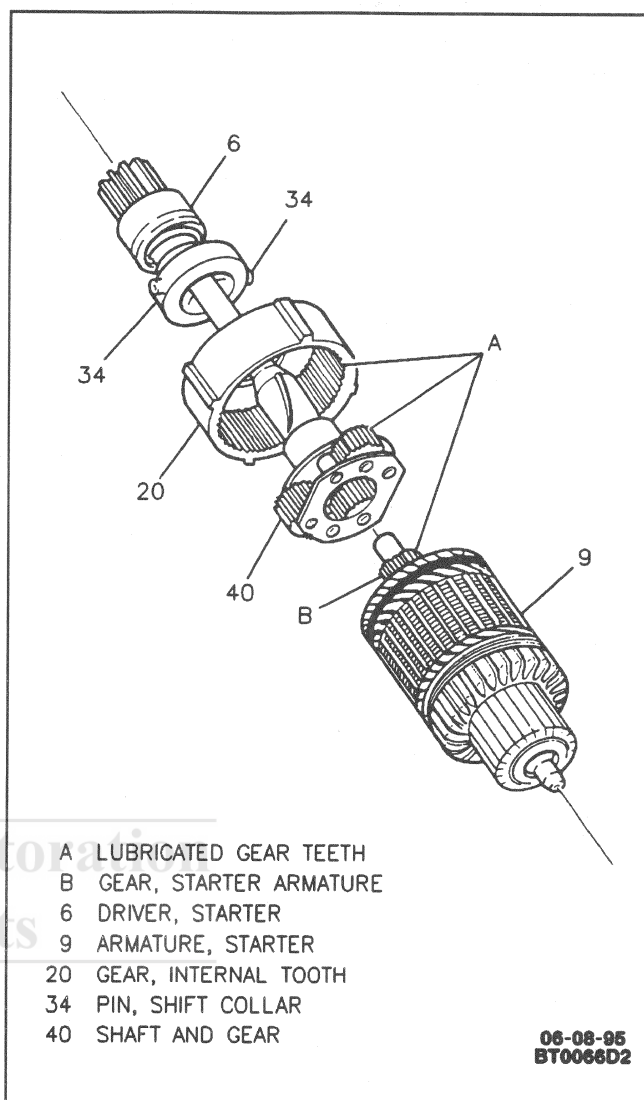


Figure 15 - PG-250 Starter Armature and Drive Assembly.

- Collar (24) to end of shaft with flange toward retainer (3). Use pliers as shown in figure 10 to snap collar (41) over retainer (3).
- Drive assembly (6) and shaft and gear (40) into housing (126).
 - Use a screwdriver to gently guide shift lever over pins (34) on drive assembly (6).
- Shield (17) and frame and field (26) into housing (126).



Inspect

- Brushes. Replace if damaged or excessively worn.
- Brush holder (27) onto armature (9).
- Bearing (11) onto armature (9) by pressing on inner race until bearing (11) rests against shoulder on armature shaft.

CAUTION: Magnets in frame and field have strong attraction to armature. Keep fingers clear of pinch points to avoid personal injury.

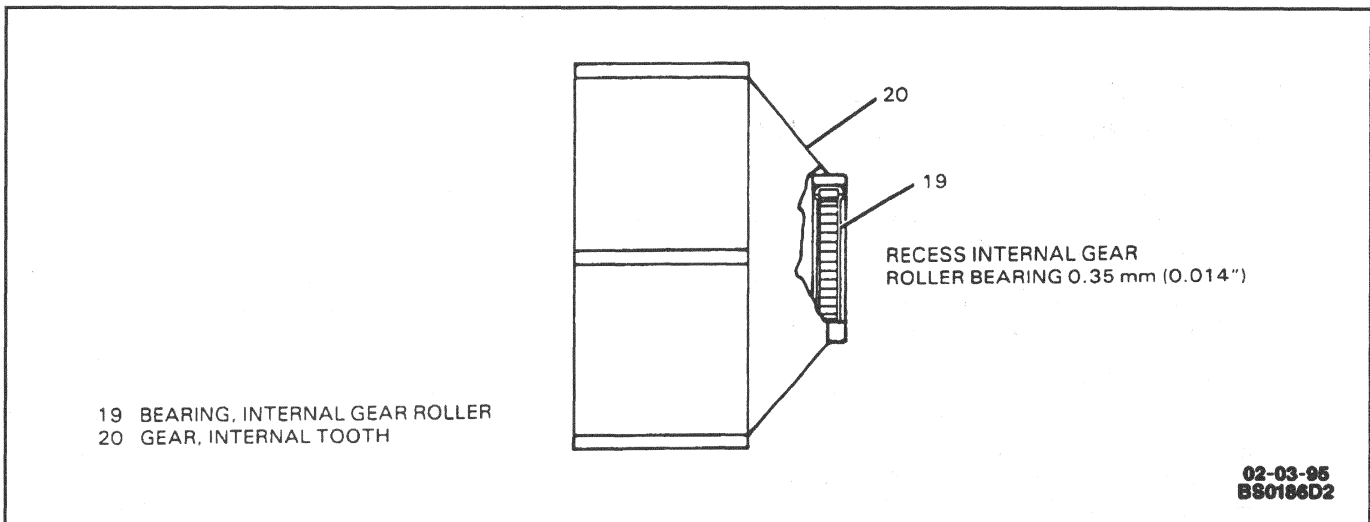


Figure 16 - Internal Gear Roller Bearing.

11. Armature (9) to frame and field (26).
12. Frame (29) to brush holder (27) using bolts/screws (30).

 Tighten

- Bolts/screws (30) to 6.5 N.m (58 lb. in.).

13. Through bolts/screws (31).

 Tighten

- Bolts/screws (31) to 8.5 N.m (75 lb. in.).

 Measure

- Pinion clearance. Refer to "Checking Drive Pinion Clearance (PG-250 Starter Motor)" in this section.

NOTICE: When installing electrical connections to starter motor, the inside nut on the solenoid switch battery terminal must be tightened before battery cable is attached. If inside nut is not tight, cap may be damaged during installation of battery cable.

 Tighten

- Starter solenoid switch battery terminal inside nut to 8 N.m (71 lb. in.).

14. Field lead to solenoid switch terminal.

15. Nut (21).

 Tighten

- Nut (21) to 8 N.m (71 lb. in.).

PG-260 STARTER MOTOR

Only the SD-260 and PG-250 unit repair service information is included in this section. The PG-260 starter motor should be serviced as an assembly.

SPECIFICATIONS

STARTER MOTOR PERFORMANCE

4.3L Engine With SD-260 Starter Motor

- No Load Test With 10 Volts
 - Current..... 51 - 71 Amps
 - Starter Drive Pinion Speed..... 7,000 - 11,000 rpm
- Starter Solenoid Switch
 - Hold-in Windings at 10 Volts 10 - 20 Amps
 - Both Windings at 10 Volts..... 56 - 80 Amps

5.7L LT1 Engine With PG-250 Starter Motor

- No Load Test With 10 Volts
 - Current..... 65 - 90 Amps
 - Starter Drive Pinion Speed..... 2700 - 3200 rpm
- Starter Solenoid Switch
 - Hold-in Windings at 10 Volts 10 - 20 Amps
 - Both Windings at 10 Volts..... 60 - 85 Amps

5.7L LT1 Engine With PG-260 Starter Motor

- No-Load Test at 10 volts
 - Current..... 64-95 Amps
 - Starter Drive Pinion Speed..... 2825-3275 RPM
- Starter Solenoid Switch
 - Hold-in Windings at 10 Volts 10-20 Amps
 - Both Windings at 10 Volts..... 60-85 Amps

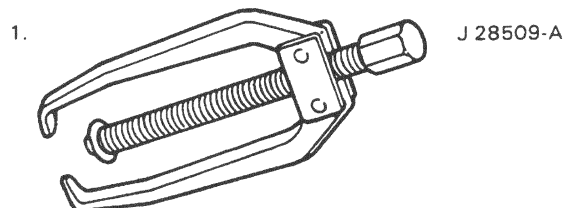
FASTENER TIGHTENING SPECIFICATIONS

Battery Negative Cable.....	15 N.m (11 lb. ft.)
Starter Motor Heat Shield Nut.....	8 N.m (71 lb. in.)
Starter Motor Bolt/Screw	47 N.m (35 lb. ft.)
Starter Motor Brush Holder Attachment Bolt/Screw (PG-250)	6.5 N.m (58 lb. in.)
Starter Motor Commutator End Frame Bolt/Screw	8.5 N.m (75 lb. in.)
Starter Solenoid Switch "BAT" Terminal Inner Nut	9 N.m (80 lb. in.)
Starter Solenoid Switch "BAT" Terminal Outer Nut.....	9 N.m (80 lb. in.)
Starter Solenoid Switch Clamp Bolt/Screw.....	11 N.m (97 lb. in.)
Starter Solenoid Switch "M" Terminal Inner Nut	9 N.m (80 lb. in.)
Starter Solenoid Switch Outer Nut (PG-250).....	8 N.m (71 lb. in.)
Starter Solenoid Switch "S" Terminal Nut	2.5 N.m (22 lb. in.)
Starter Through-Bolt/Screw (PG-250).....	8.5 N.m (75 lb. in.)

GENERAL SPECIFICATIONS

Pinion Clearance	0.25 mm to 4.06 mm (0.010 to 0.160 inch)
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SPECIAL TOOLS



1. COUNTER GEAR BEARING REMOVER

SECTION 6D3

CHARGING SYSTEM

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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CS Generator On-Vehicle Check	6D3-1	Generator Usage Chart	6D3-11
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GENERAL DESCRIPTION

CS-130 AND CS-144 GENERATORS

The charging system (CS) generators use a built-in voltage regulator with fault detection, a stator, rectifier bridge, and rotor with slip rings and brushes. A conventional pulley and fan is used to cool the slip ring end frame, rectifier bridge and voltage regulator. These generators use only two connections - battery positive and "L" terminal to the charge indicator bulb, in addition to the ground path through the generator bracket. Use of the "P," "I," and "S" terminals is optional. The "P" terminal is connected to the stator and may be connected externally to a tachometer or other device. The "I" terminal can be connected directly to battery voltage to power the generators instead of, or in addition to, the "L" terminal which must be stepped down. The "S" terminal may be connected to an external voltage source, such as a voltage near the battery, for voltage control. If the "S" terminal is not used, internal generator voltage is used for control.

The charge indicator bulb receives ignition voltage. This voltage is then sent to the generator for power to the field. If the generator detects an error within, it will ground this circuit which will illuminate the Charge Indicator bulb. This bulb will also illuminate if the engine is not running (generator shaft not rotating). If the charge indicator is illuminated with the engine running, a charging system condition

requiring diagnosis is indicated. The charge indicator will be on with the engine running if system voltage is either too high or too low.

The regulator voltage setting varies with temperature and limits system voltage by controlling rotor field current. While the field current is "on," this regulator actually switches rotor field current on and off at a fixed frequency of about 400 cycles per second to help in controlling radio noise. By varying the overall on-off time, correct average field current for proper system voltage control can be obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, on-off time may be 90 percent and 10 percent respectively.

DIAGNOSIS

CS GENERATOR ON-VEHICLE CHECK

Tool Required:

J 39688 or equivalent Digital Multimeter

When the CS charging system is operating normally, the warning lamp will come on when the ignition switch is turned on and will go out when the engine starts. If the lamp operates abnormally, or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight, or by a rear compartment or instrument panel compartment lamp

6D3-2 CHARGING SYSTEM

that stays on. If an undercharged battery is noted after vehicle is left overnight, refer to SECTION 6D1 for parasitic load diagnosis.

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts/screws, worn or dirty bearings, faulty diode or faulty stator. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not reverse connections to generator.
- Do not short across or ground any of the terminals in charging circuit, except as directed by instructions.
- NEVER disconnect generator "BAT" terminal with generator operating.
- When connecting charger or booster battery to battery, refer to SECTION 6D1.
- In Chevrolet vehicles, voltmeter is used instead of warning lamp. In this case, steps 1 through 4 below, pertaining to faulty warning lamp operation, should be omitted from troubleshooting procedure.
- Do not attempt to disassemble CS-130 generator. Damage to generator could result.

Trouble in the charging system will show up as one or more of the following conditions:

- Faulty warning lamp operation.
- Undercharged battery, as evidenced by slow cranking or dark hydrometer.
- Overcharged battery, as evidenced by spewing of electrolyte from vents or a yellow hydrometer.

To diagnose the CS-130 or CS-144 charging system, use the following procedure:

Important

- Only the CS-144 generator may be repaired.
1. Visually check belt and wiring.
 2. For vehicles without charge warning lamp, go to step 5.
 3. With ignition switch in "RUN" and engine stopped, lamp should be on. If lamp is not on, detach harness at generator and ground "L" terminal in wiring harness.
 - Lamp lights - repair or replace generator.
 - Lamp does not light - locate open circuit between grounding lead and ignition switch. Lamp bulb may be burned out.
 4. With ignition switch in "RUN" and engine running, lamp should be off. If lamp is not off, detach wiring harness at generator.
 - If lamp goes off, repair or replace generator.
 - If lamp stays on, check for grounded terminal "L" wire in harness.
 5. Battery undercharged or overcharged.
 - A. Detach wiring harness connector from generator.
 - B. With ignition switch in "RUN" and engine not running, connect J 39688 as voltmeter from ground to "L" terminal in wiring harness

connector. Connect to "F" or "I" terminal for gage equipped vehicles. At least one terminal should have battery voltage.

- C. Zero volts indicates open circuit between terminal and battery. Lamp bulb may be burned out. Refer to SECTION 8A-30.
- D. Reconnect harness connector to generator.

CAUTION: Disconnect battery negative cable before installing or removing a series-type ammeter at generator battery terminal.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

- E. Install ammeter at generator output terminal. With load off, install carbon pile load test across battery terminals. Start engine and run at moderate speed.
- F. Measure voltage across battery, using J 39688. If voltage is above 16 volts, replace or repair generator.
- G. Turn on accessories and load battery with carbon pile to obtain maximum generator output. Maintain voltage at 13 volts or above. Use ammeter to check amperage. Compare output to ampere rating in "Specifications" at the end of this section.
 - If within 15 amps of rated output, generator is OK.
 - If not within 15 amps of rated output, repair or replace generator.

CS GENERATOR BENCH CHECK

Figure 1

Tool Required:

J 39688 or equivalent Digital Multimeter

The following bench check may be used to simulate operation on a vehicle. Use the bench check to verify operation of a CS-144 generator that has been repaired.

1. Mount generator in suitable test stand according to test stand manufacturer's instructions. Test stand must be capable of driving generator assembly at 6,500 rpm.
2. Make connections as shown in Figure 1. Be sure carbon pile is turned off. Ground polarity of generator and battery must be same. Battery must be fully charged. Use a 30-500 ohm resistor between battery and "L" terminal of generator.
3. Slowly increase generator speed and observe voltage using J 39688.

Important

- The battery must be fully charged when making this test.
4. If voltage is uncontrolled and increases above 16 volts, repair or replace generator.

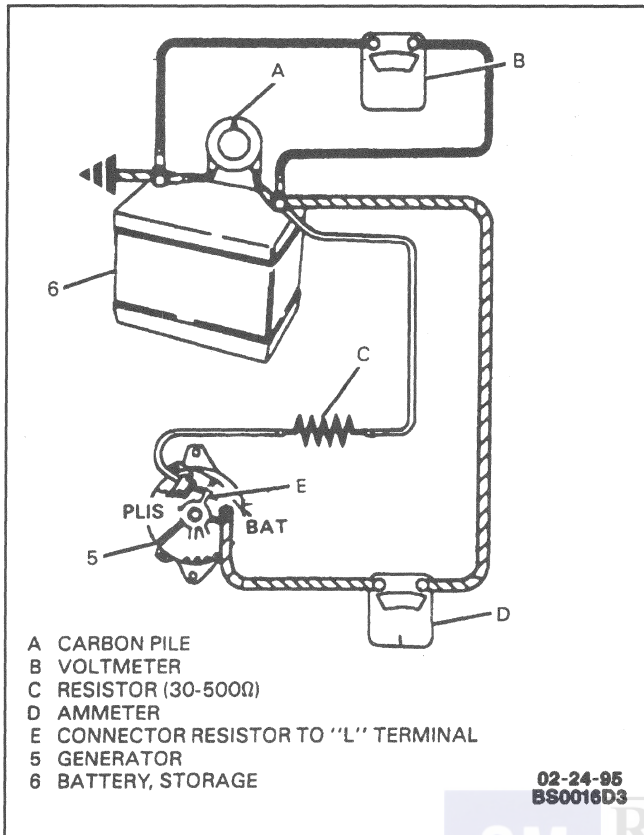


Figure 1 - Generator Bench Check

5. If voltage is below 16 volts, increase speed and connect and adjust carbon pile to obtain maximum amperage output. Maintain voltage above 13 volts.
6. Use ammeter to check amperage. If output is within 15 amps of rated output, generator is good.
7. If output is not within 15 amps of rated output, repair or replace generator.

! Important

- Only the CS-144 generator may be repaired.

ON-VEHICLE SERVICE

The CS generators do not require periodic lubrication. The rotor shaft is mounted on internally-lubricated, sealed bearings which do not require periodic lubrication. At periodic intervals, check mounting bolts/screws for tightness and check belt tension. Refer to SECTION 6A4A.

GENERATOR REPLACEMENT

Figures 2 and 3

↔ Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable from battery terminal.
2. Battery positive cable from generator "BAT" terminal.
3. Nut (27) and bolt/screw (21) from generator (5).
 - Loosen nut (29) and move brace (26) out of way.
4. Bolt/screw (9), nut (12) and brace (1).
5. Nuts (31 and 35), bolt/screw (17) and brace (10).
6. Generator (5).
7. Engine harness electrical connector from generator (5).

→ Install or Connect

NOTICE: Refer to "Notice" on page 6D3-1 of this section.

1. Engine harness electrical connector to generator (5).
2. Generator (5) into position.
3. Brace (10), bolt/screw (17) and nuts (31 and 35).

⌚ Tighten

- Nut (35) to 41 N·m (30 lb. ft.).
 - Nut (31) or bolt/screw (17) to 50 N·m (37 lb. ft.).
4. Brace (1), nut (12) and bolt/screw (9).

⌚ Tighten

- Nut (12) to 41 N·m (30 lb. ft.).
 - Bolt/screw (9) to 50 N·m (37 lb. ft.).
5. Move brace (26) into position.
 6. Nut (27) and bolt/screw (21).

⌚ Tighten

- Nut (27) or bolt/screw (21) to 50 N·m (37 lb. ft.).
 - Nut (29) to 41 N·m (30 lb. ft.).
7. Battery positive cable to generator "BAT" terminal.

⌚ Tighten

- Generator battery terminal nut to 12 N·m (106 lb. in.).
8. Battery negative cable to battery terminal.

⌚ Tighten

- Battery negative cable bolt/screw to 17 N·m (13 lb. ft.).

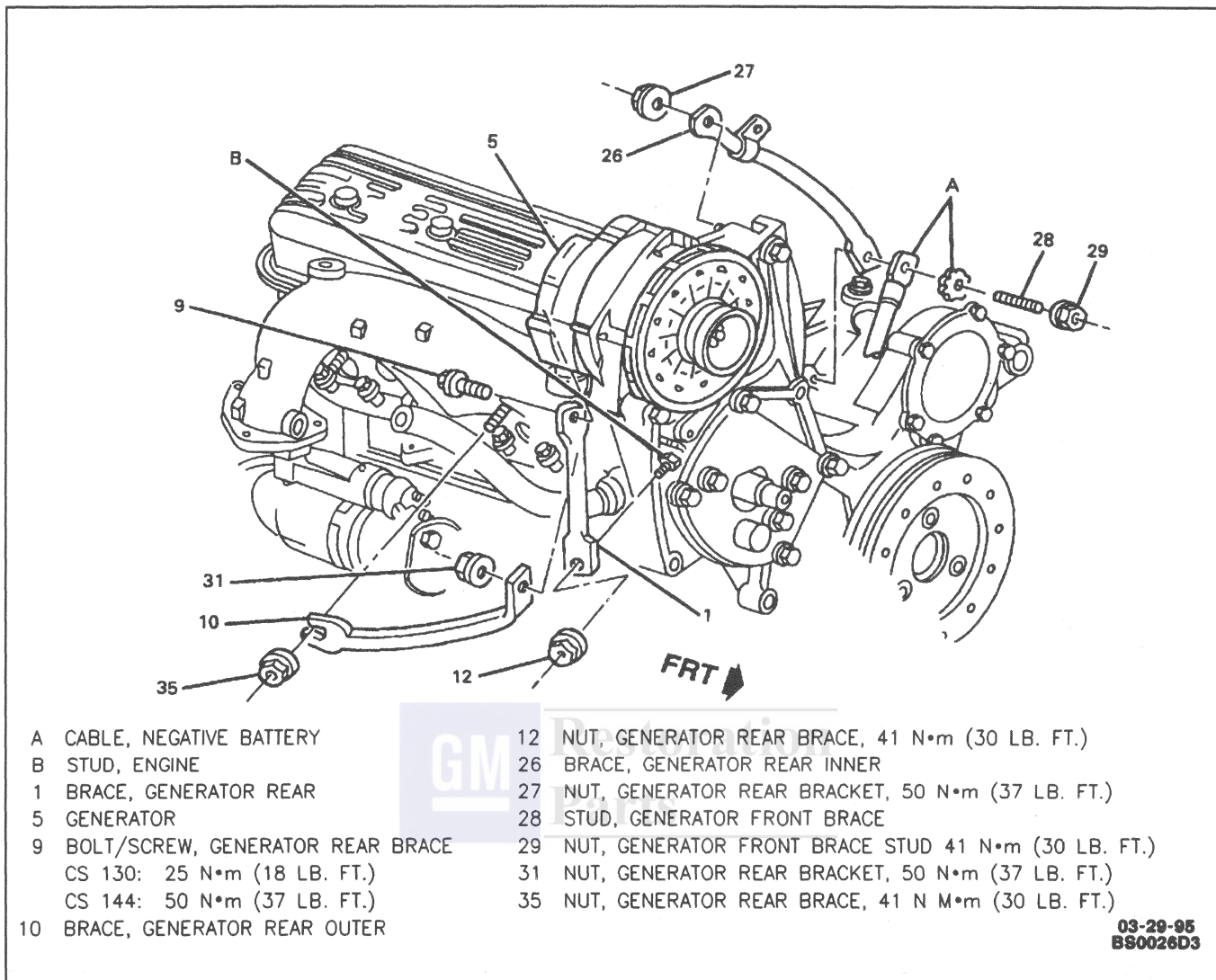


Figure 2 - Generator and Generator Braces

GENERATOR AND POWER STEERING PUMP BRACKET REPLACEMENT

Figures 2 and 3

This bracket is used to mount the generator and power steering pump on the engine. Bracket replacement procedures are the same for engines equipped with the CS-130, 105-amp generator (K68); and the CS-144, 140 amp generator (KG9).



Remove or Disconnect

1. Radiator upper fan shroud, if vehicle is equipped with mechanical fan. Refer to SECTION 6B.
2. Generator. Refer to "Generator Replacement" in this section.
3. Heater hose clip bolt/screw from bracket (7).
4. Radiator outlet hose nuts from air conditioning compressor studs, if vehicle is equipped with mechanical fan.

- Reposition radiator outlet hose to provide clearance to air conditioning compressor mounting studs.

5. Power steering pump. Refer to SECTION 3B.
6. Air conditioning compressor mounting bolts/screws or studs and rear bracket nut.
7. Air conditioning compressor from bracket (7) and lay aside.
8. Drive belt tensioner bolts/screws (33) and tensioner (32).
9. Bolts/screws (13, 16 and 34).
10. Bracket (7).



Install or Connect

1. Bracket (7).
2. Bolts/screws (13, 16, and 34).

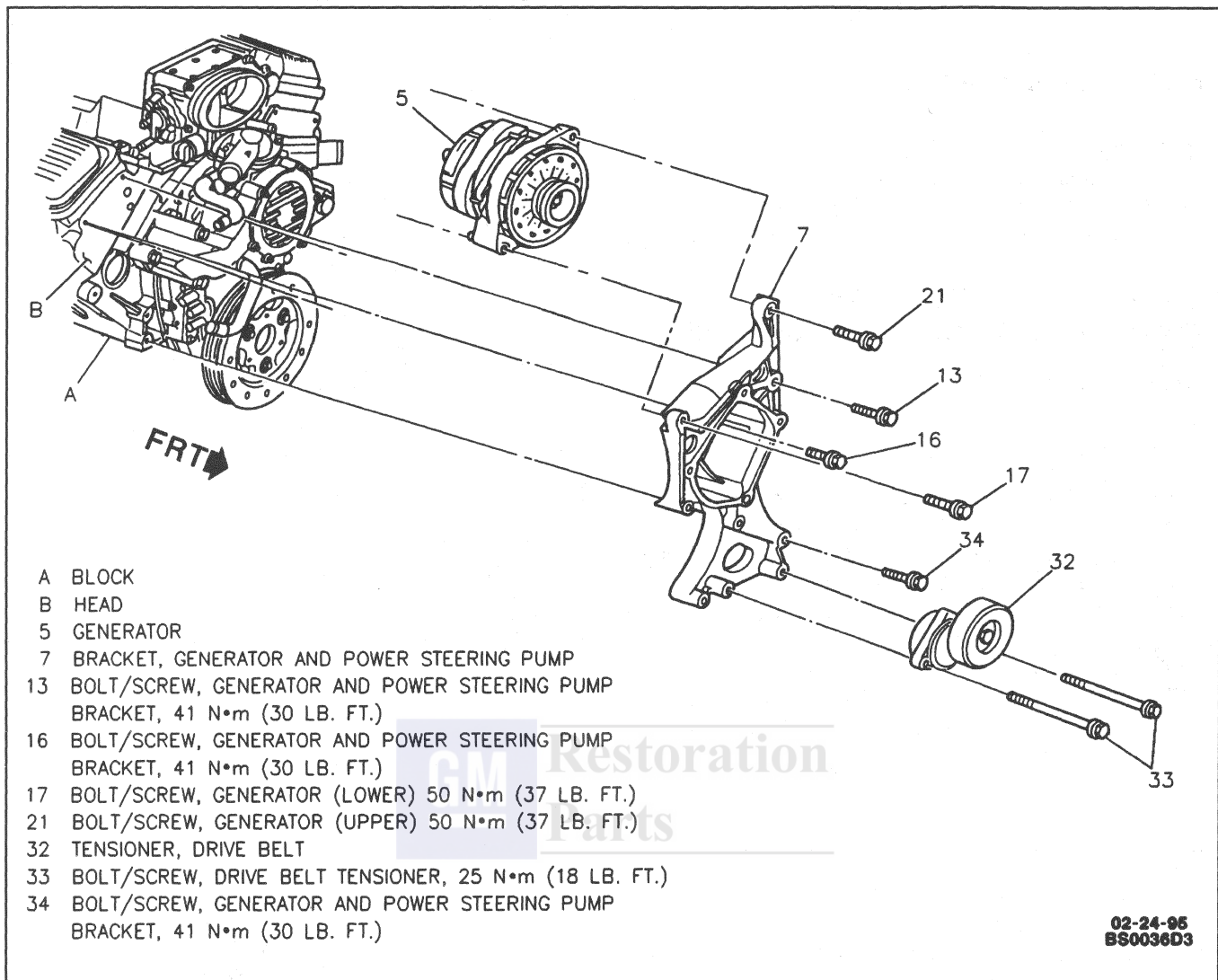


Figure 3 - Generator and Power Steering Pump Bracket

**Tighten**

- A. Bolt/screw (16) to 41 N•m (30 lb. ft.).
 - B. Bolt/screw (34) to 41 N•m (30 lb. ft.).
 - C. Bolt/screw (13) to 41 N•m (30 lb. ft.).
3. Drive belt tensioner (32) and tensioner bolts/screws (33).

**Tighten**

- Tensioner bolts/screws (33) to 25 N•m (18 lb. ft.).
4. Air conditioning compressor to bracket (7).
5. Air conditioning compressor mounting bolts/screws or studs and rear bracket nut.

**Tighten**

- Air conditioning compressor mounting bolts/screws or studs to 50 N•m (37 lb. ft.).
- Air conditioning compressor rear bracket nut to 41 N•m (30 lb. ft.).

6. Power steering pump. Refer to SECTION 3B.
7. Position radiator hose onto air conditioning compressor studs.
8. Radiator outlet hose support nuts to air conditioning compressor studs, if removed.

**Tighten**

- Radiator outlet hose support nuts to 20 N•m (15 lb. ft.).
9. Heater hose clip bolt/screw to bracket (7).

**Tighten**

- Heater hose clip bolt/screw to 1.9 N•m (17 lb. in.).
10. Generator. Refer to "Generator Replacement" in this section.
11. Radiator upper fan shroud, if removed. Refer to SECTION 6B.

6D3-6 CHARGING SYSTEM

UNIT REPAIR

CS-130 105-AMP GENERATOR

NOTICE: Do not attempt to disassemble a CS-130 generator. Damage to the generator could result. The CS-130 generator is replaced as a complete unit.

CS-144 140-AMP GENERATOR DISASSEMBLY, TEST, AND REASSEMBLY

Figures 4 through 12

Disassemble

1. Make scribe marks on slip ring end frame (43) and drive end frame (59) to ease reassembly.
2. Through-bolts/screws (61) and separate slip ring end frame (43) and drive end frame (59).
3. End frame bearing (63) from rotor shaft.

Measure

- Rotor (66) for grounds, opens and shorts (Figure 5).

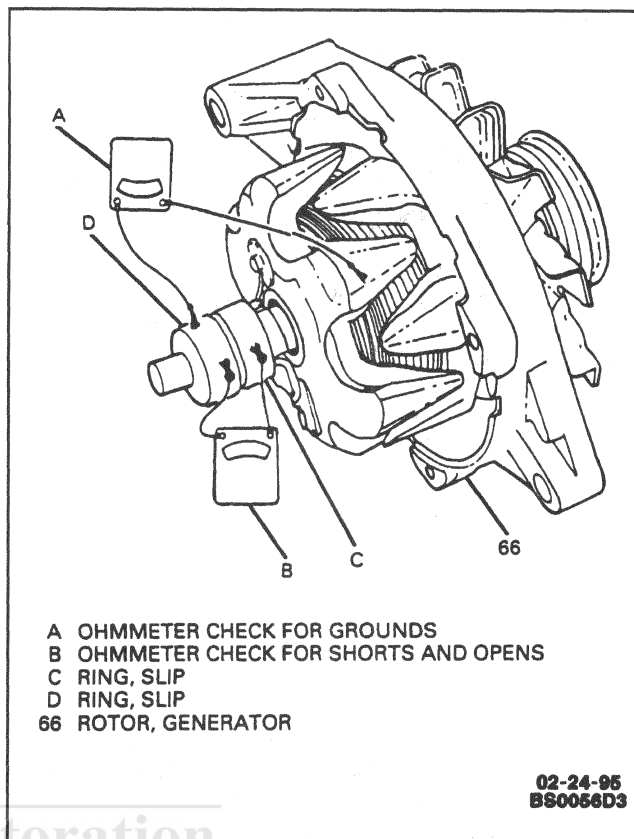


Figure 5 - Testing Generator Rotor

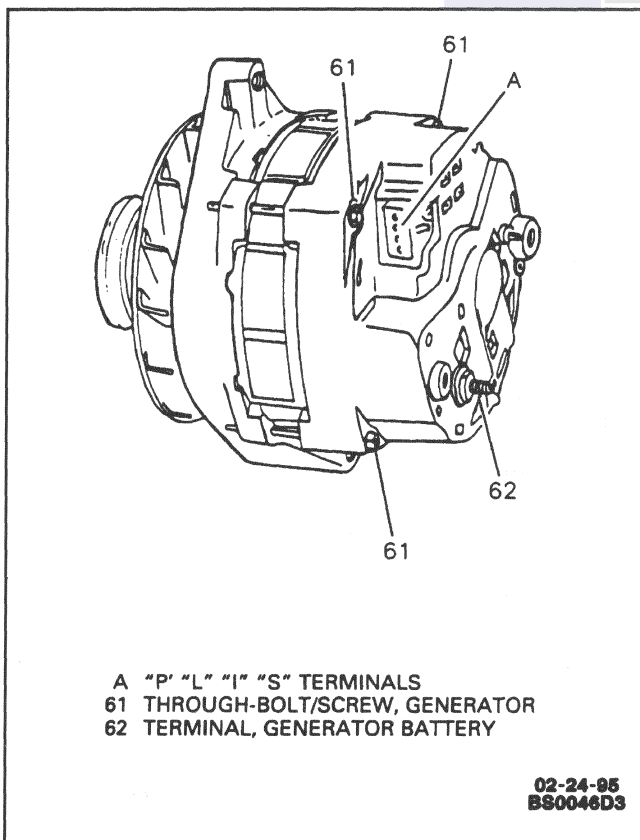


Figure 4 - Generator Through-Bolt/Screw Location

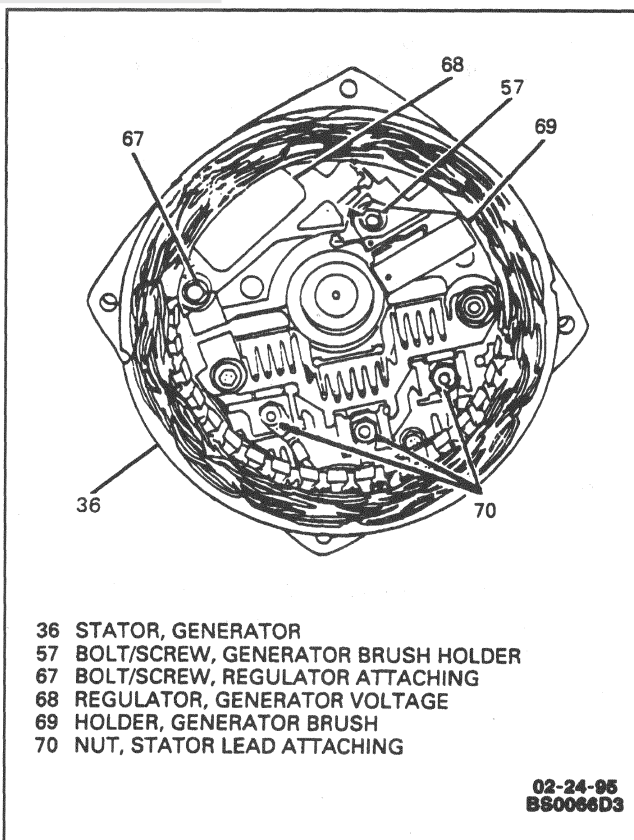


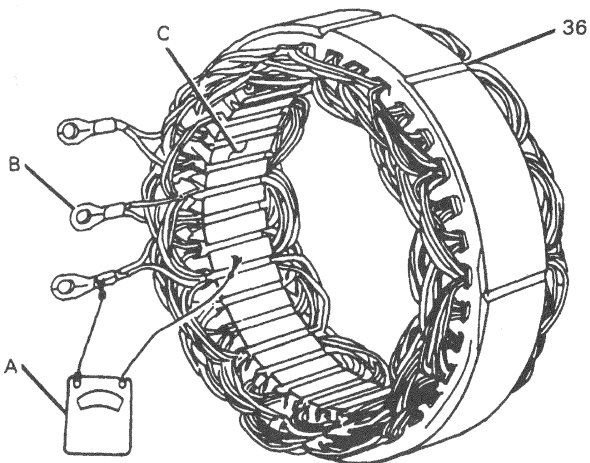
Figure 6 - Generator Slip Ring End Frame View

! Important

- Test should be performed at approximately 21°C (70°F). A different temperature may result in inaccurate ohmmeter readings.
 - A. Connect ohmmeter to slip ring and clean metal grounding surface on frame of rotor (66) to check for grounds.
 - Ohmmeter should read infinity (open). If not, replace rotor (66).
 - B. Connect ohmmeter to both slip rings to check for shorts and opens.
 - Ohmmeter should read 1.7 to 2.1 ohms. If not, replace rotor (66).
4. Nuts (70).
 5. Stator (36) from slip ring end frame (43).

Measure

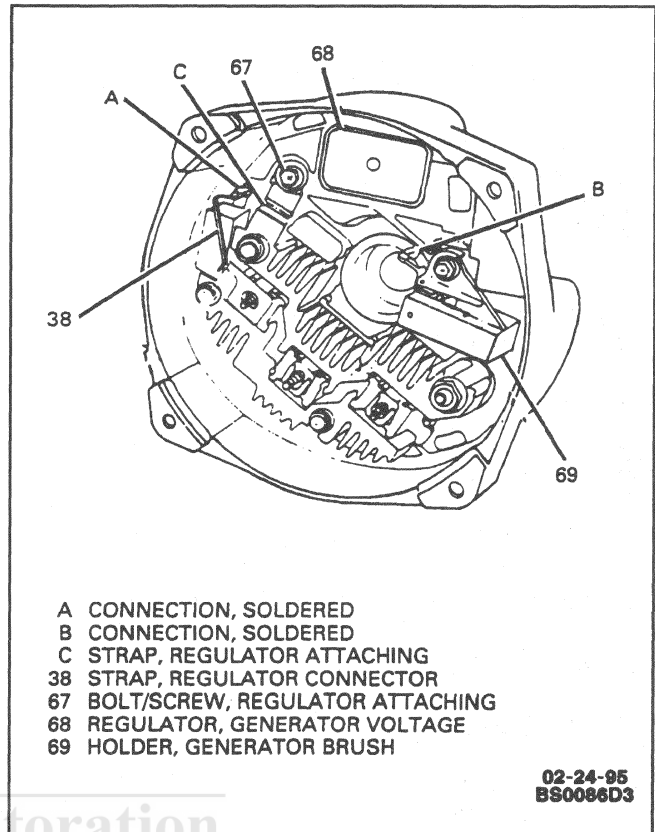
- Stator (36) for grounds (Figure 7).
 - A. Connect ohmmeter to stator terminal and to clean metal ground on laminations.
 - B. If ohmmeter reading is low, replace stator (36). Stator (36) cannot be checked for opens and shorts with ohmmeter.
6. Unsolder connections at connector strap (38) and brush holder (69) to voltage regulator (68).
 7. Bolt/screw (67) and bolt/screw (57).



- A OHMMETER CHECK FOR GROUNDS
 B TERMINAL, GENERATOR STATOR
 C LAMINATIONS
 36 STATOR, GENERATOR

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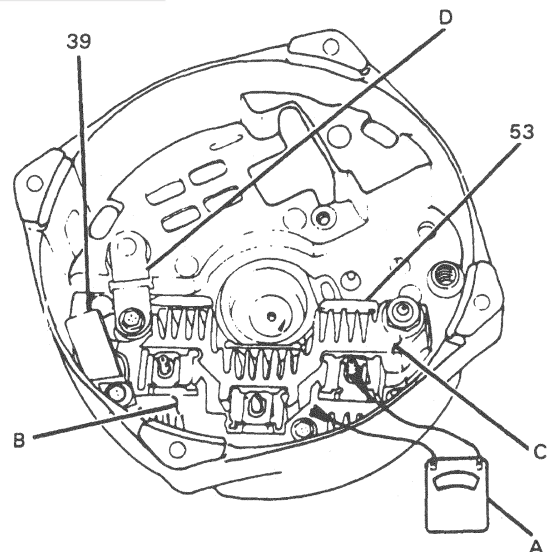
Figure 7 - Testing Generator Stator



- A CONNECTION, SOLDERED
 B CONNECTION, SOLDERED
 C STRAP, REGULATOR ATTACHING
 38 STRAP, REGULATOR CONNECTOR
 67 BOLT/SCREW, REGULATOR ATTACHING
 68 REGULATOR, GENERATOR VOLTAGE
 69 HOLDER, GENERATOR BRUSH

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Figure 8 - Removing Generator Voltage Regulator and Generator Brush Holder



- A OHMMETER
 B SINK, GROUNDED HEAT
 C SINK, INSULATED HEAT
 D STRAP, GENERATOR CAPACITOR
 39 CAPACITOR, GENERATOR
 53 BRIDGE, GENERATOR RECTIFIER

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Figure 9 - Testing Generator Rectifier Bridge

6D3-8 CHARGING SYSTEM

8. Voltage regulator (68) and brush holder (69) with dust shield (60) from slip ring end frame (43).
 - Tap plastic retaining pin from dust shield retaining clip. Be sure to keep pin for reassembly.
9. Brushes (41) and dust shield (60) from brush holder (69).



Clean

- Brushes (41) with soft, dry cloth.



Measure

- Rectifier bridge (53) for continuity (Figure 9).
 - A. Connect ohmmeter to grounded heat sink and flat metal clip at rectifier bridge (53).
 - B. Reverse leads. One reading should be high (open) and one low (continuity). If both readings are the same, replace rectifier bridge (53).
 - C. Repeat test between grounded heat sink and clips at two other bridge terminals.
 - D. Repeat test between insulated heat sink and at bridge terminals.
- 10. Capacitor (39) and rectifier bridge (53).
- 11. Washers (55) and bolts/screws (56 and 58).
- 12. Bearing (63) from slip ring end frame (43) by pushing through to inside.
- 13. Nut (49), using hex wrench to hold rotor shaft.
- 14. Washer (47), pulley (48), fan collar (46), fan (45) and outside collar (50).

15. Rotor (66) from drive end frame (59).
16. Collar (52) from rotor (66).
17. Bolt/screw (51) and retainer (42).
18. Bearing (44).



Assemble

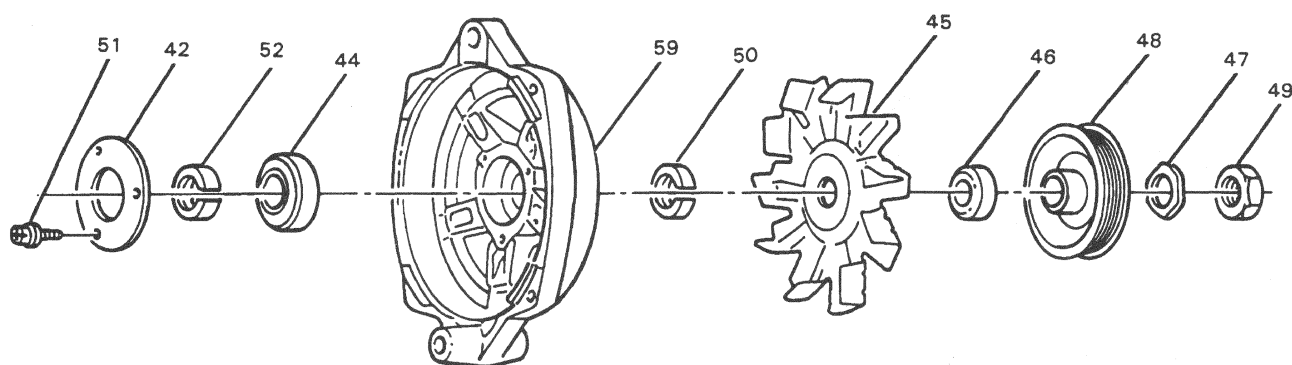
NOTICE: Refer to "Notice" on page 6D3-1 of this section.

1. Bearing (44) in drive end frame (59) by pushing against outer race.
 - Bearing (44) is double sealed; no additional lubricant is required.
2. Retainer (42) and bolts/screws (51).
3. Inside collar (52) onto rotor (66).
4. Rotor (66) to drive end frame (59).
5. Outside collar (50), fan (45), fan collar (46), pulley (48) and washer (47) onto rotor shaft.
6. Nut (49).



Tighten

- Nut (49) to 100 N·m (75 lb. ft.).
- 7. Bearing (63) into slip ring end frame (43) from outside, until flush with outside shoulder of slip ring end frame (43).

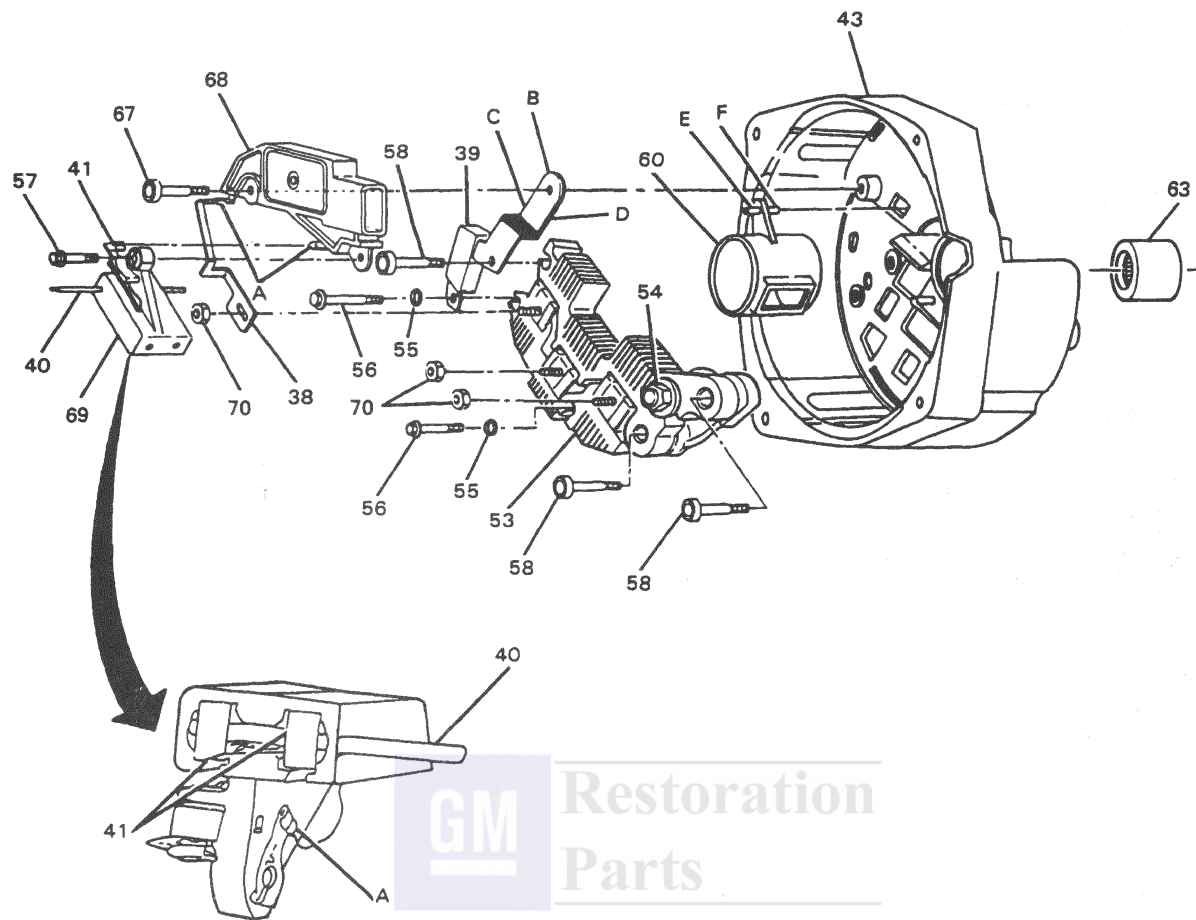


- 42 RETAINER, GENERATOR ROTOR DRIVE END BEARING
44 BEARING, GENERATOR ROTOR DRIVE END
45 FAN, GENERATOR
46 COLLAR, GENERATOR ROTOR DRIVE END FAN
47 WASHER, GENERATOR ROTOR SHAFT DRIVE END
48 PULLEY, GENERATOR
49 NUT, GENERATOR ROTOR SHAFT DRIVE END, 100 N·m (75 LB. FT.)

- 50 COLLAR, GENERATOR ROTOR DRIVE END BEARING OUTSIDE
51 BOLT/SCREW, GENERATOR ROTOR DRIVE END BEARING RETAINER
52 COLLAR, GENERATOR ROTOR DRIVE END BEARING INSIDE
59 FRAME, GENERATOR DRIVE END

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Figure 10 - Generator Rotor Drive End Bearing



- A CLIPS, SOLDER
- B STRAP, GENERATOR CAPACITOR
- C METAL SIDE
- D INSULATED SIDE
- E PIN, PLASTIC RETAINING
- F CLIP, DUST SHIELD RETAINING
- 38 STRAP, REGULATOR CONNECTOR
- 39 CAPACITOR, GENERATOR
- 40 PIN, BRUSH RETAINING
- 41 BRUSH, GENERATOR
- 43 FRAME, GENERATOR SLIP RING END
- 53 BRIDGE, GENERATOR RECTIFIER
- 54 NUT, GENERATOR BATTERY TERMINAL
- 55 WASHER, GENERATOR RECTIFIER BRIDGE
- 56 BOLT/SCREW, GENERATOR RECTIFIER BRIDGE
- 57 BOLT/SCREW, GENERATOR BRUSH HOLDER
- 58 BOLT/SCREW, GENERATOR CAPACITOR/RECTIFIER BRIDGE
- 60 SHIELD, DUST
- 63 BEARING, GENERATOR ROTOR SLIP RING END FRAME
- 67 BOLT/SCREW, REGULATOR ATTACHING
- 68 REGULATOR, GENERATOR VOLTAGE
- 69 HOLDER, GENERATOR BRUSH
- 70 NUT, STATOR LEAD ATTACHING

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Figure 11 - Generator Slip Ring End Frame Components

6D3-10 CHARGING SYSTEM

! Important

- Installation of the slip ring end frame electrical components must be done in the following order to ensure proper operation of the unit. Assembly in any other manner will result in either no output from generator or a direct internal ground in the generator.

8. Rectifier bridge (53).
9. Capacitor (39).
10. Washers (55).
11. Bolts/screws (56 and 58).

! Important

- The capacitor (39) has an insulated material on one side which must rest against the drive end frame (59) (ground).
- The capacitor/rectifier bridge insulated attaching bolt/screw (58) must be installed in the proper hole, attaching the capacitor strap and rectifier bridge (53) to the slip ring end frame (43).

12. Brushes (41) into brush holder (69) with retaining pin (40).
13. Dust shield (60) onto brush holder (69).
14. Voltage regulator (68), and brush holder (69) with dust shield (60), brushes (41) and retaining pin (40) installed into slip ring end frame (43).

! Important

- The metal side of the capacitor strap must be against the regulator connection.
15. Tap plastic retaining pin on dust shield (60) into retaining clip.
 - Be sure brush retaining pin (40) goes through access hole to outside of slip ring end frame (43) for removal after generator is assembled.
 16. Bolt/screw (67) and bolt/screw (57).

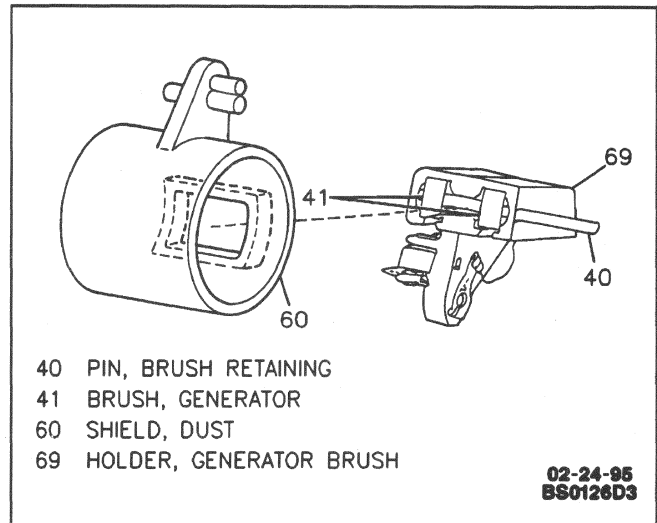


Figure 12 - Generator Brushes Retained in Generator Brush Holder

17. Connector strap (38) to voltage regulator solder clip, and brush holder connection to other voltage regulator solder clip.
 - Crimp and solder voltage regulator solder clip connections.

NOTICE: Avoid excessive heat when soldering connections, as this can cause voltage regulator damage.

18. Stator (36), placing stator terminals over rectifier bridge terminals.
19. Nuts (70).
20. Slip ring end frame (43) and drive end frame (59), noting scribe marks.
21. Slip ring end bearing outer race into bearing well in slip ring end frame casting.
22. Through-bolts/screws (61).
23. Remove retaining pin (40) to release brushes (41) against slip rings.

SPECIFICATIONS

GENERATOR USAGE CHART

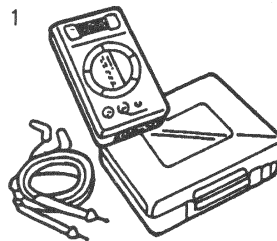
GEN/MODEL	ENGINE	RATED AMPERES
CS - 130 (RPO - K68)	L99 or LT1	105
CS - 144 (RPO - KG9)	L99 or LT1	140

FASTENER TIGHTENING SPECIFICATIONS

Air Conditioning Compressor Mounting Bolt/Screw	50 N·m (37 lb. ft.)
Air Conditioning Compressor Mounting Stud	50 N·m (37 lb. ft.)
Air Conditioning Compressor Rear Bracket Nut	41 N·m (30 lb. ft.)
Battery Negative Cable Bolt/Screw	17 N·m (13 lb. ft.)
Drive Belt Tensioner Bolt/Screw	25 N·m (18 lb. ft.)
Generator and Power Steering Pump Bracket Bolt/Screw*	41 N·m (30 lb. ft.)
Generator Battery Terminal Nut (CS-130)	8 N·m (71 lb. in.)
Generator Battery Terminal Nut (CS-144)	12 N·m (106 lb. in.)
Generator Bolt/Screw	50 N·m (37 lb. ft.)
Generator Front Brace Stud Nut	34 N·m (25 lb. ft.)
Generator Rear Brace Bolt/Screw (CS 130)	25 N·m (18 lb. ft.)
Generator Rear Brace Bolt/Screw (CS 144)	50 N·m (37 lb. ft.)
Generator Rear Brace Nut	41 N·m (30 lb. ft.)
Generator Rear Bracket Nut	50 N·m (37 lb. ft.)
Generator Rotor Shaft Drive End Nut	100 N·m (75 lb. ft.)
Heater Hose Clip Bolt/Screw	1.9 N·m (17 lb. in.)
Radiator Outlet Hose Support Nut	20 N·m (15 lb. ft.)

*See text for tightening sequence.

SPECIAL TOOLS



J 39688

1 DIGITAL MULTIMETER

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SECTION 6D4

IGNITION SYSTEM

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with “live” exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the “OFF” or “LOCK” position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Ignition Switch.....	6D4-2	Distributor.....	6D4-8
Knock Sensor System.....	6D4-2	Distributor Cap, Cover, Rotor, and Base.....	6D4-10
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GENERAL DESCRIPTION

The ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy and control of exhaust emissions, the powertrain control module (PCM) controls distributor spark advance (timing) with an ignition control system.

IGNITION SYSTEM

The engine ignition system consists of a distributor, control circuits for ignition timing in the powertrain control module (PCM), a separate ignition coil/ignition control module, a vacuum harness primary and secondary wiring, and the spark plugs. All ignition timing is controlled by the PCM; there is no “bypass” mode built into the ignition control module as in other ignition systems.

The distributor is mounted directly to the camshaft behind the water pump. It directs the spark from the ignition coil to the proper spark plug secondary wire through a rotor. Spark plug secondary wire connectors in the cap are arranged for

convenience in routing spark plug wire harnesses. The corresponding cylinder number is molded into the distributor cap next to each spark plug secondary wire connector.

The distributor also contains a signal disk and two optical camshaft position (CMP) sensors that provide signals to the PCM for timing control. One sensor sends 360 pulses per crankshaft revolution for high-resolution timing control. The other senses eight disk slots of variable length, providing four pulses per crankshaft revolution for a low-resolution signal that tells the PCM which spark plug is being fired. The PCM can determine if one of the timing inputs is not being received by comparing the two inputs. If the PCM detects one timing pulse without detecting the other timing pulse, diagnostic trouble codes 16 or 36 will set. Power for the optical CMP sensors, a system ground, and the two CMP sensor signals is transferred between the PCM and the distributor through a shielded harness connected to the four-terminal connector on the distributor. The reference signals toggle between 0 and 5 volts as the camshaft turns. Therefore, an open circuit, a short to voltage, a short to ground, or a defective sensor inside the distributor can prevent the voltage from pulsing at the PCM.

6D4-2 IGNITION SYSTEM

The ignition coil/ignition control module provides spark to the distributor, timed by signals from the PCM. Power (B+) for the ignition coil primary circuit and the ignition control module is supplied through the ignition switch. The PCM combines the camshaft position information supplied by the distributor with other system parameters and calculates the required spark advance. The PCM signals the ignition control module, which turns on the primary current to the ignition coil by grounding the primary circuit, and then turns it off by removing the ground. When the primary current flow stops, high voltage induced in the ignition coil secondary winding becomes the spark voltage for the spark plug. The spark voltage is delivered to the distributor through the coil output (secondary) wire, and then directed to the proper spark plug connector by the distributor rotor. For more information, refer to SECTION 6E3.

SPARK PLUG WIRE HARNESSES

The spark plug wire harnesses use carbon impregnated cord conductors, encased in 8 mm (5/16-inch) diameter silicone jackets. The silicone jackets withstand very high temperatures and also provide excellent insulation for the high voltage of the system. Silicone spark plug boots form a tight seal to the spark plugs.

SPARK PLUGS

Figure 1

Platinum-tipped, resistor-type, tapered-seat spark plugs are used on the engine. No gasket is used on these tapered-seat spark plugs. For spark plug type and gap size, refer to SPECIFICATIONS in this section. When replacing spark plugs, use only the type specified. It is important that technicians wash their hands after handling coated spark plugs and before smoking. The coating itself is a nonhazardous material and incidental contact will not cause any adverse affects. However, exposure to polymer vapors (the result of a cigarette being coated from handling, then burned) may cause flu like symptoms and should be avoided. Normal service is assumed to be a mixture of idling, slow speed, and high speed driving. Occasional or intermittent high-speed driving is needed for good spark plug performance. It gives increased combustion heat, burning away carbon or oxides that have built up from frequent idling, or continual stop-and-go driving.

IGNITION SWITCH

The mechanical key and lock cylinder ignition switch is located in the steering column on the right-hand side, just below the steering wheel. The electrical switching portion is separate from the key and lock cylinder. However, both are synchronized and work in conjunction through the action of the actuator rod. For a complete explanation of the key and lock cylinder, and the actuator rod, refer to SECTION 3F5A or 3F5B. For electrical switching information, refer to SECTION 8A.

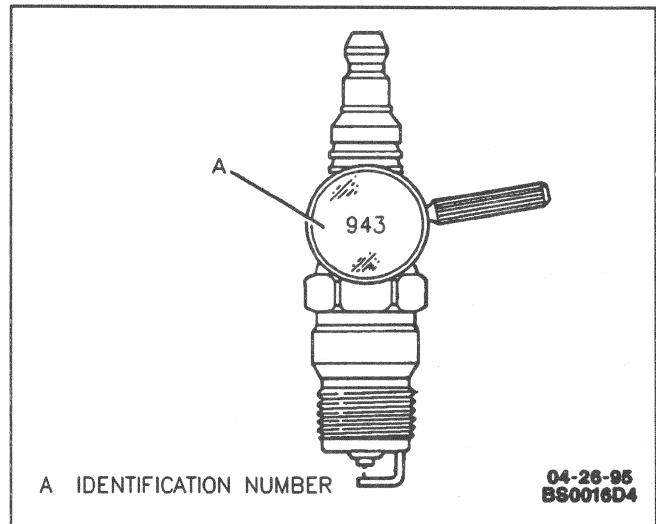


Figure 1 - Spark Plug Identification

KNOCK SENSOR SYSTEM

The knock sensor system retards the spark advance when detonation occurs. Further information is found in SECTION 6E3.

IGNITION TIMING

The base timing is preset when the engine is manufactured, no adjustment is possible. Timing advance and retard are accomplished through the PCM with ignition control and knock sensor systems.

DIAGNOSIS

IGNITION SYSTEM

Diagnosis for the ignition system is in SECTION 6E3.

SPARK PLUGS

Worn or dirty spark plugs may give satisfactory operation at idling speed, but frequently fail at higher rpm. Faulty spark plugs may cause poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance. Follow the scheduled maintenance services recommendations given in SECTION 0B, to assure satisfactory spark plug performance. Normal spark plug operation will result in brown to grayish-tan deposits appearing on the portion of the spark plug that projects into the cylinder area. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products of fuels and lubricating oils with additives. Engines which are not running properly are often referred to as "misfiring." This means the ignition spark is not igniting the fuel/air mixture at the proper time. While other ignition and fuel system causes must also be considered, possible causes include ignition system conditions which allow the spark voltage to reach ground in some other manner than by jumping across the air gap at the tip of the spark plug, leaving the fuel/air mixture unburned. Refer to SECTION 6E3.

Misfiring may also occur when the tip of the spark plug becomes overheated and ignites the mixture before the spark jumps. This is referred to as "pre-ignition."

Carbon fouling of the spark plug is indicated by dry, black carbon (soot) deposits on the portion of the spark plug in the cylinder. Excessive idling and slow speeds under light engine loads can keep the spark plug temperatures so low that these deposits are not burned off. Over-rich fuel mixtures or poor ignition system output may also be the cause. Refer to SECTION 6E3 for diagnosis. Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder. This may be caused by oil getting past worn piston rings. This condition also may occur during break-in of new or newly overhauled engines. Deposit fouling of the spark plug occurs when the normal red-brown, yellow or white deposits of combustion by-products become sufficient to cause misfiring. In some cases, these deposits may melt and form a shiny glaze on the insulator around the center electrode. If the fouling is found in only one or two cylinders, valve stem clearances or intake valve seals may be allowing excess lubricating oil to enter the cylinder, particularly if the deposits are heavier on the side of the spark plug that was facing the intake valve. Cracked or broken insulators may be the result of improper installation or heat shock to the insulator material. Upper insulators can be broken when a poorly fitting tool is used during installation or removal, or when the spark plug is hit from the outside. Cracks in the upper insulator may be inside the shell and not visible. Also, the breakage may not cause problems until oil or moisture penetrates the crack later.

A broken or cracked lower insulator tip (around the center electrode) may result from "heat shock" (spark plug suddenly operating too hot). "Heat shock" breakage in the lower insulator tip generally occurs during severe engine operating conditions (high speeds or heavy loading) and may be caused by over-advanced timing or low grade fuels. Heat shock refers to a rapid increase in the tip temperature that causes the insulator material to crack. Damage during gapping can happen if the gapping tool is pushed against the center electrode or the insulator around it, causing the insulator to crack. When gapping a spark plug, make the adjustment by only bending the ground side terminal, keeping the tool clear of other parts.

SPARK PLUG WIRE HARNESSES

Inspect spark plug wires visually first for any cuts, burns, or damage. While engine is running, inspect for any arcing to ground or other components. Use a spray bottle to lightly coat the spark plug wires with water while observing idle quality. If idle quality diminishes or engine stalls, spark plug wires should be replaced.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

- Allow engine to cool before removing spark plugs. Attempting to remove spark plugs from a hot engine may cause spark plugs to seize, causing damage to cylinder head threads.
- Clean spark plug recess area before removing spark plug. Failure to do so can result in engine damage due to dirt or foreign material entering cylinder head, or in contamination of cylinder head threads. Contaminated threads may prevent proper seating of new spark plug.
- Use only the spark plug specified in SECTION 0B. Spark plug gap must be checked using a "wire-type" gauge before installing into engine. Refer to SECTION 0B for correct gap.
- The tachometer terminal must never be allowed to touch ground, as damage to the PCM and/or ignition coil can result.
- The material used to construct spark plug wires is very soft. This wire will withstand more heat and carry a higher voltage, but chaffing and cutting become easier. The spark plug wires must be routed correctly to prevent chaffing or cutting. See "Spark Plug Wire Harness Replacement" in the following procedure, for routing. When removing a spark plug wire from a spark plug, twist the boot on the spark plug one-half turn while pulling on the boot.

SPARK PLUG WIRE HARNESS REPLACEMENT

Figures 2 through 5

NOTICE: The boots should be twisted one-half turn while removing. Do not pull on the wire harnesses to remove them from the spark plugs. Pull on the boots, or use a tool designed for this purpose.



Remove or Disconnect

1. Left bank spark plug wire boots from spark plugs.
2. Left bank spark plug wire harness support channel bolts/screws (19) and channel.
 - Rear bolt/screw (19) is located behind exhaust manifold takedown. Loosen this bolt/screw using a 10 mm wrench, then slide channel upward to disengage from bolt/screw (19).
3. Left bank spark plug wire harness from clip (17) located behind air pump.
4. Right bank spark plug wire boots from spark plugs.
5. Air intake resonator if vehicle is equipped with a mechanical cooling fan. Refer to SECTION 6E3.
6. Upper radiator fan shroud, if vehicle is equipped with a mechanical cooling fan. Refer to SECTION 6B.

6D4-4 IGNITION SYSTEM

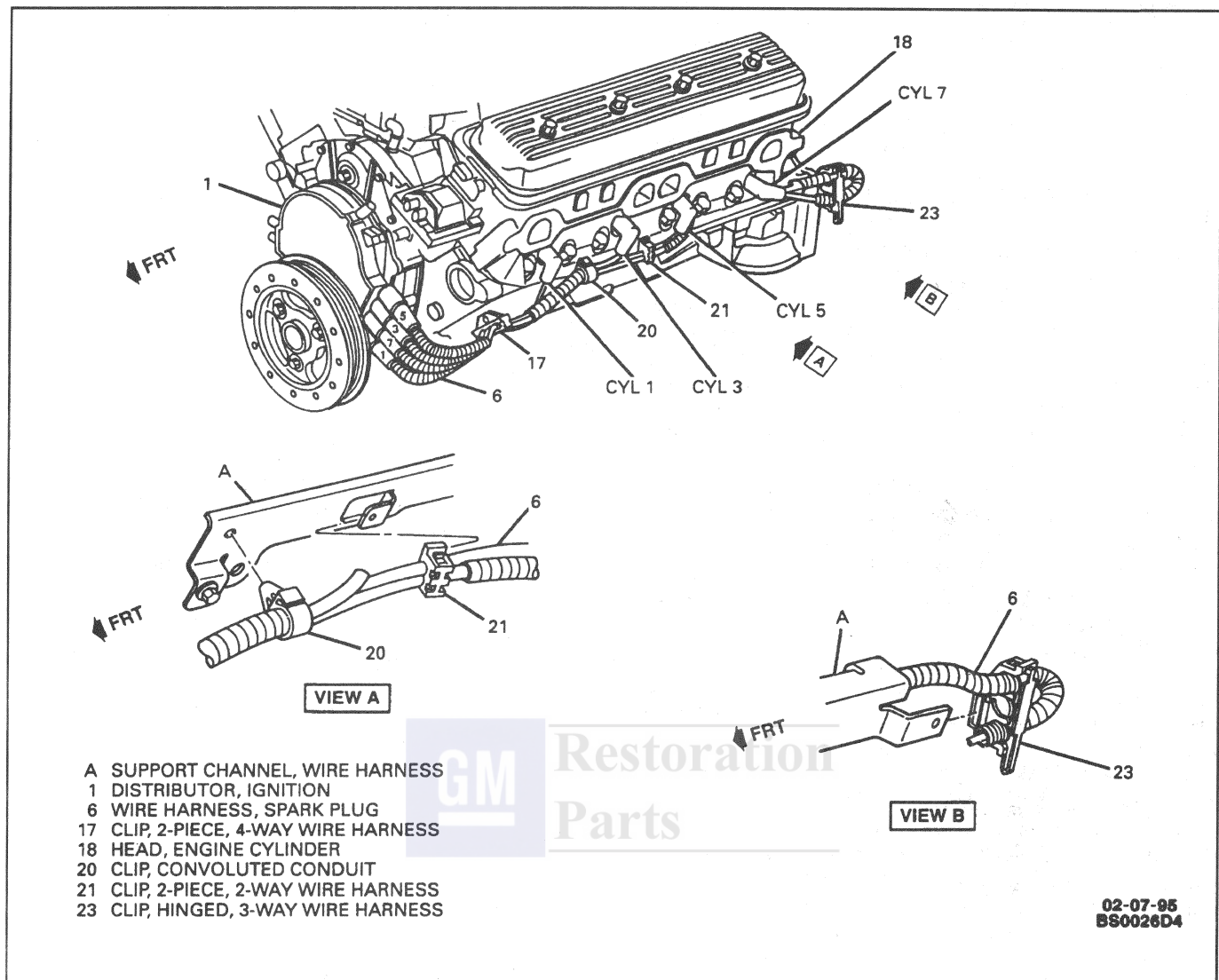


Figure 2 - Spark Plug Wire Harness (Left Side)

7. Loosen fan pulley nuts if vehicle is equipped with a mechanical cooling fan.
8. Fan belt if vehicle is equipped with a mechanical cooling fan.
9. Mechanical fan and pulley, if equipped.
10. Mechanical fan pulley bracket nuts and bracket.
11. Radiator outlet pipe nuts from A/C compressor mounting studs, if vehicle is equipped with a mechanical fan.
12. Serpentine drive belt.
13. Raise and suitably support vehicle. Refer to SECTION 0A.
14. Transmission oil cooler line support bolt/screw from accessory drive bracket.
15. Serpentine drive belt tensioner bolts/screws and tensioner.
16. A/C compressor attaching bolts/screws and rear bracket nut.
 - Reposition A/C compressor to provide access to front wire harness support (27).
17. Right wire harness support bolt/screw (28).
18. Right wire harness from support (27).

19. Left and right bank spark plug wire harnesses (6) from distributor.
20. Left wire harness from clips (17, 20, 21, and 23).
 - Insert screwdriver into tab on top of clip to disengage.
21. Right wire harness from clips (16, 17, and 21).
 - Insert screwdriver into tab on top of clip to disengage.

Install or Connect

NOTICE: Refer to "Notice" on page 6D4-1 of this section.

NOTICE: When replacing spark plug wires (secondary wiring), route the wire harnesses correctly through the proper retainers. Failure to route the wire harnesses properly can lead to radio ignition noise and cross-firing of the spark plugs, or shorting of the leads to ground.

1. Right wire harness to clips (16, 17, and 21).
2. Left wire harness to clips (17, 20, 21, and 23).
3. Right wire harness to support (27).

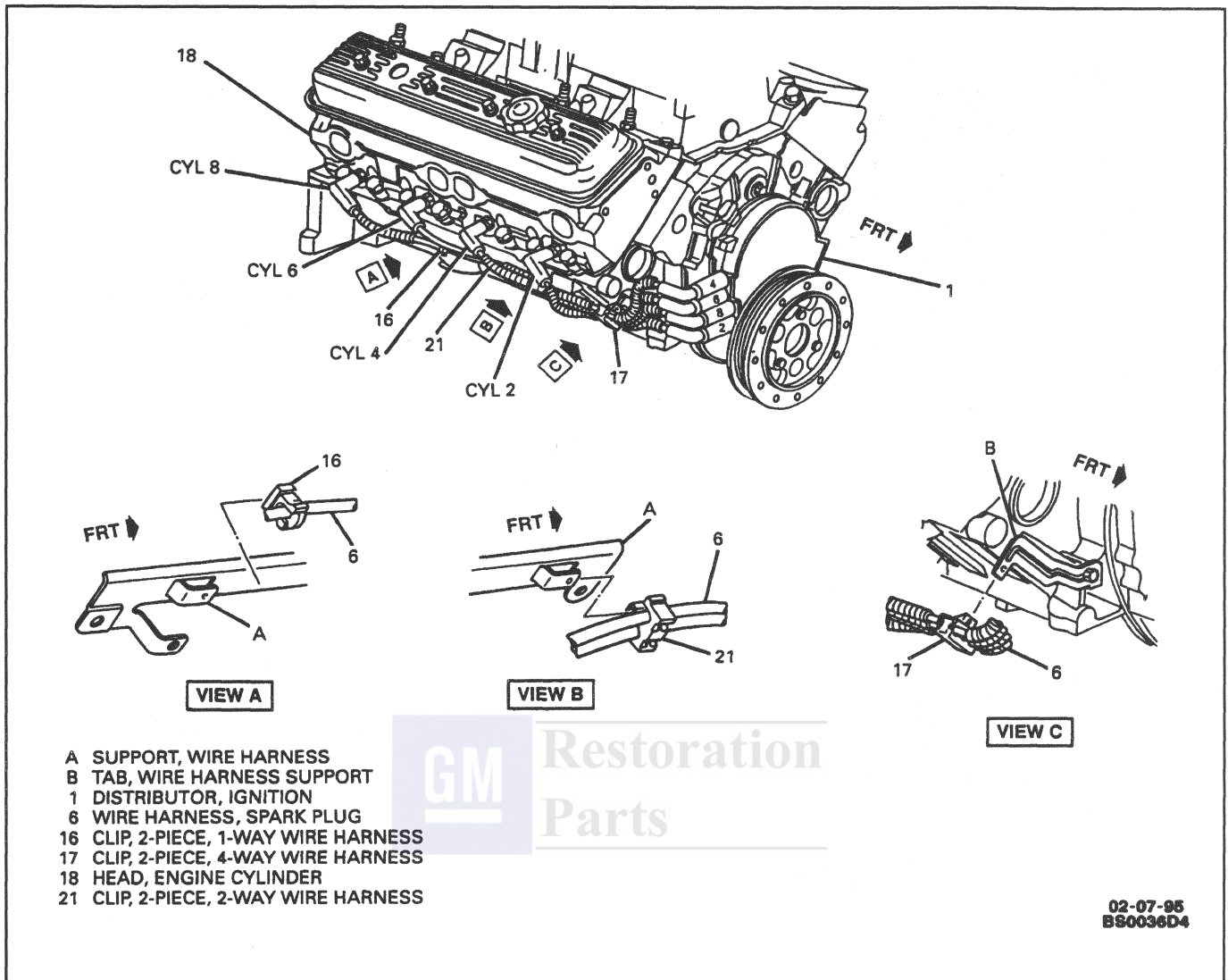


Figure 3 - Spark Plug Wire Harness (Right Side)

4. Right wire harness support bolt/screw (28).

Tighten

- Bolt/screw (28) to 40 N.m (30 lb. ft.).

5. A/C compressor to bracket.

6. A/C compressor attaching bolts/screws and rear bracket nut.

Tighten

- A. A/C compressor bolts/screws to 50 N.m (37 lb. ft.).
- B. A/C compressor rear bracket nut to 41 N.m (30 ft. ft.).

7. Serpentine drive belt tensioner and tensioner bolts/screw.

Tighten

- Tensioner bolts/screws to 25 N.m (18 lb. ft.).

8. Transmission oil cooler line support bolt/screw.

Tighten

- Oil cooler line support bolt/screw to 1.9 N.m (17 ft. lb.).

9. Lower vehicle.

10. Serpentine drive belt.

11. Radiator outlet pipe nuts, if removed.

Tighten

- Radiator outlet pipe nuts to 16 N.m (12 lb. ft.).
12. Mechanical fan pulley bracket nuts, if removed.

Tighten

- Mechanical fan pulley bracket nuts to 50 N.m (37 ft. lb.).
13. Mechanical fan pulley, fan and nuts, if removed.

- Finger tighten nuts.
14. Mechanical fan belt, if removed.

6D4-6 IGNITION SYSTEM

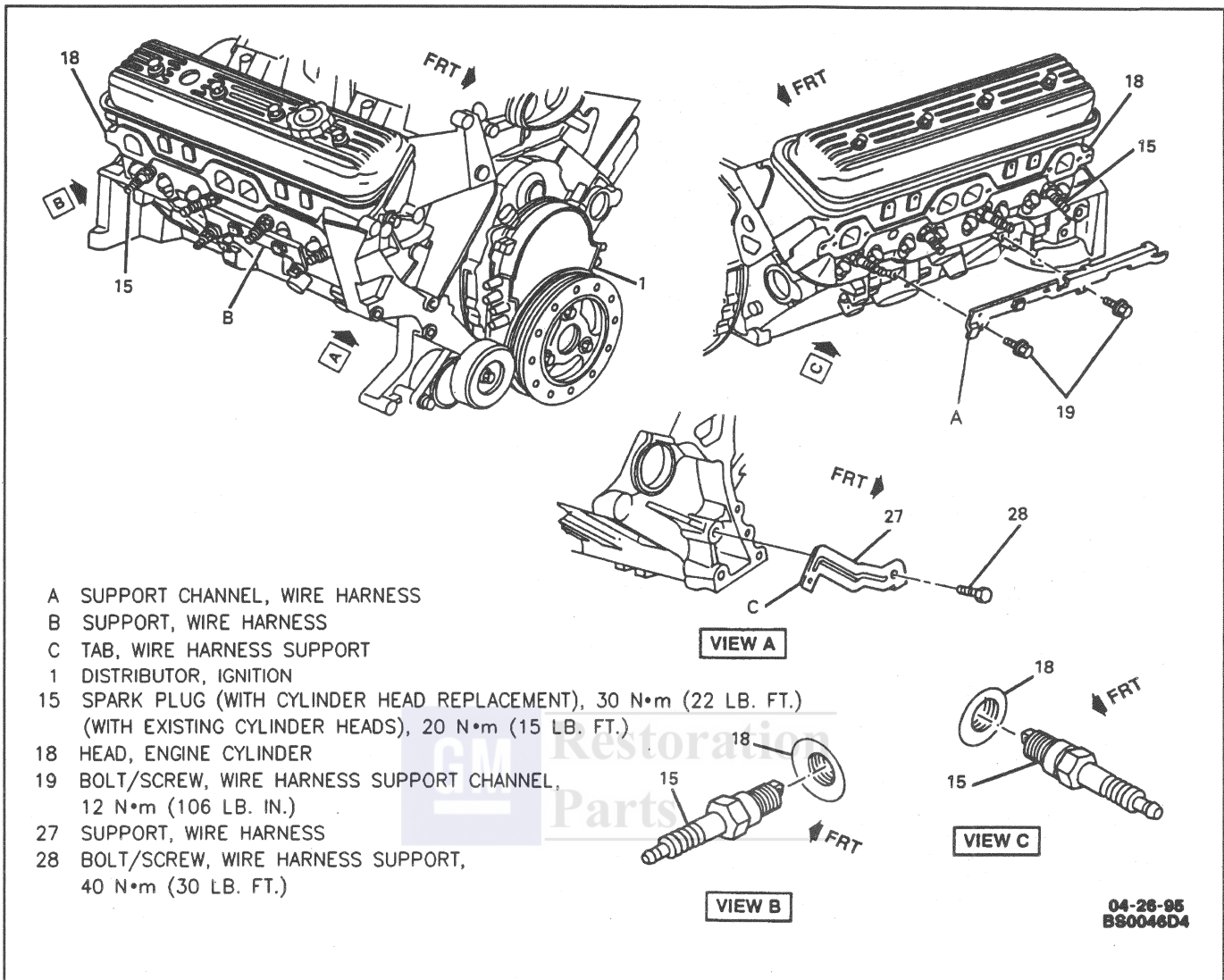


Figure 4 - Spark Plugs



Tighten

- Mechanical fan nuts to 26 N·m (19 lb. ft.).
- 15. Upper radiator fan shroud, if removed, Refer to SECTION 6B.
- 16. Air intake resonator, if removed. Refer to SECTION 6E3.
- 17. Right bank spark plug wire boots to spark plugs.
- 18. Left bank spark plug harness to clip (17) located behind air pump.
- 19. Left bank spark plug wire harness support channel and bolts/screws (19).
 - Rear bolt/screw (19) is located behind exhaust manifold takedown. Slide channel onto bolt/screw (19) then tighten using a 10 mm wrench.
- 20. Left bank spark plug wire harness boots to spark plugs.

SPARK PLUGS

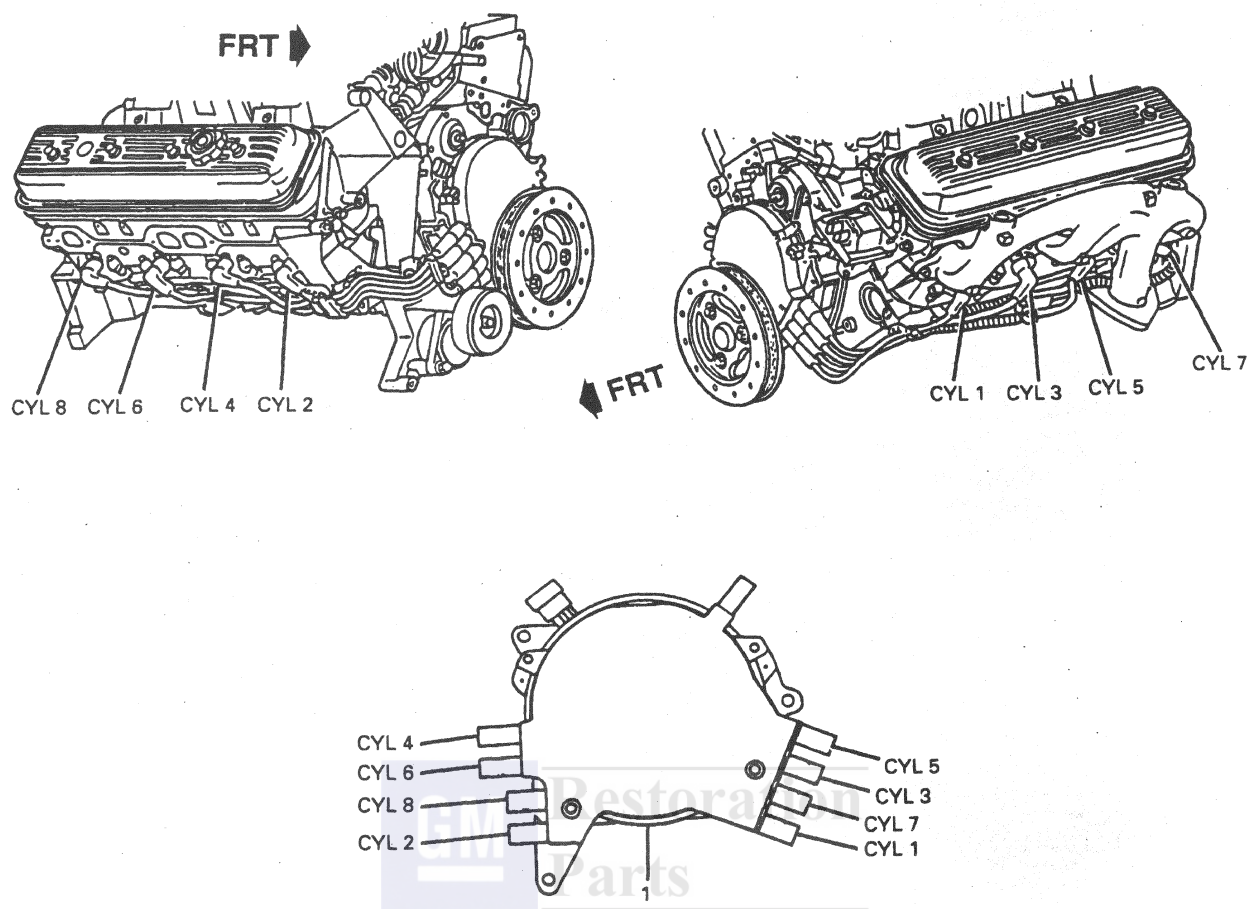
Figures 2 through 5

CAUTION: If you smoke while handling coated spark plugs, wear gloves to prevent transfer of the coating to cigarettes and subsequent burning of the coating. Wash hands after installing spark plugs.



Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Spark plug wire harness from spark plugs. Refer to "Spark Plug Wire Harness Replacement" in this section.
 - Note positions of wires before removing.



1 DISTRIBUTOR, IGNITION

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Figure 5 - Spark Plug Wire Harness Routing

! Important

- Clean dirt and debris from spark plug recess areas.

3. Spark plugs from cylinder head.

→→ Install or Connect

NOTICE: Be sure spark plugs thread smoothly into cylinder head and are fully seated. Cross-threading or failing to fully seat spark plugs can cause overheating of spark plugs, exhaust blow-by, or thread damage. Follow recommended torque specifications carefully. Over or under-tightening can also cause severe damage to cylinder head or spark plugs.

! Important

- Check spark plug gap using a wire type gauge before installing. If spark plug gaps are not adjusted correctly, engine idle quality may be

seriously affected. A wire type gauge must be used (as opposed to a flat feeler type gauge) to insure an accurate reading. Refer to "Specifications" at the end of this section for correct spark/plug type and gap.

1. Spark plugs to cylinder head.

⌚ Tighten

- Spark plugs to 30 N.m (22 lb. ft.) with new head installation.
 - Spark plugs to 20 N.m (15 lb. ft.) with existing engine assembly.
2. Spark plug wire harness, routed properly as note during removal. Refer to "Spark Plug Wire Harness Replacement" in this section.

DISTRIBUTOR VENTILATION SYSTEM**Figure 6**

The ventilation system vacuum harness (24), connected to the air intake duct (25), the distributor (1) and the air intake manifold (26), provides

6D4-8 IGNITION SYSTEM

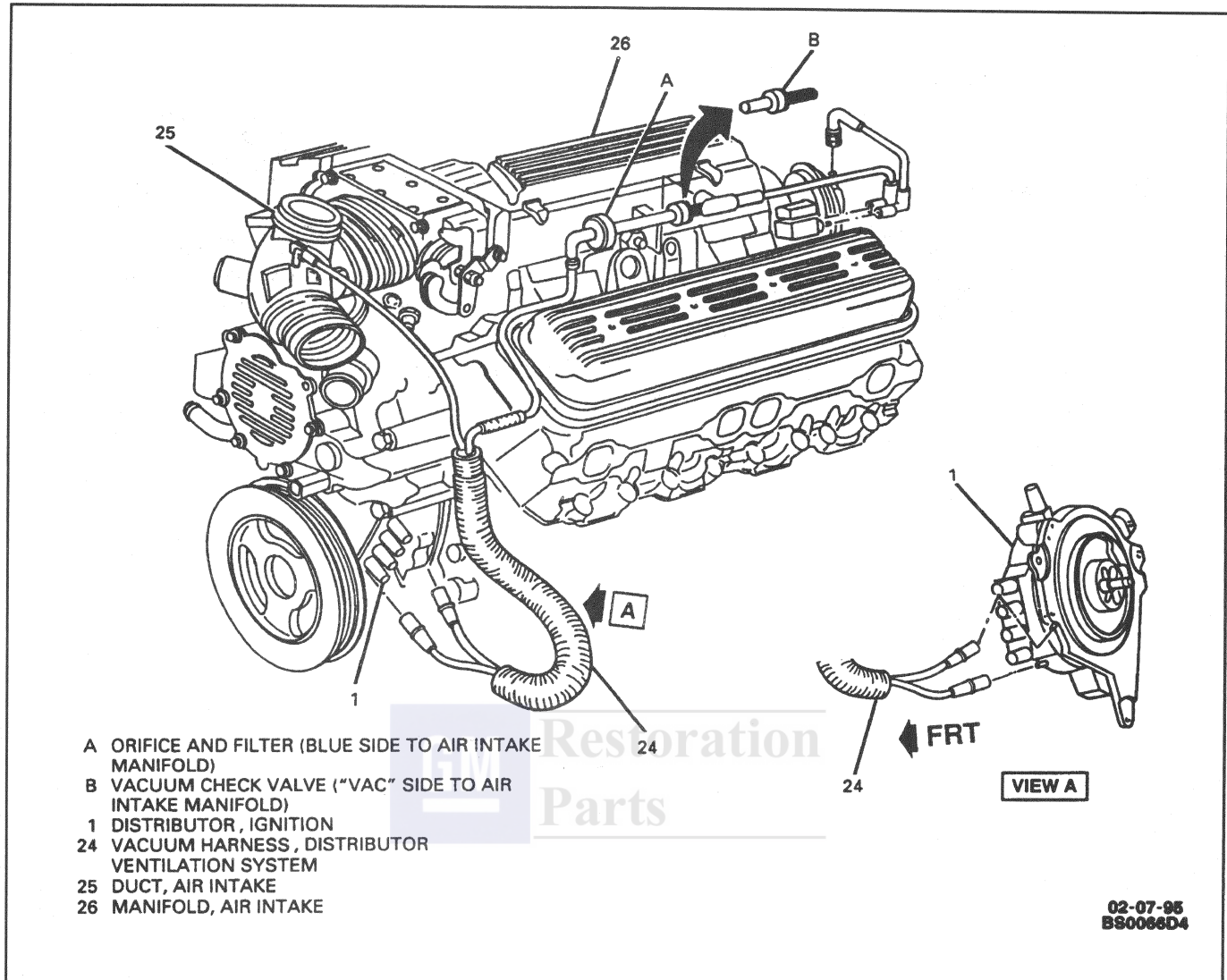


Figure 6 - Distributor Assembly Ventilation System

ventilation to the distributor (1), thus preventing moisture build-up and possible ignition system failure. A check valve at the air intake duct connection insures one-way flow through the distributor (1) to the air intake manifold (26), refer to Figure 6 for correct orientation. The ventilation system vacuum harness (24) connects to the air intake duct (25) and the air intake manifold (26) with vacuum fittings. It attaches to the distributor (1) at two places with separately sized connectors. In the case of ignition system failure, check vacuum harness (24) for proper hook-up and/or kinks. If OK, check the ventilation system for a possible restriction before removing the distributor (1). Disconnect the vacuum harness (24) at the air intake duct (25) and check for vacuum using a vacuum gauge. The gauge needle should slowly move towards manifold vacuum. If no vacuum is present, replace the vacuum harness (24). Once it has been determined that the ventilation system vacuum harness is functioning properly, disconnect the vacuum hose to the air intake duct. Running the engine with manifold vacuum present in the distributor may lead to engine misfire.

Important

- Failure to connect all hoses of the ventilation system will eventually result in distributor failure.

DISTRIBUTOR

Figures 6 and 7

Remove or Disconnect

1. Check the distributor ventilation system for proper operation. Refer to "Distributor Ventilation System" in this section.
2. Be sure ignition switch is in the "OFF" or "LOCK" position.
3. Water pump. Refer to SECTION 6A4A.
4. Crankshaft balancer. Refer to SECTION 6A4A.

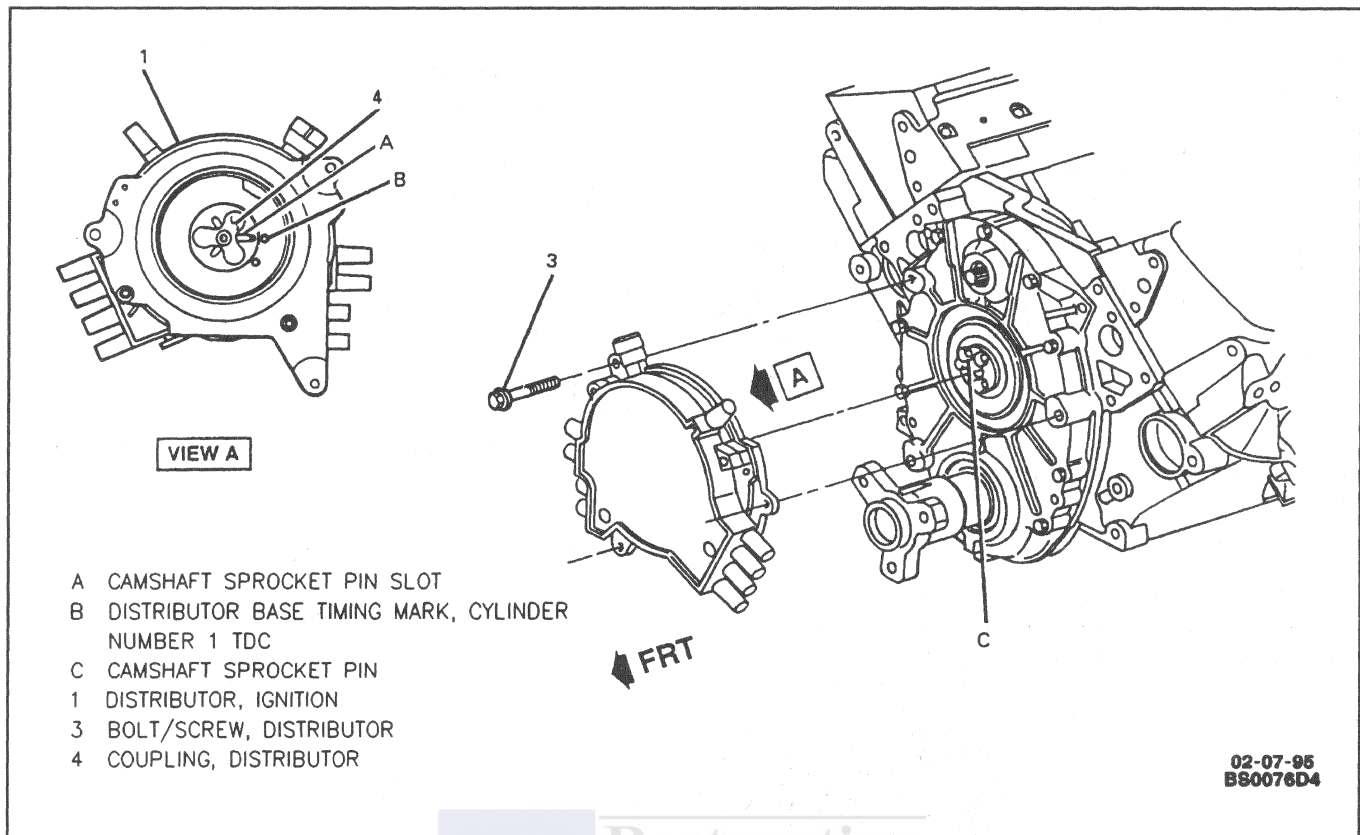


Figure 7 - Distributor Mounting

! Important

- Make sure all coolant has been wiped off distributor and surrounding area before disconnecting any electrical connectors or spark plug wire harness.
- 5. Spark plug wire harness from distributor (1). Refer to "Spark Plug Wire Harness Replacement" in this section.
- 6. Four-terminal PCM connector from distributor (1).
- 7. Vacuum harness (24) from distributor (1). Refer to "Distributor Ventilation System" in this section.
- 8. Distributor bolts/screws (3).
- 9. Distributor (1).
 - Pull distributor forward until coupling (4) disengages from end of camshaft.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6D4-1 of this section.

! Important

- Replace the O-Rings on the coupling shaft or ignition system performance may be affected.
- Lubricate O-Rings and end of camshaft with GM lubricant P/N 9985007, or equivalent.
- 1. Distributor (1) with new coupling shaft "O" rings.

- A. Rotate distributor coupling until camshaft sprocket pin slot aligns with camshaft sprocket pin.
- B. Slide distributor (1) onto end of camshaft until fully seated on engine front cover.

! Important

- Do not attempt to fully seat distributor (1) using bolts/screws (3). If distributor (1) will not seat by hand, it is not properly aligned with camshaft. Rotate crankshaft until engine is at number 1 cylinder TDC (camshaft sprocket pin at the 9 o'clock position). Rotate the distributor coupling (4) until the camshaft sprocket pin slot aligns with the distributor base timing mark. Install distributor (1) using hand pressure to fully seat.
- 2. Distributor bolts/screws (3).

⚙ Tighten

- Bolts/screws (3) to 12 N.m (106 lb. in.).
- 3. Four-terminal PCM connector to distributor (1).
- 4. Vacuum harness (24) to distributor (1). Refer to "Distributor Ventilation System" in this section.
- 5. Spark plug wire harness to distributor (1). Refer to "Spark Plug Wire Harness Replacement" in this section.
- 6. Crankshaft balancer. Refer to SECTION 6A4A.
- 7. Water pump. Refer to SECTION 6A4A.

6D4-10 IGNITION SYSTEM

DISTRIBUTOR CAP, COVER, ROTOR, AND BASE

Figure 8

Tools Required:

- J 39997 Ignition Distributor Cap Socket
- J 39998 Ignition Distributor Rotor

NOTICE: The distributor and timing disk must be kept clean and free of oil, dirt and engine coolant. Any contamination may lead to engine misfire and distributor damage. Do not disassemble the distributor until all coolant has been cleaned from the distributor and surrounding area.

Remove or Disconnect

1. Water pump and crankshaft balancer. Refer to SECTION 6A4A.
2. Spark plug wire harness from distributor.
3. Four-terminal PCM connector from distributor.
4. Vacuum harness from distributor.

5. Distributor cap bolts/screws (29) using J 39997 or equivalent.
6. Distributor cap (30).
7. Rotor bolts/screws (32) using J 39998 or equivalent.
8. Rotor (32).
9. Distributor cover (33) and shield (34).

Important

- Do not touch timing disk, sensor or distributor base.

Inspect

- Distributor base and timing disk, for damage, corrosion or plastic particles. If any are present replace entire distributor.

Install or Connect

1. Shield (34) and distributor cover (33).
2. Rotor (32).

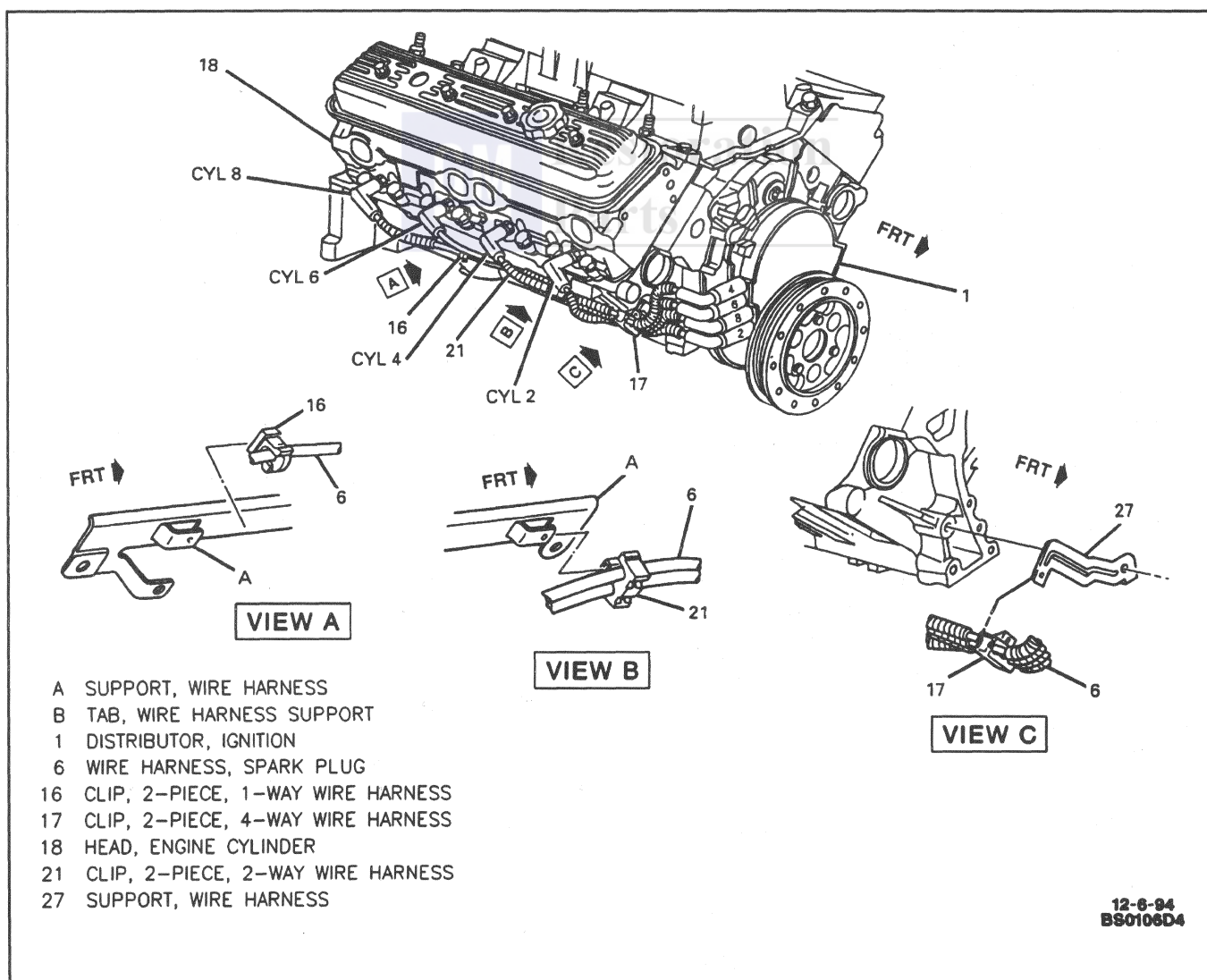


Figure 8 - Distributor Cap, Cover, Rotor and Base

3. Rotor bolts/screws (31) using J 39998 or equivalent.

Tighten

- Rotor bolts/screws (31) to 0.7 N.m (6 lb. in.).
4. Distributor cap (30).
 5. Distributor cap bolts/screws (29) using J 39997 or equivalent.

Tighten

- Distributor cap bolts/screws (29) to 2.8 N.m (25 lb. in.).
6. Vacuum harness to distributor.
 7. Connect four-terminal PCM connector to distributor.
 8. Spark plug wire harness to distributor.
 9. Crankshaft balancer and water pump. Refer to SECTION 6A4A.

IGNITION COIL

Figures 9 and 10

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Four-terminal PCM connector at ignition coil module.
3. Ignition coil wiring connectors.

4. Ignition coil harness.
 5. Studs (5).
 6. Ignition coil (8).
- Do not wipe silicone grease from bottom of ignition coil (8) if it is to be reinstalled.

Install or Connect

NOTICE: Refer to "Notice" on page 6D4-1 of this section.

NOTICE: If a new ignition coil is to be installed, a package of silicone grease will be included in the box. This grease is necessary for ignition coil cooling.

1. Spread silicone grease on metal mounting face of ignition coil bracket (14) if necessary, and position ignition coil (8) to cylinder head.
2. Studs (5).

Tighten

- Studs (5) to 25 N.m (18 lb. ft.).
3. Ignition coil harness.
 4. Ignition coil wiring connectors.
 5. Four-terminal PCM connector to ignition coil module.

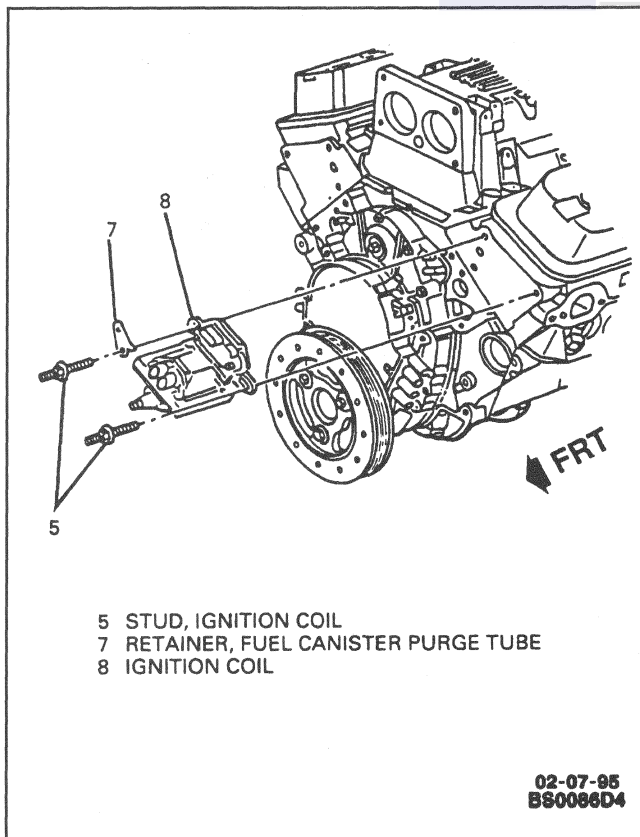


Figure 9 - Ignition Coil

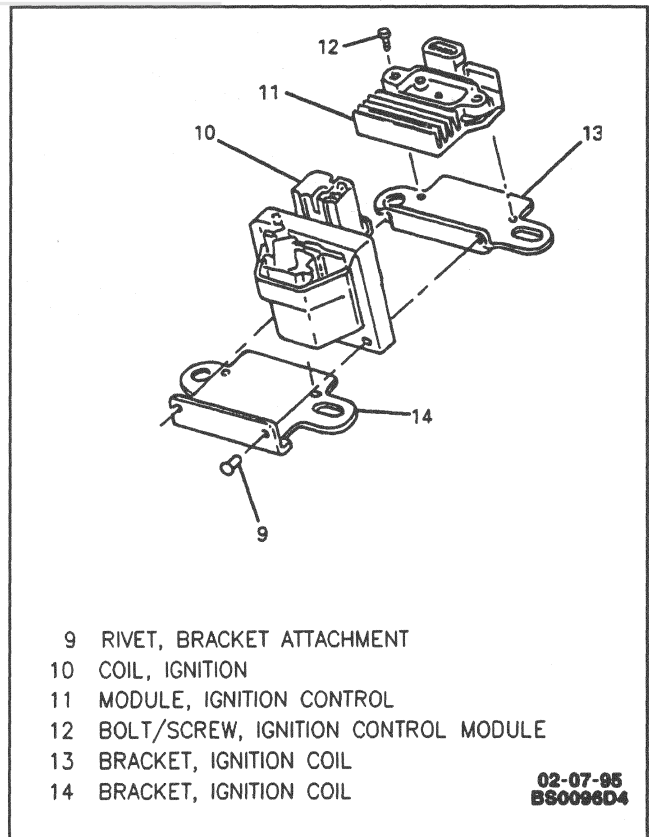


Figure 10 - Ignition Coil and Ignition Control Module

UNIT REPAIR

IGNITION COIL AND IGNITION CONTROL
MODULE*Figures 9 and 10***Disassemble**

1. Coil (10) from brackets (13 and 14) by drilling out rivets (9).
2. Bolts/screws (12).
3. Ignition control module (11).

**Assemble**

NOTICE: Refer to "Notice" on page 6D4-1 of this section.

NOTICE: A package of silicone grease is included with a new ignition control module. This grease is necessary for ignition control module cooling.

1. Spread silicone grease on metal face of ignition control module (11) and on bracket (13) where it seats, and position ignition control module (11) to bracket (13).
2. Bolts/screws (12).

**Tighten**

- Bolts/screws (12) to 1.7 N.m (15 lb. in.).
3. Coil (10) to brackets (13 and 14) using bolts/screws provided with replacement coil (10).

**Tighten**

- Bolts/screws to 2.8 N.m (25 lb. in.).

SPECIFICATIONS

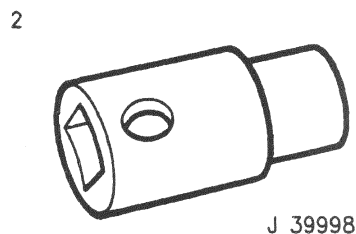
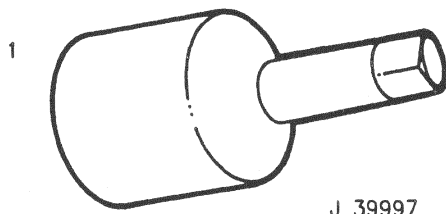
GENERAL SPECIFICATIONS

Spark Plug Identification Number	A/C 41-943
Spark Plug Gap (A/C 41-943)	0.050 (1.24mm)

FASTENER TIGHTENING SPECIFICATIONS

Distributor Bolt/Screw	12 N.m (106 lb. in.)
Distributor Cap Bolt/Screw	2.8 N.m (25 lb. in.)
Distributor Rotor Bolt/Screw	0.7 N.m (6 lb. in.)
Ignition Coil Bolt/Screw	25 N.m (18 lb. ft.)
Ignition Coil Stud	25 N.m (18 lb. ft.)
Ignition Coil Module Bolt/Screw	1.7 N.m (15 lb. in.)
Replacement Ignition Coil-to-Bracket Bolt/Screw	2.8 N.m (25 lb. in.)
Spark Plug (with head replacement)	30 N.m (22 lb. ft.)
Spark Plug (with existing engine assembly)	20 N.m (15 lb. ft.)
Wire Harness Support Bolt/Screw	40 N.m (30 lb. ft.)
Wire Harness Support Channel Bolt/Screw (Right)	12 N.m (106 lb. in.)
Wire Harness Support Channel Bolt/Screw (Left)	12 N.m (106 lb. ft.)

SPECIAL TOOLS



- 1 E-4 THIN WALL TORX[®] SOCKET
- 2 T-9 MALE TORX[®] BIT

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SECTION 6D5

ENGINE WIRING

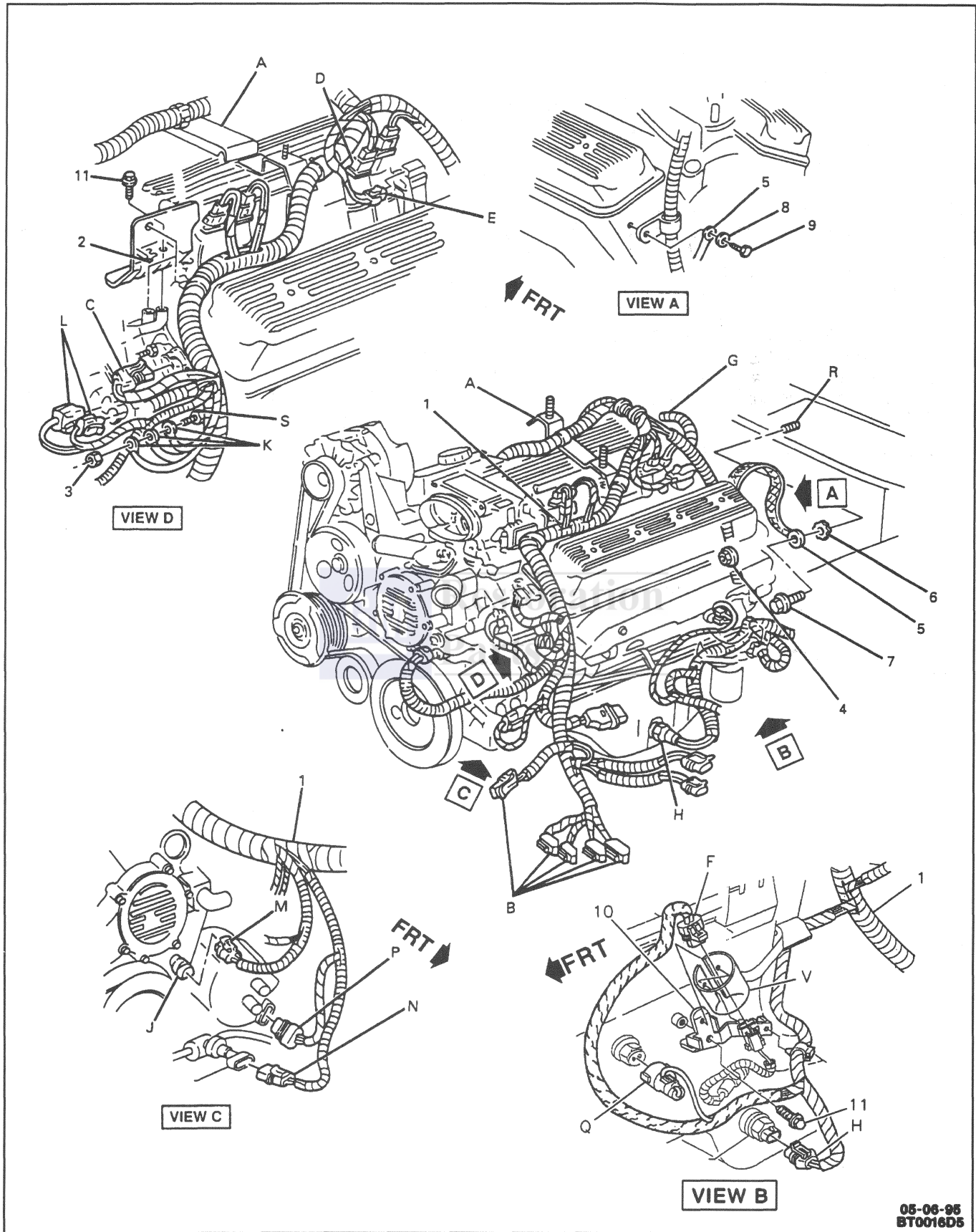
NOTICE: This vehicle uses a sequential multiport fuel injected engine. Fuel injector connectors must be positioned onto their appropriate fuel injectors or engine performance and exhaust emissions may be seriously affected. Fuel injector connectors are numbered to match their correct fuel injector for that cylinder. If fuel injector connector numbers can not be identified, refer to SECTION 8A-20 for correct fuel injector connector wire color to fuel injector for each cylinder.

CONTENTS

Left-Hand Side Engine Wiring Harness	6D5-2	Transmission Engine Wiring Harness	
Left-Hand Side Engine Wiring Harness		(Electrical Center).....	6D5-5
(Legend)	6D5-3	Engine Wiring Harness	
Right-Hand Side Engine Wiring Harness	6D5-4	(Electrical Center).....	6D5-5

The following figure illustrates engine wiring harness routing and the various electrical/electronic components that have terminal connectors attached to them. In the illustration legends, the connectors are identified by the component names which complete their connection. Refer to SECTION 8A for detailed diagnostics.

6D5-2 ENGINE WIRING



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Figure 1 - Left Side Engine Wiring Harness

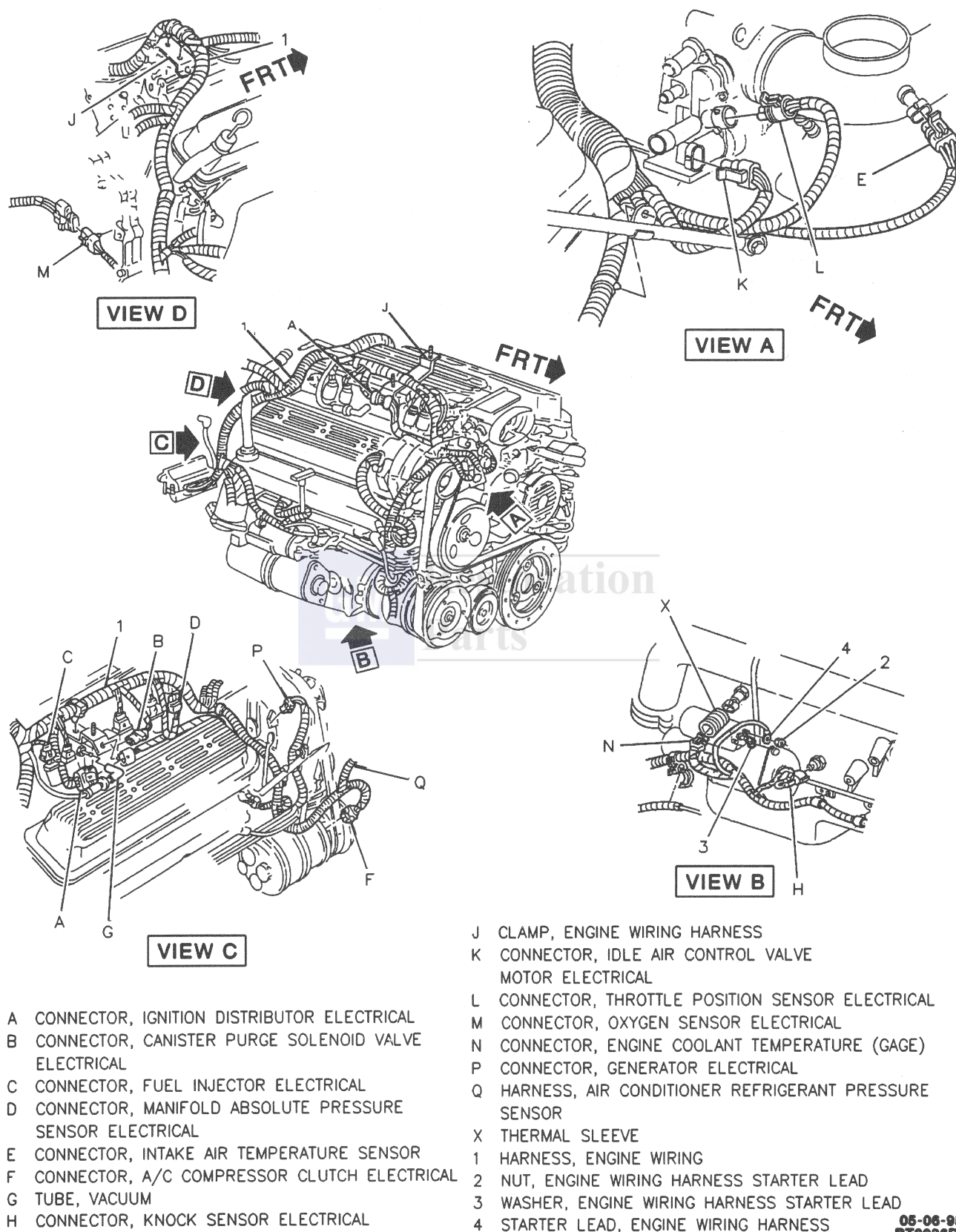
A	BRACKET, AIR RESONATOR	Q	CONNECTOR, KNOCK SENSOR ELECTRICAL
B	CONNECTOR, POWERTRAIN CONTROL MODULE	R	STUD
C	CONNECTOR, ELECTRONIC IGNITION MODULE	S	TERMINAL, GROUND
D	CONNECTOR, FUEL INJECTOR ELECTRICAL	V	THERMAL PATCH
E	CONNECTOR, EXHAUST GAS RECIRCULATION SOLENOID VALVE ELECTRICAL	1	HARNESS, ENGINE WIRING
F	CONNECTOR, OXYGEN SENSOR ELECTRICAL	2	BRACKET, ENGINE WIRING HARNESS SHIELD
G	CONNECTOR, OIL PRESSURE SENSOR ELECTRICAL	3	NUT, ENGINE WIRING HARNESS GROUND
H	CONNECTOR, OIL LEVEL SENSOR ELECTRICAL	4	NUT, ENGINE GROUND STRAP
J	CONNECTOR, ENGINE COOLANT TEMPERATURE SENSOR ELECTRICAL	5	STRAP, ENGINE GROUND
K	LEAD, GROUND	6	WASHER, ENGINE GROUND STRAP
L	CONNECTOR, IGNITION COIL ELECTRICAL	7	BOLT/SCREW, BODY FRONT WIRING HARNESS GROUND (REPAIR ONLY) 6 N•m (53 LB. IN.)
M	CONNECTOR, ENGINE COOLANT TEMPERATURE SENSOR ELECTRICAL	8	WASHER, ENGINE WIRING HARNESS CLIP
N	CONNECTOR, POWER STEERING CUTOUT SWITCH	9	BOLT/SCREW, ENGINE WIRING HARNESS CLIP 4 N•m (35 LB. IN.)
P	CONNECTOR, SECONDARY AIR INJECTION AIR PUMP	10	BRACKET, ENGINE WIRING HARNESS
		11	BOLT/SCREW, ENGINE WIRING HARNESS BRACKET 34 N•m (25 LB. FT.)

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Figure 2 - Left Side Engine Wiring Harness -Legend



6D5-4 ENGINE WIRING



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Figure 3 - Right Side Engine Wiring Harness

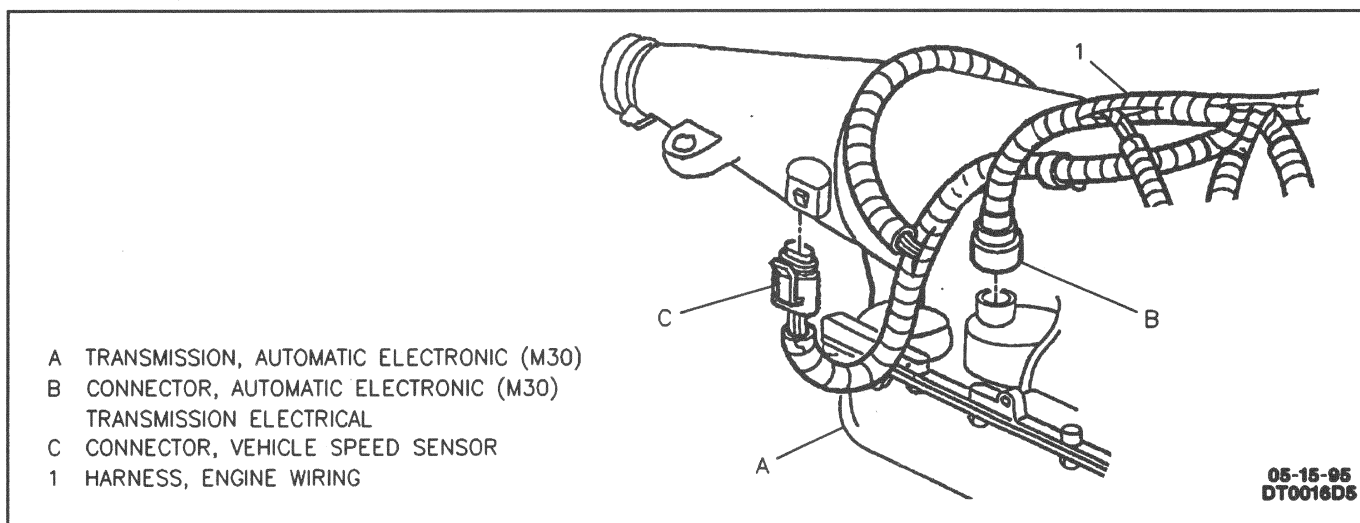


Figure 4 - Transmission Engine Wiring Harness (M30)

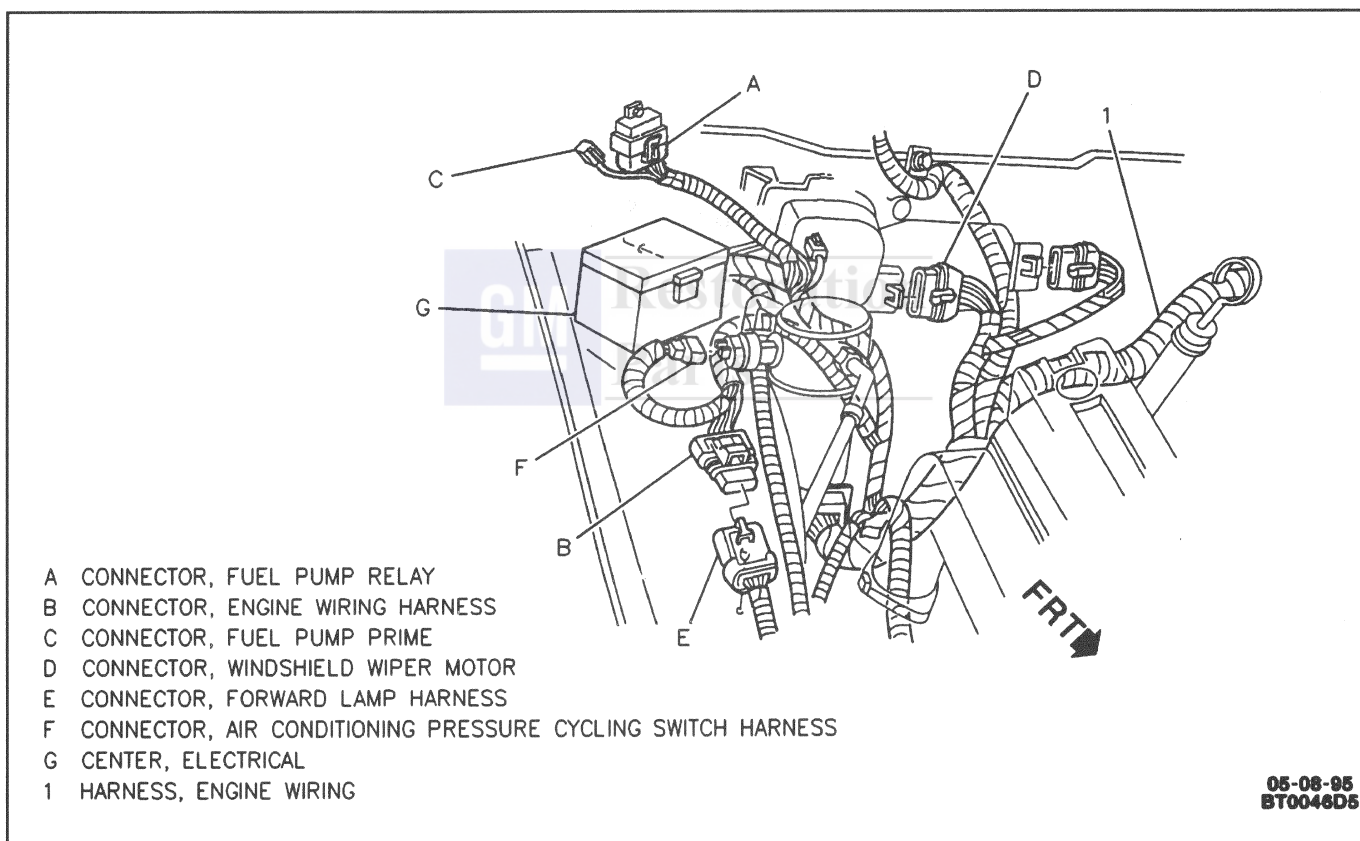


Figure 5 - Engine Wiring Harness (Electrical Center)

BLANK



Restoration
Parts

SECTION 6F

EXHAUST SYSTEM

NOTICE: All new GM vehicles are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards, thus, these adjustment points either have been permanently sealed and/or made inaccessible to prevent indiscriminate adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, caps, etc., for the purpose of servicing the product must be strictly followed and, where practical, returned to the original intent of the design.

NOTICE: Exhaust system components must have enough clearance from the underbody to prevent overheating of the floor panel and possible damage to the passenger compartment, insulation and trim materials.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



General Description.....	6F-1	Complete Exhaust System Replacement.....	6F-9
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Exhaust Resonator Rear Hanger.....	6F-9		

GENERAL DESCRIPTION

NOTICE: When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating of the floor panel and possible damage to the passenger compartment, insulation and trim materials.

The 4.3L L99 engine used in the Chevrolet has a single exhaust system with dual warmup three way catalytic converters. The 5.7L LT1 engine used for

both Chevrolet and Buick has a dual exhaust system with dual warmup three way catalytic converters.

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for service, it is advisable to check the condition of the complete exhaust system.

Check complete exhaust system, nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration that could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may indicate a problem in

6F-2 EXHAUST SYSTEM

one of these areas. Any faulty areas should be corrected immediately. To help ensure continued integrity, the exhaust system pipes rearward of the exhaust muffler must be replaced whenever a new exhaust muffler is installed.

WARMUP THREE WAY CATALYTIC CONVERTER

Figure 1

CAUTION: Prolonged operation with a misfiring or flooded engine may cause the warmup three way catalytic converters to overheat. This could cause damage either to the catalyst itself or the operating vehicle and possible personal injury.

The warmup three way catalytic converters are emission control devices added to the exhaust system to reduce pollutants from the exhaust gas stream.

NOTICE: The warmup three way catalytic converters require the use of unleaded fuel only, or damage to the catalyst may result.

A dual catalytic converter system is used. This type of catalytic converter is known as a warmup three way catalytic converter.

The catalysts have coatings that contain platinum and rhodium. The three way catalyst lowers the levels of oxides of nitrogen (NO₃) as well as hydrocarbons (HC) and carbon monoxide (CO).

EXHAUST MUFFLER

The exhaust muffler is a tri-flow design. The exhaust muffler has a slot in the outlet pipe that indexes to a key (tab) welded on the exhaust resonator inlet to help maintain alignment.

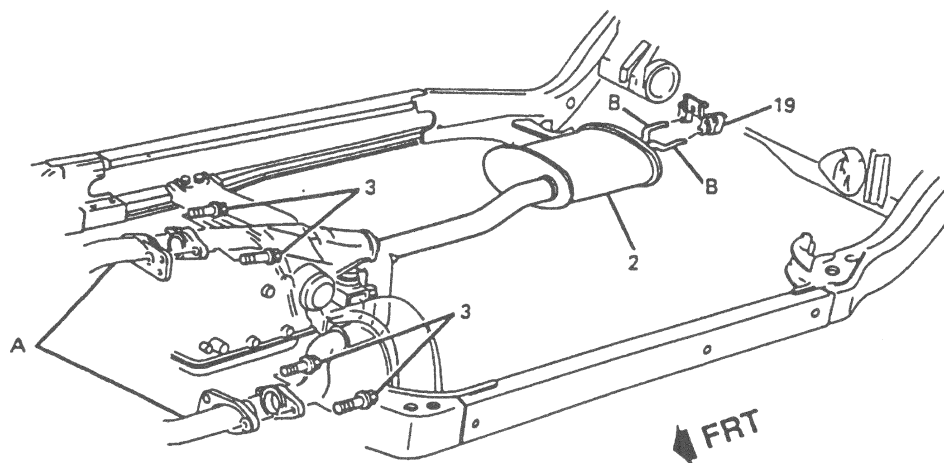
HANGERS

! Important

- The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations that can be difficult to diagnose.

Two types of hangers are used. The first uses a rigid metal brace that is attached to the transmission housing and solidly bolted to both right and left sides of the exhaust system. A vibration dampener is installed at the right-hand side attachment. Cracking of the catalytic converters may occur if the brace and dampener are not installed.

The second type of hanger uses a pair of molded rubber insulators pierced by four metal rods. Two of the rods are from the exhaust system component being supported by the hanger. These rods pierce the lower holes of the insulators. The other two rods that pierce the upper holes of the insulators are on the chassis-mounted hanger bracket.



- A OUTLET, WARMUP THREEWAY CATALYTIC CONVERTER (WITH EXHAUST PIPE)
- B ROD, EXHAUST MUFFLER
- 2 MUFFLER, EXHAUST
- 3 BOLT/SCREW, EXHAUST MUFFLER, 20 N•m (15 LB. FT.)
- 19 INSULATOR, EXHAUST TAILPIPE FRONT HANGER

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Figure 1 - Exhaust System Mid Portion (Chevrolet with 4.3L L99 Engine)

CLAMPS AND CONNECTIONS

CAUTION: Coat slip joints with exhaust system sealer before assembly to prevent exhaust from entering the vehicle and causing personal injury.

Three methods are used for connecting exhaust system components: U-bolt type clamps, bolt and cup fittings and flange-to-flange fittings.

Before attaching exhaust system components together, all mating surfaces must be clean and in good condition. Flange-to-flange fittings are the only fittings that require gaskets.

EXHAUST RESONATOR

The resonator allows the use of mufflers with less back pressure and provides for best exhaust system tuning characteristics. Dual exhaust systems use two resonators and single exhaust systems use one resonator. The resonators and tailpipes are serviced as an assembly.

DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Leaking Exhaust Gases.	Leaks at pipe joints.	Tighten nuts/bolts at leaking joints to specifications.
Exhaust Noises.	1. Exhaust pipes contacting heat shields, or loose heat shields. Inspect when cold and after warmup. 2. Leaks at manifold or pipe connections. 3. Burned or blown out exhaust muffler. 4. Burned or rusted out exhaust pipe. 5. Leaking exhaust pipe at manifold flange. 6. Cracked or broken exhaust manifold. 7. Leak between manifold and cylinder head.	1. Tighten heat shield bolts/screws to 1.9 N·m (17 lb. in.). Align exhaust system if necessary. 2. Tighten clamps at leaking connections to specifications. 3. Replace exhaust muffler. 4. Replace exhaust pipe. 5. Replace gasket. 6. Replace manifold. 7. Tighten manifold-to-cylinder head stud nuts or bolts/screws to specifications.
Exhaust Vibrations.	1. Exhaust component contacting body component. 2. Exhaust vibration dampener loose, damaged or missing. 3. Exhaust pipes contacting heat shields.	1. Loosen clamps and realign exhaust system. 2. Tighten or replace exhaust vibration dampener. 3. Loosen clamps and realign exhaust system.
Loss of Engine Power and/or Internal Rattles in Muffler or Catalytic Converters.	Dislodged turning tubes and/or baffles in muffler, cracked or melted substrate in catalytic converter or exhaust pipe.	Replace muffler, catalytic converter, or exhaust pipe.

ON-VEHICLE SERVICE

COMPONENT REPLACEMENT

Exhaust system service includes replacement of the following items:

- Warmup three way catalytic converter.
- Exhaust muffler with crossover pipe (single exhaust).
- Exhaust muffler with intermediate pipe (dual exhaust).
- Exhaust resonator (with tailpipe).
- Catalytic converter hanger and exhaust muffler vibration dampener.
- Exhaust tailpipe front hanger.
- Exhaust resonator rear hanger.

- Complete exhaust system.
- Catalytic converter heat shield.
- Exhaust muffler heat shield.
- Fuel tank heat shields.

WARMUP THREE WAY CATALYTIC CONVERTER

Figures 1 and 3

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Heated oxygen sensor. Refer to SECTION 6E3.
3. Muffler bolts/screws (3).

6F-4 EXHAUST SYSTEM

4. Converter hanger bolts/screws (4) from converter (9) (right-hand only).
5. Dampener (7) (right-hand only).
6. Bolts/screws (53) (left-hand only).
7. Dampener (54) (left-hand only).
8. Nuts (8) from manifold studs.
9. Converter (9 or 10).
10. Gasket (11).



Clean

- Gasket sealing surfaces.



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. New gasket (11).
2. Converter (9 or 10).
3. Converter nuts (8), loosely.
4. Dampener (54) (left-hand only).
5. Bolts/screws (53) (left-hand only).



Tighten

- 41 N.m (30 lb. ft.).
6. Insert converter hanger bolts/screws (4) through dampener (7) and converter support (5) (right-hand only) into converter (9).
 7. Finger tighten converter hanger bolts/screws (4) into converter (9) (right-hand only).
 8. Loosely install muffler bolts/screws (3).



Tighten

- A. Nuts (8) to 50 N.m (37 lb. ft.).

- B. Converter hanger bolts/screws (4) to 34 N.m (25 lb. ft.). Ensure bottom edge of dampener is horizontal (right-hand only).

- C. Muffler bolts/screws (3) to 20 N.m (15 lb. ft.).

9. Heated oxygen sensor. Refer to SECTION 6E3.

10. Lower vehicle.

EXHAUST MUFFLER (WITH INTERMEDIATE PIPE)

CHEVROLET WITH 4.3L L99 ENGINE

Figures 1, 5, and 6



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Clamp (16).
3. Resonator rods from insulators (17).
4. Resonator (59) from muffler (2).



Important

- Ensure resonator pipe does not hang on axle, otherwise brake line on axle may be damaged.

5. Support resonator (59).
6. Exhaust muffler bolts/screws (3).
7. Muffler rods from insulators (19).
8. Muffler (2) with intermediate pipe.



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Muffler (2) with intermediate pipe.

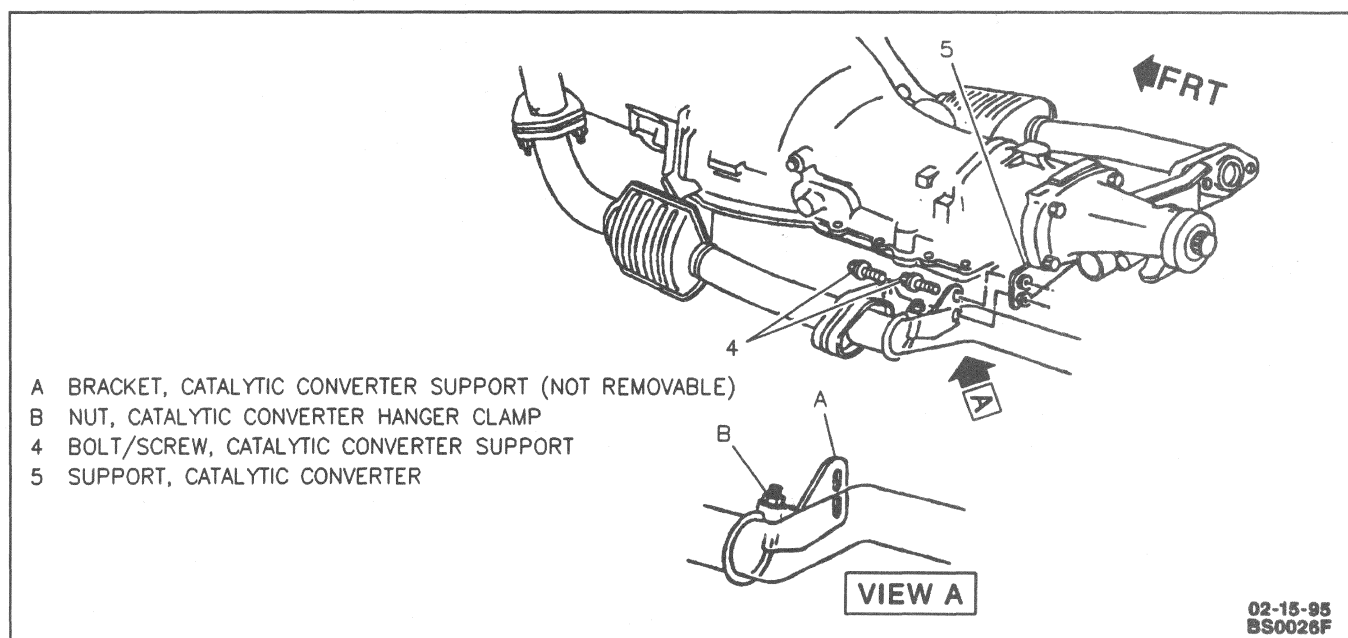


Figure 2 - Catalytic Converter Hanger Bracket

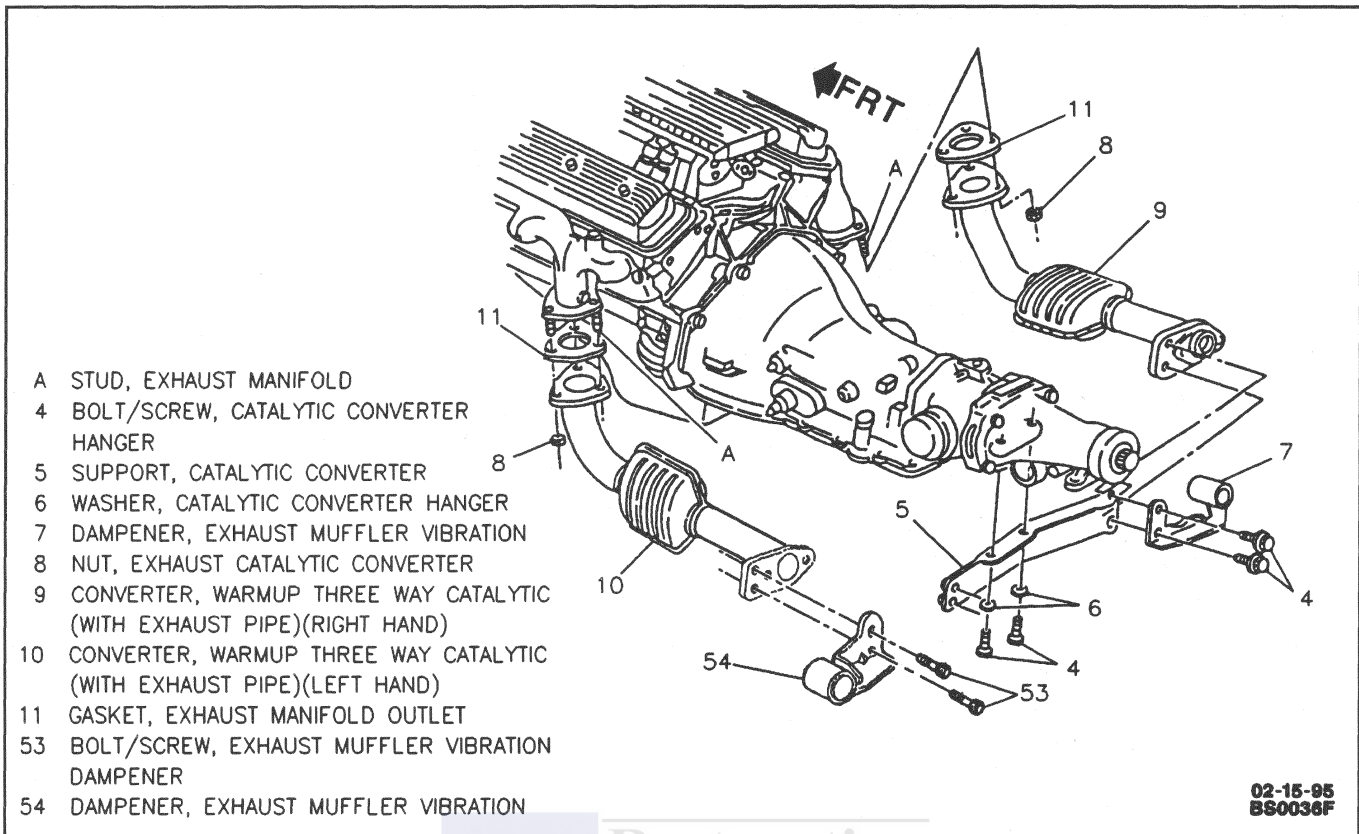


Figure 3 - Exhaust System Front Portion

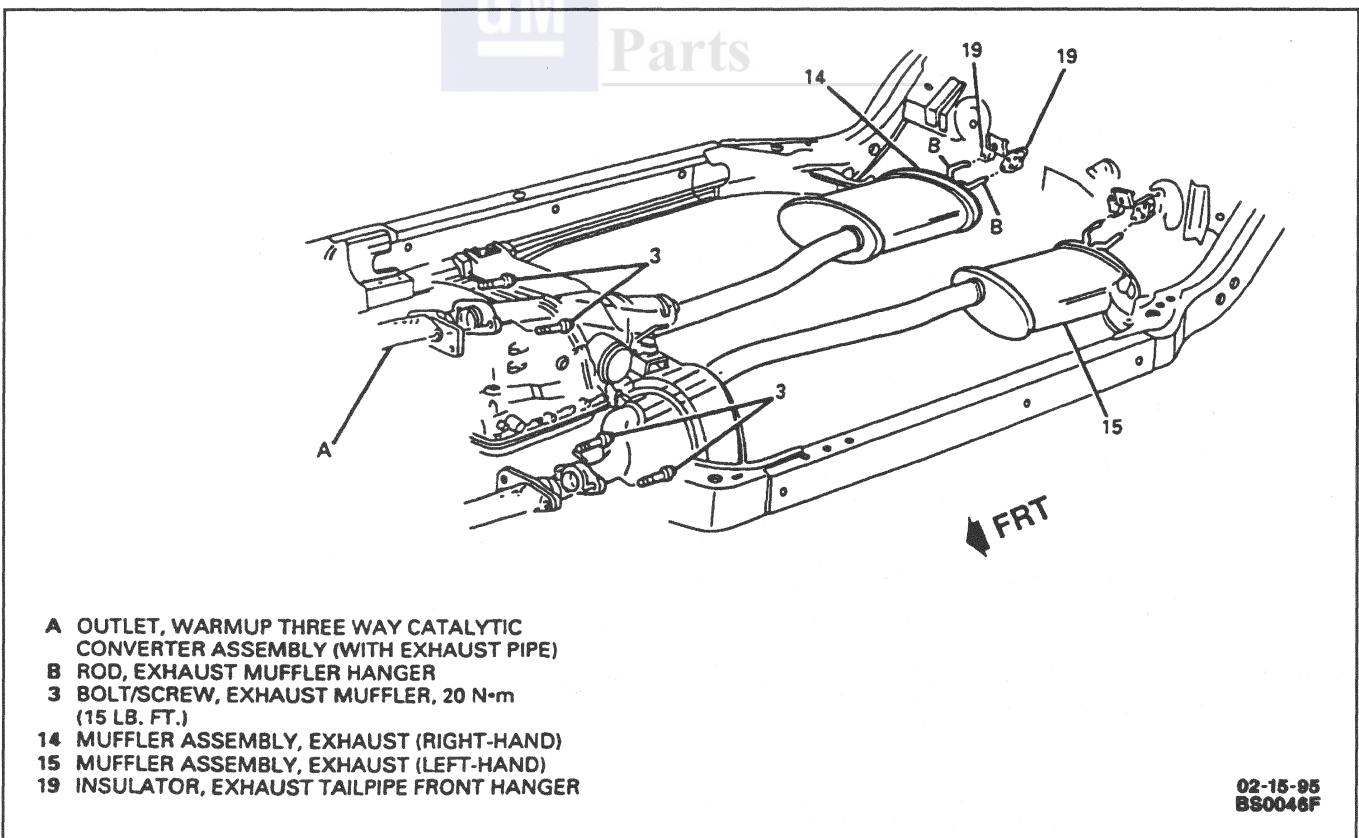


Figure 4 - Exhaust System Mid Portion (5.7L LT1 Engine)

6F-6 EXHAUST SYSTEM

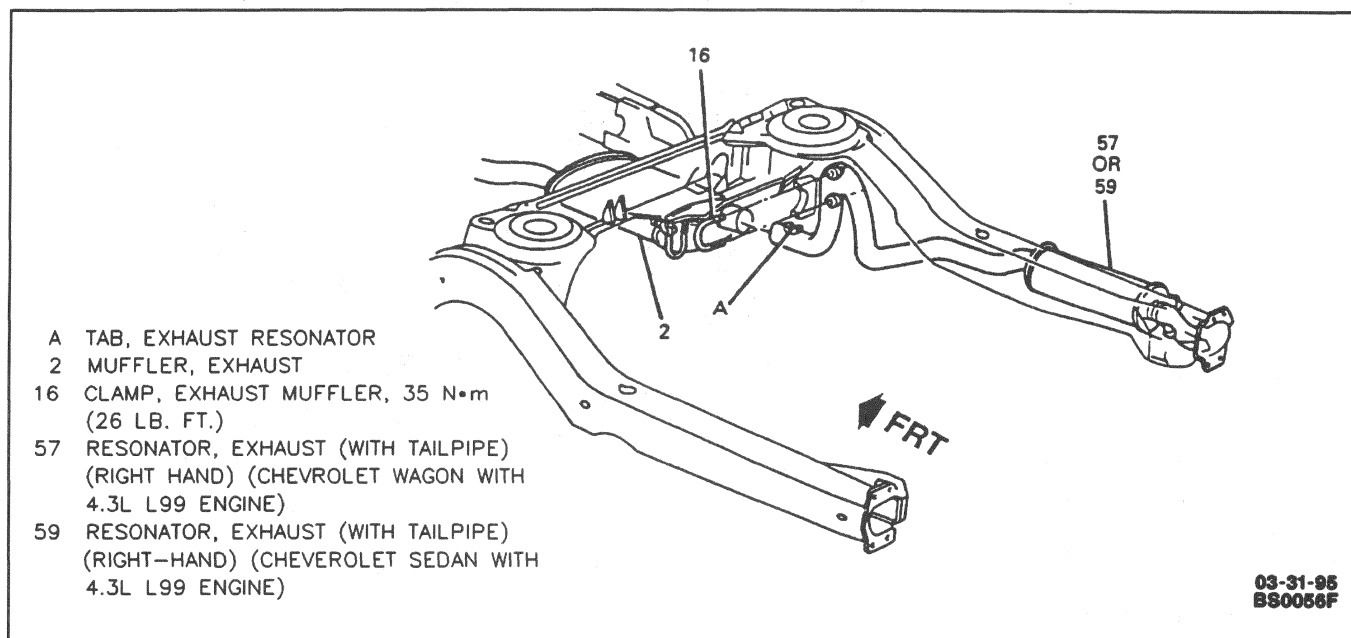


Figure 5 - Exhaust System Rear Portion (Chevrolet with 4.3L L99 Engine)

2. Muffler rods into insulators (19).
3. Exhaust muffler bolts/screws (3), loosely.
4. Resonator (59) into muffler (2).
 - Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
5. Resonator rods into insulators (17).
6. Clamp (16).
 - A. Assemble clamp around resonator pipe and loosely install nuts.
 - B. Tap clamp (16) rearward to contact tab on resonator.



Tighten

- A. Exhaust muffler bolts/screws (3) to 20 N·m (15 lb. ft.).
- B. Clamp nuts to 35 N·m (26 lb. ft.).
7. Lower vehicle.

5.7L LT1 ENGINE

Figures 4, 6, and 7



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Clamp (16).
3. Resonator rods from insulators (17).
4. Resonator (18 or 20) from muffler (14 or 15).



Important

- Ensure resonator pipe does not hang on axle, otherwise brake line on axle may be damaged.
5. Support resonator (18 or 20).
 6. Exhaust muffler bolts/screws (3).



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Muffler (14 or 15) with intermediate pipe into position.
2. Muffler rods into insulators (19).
3. Exhaust muffler bolts/screws (3), loosely.
4. Resonator (18 or 20) into muffler (14 or 15).
 - Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
5. Resonator rods into insulators (17).
6. Clamp (16).
 - A. Assemble clamp around resonator pipe and loosely install nuts.
 - B. Tap clamp (16) rearward to contact tab on resonator.



Tighten

- A. Exhaust muffler bolts/screws (3) to 20 N·m (15 lb. ft.).
- B. Clamp nuts to 35 N·m (26 lb. ft.).
7. Lower vehicle.

EXHAUST RESONATOR (WITH TAILPIPE) CHEVROLET WITH 4.3L L99 ENGINE

Figures 5 and 6



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

2. Clamp nuts and clamp (16).
3. Resonator rods from insulators (17).
4. Resonator (59) from muffler (2).

! Important

- Carefully lift resonator pipe over axle to prevent damaging brake line on axle.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Resonator (59) into muffler (2).
 - Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
2. Resonator rods into insulators (17).
3. Clamp (16) and nuts.
 - A. Assemble clamp around resonator pipe and loosely install nuts.
 - B. Tap clamp (16) rearward to contact tab on resonator.

⌚ Tighten

- Exhaust muffler clamp nuts on clamp to 35 N.m (26 lb. ft.).
4. Lower vehicle.

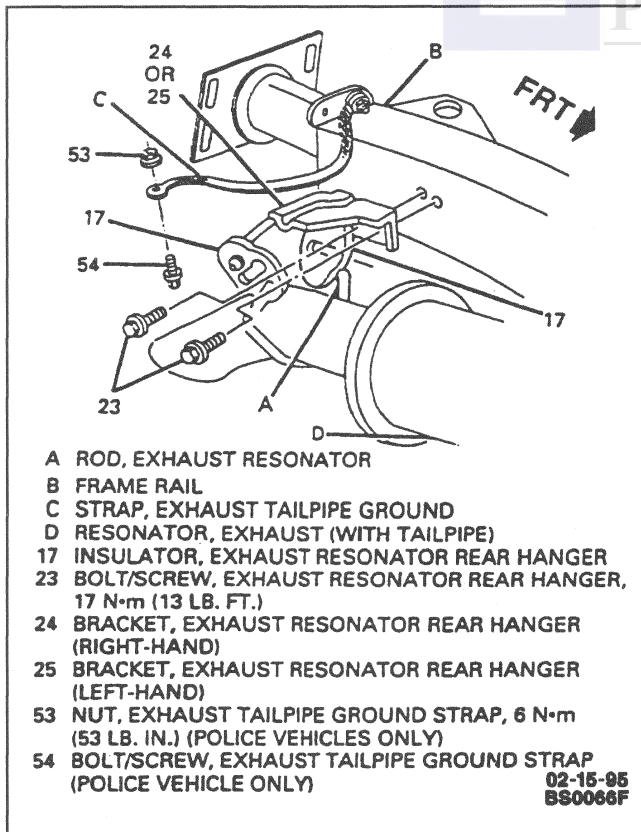


Figure 6 - Exhaust Resonator Rear Hanger (Right Hand Shown; Left Hand, if Equipped, Reversed)

5.7L LT1 ENGINE

Figures 6 and 7

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Ground strap nut (53) and bolt/screw (54) from right-hand resonator outlet for police vehicles only.
3. Clamp (16).
4. Resonator rods from insulators (17).
5. Resonator (18 or 20) from muffler (14 or 15).

! Important

- Carefully lift resonator pipe over axle to prevent damaging brake line on axle.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Resonator (18 or 20) onto muffler (14 or 15).
 - Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
2. Resonator rods into insulators (17).
3. Clamp (16).
 - A. Assemble clamp around resonator pipe and loosely install nuts.
 - B. Tap clamp (16) rearward to contact tab on resonator.

⌚ Tighten

- Nuts on clamp (16) to 35 N.m (26 lb. ft.).
4. Bolt/screw (54) through right-hand resonator outlet and ground strap, on police vehicles only.
 5. Nut (53), for police vehicles only.

⌚ Tighten

- Ground strap nut (53) to 6 N.m (53 lb. in.), on police vehicles only.
6. Lower vehicle.

CATALYTIC CONVERTER SUPPORT AND EXHAUST MUFFLER VIBRATION DAMPENERS

Figures 2 and 3

! Important

- Catalytic converter hanger bracket can not be separated from exhaust piping without damage to piping or bracket.

6F-8 EXHAUST SYSTEM

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Transmission support crossmember. Refer to SECTION 7A.
3. Bolts/screws (4) with washers (6).
4. Dampener (7).
5. Converter support (5).
6. Bolts/screws (53).
7. Dampener (54).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Dampener (54).
2. Bolts/screws (53).

⌚ Tighten

- Bolts/screws (53) to 41 N.m (30 lb. ft.).
 - Ensure bottom edge of dampener is horizontal.
3. Two bolts/screws (4) with washers (6) loosely securing support (5) to transmission case.
 4. Two bolts/screws (4), loosely securing hanger bracket to support (5).
 5. Two bolts/screws (4), loosely securing dampener to support (5) and right-hand converter (9).

⌚ Tighten

- Bolts/screws (4) to 34 N.m (25 lb. ft.).
 - Ensure bottom edge of dampener (7) is horizontal.
6. Transmission support crossmember. Refer to SECTION 7A.
 7. Lower vehicle.

EXHAUST TAILPIPE FRONT HANGER

Figure 8

↔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (21).
3. Hanger bracket (22 or 26) with insulators (19) from rear crossmember.
4. Insulators (19) from muffler rods.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Insulators (19) onto bracket (22 or 26) by inserting bracket rods through upper holes in insulator.

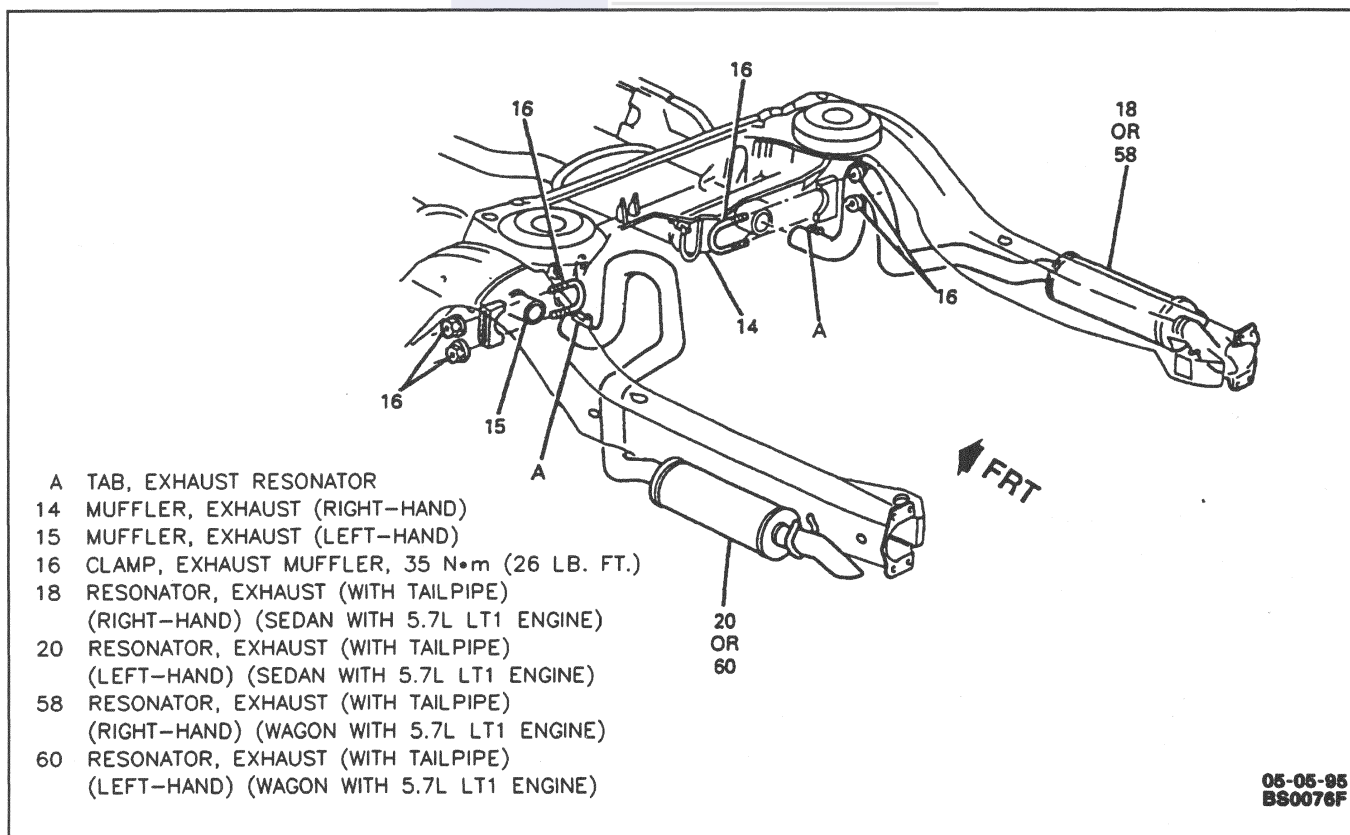


Figure 7 - Exhaust System Rear Portion (5.7L LT1 Engine)

2. Insulator (19) with bracket (22 or 26) onto muffler rods.
3. Bracket (22 or 26) onto rear crossmember.
4. Bolts/screws (21).



Tighten

- Bolts/screws (21) to 50 N.m (37 lb. ft.).
5. Lower vehicle.

EXHAUST RESONATOR REAR HANGER

Figure 6



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (23).
3. Hanger bracket (24 or 25) with insulators (17) from rear frame rail.
4. Insulators (17) from resonator rods and bracket rods.



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Insulators (17) onto bracket (24 or 25) by inserting bracket rods through upper holes in insulators.

2. Insulator (17) with bracket (24 or 25) onto resonator by inserting resonator rods through lower holes in insulator.
3. Bracket (24 or 25) onto rear frame rail.
4. Bolts/screws (23).



Tighten

- Bolts/screws (23) to 17 N.m (13 lb. ft.).
5. Lower vehicle.

COMPLETE EXHAUST SYSTEM REPLACEMENT

CHEVROLET WITH 4.3L L99 ENGINE

Figures 1, 2, 3, 5, 6, and 8



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Muffler clamp (16).
3. Rear hanger bracket bolts/screws (23).
4. Resonator (59) with insulators (17) and bracket (24) from muffler outlet.



Important

- Ensure that resonator pipe does not hang on axle, otherwise brake line on axle may be damaged.
5. Support crossover pipe and catalytic converters (9 and 10).
 6. Heated oxygen sensor. Refer to SECTION 6E3.
 7. Muffler bolts/screws (3).
 8. Only those two converter hanger bolts/screws (4) attaching hanger bracket to converter support (5).
 9. Tailpipe front hanger bracket bolts/screws (21).
 10. Exhaust muffler (2) with crossover pipe, insulators (19) and bracket (22), as an assembly.
 11. Bolts/screws (53).
 12. Dampener (54).
 13. Converter nuts (8).
 14. Only the two converter hanger bolts/screws (4) attaching dampener (7) and converter support (5) to converter (9).
 15. Converters (9 and 10).
 16. Gaskets (11).
 17. Transmission support crossmember. Refer to SECTION 7A.
 18. Remaining two bolts/screws (4) and washers (6).
 19. Converter support (5).



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. New exhaust manifold outlet gaskets (11).

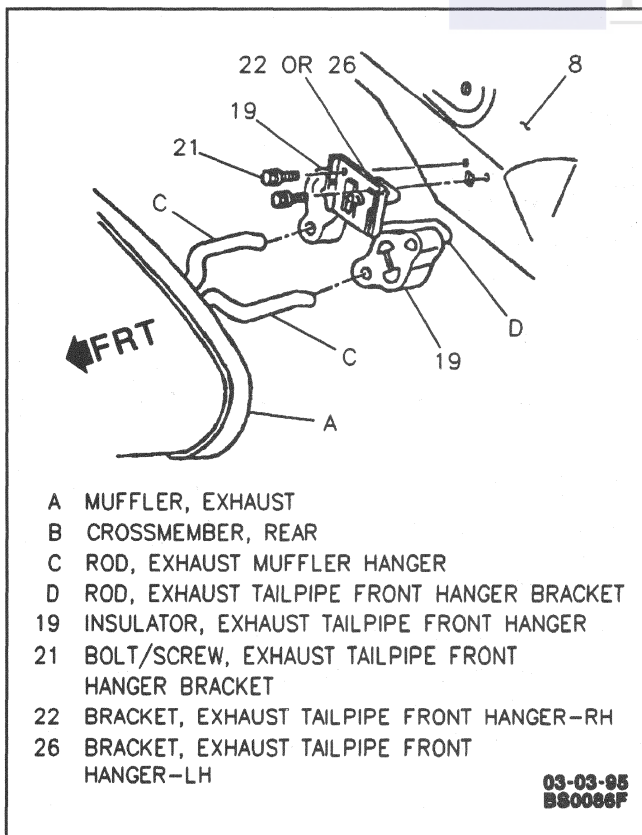


Figure 8 - Exhaust Tail Pipe Front Hanger

6F-10 EXHAUST SYSTEM

2. Converters (9 and 10).
3. Converter nuts (8), loosely.
4. Converter support (5) to underside of transmission case.
5. Only those two converter hanger bolts/screws (4) with washers (6) that attach converter support (5) to transmission case.

Tighten

- Converter hanger bolts/screws (4) to 34 N.m (25 ft. lb.).
6. Dampener (7).
 7. Only those two converter hanger bolts/screws (4) securing dampener (7) and support (5) onto converter (9), loosely.

Tighten

- A. Converter nuts (8) to 50 N.m (37 lb. ft.).
- B. Hanger bolts/screws (4) to 34 N.m (25 lb. ft.).
 - Ensure bottom edge of dampener (7) is horizontal.
8. Transmission support crossmember. Refer to SECTION 7A.
9. Front tailpipe hanger bracket rods into upper holes of insulators (19).
10. Insulators (19) with hanger bracket (22) onto muffler rods.
11. Hanger bracket (22) to rear crossmember.
12. Hanger bracket bolts/screws (21), loosely.
13. Muffler (2) with crossover pipe to converters (9 and 10).
14. Muffler bolts/screws (3), loosely.
15. Dampener (54).
16. Bolts/screws (53), loosely.
17. Resonator rear hanger bracket (24) to rear frame rail.
18. Resonator rear hanger bracket bolts/screws (23).

Tighten

- A. Tailpipe front hanger bracket bolts/screws (21) to 50 N.m (37 lb. ft.).
 - B. Resonator rear hanger bracket bolts/screws (23) to 17 N.m (13 lb. ft.).
19. Muffler clamp (16) onto muffler outlet.
 20. Resonator (57 or 59).
 - A. Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
 - B. Insulators (17) onto rear hanger bracket (24).
 - Insert bracket rods through upper holes in insulators (17).
 - C. Resonator rods into lower holes in insulators (17).
 - D. Tap muffler clamp (16) rearward to contact tab on resonator.

Tighten

- A. Nuts on clamp (16) to 35 N.m (26 lb. ft.).
 - Ensure clamp U-bolt is positioned with threaded ends pointed outboard.
 - B. Muffler bolts/screws (3) to 20 N.m (15 lb. ft.).
 - C. Dampener bolts/screws (53) to 41 N.m (30 lb. ft.).
 - Ensure bottom of dampener is horizontal.
21. Position converter hanger bracket and clamp (16) (part of crossover pipe) to front face of converter support (5).
 22. Remaining two converter hanger bolts/screws (4).

Tighten

- A. Converter hanger bolts/screws (4) to 34 N.m (25 lb. ft.).
 - B. Converter hanger bracket and clamp nut to 35 N.m (26 lb. ft.).
23. Heated oxygen sensor. Refer to SECTION 6E3.
 24. Lower vehicle.

5.7L LT1 ENGINE

Figures 2, 3, 4, 6, 7, and 8

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Muffler clamp (16).
3. Rear hanger bracket bolts/screws (23).
4. Resonator (18 and 20) with insulators (17) and bracket (24 and 25) from muffler outlet.

Important

- Ensure resonator pipe does not hang on axle, otherwise brake line on axle may be damaged.
5. Support intermediate pipes (12 and 13).
 6. Bolts/screws (53).
 7. Dampener (54).
 8. Muffler bolts/screws (3).
 9. Only those two converter support bolts/screws (4) attaching support bracket to converter support (5).
 10. Right hand tailpipe front hanger bracket bolts/screws (21).
 11. Muffler (14) with intermediate pipe, insulators (19) and bracket (22), as an assembly.
 12. Two converter support bolt/screws (4) that attach support (5) to hanger bracket on intermediate pipe (13).
 13. Left-hand tailpipe front hanger bolts/screws (21).
 14. Muffler (15) with intermediate pipe, insulator (19) and bracket (26) as an assembly.
 15. Heated oxygen sensor. Refer to SECTION 6E3.
 16. Converter nuts (8).
 17. Converters (9 and 10).
 18. Gaskets (11).

19. Transmission support crossmember if removing converter support (5). Refer to SECTION 7A.
20. Remaining two converter support bolts/screws (4) and washers (6).
21. Converter support (5).

Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. New exhaust manifold outlet gaskets (11).
2. Converters (9 and 10).
3. Converter nuts (8), loosely.
4. Converter support (5) to underside of transmission case.
5. Converter support bolts/screws (4) with washers (6) that attach converter support (5) to transmission case.

Tighten

- Converter hanger bolts/screws (4) to 34 N.m (25 lb. ft.).
6. Dampener (7).
 7. Converter support bolts/screws (4) that attach dampener (7) and support (5) onto converter (9), loosely.

Tighten

- A. Converter nuts (8) to 50 N.m (37 lb. ft.).
- B. Converter hanger bolts/screws (4) to 34 N.m (25 lb. ft.).
8. Transmission support crossmember. Refer to SECTION 7A.
9. Front tailpipe hanger bracket rods into upper holes of insulators (19).
10. Insulators (19) with hanger bracket (22 and 26) onto muffler rods.
11. Right-hand hanger bracket (22) to rear crossmember.
12. Hanger bracket bolts/screws (21), loosely.
13. Muffler (14) with intermediate pipe to converter (9).
14. Left-hand hanger bracket (26) to rear cross member.
15. Hanger bracket bolts/screws (21) for left-hand bracket.

Tighten

- Front hanger bracket bolts/screws (21) to 50 N.m (37 lb. ft.).
16. Muffler (15) with intermediate pipe to converter (10).
 17. Muffler bolts/screws (3), loosely.
 - A. Tailpipe front hanger bracket bolts/screws (21) to 50 N.m (37 lb. ft.).
 - B. Resonator rear hanger bracket bolts/screws (23) to 17 N.m (13 lb. ft.).

18. Resonator rear hanger brackets (24 and 25) to rear frame rail.
19. Resonator rear hanger bracket bolts/screws (23) to 17 N.m (13 lb. ft.).

Tighten

- Rear hanger bracket bolts/screws (23) to 17 N.m (13 lb. ft.).
20. Muffler clamps (16) onto muffler outlets.
 21. Resonators (18 and 20).
 - A. Slide resonator pipe into muffler outlet until tab on resonator contacts bottom of slot on top of muffler outlet.
 - B. Insulators (17) onto rear hanger bracket (24 and 25).
 - Insert bracket rods through upper holes in insulators (17).
 - C. Resonator rods into lower holes in insulators (17).
 - D. Tap muffler clamps (16) rearward to contact tab on resonators.

Tighten

- A. Nuts on clamp (16) to 35 N.m (26 lb. ft.).
- B. Muffler bolts/screws (3) to 20 N.m (15 lb. ft.).
22. Dampener (54).
23. Bolts/screws (53).

Tighten

- A. Bolts/screws (53) to 41 N.m (30 lb. ft.).
- B. Ensure bottom edge of dampener (54) is horizontal.
24. Position converter support bracket and clamp (part of left-hand intermediate pipe (13) to front face of converter support (15).
25. Remaining two converter support bolts/screws (4).

Tighten

- A. Converter support bolts/screws (4) to 34 N.m (25 lb. ft.).
- B. Converter support bracket and clamp nut to 35 N.m (26 lb. ft.).
26. Heated oxygen sensor. Refer to SECTION 6E3.
27. Lower vehicle.

EXHAUST SYSTEM REALIGNMENT

Figures 1 through 7

Use the following procedure to realign the exhaust system:

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Loosen converter nuts (8). Do not remove.
3. Loosen muffler bolts/screws (3). Do not remove.

6F-12 EXHAUST SYSTEM

4. Loosen four converter support bolts/screws (4) that attach support (5) to converter (9) and support (5) to support bracket clamp on intermediate pipe (for 5.7L LT1 engine) or left leg of crossover pipe (for Chevrolet with 4.3L L99 engine).
5. Loosen converter support bracket clamp nut until bracket clamp can slide on left-hand intermediate pipe (for 5.7L LT1 engine) or on left leg of crossover pipe (for Chevrolet with 4.3L L99 engine). Do not remove.
6. Loosen muffler clamp nuts until clamp can slide on muffler outlet. Repeat for other side, if equipped.



Tighten

- A. Converter nuts (8) to 50 N.m (37 lb. ft.).
 - B. Only those two converter support bolts/screws (4) that secure dampener (7) to support (5) and converter (9) to 34 N.m (25 lb. ft.). Ensure bottom edge of dampener (7) is horizontal.
7. Tap muffler clamp (16) rearward to contact tab on resonator (right-hand only for Chevrolet with 4.3L L99 engine) (both right-hand and left-hand for 5.7L LT1 engine).



Tighten

- A. Muffler clamp nuts to 35 N.m (26 lb. ft.). Ensure clamp U-bolts are positioned with threaded ends pointed outboard.

- B. Muffler bolts/screws (3) to 20 N.m (15 lb. ft.).
8. Position converter support bracket (on left leg of crossover pipe on Chevrolet with 4.3L L99 engine or left hand intermediate pipe on 5.7L LT1 engine) to front face of converter support (5).



Tighten

- A. Remaining two converter support bolts/screws (4) that secure support bracket to support (5) to 34 N.m (25 lb. ft.).
- B. Converter support bracket clamp nut to 35 N.m (26 lb. ft.).
9. Lower vehicle.

CATALYTIC CONVERTER HEAT SHIELDS

Figure 9



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Converter heat shield bolts/screws (27) from converter heat shields (28 and 29).
3. Converter heat shields (28 and 29).



Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

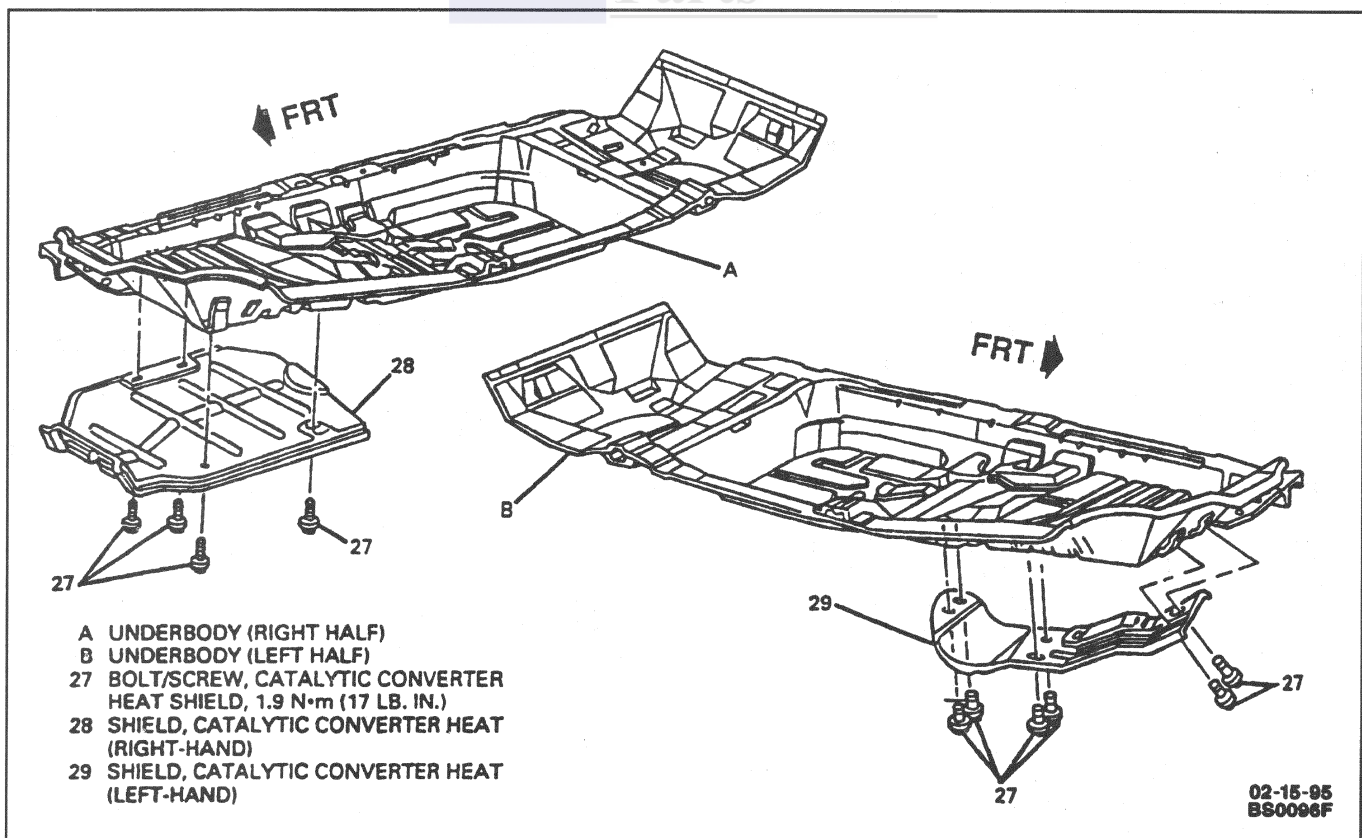


Figure 9 - Catalytic Converter Heat Shields

1. Converter heat shields (28 and 29).
2. Converter heat shield bolts/screws (27).

**Tighten**

- Converter heat shield bolts/screws (27) to 1.9 N·m (17 lb. in.).
3. Lower vehicle.

EXHAUST MUFFLER HEAT SHIELDS**Figure 10****Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Muffler heat shield bolts/screws (30) from right-hand muffler heat shield (31).
3. Right-hand muffler heat shield (31).
4. Muffler heat shield bolts/screws (30) from left-hand muffler heat shield (32).
5. Left-hand muffler heat shield (32).

**Install or Connect**

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Muffler heat shields (31 and 32).
2. Muffler heat shield bolts/screws (30).
 - Muffler heat shield bolts/screws (30) to 1.9 N·m (17 lb. in.).
3. Lower vehicle.

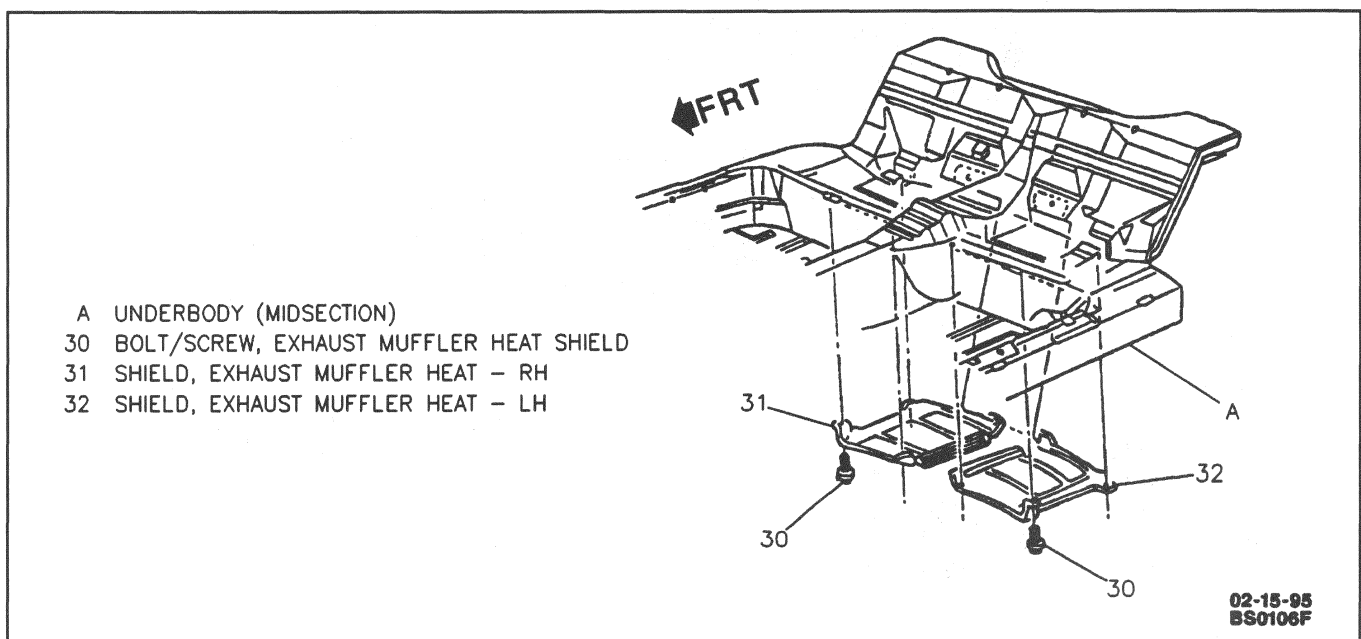
FUEL TANK, FUEL TANK FRONT, AND EXHAUST PIPE FRONT HEAT SHIELDS**SEDAN****Figures 11 and 12****Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (33) from right-hand fuel tank front shield (34).
3. Shield (34), if equipped.
4. Bolts/screws (33) from left-hand fuel tank front shield (35).
5. Shield (35), if equipped.
6. Bolts/screws (36 and 37) from right-hand exhaust pipe front heat shield (38) and right-hand fuel tank heat shield (40).
7. Connected shields (38 and 40) from underbody.
8. Bolts/screws (36 and 37) from left-hand exhaust pipe front heat shield (39) and left-hand fuel tank heat shield (41).
9. Connected shields (39 and 41) from underbody.
10. Bolts/screws (33) connecting shields (38 and 40) and (39 and 41).
11. Nuts (42) from shields (38 and 40) and shields (39 and 41).

**Install or Connect**

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Nuts (42) to shields (38 and 40) and shields (39 and 41).

**Figure 10 - Exhaust Muffler Heat Shields**

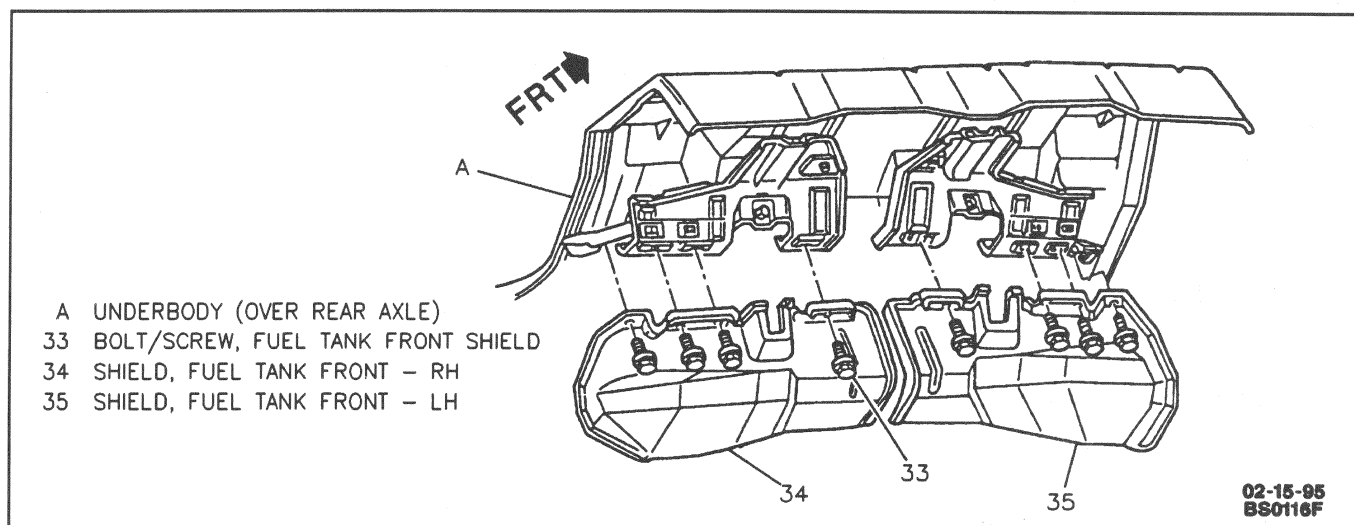


Figure 11 - Fuel Tank Front Shields (Sedan)

2. Shields (38 and 40) and shields (39 and 41) to each other with bolts/screws (33).


Tighten

- Bolts/screws (33) to 1.9 N.m (17 lb. in.).
3. Position assembled shields (38 and 40) and shields (39 and 41) to underbody.
 4. Bolts/screws (36 and 37).


Tighten

- Bolts/screws (36 and 37) to 1.9 N.m (17 lb. in.).
5. Shield (34) to shields (38 and 40), and if equipped, shield (35) to shields (39 and 41).
 6. Bolts/screws (33).


Tighten

- Bolts/screws (33) to 1.9 N.m (17 lb. in.).
7. Lower vehicle.

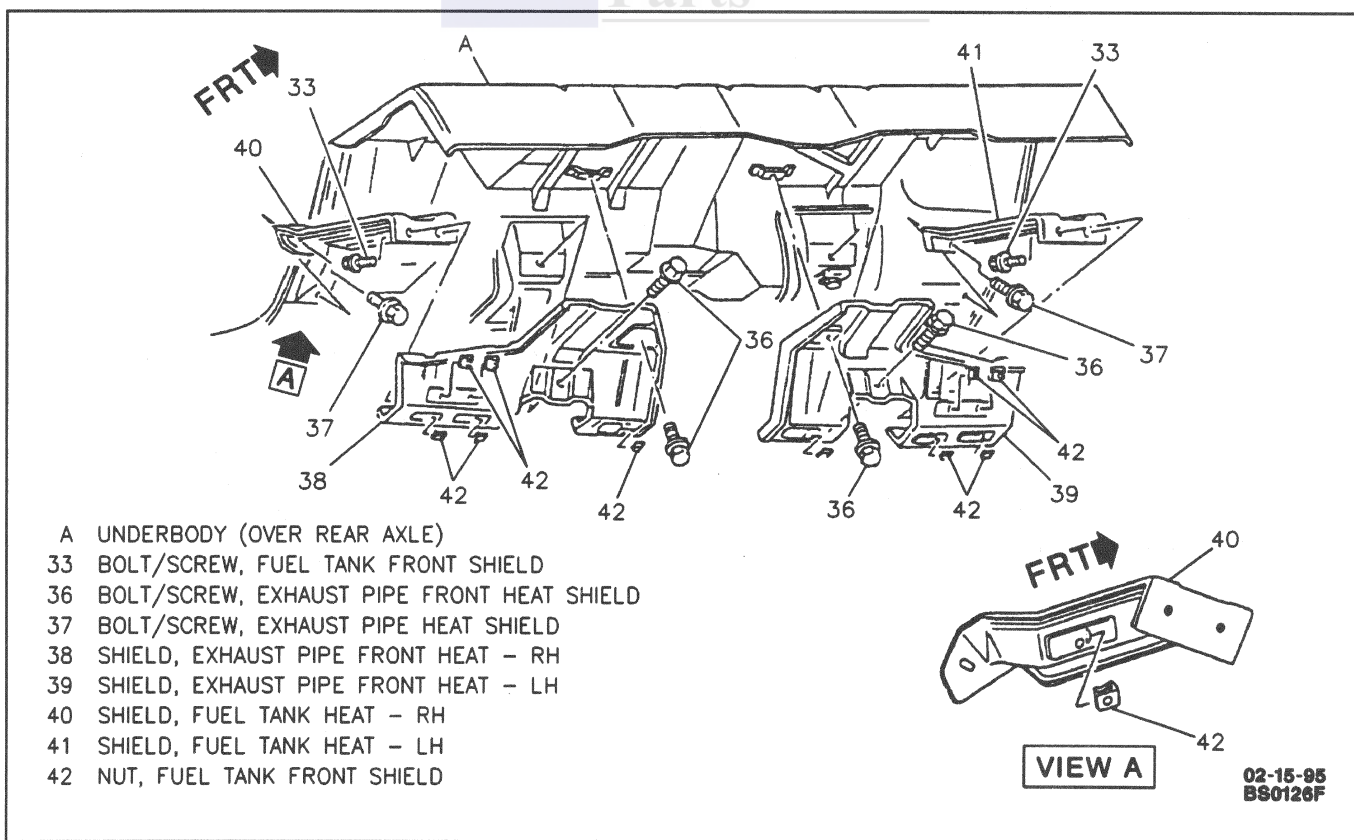


Figure 12 - Exhaust Pipe Front and Fuel Tank Heat Shields (Sedan)

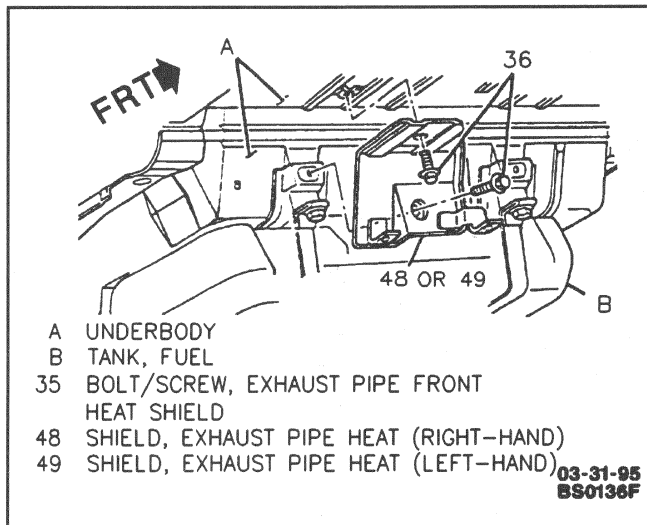


Figure 13 - Exhaust Pipe and Fuel Tank Front Heat Shields (Wagon)

FUEL TANK FRONT AND EXHAUST PIPE HEAT SHIELDS

WAGON

Figures 13 and 14

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (33 and 43) from front shield (44) and bracket (46) and, if equipped, from front shield (45) and bracket (47).
3. Front shield (44) with bracket (46) from underbody and heat shield (48).
4. Front heat shield (45) with bracket (47) from underbody and heat shield (49), if equipped.
5. Bolts/screws (36).
6. Heat shield (48) and if equipped, heat shield (49) from underbody.

Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Position heat shield (48) and, if equipped, heat shield (49) to underbody.
2. Bolts/screws (36).

Tighten

- Bolts/screws (36) to 1.9 N.m (17 lb. in.).
3. Position bracket (46) and fuel tank front shield (44) to exhaust pipe front heat shield (48) and to underbody.

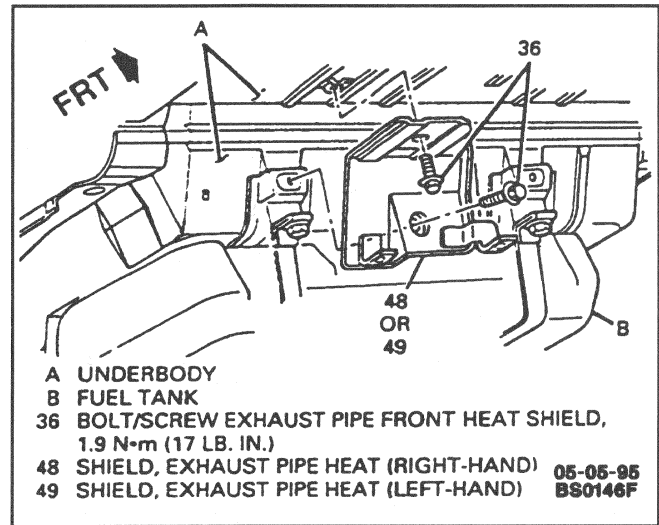


Figure 14 - Exhaust Pipe Heat Shield (Wagon) (Right Hand Shown, Left Hand, Reversed)

4. Position bracket (47) and fuel tank front shield (45) to exhaust pipe front heat shield (49), if equipped.
5. Bolts/screws (33 and 43).

Tighten

- Bolts/screws (33 and 43) to 1.9 N.m (17 lb. in.).
6. Lower vehicle.

FUEL TANK HEAT SHIELDS

WAGON

Figure 15

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (50).
3. Shield (51) from right-hand frame rail.
4. Shield (52) from left-hand frame rail, if equipped.

Install or Connect

NOTICE: Refer to "Notice" on page 6F-1 of this section.

1. Position shield (51) to right hand frame rail.
2. Position shield (52) to left-hand frame rail, if equipped.
3. Bolts/screws (50).

Tighten

- Bolts/screws (50) to 6 N.m (53 lb. in.).
4. Lower vehicle.

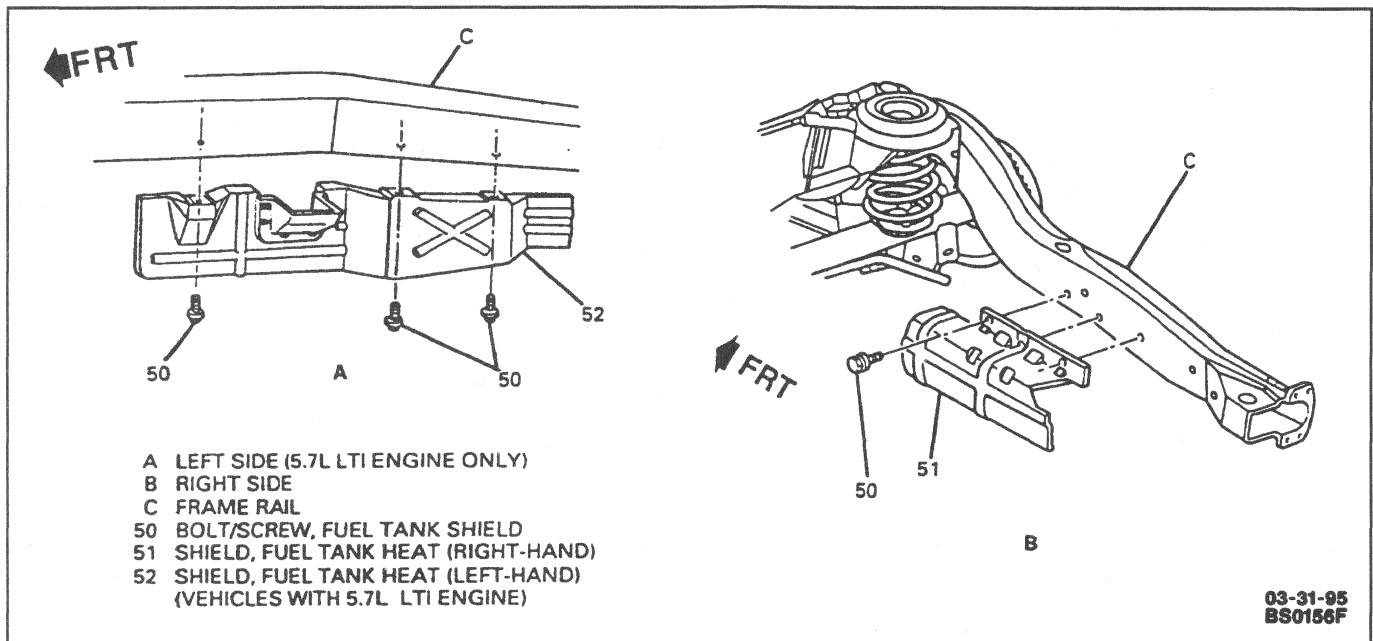


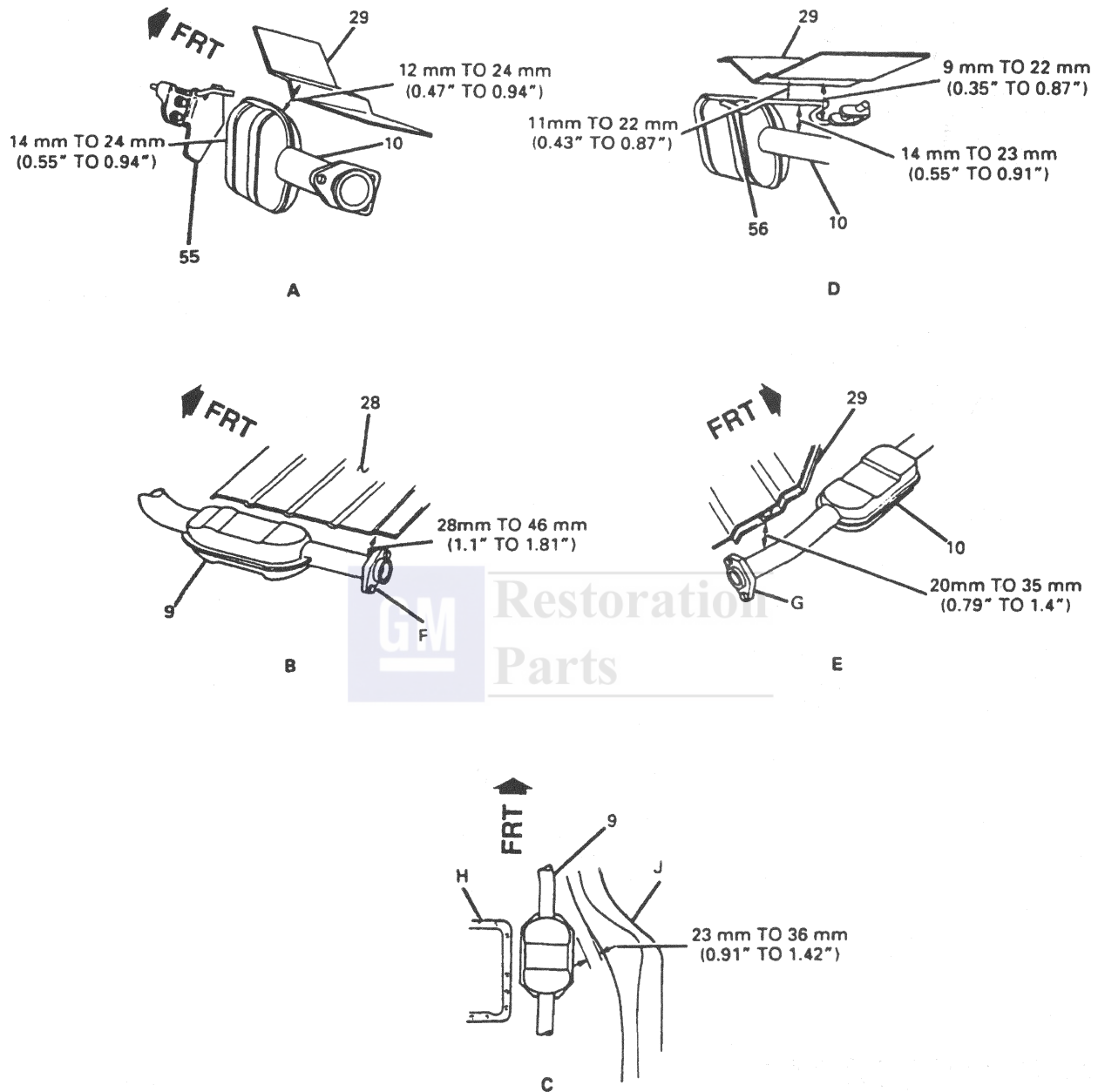
Figure 15 - Fuel Tank Heat Shields (Wagon)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Catalytic Converter Nut.....	50 N.m (37 lb. ft.)
Catalytic Converter Support Bolt/Screw.....	34 N.m (25 lb. ft.)
Catalytic Converter Support Clamp Nut.....	35 N.m (26 lb. ft.)
Catalytic Converter Heat Shield Bolt/Screw.....	1.9 N.m (17 lb. in.)
Exhaust Muffler Bolt/Screw.....	20 N.m (15 lb. ft.)
Exhaust Muffler Clamp Nut.....	35 N.m (26 lb. ft.)
Exhaust Muffler Heat Shield Bolt/Screw.....	1.9 N.m (17 lb. in.)
Exhaust Muffler Vibration Dampener.....	41 N.m (30 lb. ft.)
Exhaust Pipe Front Heat Shield Bolt/Screw.....	1.9 N.m (17 lb. in.)
Exhaust Resonator Rear Hanger Bolt/Screw.....	17 N.m (13 lb. ft.)
Exhaust Tailpipe Front Hanger Bracket Bolt/Screw.....	50 N.m (37 lb. ft.)
Fuel Tank Front Shield Bolt/Screw.....	1.9 N.m (17 lb. in.)
Fuel Tank Shield Bolt/Screw (Sedan).....	1.9 N.m (17 lb. in.)
Fuel Tank Shield Bolt/Screw (Wagon).....	6 N.m (53 lb. in.)
Fuel Tank Shield Bracket Bolt/Screw.....	1.9 N.m (17 lb. in.)

FRONT PORTION EXHAUST SYSTEM CLEARANCES

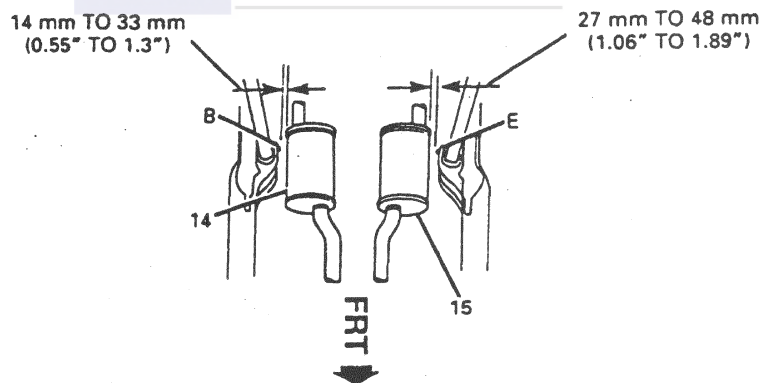
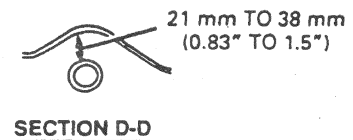
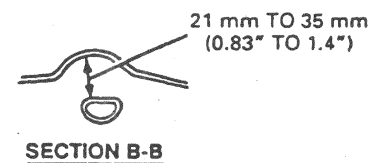
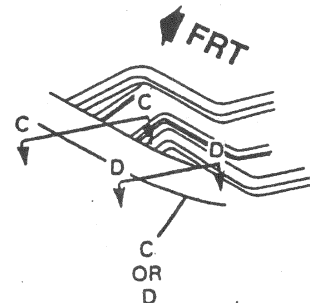
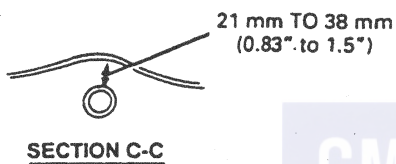
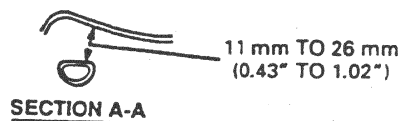
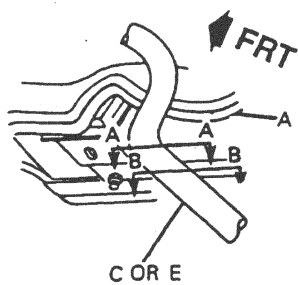


- A LEFT-HAND CATALYTIC CONVERTER-TO-UNDERBODY HEAT SHIELD AND BRAKE PIPE HEAT SHIELD
- B RIGHT-HAND CATALYTIC CONVERTER FLANGE TO HEAT SHIELD
- C RIGHT-HAND CATALYTIC CONVERTER TO TRANSMISSION OIL PAN
- D LEFT-HAND CATALYTIC CONVERTER TO TRANS RANGE SELECTOR ROD AND ROD-TO-UNDERBODY HEAT SHIELD
- E LEFT-HAND CATALYTIC CONVERTER FLANGE-TO-CONVERTER HEAT SHIELD
- F FLANGE, WARMUP THREE WAY CATALYTIC CONVERTER (WITH EXHAUST PIPE) OUTLET (RIGHT-HAND)

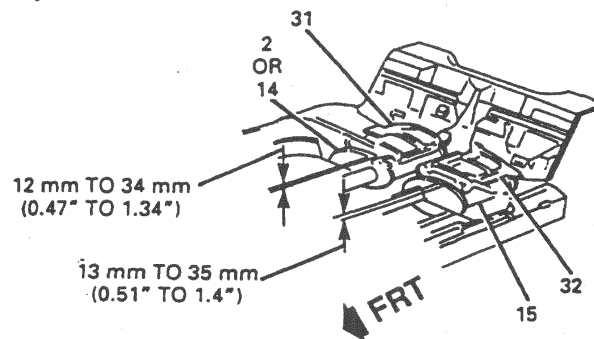
- G FLANGE, WARMUP THREE WAY CATALYTIC CONVERTER (WITH EXHAUST PIPE) OUTLET (LEFT-HAND)
- H PAN, TRANSMISSION OIL
- J FRAME
- 9 CONVERTER WARMUP THREE WAY CATALYTIC (WITH EXHAUST PIPE) (RIGHT-HAND)
- 10 CONVERTER, WARMUP THREE WAY CATALYTIC (WITH EXHAUST PIPE) (LEFT-HAND)
- 28 SHIELD, CATALYTIC CONVERTER HEAT (RIGHT-HAND)
- 29 SHIELD, CATALYTIC CONVERTER HEAT (LEFT-HAND)
- 55 SHIELD, BRAKE PIPE HEAT
- 56 ROD, TRANSMISSION RANGE SELECTOR

6F-18 EXHAUST SYSTEM

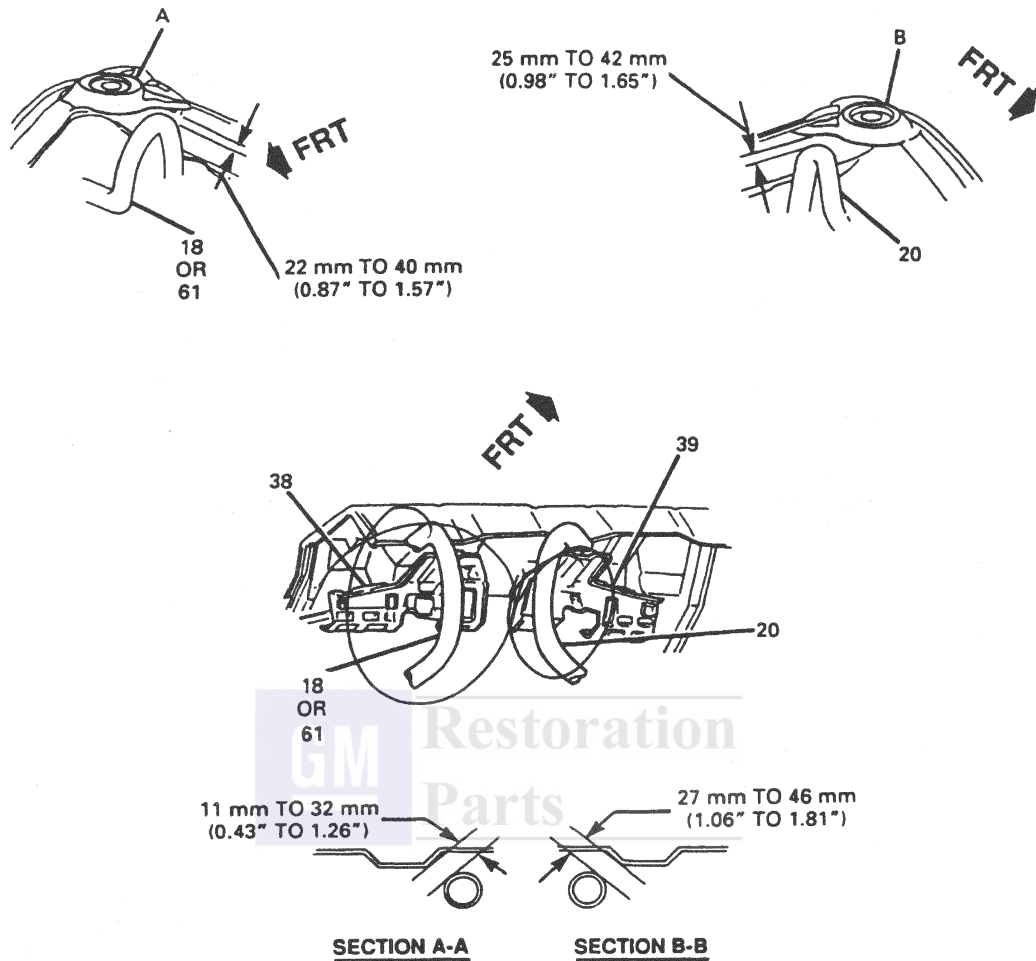
MID PORTION EXHAUST SYSTEM CLEARANCES



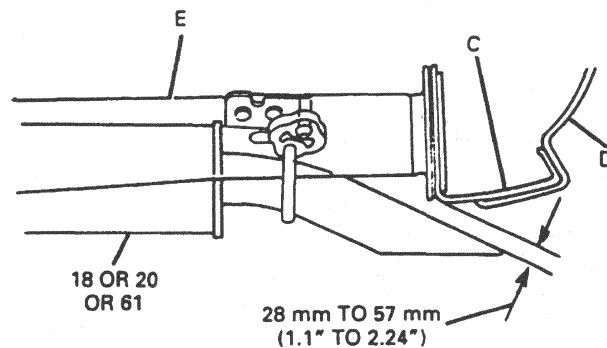
- A CROSSMEMBER, TRANSMISSION SUPPORT
- B BOLT/SCREW, LOWER CONTROL ARM
- C PIPE, EXHAUST CROSSOVER (CHEVROLET WITH 4.3L L99 ENGINE)
- D PIPE, EXHAUST INTERMEDIATE (RIGHT-HAND) (5.7L LT1 ENGINE)
- E PIPE, EXHAUST INTERMEDIATE (LEFT-HAND) (5.7L LT1 ENGINE)
- 2 MUFFLER, EXHAUST (CHEVROLET WITH 4.3L L99 ENGINE)
- 14 MUFFLER, EXHAUST (RIGHT-HAND) (5.7L LT1 ENGINE)
- 15 MUFFLER, EXHAUST (LEFT-HAND) (5.7L LT1 ENGINE)
- 31 SHIELD, EXHAUST MUFFLER HEAT (RIGHT-HAND)
- 32 SHIELD, EXHAUST MUFFLER HEAT (LEFT-HAND)



REAR PORTION EXHAUST SYSTEM CLEARANCES (SEDAN)

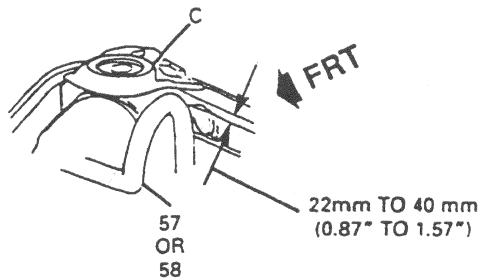


- A SEAT, FRAME - SPRING (RIGHT-HAND)
- B SEAT, FRAME - SPRING (LEFT-HAND)
- C BAR, IMPACT
- D FASCIA, REAR
- E FRAME
- 18 RESONATOR ASSEMBLY, EXHAUST (WITH TAILPIPE) (RIGHT-HAND) (SEDAN WITH 5.7L LT1 ENGINE)
- 20 RESONATOR ASSEMBLY, EXHAUST (WITH TAILPIPE) (LEFT-HAND) (SEDAN WITH 5.7L LT1 ENGINE)
- 38 SHIELD, EXHAUST PIPE FRONT HEAT (RIGHT-HAND)
- 39 SHIELD, EXHAUST PIPE FRONT HEAT (LEFT-HAND) (VEHICLES WITH 5.7L LT1 ENGINE)
- 61 RESONATOR ASSEMBLY, EXHAUST (WITH TAILPIPE) (RIGHT HAND) (CHEVROLET SEDAN WITH 4.3L L99 ENGINE)

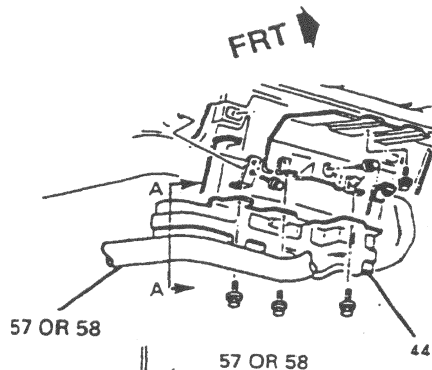
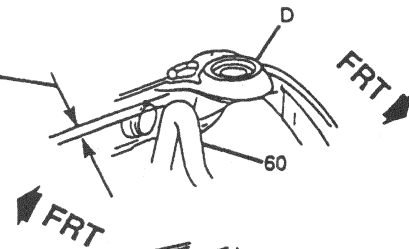


6F-20 EXHAUST SYSTEM

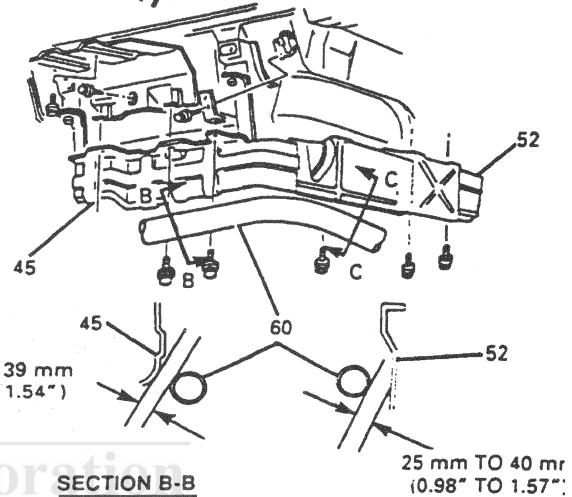
REAR PORTION EXHAUST SYSTEM CLEARANCES (WAGON)



25 mm TO 42 mm
(0.98\"/>



21 mm TO 39 mm
(0.83\"/>



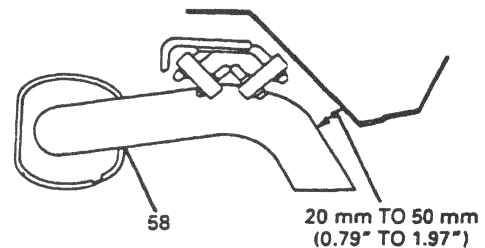
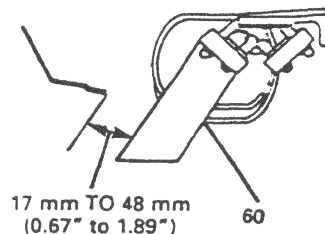
SECTION A-A

SECTION B-B

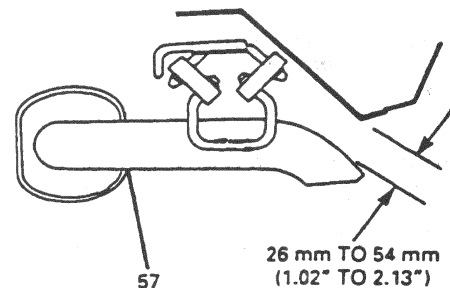
SECTION C-C

A

B



- A RIGHT SIDE
- B LEFT SIDE (VEHICLES WITH 5.7L LT1 ENGINE)
- C SEAT, FRAME-SPRING (RIGHT-HAND)
- D SEAT, FRAME-SPRING (LEFT-HAND)
- 44 SHIELD, FUEL TANK FRONT (RIGHT-HAND)
- 45 SHIELD, FUEL TANK FRONT (LEFT-HAND)
(VEHICLES WITH 5.7L LT1 ENGINE)
- 52 SHIELD, FUEL TANK REAR (LEFT-HAND)
(VEHICLES WITH 5.7L LT1 ENGINE)
- 57 RESONATOR ASSEMBLY, EXHAUST (WITH
TAILPIPE) (RIGHT-HAND) (CHEVROLET WAGON
WITH 4.3L L99 ENGINE)
- 58 RESONATOR ASSEMBLY, EXHAUST (WITH
TAILPIPE) (RIGHT-HAND) (WAGON WITH
5.7L LT1 ENGINE)
- 60 RESONATOR ASSEMBLY, EXHAUST (WITH
TAILPIPE) (LEFT-HAND) (WAGON WITH
5.7L LT1 ENGINE)



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SECTION 7

AUTOMATIC TRANSMISSION GENERAL INFORMATION

CONTENTS

General Description.....	7-1	Automatic Transmission Diagnosis	7-1
Section 7A - Automatic Transmission On-Vehicle Service.....	7-1	Unit Repair.....	7-1

GENERAL DESCRIPTION

Section 7 contains information on where to locate on-vehicle service, unit repair, and diagnostic procedures for the automatic transmission.

SECTION 7A - AUTOMATIC TRANSMISSION ON-VEHICLE SERVICE

Refer to SECTION 7A in this manual for on-vehicle service information. This section contains information on transmission identification, fluid level checking procedures and specific information on servicing some components while transmission is in the vehicle. This section also contains removal and installation of the transmission from the vehicle.

AUTOMATIC TRANSMISSION DIAGNOSIS

Refer to SECTION 7A-14A in this manual for diagnostic service information. This section contains information to assist in diagnosing automatic

transmission operating conditions when the unit is in the vehicle. The diagnosis covers: road test procedures, diagnosis charts, electrical wiring diagrams, automatic transmission oil passage identification, and torque converter clutch diagnosis.

For fluid-flow diagrams and circuit descriptions, refer to the Transmission/Transaxle/Transfer Case Unit Repair manual.

UNIT REPAIR

Refer to the Transmission/Transaxle/Transfer Case Unit Repair Manual. This manual contains the disassembly, inspection, overhaul and assembly procedures for the mechanical components in the transmission. Also included is information on the gaging of certain components, proper use of special tools, and torque specifications required for assembly.



SECTION 7A

AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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7A-2 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

GENERAL INFORMATION

TRANSMISSION IDENTIFICATION

Figures 1 and 2

The HYDRA-MATIC 4L60-E transmission is the only transmission available on the Chevrolet and Buick. All HYDRA-MATIC 4L60-E transmissions have a stamped identification number on the transmission oil pan rail. This is shown in Figure 1. The identification information will help in servicing the unit and ordering necessary parts through a GM parts catalog. The service parts identification label contains information on the regular production options (RPO) as well as standard and mandatory options. Refer to Figure 2. This label is affixed to the inside of each vehicle at the assembly plant. Refer to SECTION 0A for label location and additional information.

TRANSMISSION DEFINITIONS

The following definitions are provided to establish a common language and assist the user in describing transmission related conditions. Some of these terms or conditions are used in the transmission diagnosis section of this service manual.

Throttle Positions

Minimum Throttle - least amount of throttle opening required for an upshift.

Light Throttle - approximately 1/4 of accelerator pedal travel (25% throttle position).

Medium Throttle - approximately 1/2 of accelerator pedal travel (50% throttle position).

Heavy Throttle - approximately 3/4 of accelerator pedal travel (75% throttle position).

Wide Open Throttle - full travel of accelerator pedal (100% throttle position).

Full Throttle Detent Downshift - quick application of accelerator pedal to its full travel, forcing a downshift.

Zero Throttle Coastdown - full release of accelerator pedal while vehicle is in motion and in drive range.

Engine Braking - condition where engine is used to slow vehicle by manually downshifting during zero throttle coastdown.

Shift Conditions

Bump - sudden and forceful application of clutch or band.

Chuggle - bucking or jerking condition that may be engine related. May be most noticeable when the torque converter clutch is engaged. Similar to the feel of towing a trailer.

Delayed - condition where shift is expected but does not occur for a period of time. Samples of this condition could be described as clutch or band engagement that does not occur as quickly as expected during part throttle or wide open throttle application of accelerator, or when manually downshifting to lower range. Also defined as "late" or "extended."

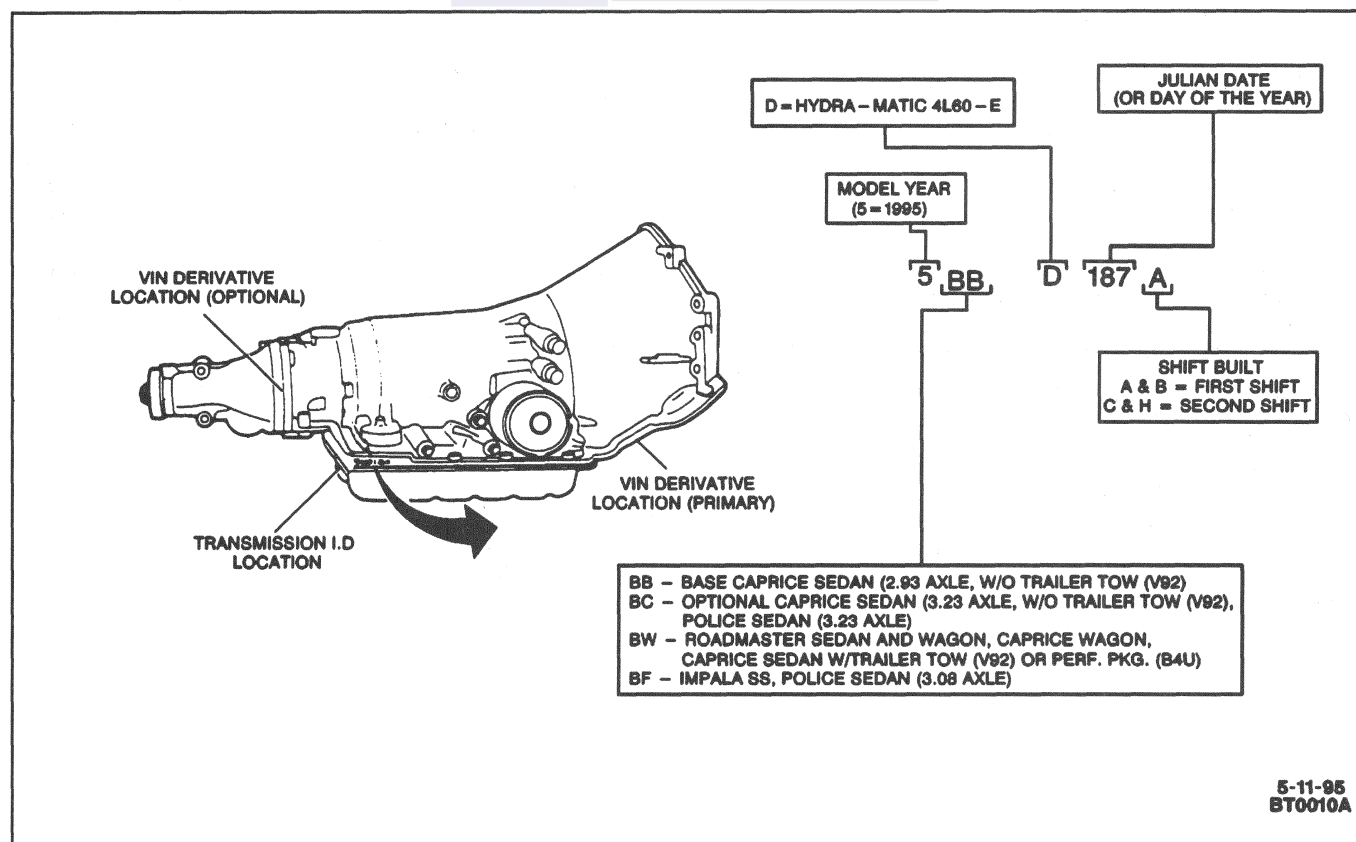


Figure 1 - Automatic Transmission Identification Information

MXO - DESIGNATES 4 SPEED	M30 - DESIGNATES HYDRA-MATIC 4L60-E
--------------------------	-------------------------------------

Service Parts Identification	DO NOT REMOVE
1G4BN6371NW400001 AG9 A90 B48 C09 D33 E92 LC3 N81 TR8 UF7 U26 U81 ZK5 4BN69 AUE BMD B64 C49 B64 F40 MXO M30 TT8 UN3 U29 VES 41A 6PA 7PB A01 B51 B93 C80 D85 GU2 M31 P01 T63 UN9 U36 N30 42L 80B 8XY A42 B32 B96 DF3 E82 K19 N45 DJW T87 UP8 U76 Y79 420 601 8XY A52 B33 CD4 DIC E6E K64 WA8356 SILVER LOWER WA7886 DARK BLUE UPPER PAINT ATLANTIC PROMOTION TWO TONE BASE COAT - CLEAR COAT	EXAMPLE
WA- L8318 UB318 A8320 27T	

10-3-94
 DS0047A

Figure 2 - Service Parts Identification Label

Double Bump - two sudden and forceful applications of clutch or band. Also defined as "double feel."

Early - condition where shift occurs before vehicle has reached proper speed and tends to labor engine after upshift.

End Bump - firmer feel at end of shift as compared to feel at start of shift. Also defined as "end feel" or "slip bump."

Firm - noticeable quick application of clutch or band that is considered normal with medium to heavy throttle shift. Should not be confused with "harsh" or "rough."

Flare - quick increase in engine RPM accompanied with momentary loss of torque. This most generally occurs during a shift. Also defined as "slipping."

Harsh - more noticeable application of clutch or band or as compared to "firm." This condition is considered undesirable at any throttle position. Also defined as "rough."

Hunting - repeating quick series of upshifts and downshifts causing noticeable change in engine RPM. An example could be described as a 4-3-4 shift pattern. Also defined as "busyness."

Initial Feel - distinct firmer feel at start of shift as compared to finish of shift.

Late - shift that occurs when engine is at higher than normal RPM for given amount of throttle.

Shudder - repeating jerking sensation similar to "chuggle" but more severe and rapid in nature. This condition may be most noticeable during certain ranges of vehicle speed. May also be used to define the condition after torque converter clutch engagement.

Slipping - noticeable increase in engine RPM without vehicle speed increase. Slip usually occurs during or after initial clutch or band apply.

Soft - slow, almost unnoticeable clutch application with very little shift feel.

Surge - repeating engine related feeling of acceleration and deceleration that is less intense than "chuggle."

Tie-Up - condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with noticeable loss of engine RPM.

Noise Conditions

Gear Noise - whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.

Pump Noise - high pitched whine increasing in intensity with engine RPM. This condition may also be noticeable in "PARK" and "NEUTRAL" operating ranges with the vehicle stationary.

PRELIMINARY CHECKING PROCEDURE

Transmission performance may be influenced by one or more of the following items. These items should be checked and corrected if necessary, before attempting transmission diagnosis.

- High or low fluid level.
- Manual linkage adjustment.
- Perform "Functional Test Procedure." Refer to SECTION 7A-14A.

NOISE AND VIBRATION ANALYSIS

A noise or vibration noticeable when the vehicle is in motion may not be caused by the transmission. If a noise or vibration is noticeable in "PARK" and "NEUTRAL" with engine at idle, but is less noticeable as RPM increases, the cause may be poor engine performance or misfire. Other possible causes of noises or vibrations may be related to any one of the following:

Inspect

- Tires and wheels for:
 - A. Uneven wear.
 - B. Imbalance.
 - C. Mixed sizes.
 - D. Stones or debris lodged in tread
- Suspension components for:
 - A. Alignment and wear.
 - B. Loose fasteners. Refer to SECTION 3C.
- Engine and transmission mounts for:
 - A. Damage.
 - B. Loose bolts.
- Transmission case mounting holes for:
 - A. Missing bolts, nuts, studs.
 - B. Stripped threads.
 - C. Cracks.

7A-4 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

- Flywheel for:
 - A. Missing or loose bolts.
 - B. Cracks.
 - C. Imbalance.
- Torque converter clutch for:
 - A. Missing or loose bolts or lugs.
 - B. Missing or loose balance weights.

TRANSMISSION FLUID LEVEL INFORMATION

Checking fluid level, color and condition at regular intervals will provide early diagnosis information about the transmission. This information may be used to correct conditions that could cause major transmission repairs if not detected early. When adding or changing fluid, use only DEXTRON® III. Refer to SECTION 0B for maintenance information and servicing intervals.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to transmission.

Fluid level can be checked when transmission reaches normal operating temperatures of 82° to 93° C (180° to 200° F). This temperature is reached after approximately 24 km (15 miles) of highway driving.

- Fluid level can also be checked when transmission is cold (before driving vehicle). Fluid level should be within cold range.
- New fluid is red in color.

Important

When the fluid is new, it is red in color. The red dye is added so the assembly plant can identify it as transmission fluid and distinguish it from engine oil or coolant. The red dye is not a quality indicator, and is not permanent. As the vehicle is driven, the fluid will turn darker in color. The color may eventually turn light brown. Inaccurate fluid level readings will result if the fluid is checked immediately after the vehicle has been operating under certain conditions.

- In high ambient temperatures above 32° C (90° F).
- At sustained high speeds.
- In heavy city traffic during hot weather.
- As a towing vehicle.
- In commercial service.

TRANSMISSION FLUID CHECKING PROCEDURE

Figure 3

The fluid level should be checked with the engine at normal operating temperature, 82° to 93° C (180° to 200° F). Temperature will greatly affect fluid level. If the vehicle is not at normal operating temperature or the proper checking procedures are not followed, the fluid level indicator reading could be false, causing an improper fluid level adjustment. Improper fluid level may cause poor transmission performance and damage. Wait at least 30 minutes before checking fluid level if vehicle has been driven:

- When outside temperatures are above 32° C (90° F).
- In heavy traffic, especially in hot weather.
- While pulling a trailer.

A cold check of the fluid level can be made if the vehicle has not been operated for at least eight hours. The cold check should be used as a reference only. A hot check must be performed if fluid is added during a cold check.

1. Start engine.
 - Hot check - operate vehicle for minimum of 24 km (15 miles) or until normal operating temperature has been reached.
 - Cold check - let engine run for 5 minutes if outside temperature is 10° C (50° F) or above. If outside temperature is below 10° C (50° F), the engine may have to run longer. The cold check should only be used as a preliminary check, followed by a "Hot Check."
2. Park vehicle on level ground.
3. Move transmission control lever to "PARK."
4. Apply parking brake and block tires and wheels.
5. Press brake pedal.
6. Move transmission control lever through each gear range.
 - A. Pause approximately 3 seconds in each range.
 - B. Return transmission control lever to "PARK" position.
7. Let engine idle for 3 minutes with accessories off.

HYDRA - MATIC 4L60 - E



CHECK IN PARK, ENGINE IDLING, VEHICLE LEVEL.
TRANS HOT MUST BE IN CROSSHATCH.
DO NOT OVERFILL.
DEXTRON® - III FLUID ONLY

10-3-84
DS0057A

Figure 3 - Checking Automatic Transmission Fluid Level

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

8. Check fluid level, color and condition.
 - A. Check both sides of fluid level indicator.
 - Use lowest level.
 - B. If fluid level is low add only to "COLD" area for cold check or "HOT" area for hot check.

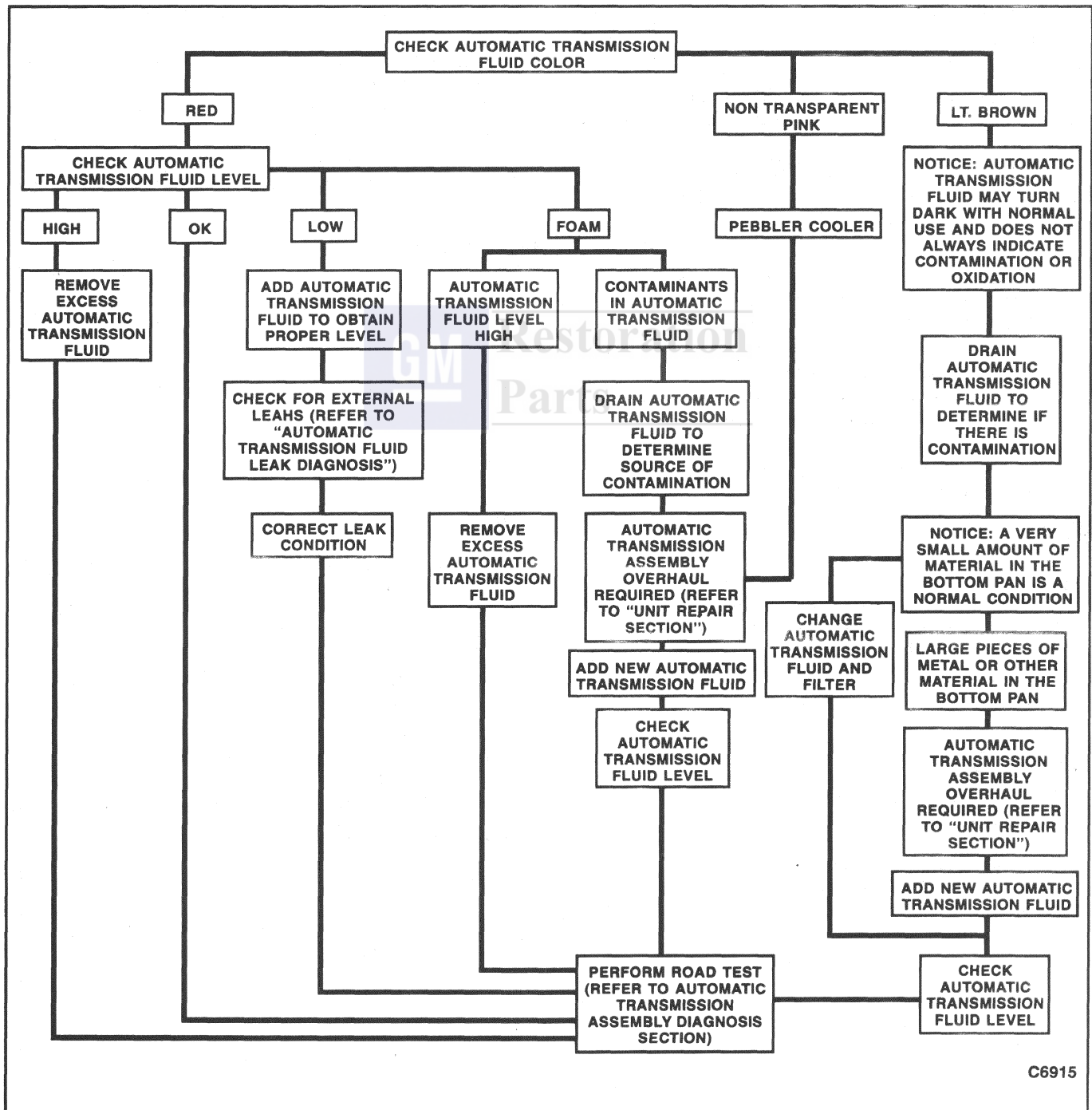
! Important

- Do not overfill.
- C. Recheck level after adding fluid.

GENERAL SERVICE PROCEDURES

NO AIR TOOL RECOMMENDATION

NOTICE: It is not recommended to use air powered tools to disassemble or assemble transmissions. Improper bolt torques can contribute to transmission repair conditions, and this information vital to diagnosis can only be detected when using hand tools.



PARTS CLEANING, INSPECTION AND REPLACEMENT

Use appropriate safety equipment such as:

- Safety glasses, safety shoes, gloves.
- Keep work areas and tools clean.
- Clean transmission exterior before removing parts.
- Do not use wipe cloths or rags.
- Do not use solvents on:
 - Rubber seals.
 - Plastic/Teflon® thrust washers or spacers.
- Blow out all passages with compressed air.
- Clean out small passages with fine wire.
- Handle parts carefully to prevent damage.

NOTICE: The assembly of some components will require use of an assembly lube. It is recommended that J 36850 Transjel™ or equivalent, be used during assembly. Do not use any type of grease to retain parts during assembly of this unit. Lubricants other than the recommended assembly lube will change fluid characteristics and cause undesirable shift conditions and/or oil filter clogging.

- When installing screws, bolts or studs into aluminum, always dip the threads in Transjel™ or equivalent.
- Recondition damaged or stripped aluminum threads with thread inserts.
- Replace all gaskets and O-ring seals.
 - Do not use gasket cement or sealers.
- Replace Teflon® and rubber lip seals only when necessary and install using the appropriate seal installer and sizer.

Inspect

- Manual linkage for:
 - A. Wear at pivoting points.
 - B. Bent or broken links and rods.
- All seals, gaskets, O-ring seals and mating surfaces for:
 - A. Nicks.
 - B. Cuts.
 - C. Damage.
- Snap rings for:
 - A. Expansion or compression.
 - B. Distortion.
 - C. Nicks.
 - D. Proper ring-to-groove fit.
- Bearings and thrust surfaces for:
 - A. Wear.
 - B. Scoring.
 - C. Pitting.

FLYWHEEL/TORQUE CONVERTER CLUTCH VIBRATION TEST PROCEDURE

NOTICE: Make sure to use the correct bolts/screws to secure the flywheel to the converter. If the bolts/screws are too long, they could bottom out in the lug nuts on the converter and dent the housing, causing internal damage to the converter.

Remove or Disconnect

1. Start engine.
2. With engine at idle speed and transmission in "PARK" or "NEUTRAL," observe vibration.
3. Shut off engine.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Transmission converter cover bolts/screws.
6. Flywheel bolts/screws.
 - Discard flywheel bolts/screws.
7. Rotate torque converter clutch 120 degrees (1/3 turn).

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Flywheel bolts/screws.
 - Hand start flywheel bolts/screws.
 - Use new flywheel bolts/screws with retaining compound removed from first three threads of flywheel bolts/screws.

Tighten

- Flywheel bolts/screws to 63 N.m (46 lb. ft.).
2. Transmission converter cover bolts/screws.

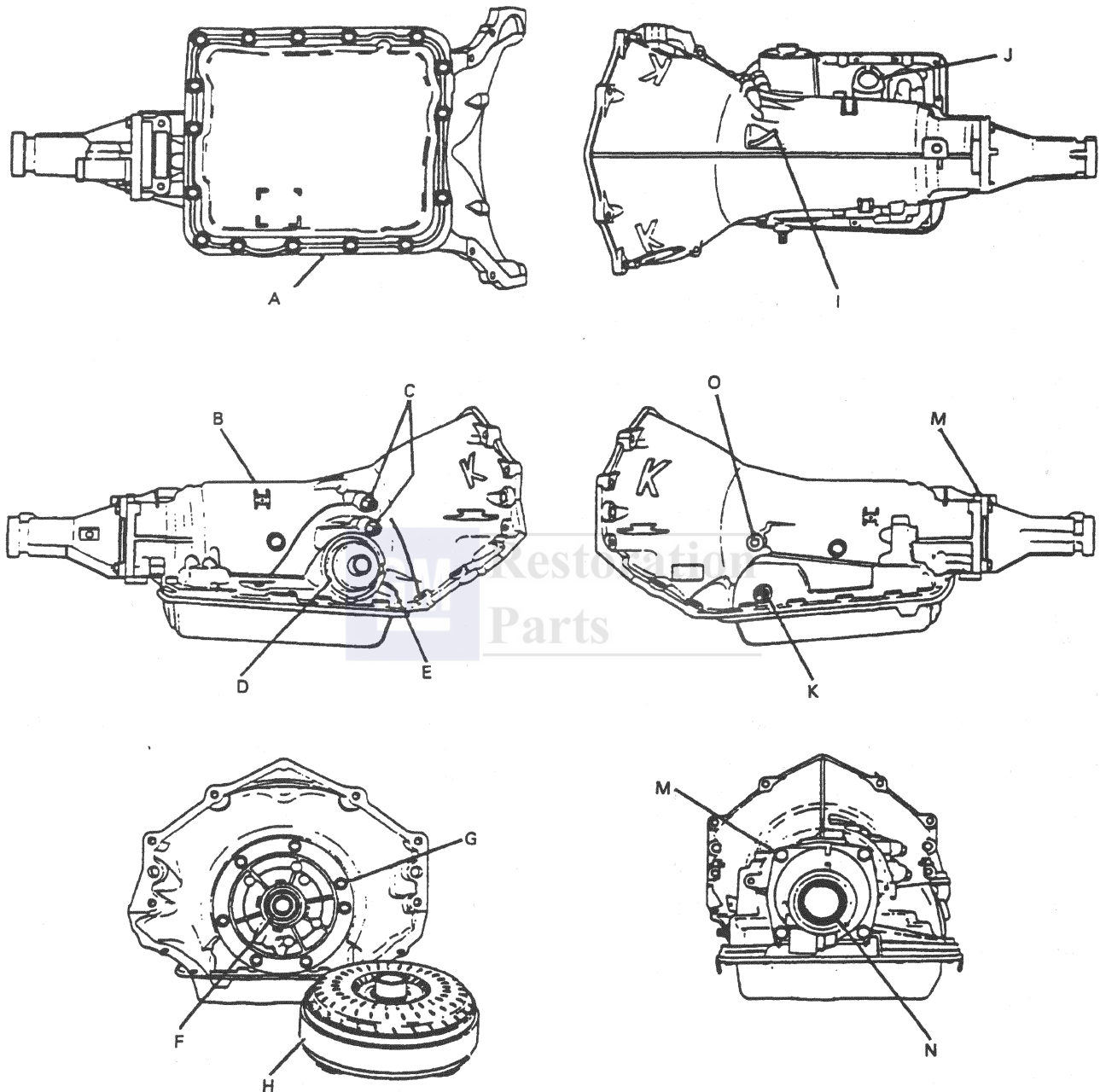
Tighten

- Transmission converter cover bolts/screws to 10 N.m (89 lb. in.).
3. Lower vehicle.
 4. Start engine and check for vibration.
 - If vibration still exists repeat this procedure until best possible balance is obtained.

FLUID LEAK DIAGNOSIS

Figure 4

The cause of most external leaks generally can be located and repaired with the transmission in the vehicle.



- A BOTTOM PAN GASKET
- B CASE
- C COOLER CONNECTORS
- D SERVO COVER SEAL
- E OIL FILL TUBE SEAL
- F OIL PUMP SEAL
- G OIL PUMP TO CASE SEAL
- H CONVERTER

- I VENT
- J ELECTRICAL CONNECTOR SEAL
- K MANUAL SHAFT SEAL
- L EXTENSION TO CASE SEAL
- M EXTENSION OIL SEAL
- N LINE PRESSURE PLUG

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BT0027A

Figure 4 - Automatic Transmission Fluid Leak Points

7A-8 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

Methods for Locating Leak

GENERAL METHOD

1. Verify leak is transmission fluid.
2. Thoroughly clean suspected leak area.
3. Operate vehicle for about 24 km (15 miles) or until normal operating temperatures are reached.
4. Park vehicle over clean paper or cardboard.
5. Shut off engine and look for fluid spots on paper.
6. Make necessary repairs.

POWDER METHOD

1. Thoroughly clean suspected leak area with solvent.
2. Apply aerosol type powder (foot powder) to suspected leak area.
3. Operate vehicle for about 24 km (15 miles) or until normal operating temperatures are reached.
4. Shut off engine.
5. Inspect suspected leak area and trace leak path through powder to find source.
6. Make necessary repairs.

DYE AND BLACK LIGHT METHOD

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow manufacturer's recommendations for amount of dye to use.
2. Detect leak with black light.
3. Make necessary repairs.

Repairing the Leak

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined for it to be properly repaired. For example, if a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must also be repaired.

The following conditions may cause a leak. Before attempting to repair a leak, these conditions should be checked and corrected if necessary.

GASKETS

Inspect

- Fluid level/pressure too high.
- Plugged or kinked vent hose.
- Improperly torqued fasteners, dirty or damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs or other damage to sealing surface.
- Damaged, worn, or improper gasket.
- Cracking or porosity of component.
- Improper sealant used, where applicable.
- Incorrect gasket.

SEALS

Inspect

- Fluid level/pressure too high.
- Plugged or kinked vent hose.
- Damaged seal bore.
- Damaged or worn seal.
- Improper installation.
- Cracks in component.
- Scratched, nicked or damaged manual or output shaft surface.
- Loose or worn bearing causing excess seal wear.

Possible Points of Fluid Leaks

OIL PAN

Inspect

- Incorrectly tightened oil pan bolts/screws.
- Improperly installed or damaged oil pan gasket.
- Damaged oil pan.
- Incorrect oil pan gasket.

CASE OR CASE EXTENSION OIL LEAK

Inspect

- Damaged or missing transmission filler tube seal.
- Mislocated filler tube bracket.
- Damaged vehicle speed sensor seal.
- Damaged manual shaft seal.
- Loose or damaged oil cooler connector fittings.
- Worn or damaged propeller shaft oil seal.
- Loose parking pawl shaft cup plug, if equipped.
- Loose line pressure pipe plug.
- Porous casting.

LEAK AT TORQUE CONVERTER END

Inspect

- Torque converter seal for damage.
 - Torque converter seal lip cut. Check torque converter hub for damage.
 - Bushing moved forward and damaged.
 - Garter spring missing from seal.
- Torque converter clutch leak in weld area.
- Porous casting of transmission case or oil pump.

LEAK AT VENT PIPE OR FLUID FILLER TUBE

Inspect

- Over-filled system.
- Fluid level indicator not locked down.
- Water or coolant in fluid. Fluid will appear milky.
- Transmission case porous.
- Incorrect fluid level indicator.
- Plugged vent.
- Plugged drain-back holes.
- Mispositioned oil pump-to-case gasket.

Transmission Case Porosity Repair

1. Clean leak area with solvent and air dry.

CAUTION: Epoxy cement may cause skin irritations and eye damage. Read and follow all information on container label as provided by manufacturer.

2. Mix sufficient amount of epoxy cement, GM P/N 1052533, or equivalent, following manufacturer's recommendations.
3. Use a heat gun to warm transmission case surface, apply epoxy cement with clean, dry soldering acid brush.
4. Allow epoxy cement to cure for three hours before starting engine.
5. Repeat fluid leak diagnosis procedures to determine if leak is fixed.

TORQUE CONVERTER CLUTCH ELECTRICAL CONTROLS

The Torque Converter Clutch (TCC) system uses controls that are both internal and external to the transmission assembly. For information on internal control components of the TCC system, refer to SECTION 7A-14A.

The external control components of the TCC system include:

Cruise Control Release Switch - To avoid stalling the engine when braking, the TCC is released any time the brake pedal is applied.

Powertrain Control Module (PCM) - Receives input signals and grounds TCC solenoid to apply clutch when proper operating conditions are met.

Throttle Position Sensor - Sends throttle position information to PCM.

Mass Air Flow (MAF) Sensor - Sends inlet air speed information to the PCM for fuel calibration and engine load.

Manifold Absolute Pressure (MAP) Sensor - Sends engine vacuum (load) information to PCM. Back-up system to MAF.

Vehicle Speed Sensor - Sends vehicle speed information to PCM.

Engine Coolant Temperature Sensor - Sends engine coolant temperature information to PCM.

TORQUE CONVERTER CLUTCH DIAGNOSIS

To properly diagnose the torque converter clutch (TCC) system, perform all electrical testing first and then hydraulic testing. Refer to SECTION 6E3 and SECTION 7A-14A for additional TCC information.

ON-VEHICLE SERVICE

STEERING COLUMN SHIFT CONTROL

Linkage Adjustment

Figure 5

Linkage should be adjusted so the engine will start in only "PARK" and "NEUTRAL."

CAUTION: Personal injury may result if the engine can be started in a drive position.

NOTICE: Steering column attachment to body must be complete and all body bolts/screws must be secure before adjusting steering column shift control linkage. Improper linkage adjustment can lead to clutch or band failure.



Adjust

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Position transmission control lever in neutral gate notch.
 - Place a 2-3 lb. weight on the end of the control lever to eliminate any play.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Loosen swivel bolt/screw (816) enough to allow rod (820) to slide freely in swivel (818).
4. Set transmission range selector lever (807) in neutral detent.
5. Hold swivel (818) flush against equalizer lever (819) and finger tighten swivel bolt/screw (816) against rod (820).
 - No force should be exerted in either direction on rod (820) or equalizer lever (819) while tightening swivel bolt/screw (816).



Tighten

- Swivel bolt/screw (816) to 28 N.m (21 lb. ft.).
6. Lower vehicle.

Shift Control Linkage

Figure 5



Remove or Disconnect

1. Place transmission control lever in neutral gate notch.
2. Retainer (804), washer (803), bearing (802) and insulator (801).
3. Rod (820) from steering column (805).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Rod (820) from equalizer lever (819).
 - Remove swivel bolt/screw (816), washer (817) and swivel (818).
6. Equalizer lever (819).
 - A. Remove retainer (808) and disconnect from lever (807).
 - B. Insulator (814), washer (810), spring (815).
7. Bracket bolts/screws (811).
8. Bracket (812).
9. Nut (809).
10. Selector lever (807).

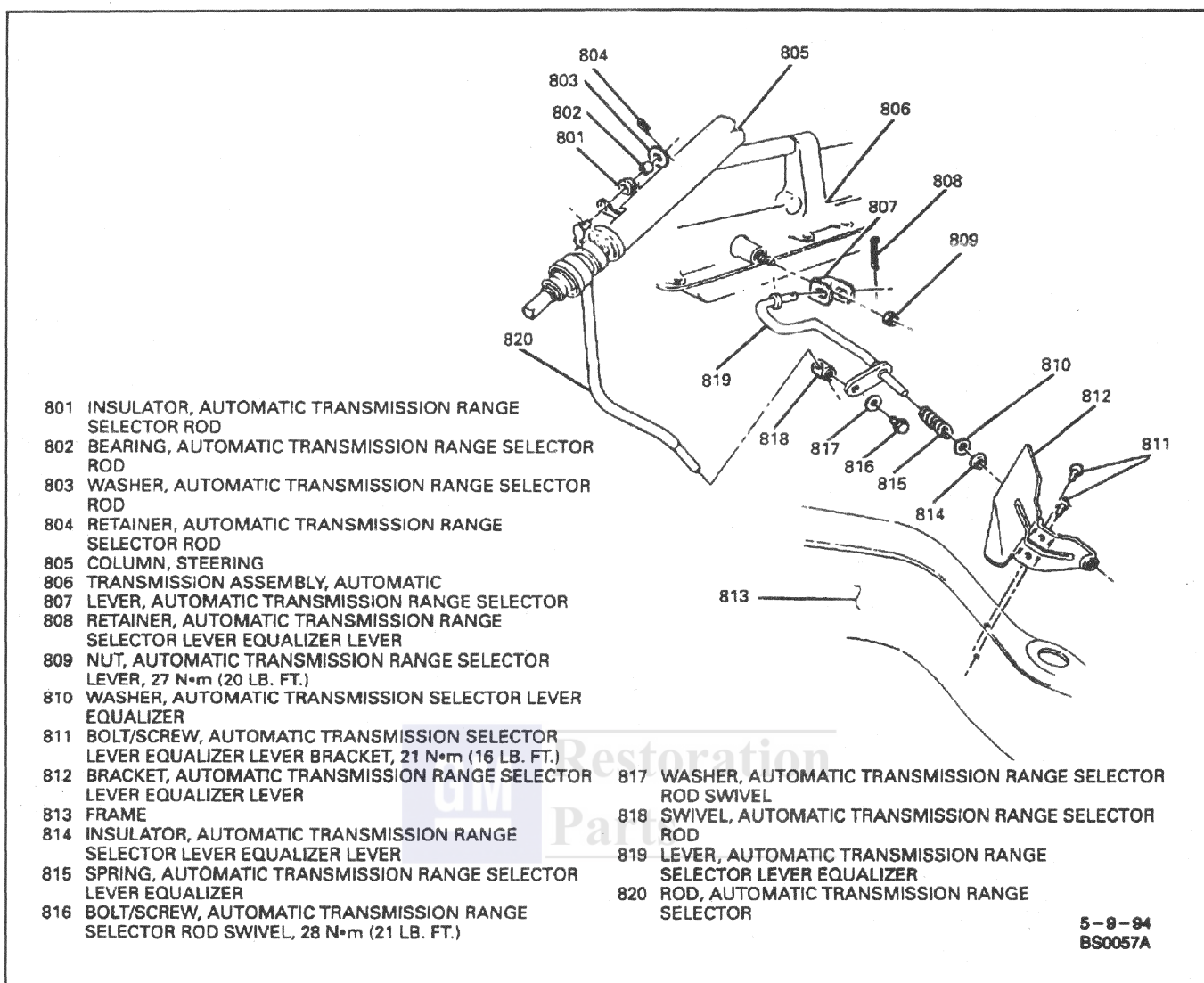


Figure 5 - Steering Column Shift Control Linkage

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Selector lever (807) to stud.
2. Nut (809).

Tighten

- Nut (809) to 27 N·m (20 lb. ft.).
3. Bracket (812) to frame (813).
4. Bracket bolts/screws (811).

Tighten

- Bracket bolts/screws (811) to 21 N·m (16 lb. ft.).

5. Spring (815), washer (810) and insulator (814) to equalizer lever (819).
 - Install equalizer lever (819) to bracket (812).
6. Equalizer lever (819) to selector lever (807) and secure with retainer (808).
 - Make sure transmission is in neutral.
7. Swivel (818), washer (817) and swivel bolt/screw (816) to rod (820).
 - Do not tighten at this time.
8. Rod (820) through bracket on steering column (805).
 - Attach insulator (801), bearing (802), washer (803) and retainer (804) to rod (820).
9. Lower vehicle.
10. Adjust floor shift control linkage if necessary. Refer to "Steering Column Shift Control Linkage Adjustment" in this section.

Backup Lamp and Transmission Position Sensor Switch

Figure 6

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Instrument panel sound insulator, if Buick. Refer to SECTION 8C.
3. Electrical connectors from switch (821).
4. Place shift lever in neutral.
5. Switch (821) from steering column.
 - Use screwdriver to carefully pry switch tangs from rectangular holes in steering column jacket (824).

Install or Connect

1. Switch (821) to steering column.
 - A. Make sure shift lever is in neutral.
 - B. Position actuator on switch about midway through it's travel so actuator will align with hole in shift tube.
 - C. Position connector (outboard) side of switch (821) to fit into cutout on steering column jacket (824).
 - D. Push down on switch (821) to fully seat.

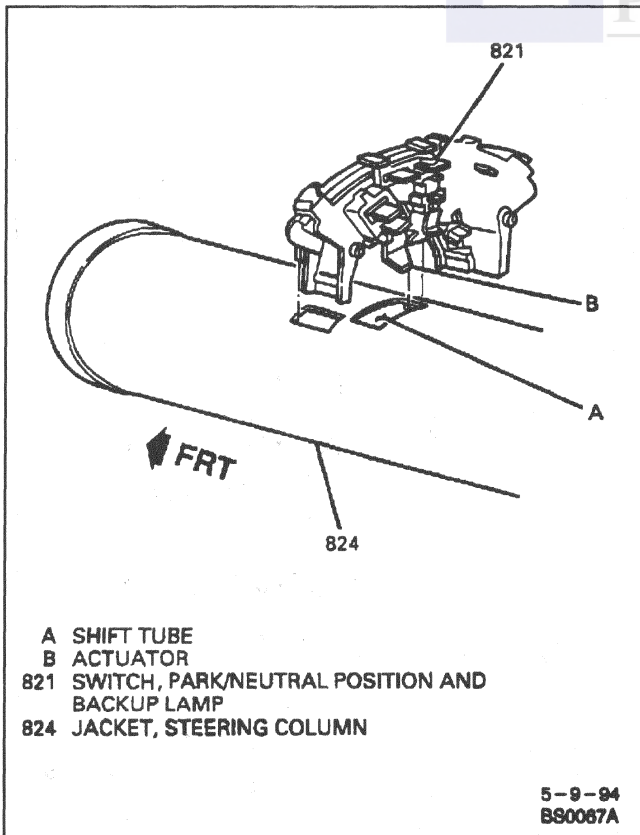


Figure 6 - Backup Lamp and Transmission Position Sensor Switch

2. Electrical connectors to switch.
3. Instrument panel sound insulator, if Buick. Refer to SECTION 8C.
4. Adjust switch (821) by placing shift lever in low gear then back to park.
5. Battery negative cable.

FLOOR SHIFT CONTROL

REMOVAL AND INSTALLATION

Figures 7 and 8

Linkage should be adjusted so the engine will start in only "PARK" and "NEUTRAL."

CAUTION: Personal injury may result if the engine can be started in a drive position.

NOTICE: Refer to "Notice" on page 7A-1 of this section.

Remove or Disconnect

1. Retainer (882) and shifter handle (881).
2. Floor shift control console, for removal procedures, refer to SECTION 8C.
3. Transmission shift (872) cable and park-lock cable (868).
4. Floor shift control assembly bolts/screws (889).
5. Floor shift control assembly (890).

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Floor shift control assembly (890).
2. Floor shift control bolts/screws (889).

Tighten

- Tighten bolts/screws (889) to 5 N.m (44 lb. in.).
3. Transmission shift (872) cable and park-lock cable (868).
 4. Console (887). For installation procedures, refer to SECTION 8C.
 5. Shifter handle (881) and retainer (882).

Brake Transmission Shift Interlock Solenoid

REMOVAL AND INSTALLATION

Figure 7

Remove or Disconnect

1. Shifter handle (881) and retainer (882).

7A-12 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

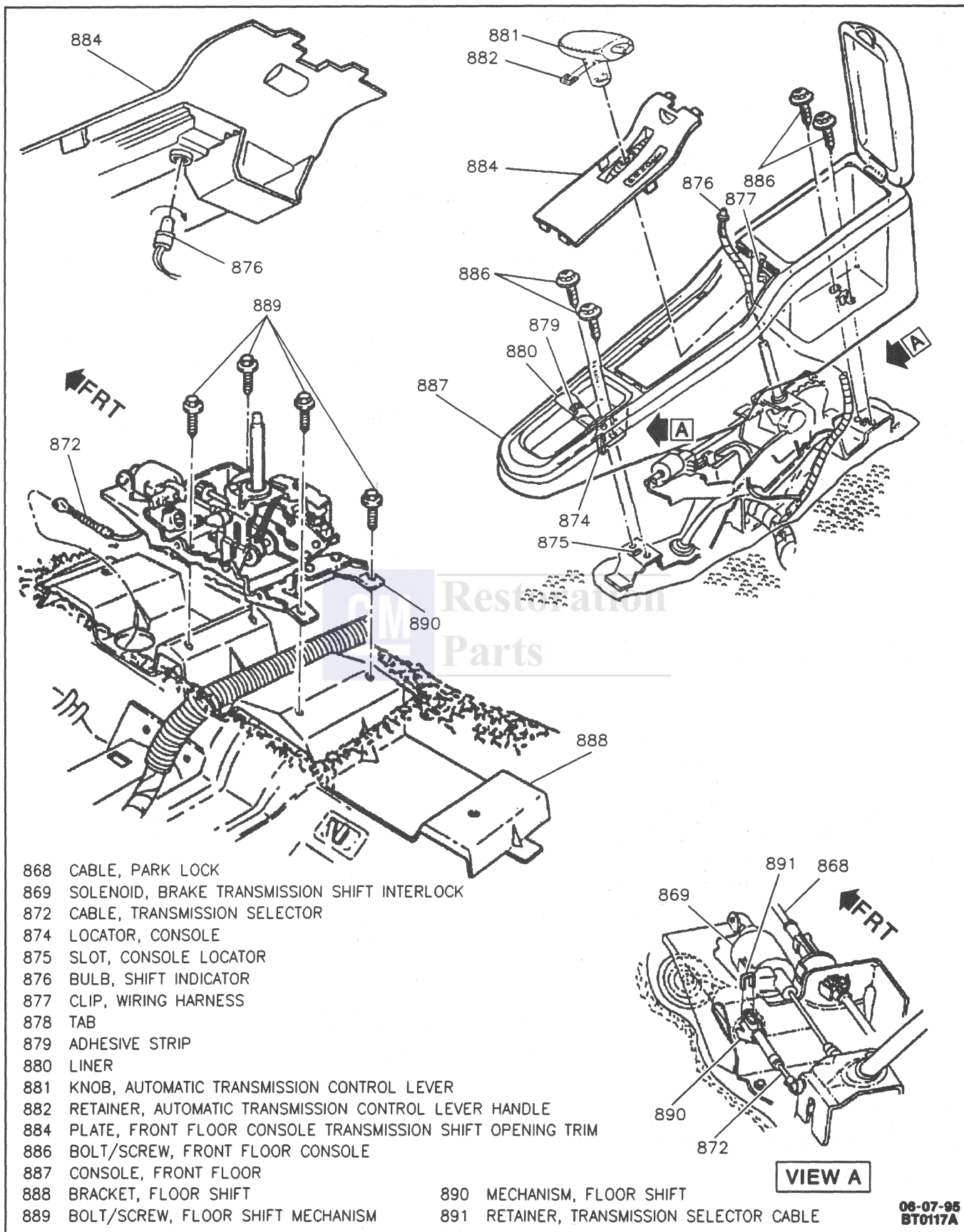


Figure 7 - Floor Shift Control Removal and Installation

2. Floor console trim plate (884). Refer to SECTION 8C.
3. BTSI solenoid electrical connector.
4. BTSI solenoid (869) and attaching clips.

Install or Connect

1. BTSI solenoid (869) and attaching clips.
2. BTSI solenoid electrical connector.
3. Floor console trim plate (884). Refer to SECTION 8C.
4. Shifter handle (881) and retainer (882).

Important

- For Brake Transmission Shift Interlock Solenoid (BTSI) removal and installation procedures with column shift, refer to SECTION 3F5A.

Backup Lamp and Transmission Position Sensor Switch

REMOVAL AND INSTALLATION

Figure 7

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Shifter handle (881) and retainer (882).
3. Floor console (887). For removal procedures, refer to SECTION 8C.
4. Backup Lamp/Transmission Position Sensor Switch electrical connector.
5. Switch bolts/screws.
6. Backup Lamp/Transmission Position Sensor Switch.

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Backup Lamp/Transmission Position Sensor Switch.
2. Backup Lamp/Transmission Position Sensor Switch bolts/screws.
3. Backup Lamp/Transmission Position Sensor Switch electrical connector.
4. Floor console (887). For installation procedures, refer to SECTION 8C.
5. Shifter handle (881) and retainer (882).
6. Battery negative cable.

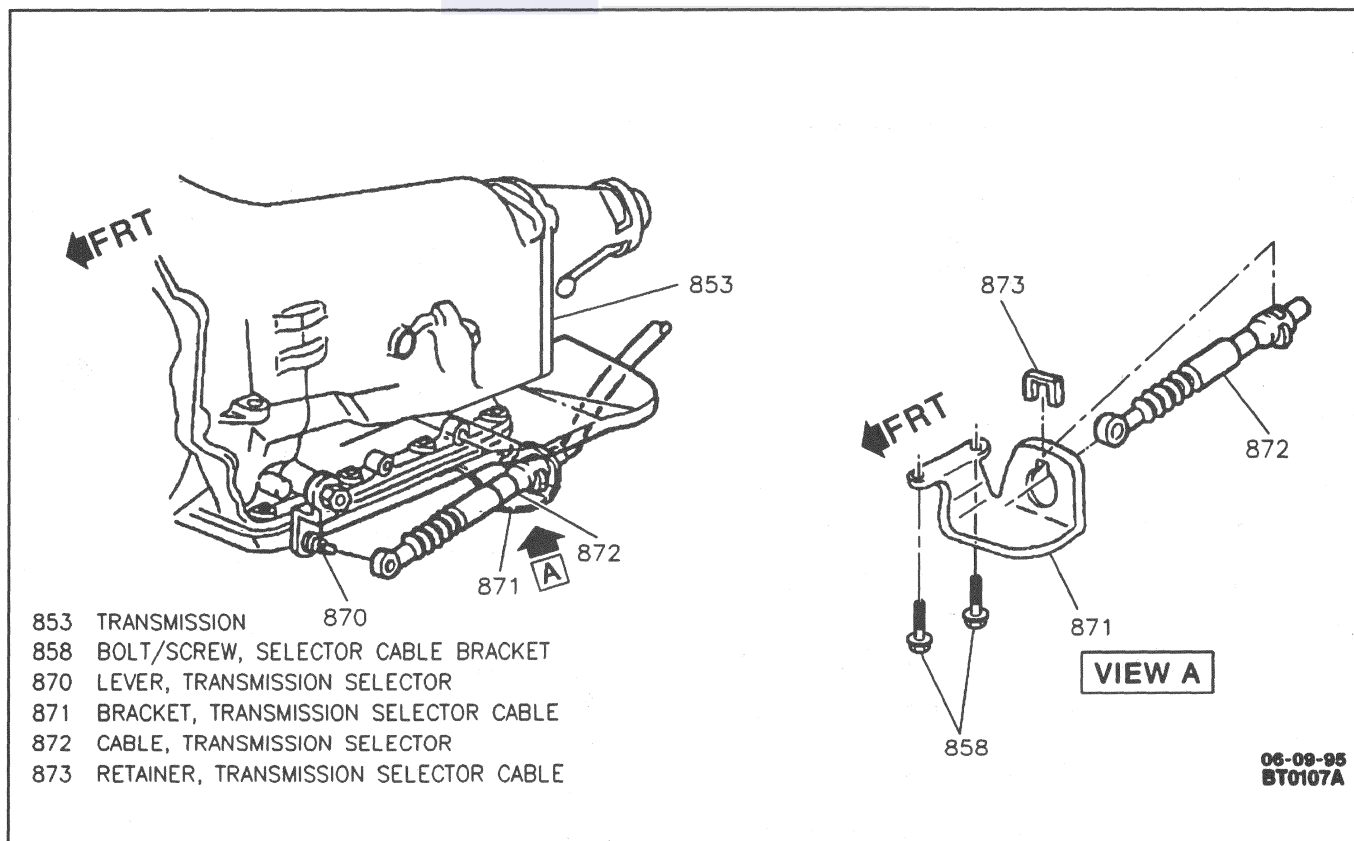


Figure 8 - Transmission Shift Control Cable

7A-14 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

Shift Control Cable

REMOVAL AND INSTALLATION

Figures 7 and 8



Remove or Disconnect

1. Raise and suitably support vehicle.
2. Shift control cable (872) from transmission lever (870).
3. Shift control cable bracket (871) and bolts/screws (858) from transmission (853).
4. Shift control cable (872) from bracket (871).
5. Lower vehicle.
6. Shifter handle (881) and retainer (882).
7. Floor console (887). For removal procedures, refer to SECTION 8C.
8. Shift control cable (872) from floor shift control assembly (890).
9. Shift control cable (872)



Install or Connect

1. Shift control cable (872) to floor shift control assembly (853).
2. Floor console (887). For installation procedures, refer to SECTION 8C.
3. Shifter handle (881) and clip (882).
4. Raise vehicle.
5. Shift control cable (872) to bracket (871).
6. Shift control cable bracket (871) and bolts/screws (858) to transmission (853).



Tighten

- Bolts/screws (858) to 24 N.m (18 lb. ft.).



Adjust

- Trans shift cable (872) (If necessary).
7. Trans shift cable (872) to transmission selector lever (870).
 8. Lower vehicle.

Park Lock Cable

REMOVAL AND INSTALLATION

Figure 7



Remove or Disconnect

1. Disable S.I.R. system. Refer to SECTION 9J.
2. Shifter handle (881) and retainer (882).
3. Floor console (887). For removal procedures, refer to SECTION 8C.
4. Lower I/P trim plate and knee bolster. Refer to SECTION 8C.
5. Park lock cable (868) from floor shift control assembly (890).
6. Park lock cable (868) from accelerator bracket.
7. Stop lamp switch.

8. Knee bolster deflector. Refer to SECTION 8C.
9. Lower Steering Column. Refer to SECTION 3F.
10. Park lock cable from ignition switch.
11. Park lock cable (868).



Install or Connect

1. Park lock cable (868).
2. Park lock cable (868) to ignition switch.
3. Raise and connect steering column. Refer to SECTION 3F.
4. Knee bolster deflector. Refer to SECTION 8C.
5. Stop lamp switch.
6. Park lock cable (868) to accelerator pedal bracket.
7. Park lock cable (868) to floor shift control assembly (890).
8. Knee bolster and lower I/P trim plate. Refer to SECTION 8C.
9. Front floor shift console (887). For installation procedures, refer to SECTION 8C.
10. Shifter handle (881) and retainer (882).
11. Enable S.I.R. Refer to SECTION 9J.

CHANGING FLUID AND OIL FILTER

Figures 9 and 10



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

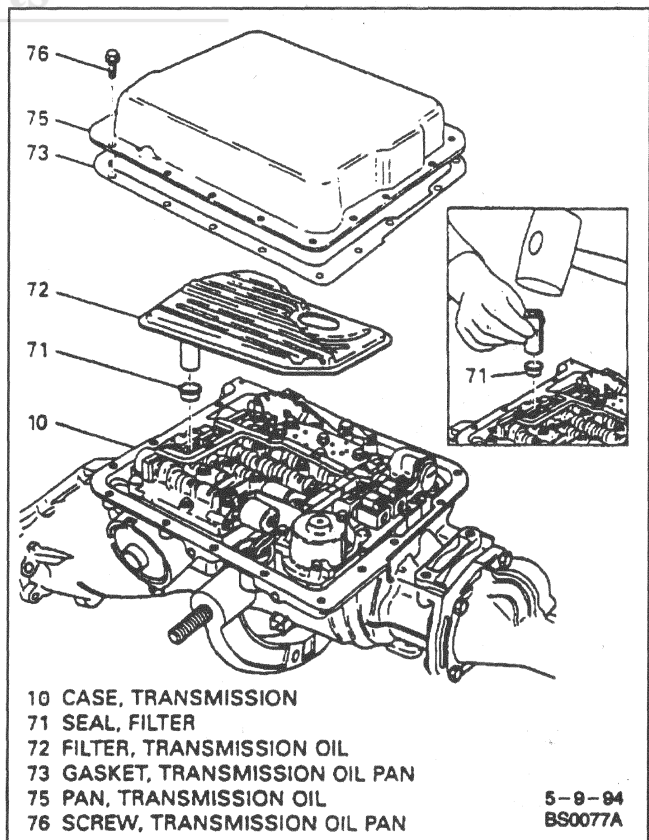


Figure 9 - Transmission Oil Pan and Transmission Oil Filter

- Place drain pan under oil pan (75).

NOTICE: When removing oil pan bolts/screws use caution in order not to damage the oil pan sealing surfaces.

- Oil pan bolts/screws (76) from front and sides only.
- Loosen rear oil pan bolts/screws (76) approximately four turns.
- Lightly tap oil pan (75) with rubber mallet or pry to drain fluid.
- Drain fluid.



Inspect

- Fluid color and condition. Refer to chart in Parts Cleaning, Inspection and Replacement of this section.
- Remaining oil pan bolts/screws (76), oil pan (75) and gasket (73).
 - Filter (72) and seal (71).
 - Pry out seal (71) using a flat bladed tool.



Inspect

- Filter (72). Open filter by prying the metal crimping away from the top of the filter (black) and pull apart. The filter may contain evidence for root cause diagnosis:
 - Clutch material.
 - Bronze slivers indicating bushing wear.
 - Steel particles.



Clean

- Transmission case and gasket surfaces with solvent and air dry.
 - All traces of gasket material must be removed.



Install or Connect

NOTICE: Refer to “Notice” on page 7A-1 of this section.

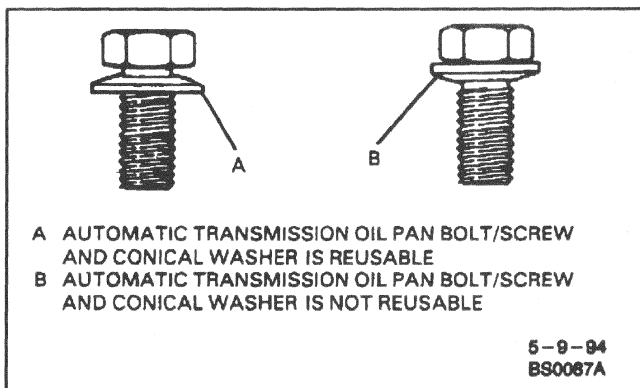


Figure 10 - Automatic Transmission Oil Pan Bolt/Screw and Conical Washer

- Coat new seal (71) with small amount of Transjel™ or equivalent.
- New seal (71) to transmission.
 - Tap into place using a suitable size socket.
- Filter (72) into transmission case.



Inspect

- Oil pan bolts/screws (76) whenever removed from pan (75).

NOTICE: Automatic transmission oil pan bolts/screws and washers must not be reused if the conical washer is reversed. Failure to replace the oil pan bolts/screws and washers may result in improper fastening of system components.

- New gasket (73) and old oil pan (75).
- Oil pan bolts/screws (76).



Tighten

- Oil pan bolts/screws (76) to 16 N.m (12 lb. ft.).
- Lower vehicle.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to transmission.

- Fill transmission with DEXRON® III to the “COLD” fluid level reading.
- Perform transmission fluid level checking procedure. Refer to “Transmission Fluid Level Checking Procedure” in this section.
 - Do not overfill.

TRANSMISSION OIL COOLER FLUSHING PROCEDURE

Figure 11

Tools Required:

- J 35944 “Transmission” Oil Cooler and Line Flusher
- J 35944-20 Cooler Flushing Fluid

NOTICE: The automatic transmission oil cooler flushing procedure must be performed whenever a transmission is removed for service to remove existing fluid which may be contaminated and to prevent contamination of new fluid. The flushing procedure must be performed after the removal of the old transmission and before the installation of the overhauled or replacement transmission.

7A-16 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

NOTICE: Flushing tool is designed for use with only J 35944-20 flushing fluid. Use of any other fluid can result in damage to the tool, automatic transmission oil cooler components, or improper flushing of the cooler. After overhauled or service replacement transmission is reinstalled in vehicle, do not reconnect oil cooler pipes.

1. Remove fill cap on J 35944 and fill with 0.6 liters (20-21 ounces) of J 35944-20.
 - A. Do not overfill tool.
 - B. Follow manufacturer's suggested procedures for handling fluid.
2. Replace cap on J 35944 and pressurize to 550-700 kPa (80-100 psi).

NOTICE: Shop air supply must be equipped with a water/oil filter, and pressure should not exceed 825 kPa (120 psi). Failure to use a water/oil filter can allow residual moisture to cause corrosion of components. Excessive air pressure can cause damage to components.

3. Install J 35944 to vehicle undercarriage with hook provided, and attach hose from flushing tool with top fitting at transmission end of the oil cooler pipe (835).
4. Install discharge hose to bottom fitting at transmission end of oil cooler pipe (836). Clip opposite end of discharge hose to oil drain container.

5. With water valve on J 35944 in "OFF" position attach the water supply to tool.
6. Turn on water supply at faucet.
7. Flush fluid by opening water valve on tool to "ON" position for about 10 seconds.
 - If water does not flow through cooler (system is completely plugged), do not complete flushing procedure. Turn water off immediately and inspect cooler and upper and lower pipes for restriction. Replace cooler and/or cooler pipes as required.
8. Turn water valve on tool to "OFF" position and clip discharge hose to 5-gallon pail. Cover pail with shop cloth to prevent splash.
9. Turn water valve on tool to "ON" position and depress trigger to mix flushing fluid into water flow.
 - Use bale clip to hold trigger down.
10. Flush cooler with water and fluid for two minutes.
 - Every 15-20 seconds during flushing procedure, attach air supply to air valve on J 35944 and leave in place for 3-5 seconds to create surging action for complete cleaning.
11. Release trigger and turn water valve on tool to "OFF" position.
12. Disconnect both hoses from upper and lower pipes (835 and 836).
13. Connect hose from flushing tool to **Bottom** fitting at transmission end of oil cooler pipe (836).

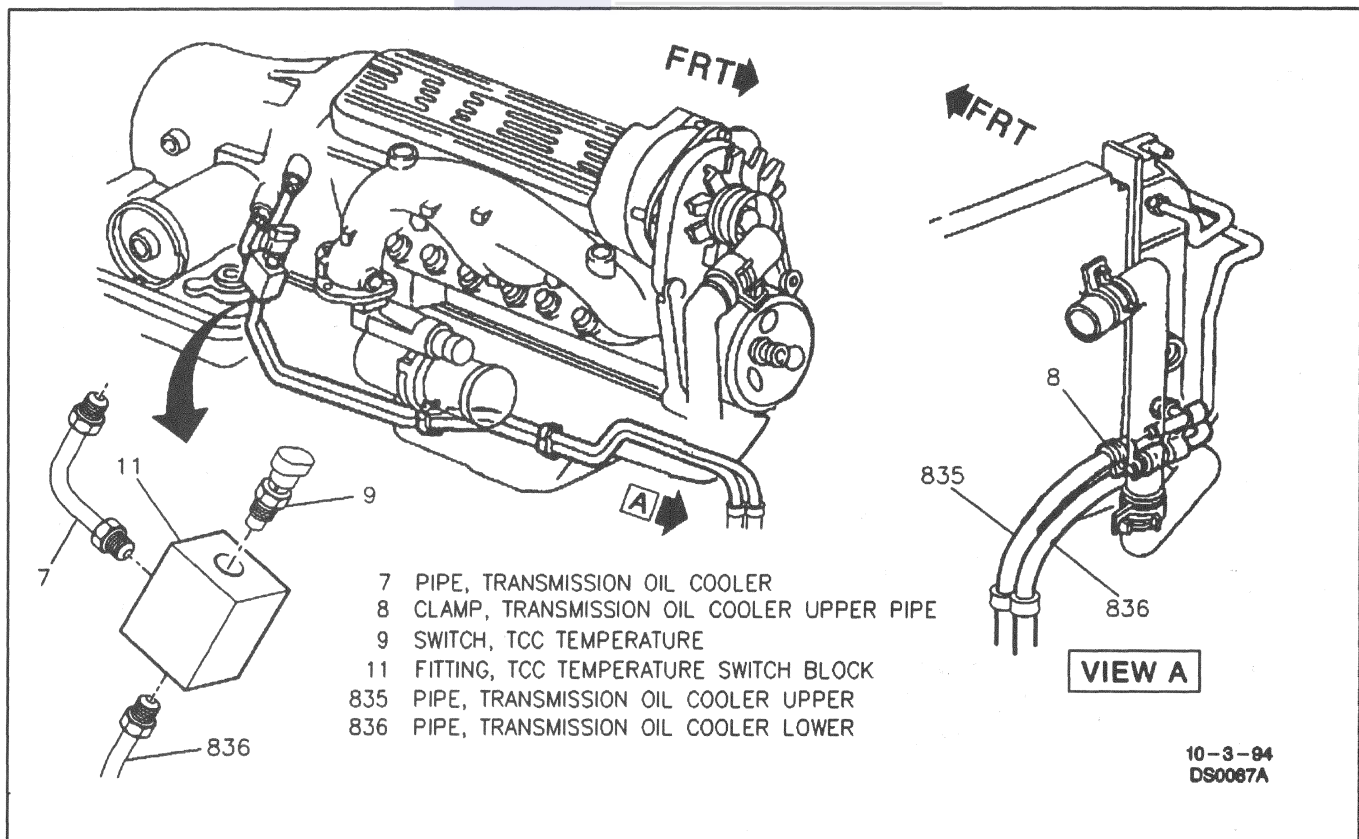


Figure 11 - Transmission Oil Cooler Pipes and TCC Temperature Switch

14. Connect discharge hose to **Top** fitting at transmission end of oil cooler pipe (835).
 - Reversing hoses will create backflush.
15. Repeat steps 9 and 10.
16. Release trigger and allow water only to rinse cooler for one minute.
17. Turn water valve on tool to "OFF" position and turn water supply off at faucet.
18. Attach air supply to air valve on J 35944 and dry system out with dry compressed air for at least two minutes. Be sure no moisture can be seen leaving hose.
 - Use air chuck clip, if available, to secure air chuck onto air valve for ease of operation.
19. Remove J 35944 and discharge hose from upper and lower pipes (835 and 836).

3. Electrical connector from switch (9).
4. Switch (9) from block fitting (11).

⇔ Install or Connect

1. If reusing switch (9), coat threads with sealer.
2. Switch (9) to block fitting (11).

⌚ Tighten

- Switch (9) to 27 N.m (20 lb. ft.) while using a backup wrench.
3. Electrical connector to switch (9).
 4. Right side three way warm up catalytic converter and heat shield. Refer to SECTION 6F.
 5. Lower vehicle.
 6. Start engine, check fluid level and fitting for leak.

SERVICEABLE COMPONENTS

**TORQUE CONVERTER CLUTCH
TEMPERATURE SWITCH**

Figure 11

⇔ Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right side three way warm up catalytic converter and heat shield. Refer to SECTION 6F.

TRANSMISSION OIL COOLER

Figure 12

⇔ Remove or Disconnect

1. Place a drain pan under oil cooler (101).
2. Oil cooler pipe fittings from oil cooler (101).
 - Use a backup wrench.
3. Bolts/screws (102) from oil cooler (101).
4. Oil cooler (101).
5. Nuts (103), if necessary.

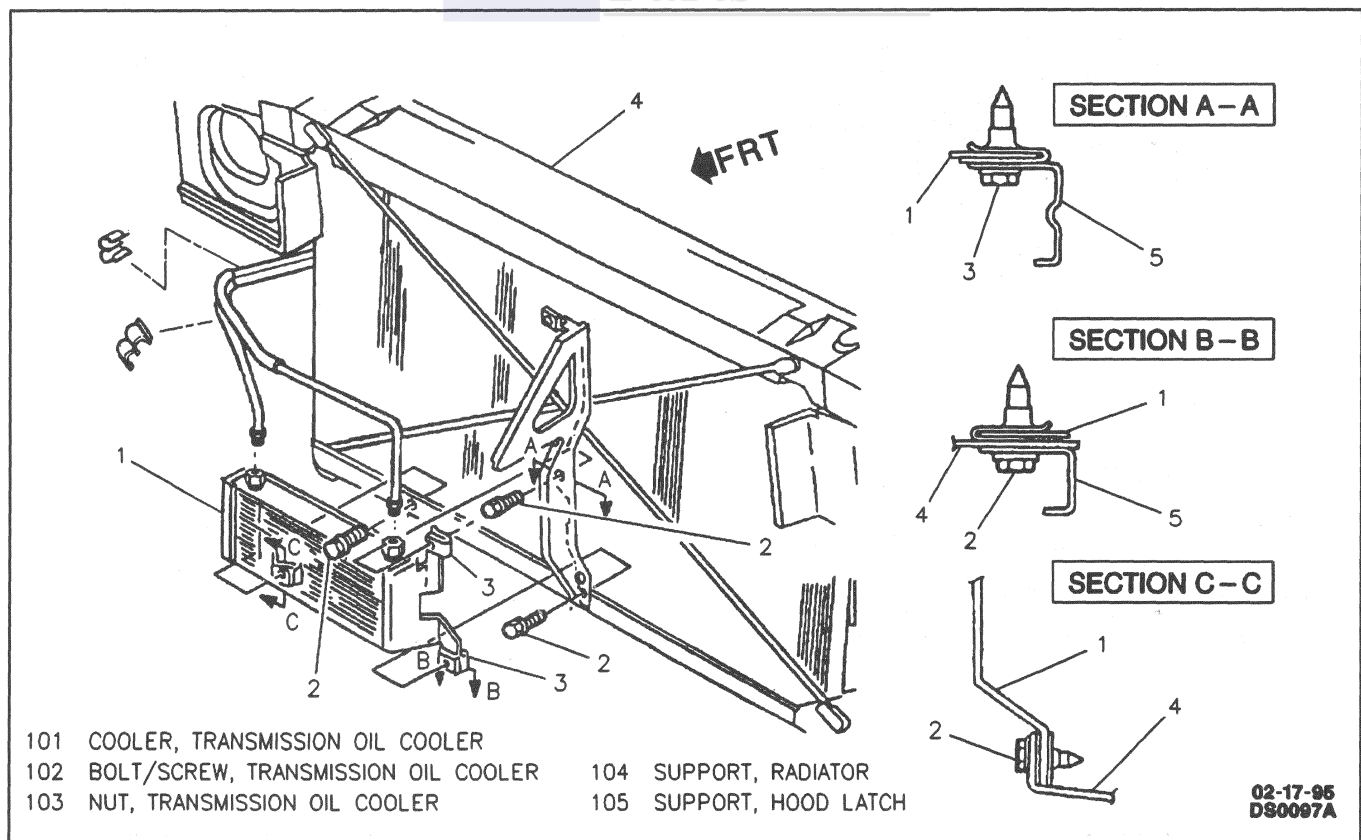


Figure 12 - Transmission Oil Cooler

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 in this section.

1. Nuts (103), if removed.
2. Oil cooler (101).
3. Bolts/screws (102) to oil cooler (101).

Tighten

- Bolts/screws to 10 N.m (89 lb. ft.).
4. Oil cooler pipe fittings to oil cooler (101).

Tighten

- Oil cooler pipe fittings to 17 N.m (13 lb. ft.) while using a backup wrench.
5. Drain pan from under oil cooler (101).

Adjust

- Fluid level. Refer to "Fluid Level Checking procedure" in this section.

FLUID FILLER TUBE AND SEAL

Figure 13

Remove or Disconnect

1. Indicator (851).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Bolt/screw (849) retaining filler tube (850) to cylinder head.
4. Loosen filler tube (850) from transmission.
5. Place drain pan under transmission.
6. Filler tube (850) from transmission.
7. Transmission filler tube seal (852) from transmission.

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

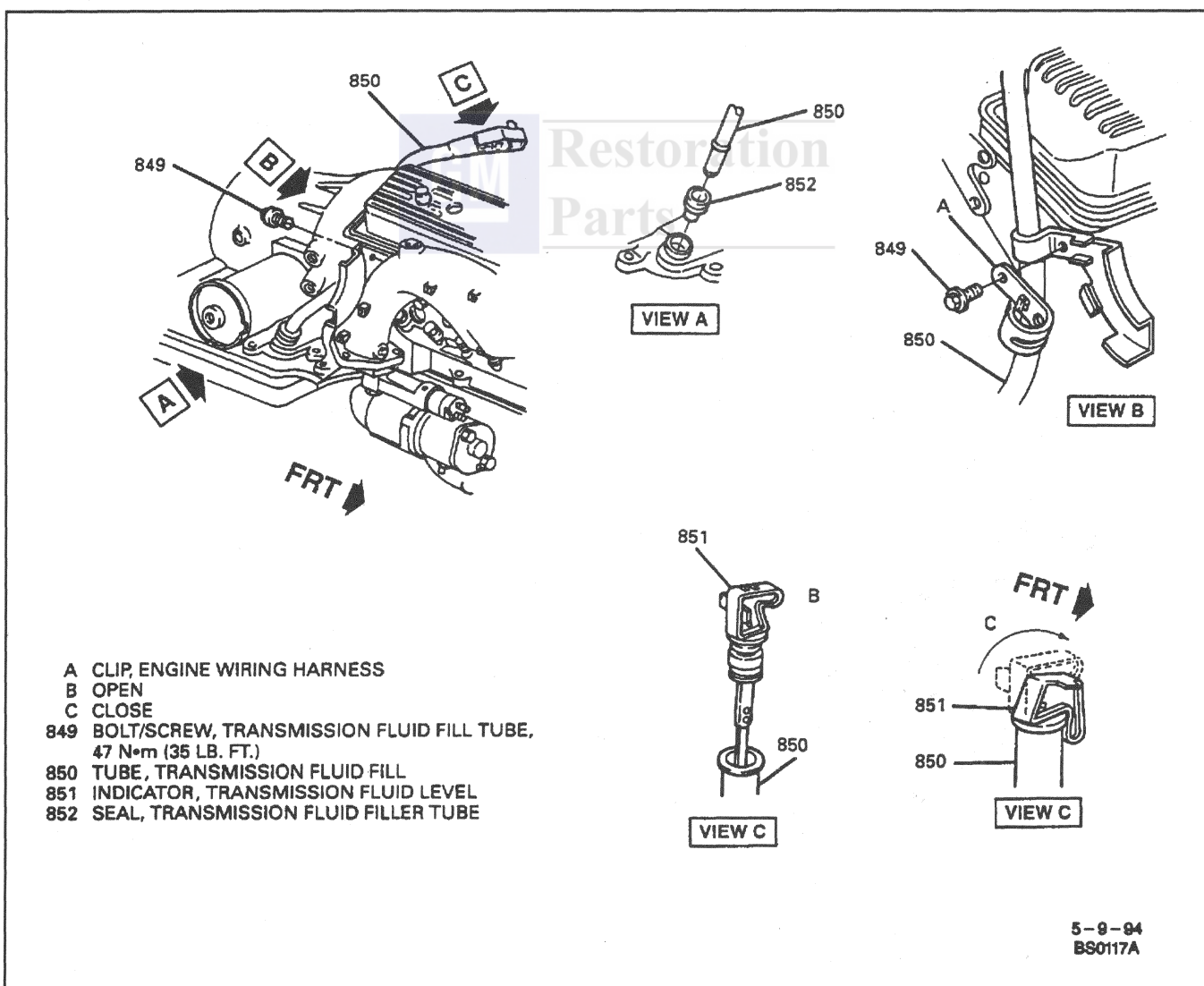


Figure 13 - Transmission Fluid Filler Tube and Transmission Fluid Level Indicator

1. Transmission filler tube seal (852) into transmission case hole.
2. Filler tube (850) to transmission.
3. Bolt/screw (849) to cylinder head.



Tighten

- Bolt/screw (849) to 47 N.m (35 lb. ft.).
4. Lower vehicle.
 5. Indicator (851).



Adjust

- Transmission fluid level. Refer to "Transmission Fluid Checking Procedure" in this section.

VENTILATION HOSE

Figure 14



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right side three way warm up catalytic converter and heat shield. Refer to SECTION 6F.
3. Ventilation hose (19) from transmission ventilation tube (17) at transmission (853).
4. Ventilation hose clips (20) from transmission support (859).
 - Squeeze clip tabs to remove from holes in transmission support (859).



Install or Connect

1. New ventilation hose clips (20) around ventilation hose (19) at white paint stripes, if required.
2. Ventilation hose clips (20) into holes on rear side of transmission support (859).
3. Ventilation hose (19) to transmission ventilation tube (17) at transmission (853).
4. Right side three way catalytic converter and heat shield. Refer to SECTION 6F.
5. Lower vehicle.

VEHICLE SPEED SENSOR

Figure 15



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Electrical connector from sensor (99).
3. Bolt/screw (100).
4. Sensor (99) and O-ring seal (42).



Inspect

- Seal (42) and transmission case (10). Replace seal (42), if necessary.



Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

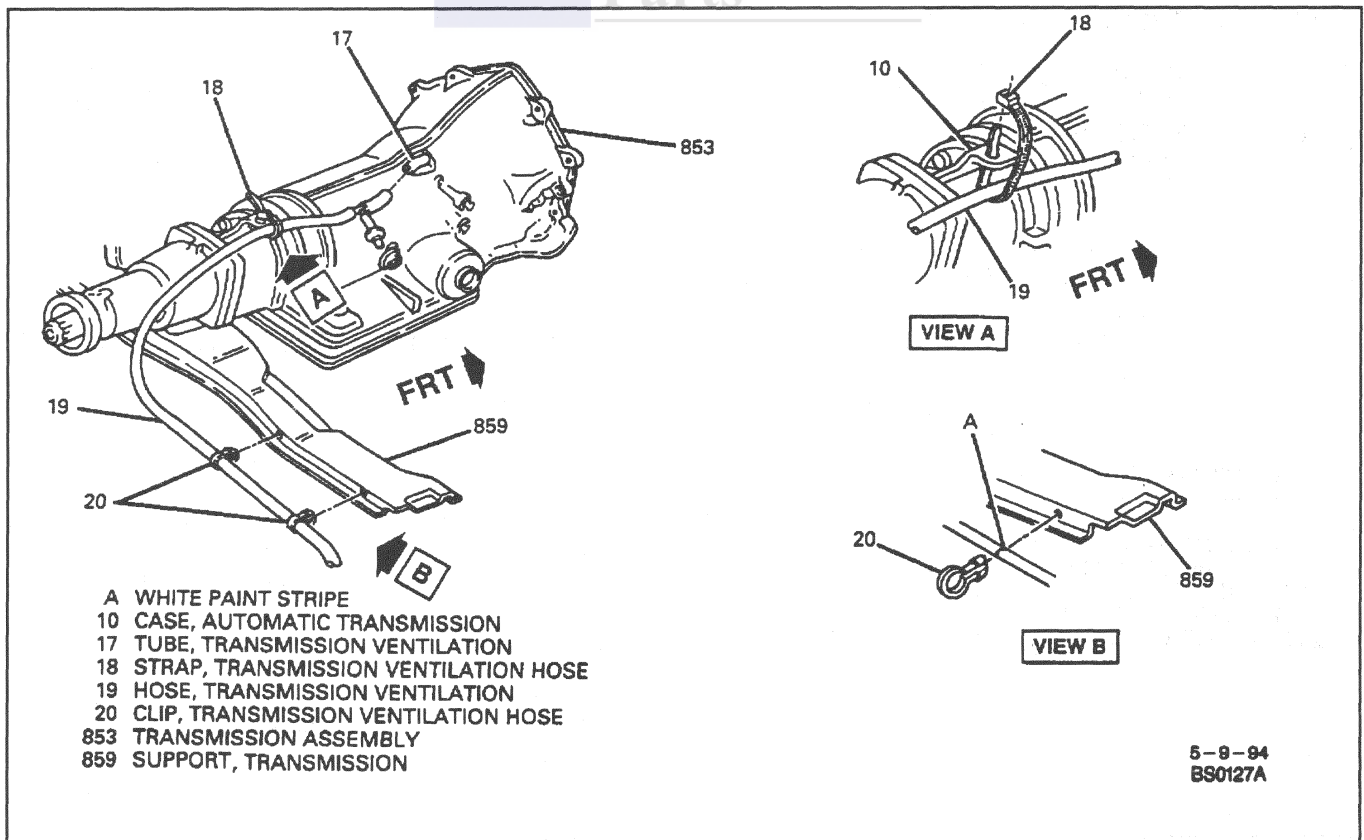


Figure 14 - Transmission Ventilation Hose

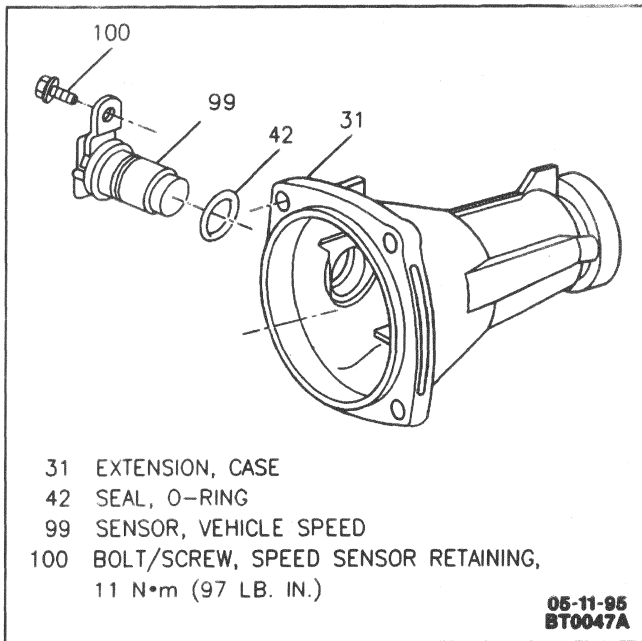


Figure 15 - Vehicle Speed Sensor

1. Sensor (99) and O-ring seal (42) to transmission.
2. Electrical connector to sensor (99).
3. Bolt/screw (100).



Tighten

- Bolt/screw (100) to 11 N•m (97 lb. in.).
4. Lower vehicle.

CASE EXTENSION

Figures 16 and 28



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Vehicle speed sensor electrical connector.
3. Vehicle speed sensor (99), seal (42), and bolt/screw (100) from case extension (31).
4. Propeller shaft. Refer to SECTION 4A.
5. Transmission mount nut (840) and washer (864).
6. Transmission mount bolts/screws (892).
 - Support and raise transmission slightly, using transmission jack.
7. Transmission mount (890) and shims (893) if present.
8. Case extension bolts/screws (32).
9. Case extension (31) with seal (30).



Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Case Extension (31) with new seal (30).

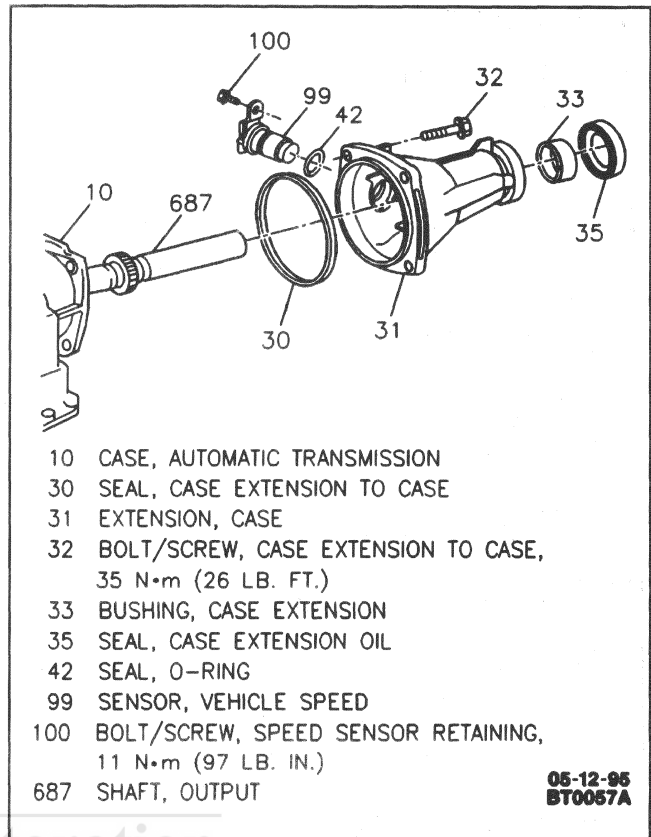


Figure 16 - Case Extension

2. Bolts/screws (32)



Tighten

- Bolts/screws (32) to 35 N•m (26 lb. ft.).
3. Transmission mount (890) and shims (893) if present.
 4. Transmission mount bolts/screws (892).



Tighten

- Bolts/screws to 34 N•m (25 lb. ft.).
5. Lower transmission.
 6. Transmission mount nut (840) and washer (864).



Tighten

- Nut to 41 N•m (30 lb. ft.).
7. Propeller shaft. Refer to SECTION 4A.
 8. Vehicle speed sensor (99), seal (42) to case extension (31).
 9. Vehicle speed sensor, bolt/screw (100).



Tighten

- Bolt/screw (100) to 11 N•m (97 lb. in.).
10. Vehicle speed sensor electric connector.
 11. Lower vehicle.

2-4 BAND SERVO

Figures 17, 18, and 28

Tool Required:
J 29714-A Servo Cover Depressor

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right side warm-up three way catalytic converter and catalytic converter heat shield. Refer to SECTION 6F.
3. Transmission mount nut (840).
4. Transmission support bolts/screws (841).
 - Support and raise transmission slightly, using transmission jack.
5. Transmission support (859).

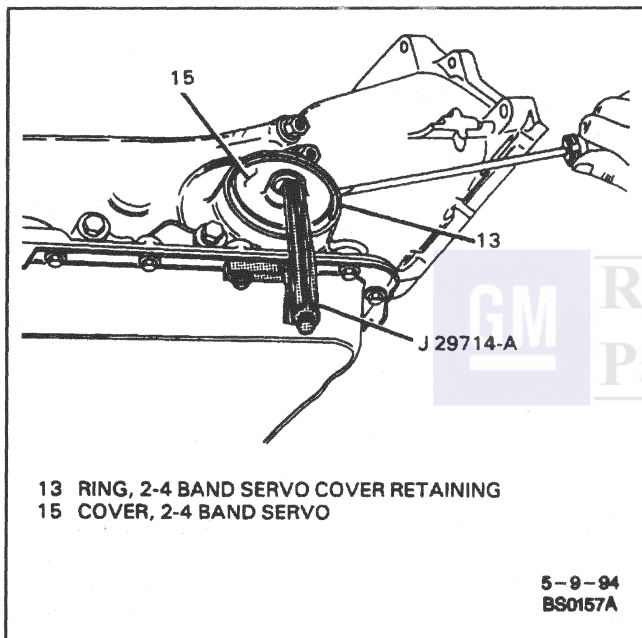


Figure 17 - 2-4 Band Servo Cover

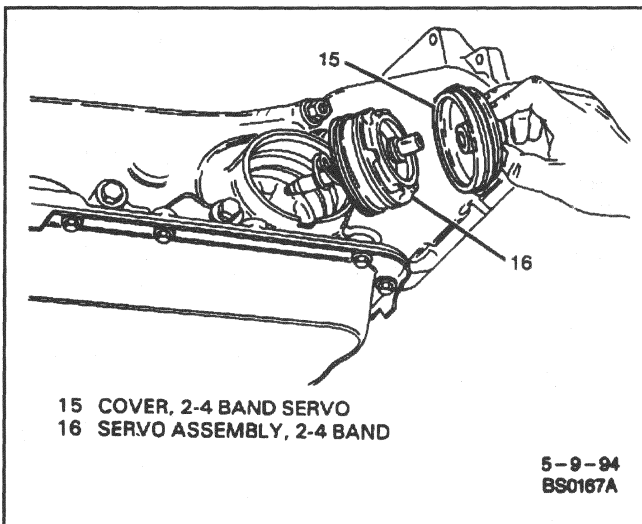


Figure 18 - 2-4 Band Servo

6. Lower transmission (853) to access servo cover (15).
7. Remove transmission oil pan bolt/screw to access transmission oil pan rail.
8. Install J 29714-A to transmission oil pan rail.
9. Depress servo cover (15).
10. Ring (13), using suitable tool.
11. J 29714-A from transmission support rail.
12. Servo cover (15).
 - A. If unable to remove by hand, use slip joint pliers.
 - B. O-ring seal may remain in transmission case.
13. Servo (16).

Inspect

- Servo. Refer to SECTION 7A-14B for inspection, disassembly and servo pin measurement procedures.

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Servo (16).
2. Servo cover (15).
 - Replace O-ring seal on servo cover (15), if removed.
3. J 29714-A to transmission oil pan rail.
4. Depress servo cover (15).
5. Ring (13).
6. Remove J 29714-A.
7. Replace transmission oil pan bolt/screw.

Tighten

- Transmission oil pan bolt/screw to 16 N.m (12 lb. ft.).
8. Raise transmission into position.
 9. Transmission support (859).
 10. Transmission support bolts/screws (841).

Tighten

- Transmission support bolts/screws (841) to 34 N.m (25 lb. ft.).
11. Transmission mount nut (840) and washer (864).

Tighten

- Transmission mount nut to 41 N.m (30 lb. ft.).
12. Warm up three way catalytic converter and catalytic converter heat shield. Refer to SECTION 6F.
 13. Lower vehicle.

Adjust

- Transmission fluid level. Refer to "Transmission Fluid Checking Procedure" in this section.

ACCUMULATORS

Figure 19

Remove or Disconnect

1. Oil pan and filter. Refer to "Changing Fluid and Oil Filter" in this section.
2. Bolts/screws (57 and 58) attaching cover and pin (62) to transmission case.
3. Cover and pin (62).
4. Piston (61), ring (60), and springs (59 and 59A).
 - Piston (61) and ring (60) may remain inside cover and pin (62).
5. Control valve, if replacing 3-4 accumulator. Refer to "Control Valve Body and Pressure Switch" in this section.
6. Spring (54), piston (52), ring (53) and pin (77).

Inspect

- Accumulators. Refer to SECTION 7A-14B for disassembly and inspection procedures.

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Spring (54), piston (52), ring (53) and pin (77).
2. Control valve, if removed. Refer to "Control Valve Body and Pressure Switch" in this section.
3. Springs (59 and 59A), ring (60), and piston (61).
4. Cover and pin (62).
5. Bolts/screws (57 and 58) attaching cover and pin (62) to transmission case.

Tighten

- Bolts/screws (57 and 58) to 11 N.m (97 lb. in.).
6. Oil pan and filter. Refer to "Changing Fluid and Oil Filter" in this section.

OIL COOLER UPPER AND LOWER PIPES

Figures 11 and 12

NOTICE: Allow sufficient clearance to transmission oil cooler upper and lower pipes to prevent damage or wear which may cause transmission fluid loss.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right side warm up three way catalytic converter. Refer to SECTION 6F.
3. Lower pipe (836) at radiator.
4. Upper and lower pipes (835 and 836) at transmission.

5. Oil cooler pipe retainer bolt/screw (833).
6. Oil cooler pipe retainer (837) from upper and lower pipes (835 and 836).
7. Upper pipe (835) from oil cooler pipe.
8. Upper and lower pipes (835 and 836) from vehicle.

Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Upper and lower pipes (835 and 836) into vehicle.
2. Upper pipe (835) to oil cooler pipe.
3. Oil cooler pipe retainer (837) to upper and lower pipes (835 and 836).
4. Oil cooler and pipe retainer bolt/screw (833).

Tighten

- Oil cooler pipe retainer bolt/screw (833) to 1.9 N.m (17 lb. in.).
5. Upper and lower cooler pipe fittings.

Tighten

- Upper and lower cooler pipe fittings to 21 N.m (15 lb. ft.).
6. Lower pipe (836) to radiator fitting.
- ### Tighten
- Fitting to 23 N.m (17 lb. ft.).
7. Right side warm up three way catalytic converter. Refer to SECTION 6F.
 8. Lower vehicle.

TRANSMISSION CONVERTER COVER

For service information on the transmission converter cover, refer to "Transmission Removal and Installation" in this section.

OIL PAN AND GASKET

For service information on the transmission oil pan and gasket, refer to "Changing Fluid and Oil Filter" in this section.

OIL FILTER AND SEAL

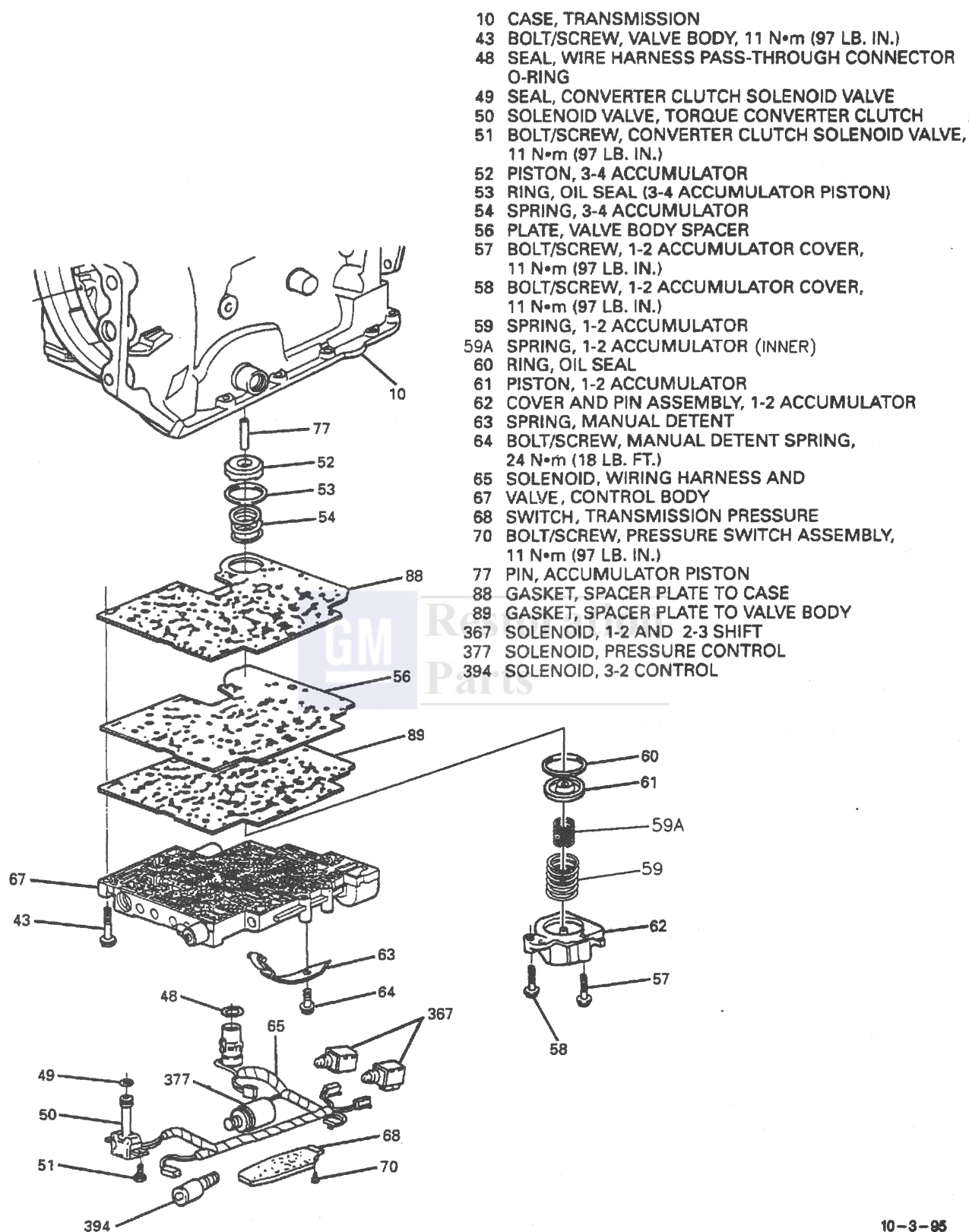
For service information on the transmission oil filter and seal, refer to "Changing Fluid and Oil Filter" in this section.

PRESSURE REGULATOR VALVE

Figure 20

Remove or Disconnect

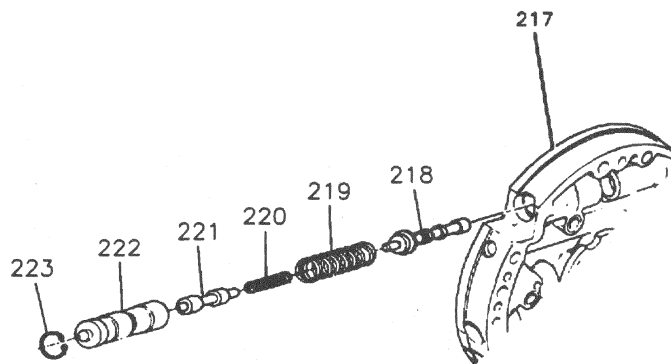
1. Oil pan. Refer to "Changing Fluid and Oil Filter" in this section.
2. Compress with small screwdriver: regulator valve (218) and spring (219), spring (220), boost valve (221), and sleeve (222).



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Figure 19 - Wiring Harness, Pressure Switch, Control Valve and Accumulators

- 217 COVER, AUTOMATIC TRANSMISSION OIL PUMP
- 218 VALVE, PRESSURE REGULATOR
- 219 SPRING, PRESSURE REGULATOR VALVE
- 220 SPRING, PRESSURE REGULATOR ISOLATOR
- 221 VALVE, REVERSE BOOST
- 222 SLEEVE, REVERSE BOOST VALVE
- 223 RING, OIL PUMP REVERSE BOOST VALVE RETAINING



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DS0137A

Figure 20 - Pressure Regulator

3. Ring (223).
4. Slowly release tension.
5. Sleeve (222), boost valve (221), spring (220), spring (219) and regulator valve (218) from transmission oil pump cover bore.

Inspect

- Pressure regulator valve. Refer to SECTION 7A-14B for inspection and disassembly procedures.

Install or Connect

1. Regulator valve (218), spring (219), spring (220), boost valve (221) and sleeve (222) to transmission oil pump cover bore.
2. Compress springs (219 and 220) with a small screwdriver.
3. Ring (223).
4. Oil pan. Refer to "Changing Fluid and Oil Filter" in this section.

CONTROL VALVE AND PRESSURE SWITCH

Figures 19, 21 through 25

Remove or Disconnect

1. Oil pan and oil filter. Refer to "Changing Fluid and Oil Filter" in this section.
2. Electrical connectors from control valve body components.
3. TCC PWM solenoid retainer (379) and solenoid (396).
4. Torque converter clutch (TCC) solenoid bolts/screws (51) and TCC solenoid (50) with O-ring seal (49) and wiring harness (65). Lay wiring harness aside.
5. Pressure switch bolts/screws (70) and pressure switch (68).

6. Manual detent spring bolt/screw (64) and spring (63).
7. Remaining control valve body bolts/screws (69).
8. Manual valve link (705).
9. Control valve (67).
10. Check balls (2, 3, 4, 5, 6, 8 and 12) from control valve (67).

Clean

- Control valve components.

Inspect

- Control valve. Refer to SECTION 7A-14B for disassembly, cleaning, inspection and repair of control valve body.

Install or Connect

NOTICE: Install all bolts/screws of valve body, then torque in a spiral pattern starting from the center. If bolts/screws are torqued at random, valve bores may be distorted and inhibit valve operation. Refer to "Notice" on page 7A-1 of this section.

1. Check balls (2, 3, 4, 5, 6, 8 and 12) to control valve (67).
2. Control valve (67) and manual valve link (705) to transmission case.
 - Be careful not to damage solenoid filter screens when installing control valve (67).
3. Control valve body bolts/screws (69).
4. Manual detent spring (63) and bolt/screw (64).
 - Do not tighten bolt/screw (64) at this time.
5. Pressure switch (68) and bolts/screws (70).
6. TCC solenoid (50) with O-ring (49) and wiring harness (65) and bolts/screws (51).

Tighten

- Bolts/screws (51) to 11 N·m (97 lb. in.).

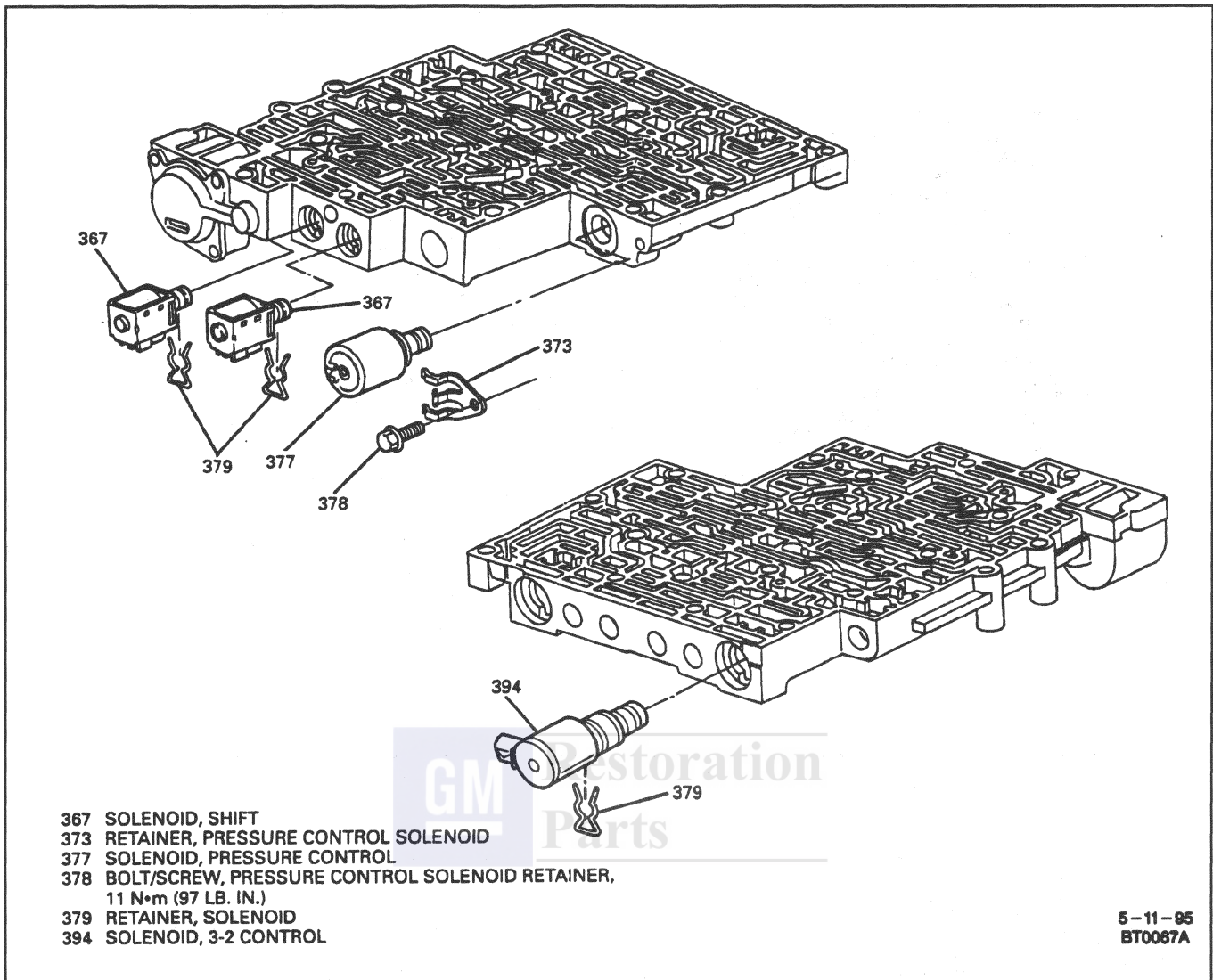


Figure 21 - Control Valve

7. TCC PWM solenoid (396) and retainer (379) to control valve (67).
8. Electrical connectors to control valve body components.



Tighten

- Control valve body bolts/screws (69) in a spiral pattern to 11 N•m (97 lb. in.).
- Pressure switch bolts/screws (70) to 11 N•m (97 lb. in.).
- Manual detent spring bolt/screw (64) to 24 N•m (18 lb. in.).

9. Oil filter and oil pan. Refer to "Changing Fluid and Oil Filter" in this section.

CONTROL AND SHIFT SOLENOIDS

Figures 19, 21, and 23



Remove or Disconnect

1. Oil pan and oil filter. Refer to "Changing Fluid and Oil Filter" in this section.

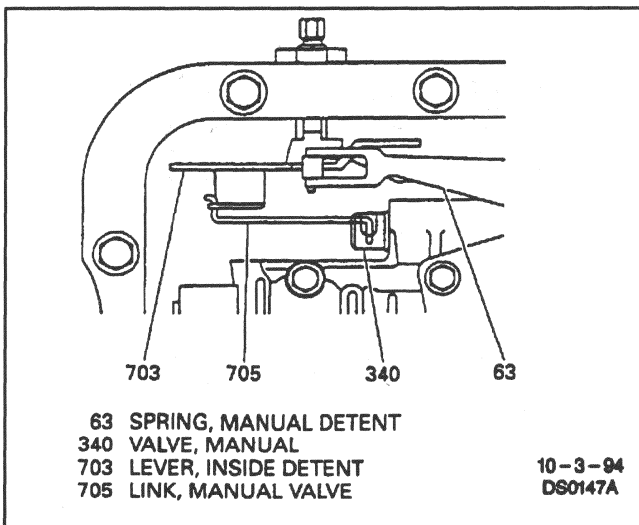


Figure 22 - Manual Valve Link

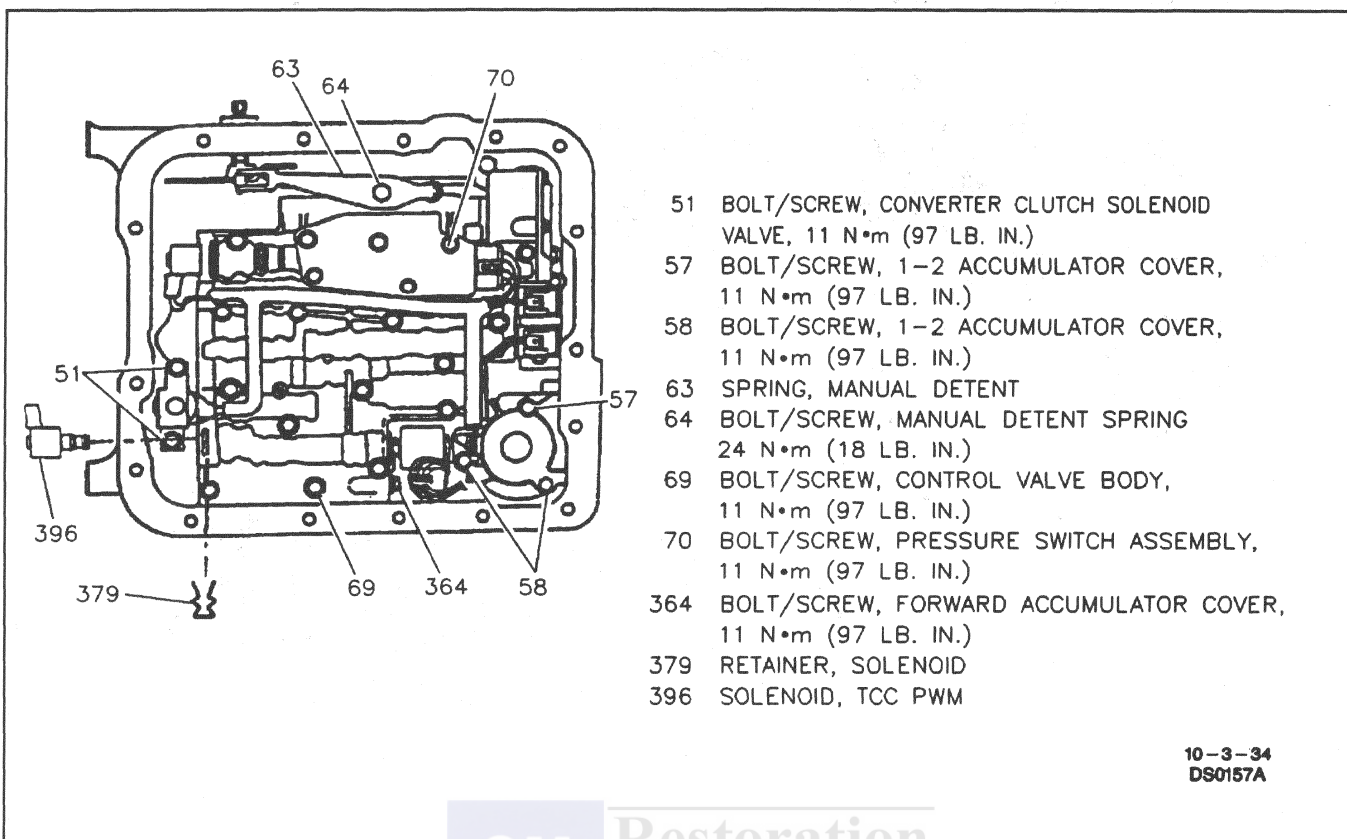


Figure 23 - Control Valve Body Bolt/Screw Locations

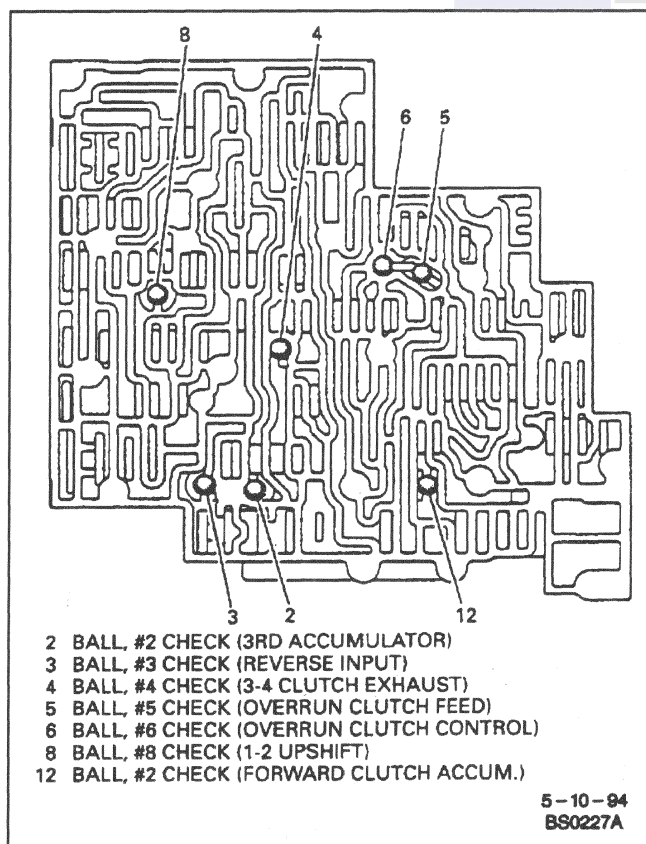


Figure 24 - Control Valve Body Check Ball Locations

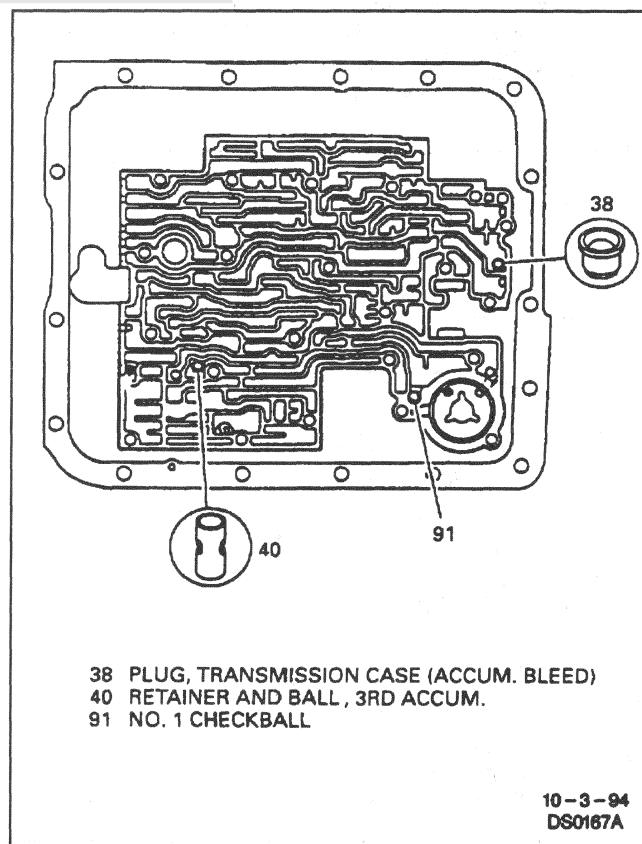


Figure 25 - Transmission Case Check Balls

2. Accumulator cover bolts/screws (57 and 58).
3. 1-2 accumulator cover (62), piston (61) and springs (59 and 59A).
4. Component electrical connectors.
5. Pressure control solenoid retainer bolt/screw (378), retainer (373) and solenoid (377).
6. Shift solenoid retainers (379) and shift solenoids (367).
7. 3-2 control solenoid retainer (379) and control solenoid (394).

 Install or Connect

1. 3-2 control solenoid (394) and retainer (379).
2. Shift solenoids (367) and retainers (379).
3. Pressure control solenoid (377), retainer (373) and retainer bolt/screw (378).
 - Position pressure control solenoid (377) with the electrical tabs facing outboard.
4. Component electrical connectors.
5. 1-2 accumulator piston (61) to the accumulator cover (62).
 - Piston legs must face toward the case when installed.
6. 1-2 accumulator springs (59 and 59A) onto piston (61).
7. 1-2 accumulator cover (62) and bolts/screws (57 and 58).

 Tighten

- Bolts (57 and 58) to 11 N.m (97 lb. in.).
8. Oil pan and oil filter. Refer to "Changing Fluid and Oil Filter" in this section.

TCC PWM SOLENOID, TCC SOLENOID VALVE AND WIRING HARNESS

Figures 19, 21, and 23

Tool Required:
J 28458 Power Piston Seal Protector and
Diaphragm Retainer Installer

 Remove or Disconnect

1. Warm up, three way catalytic converter and heat shield. Refer to SECTION 6F.
2. Oil pan and oil filter. Refer to "Changing Fluid and Oil Filter" in this section.
3. External wiring harness connector from transmission pass-through connector.
 - Squeeze fore and aft flats on connector to release locking tabs and pull connector.
4. Accumulator cover bolts/screws (57 and 58).
5. 1-2 accumulator cover (62), piston (61) and springs (59 and 59A).
6. Component electrical connectors.
7. TCC PWM solenoid retainer (379).
8. TCC PWM solenoid (396) from control valve body.

9. Pressure control solenoid retainer bolt/screw (378) and retainer (373) and solenoid (377).
10. TCC solenoid valve bolts/screws (51).
11. Pass-through electrical connector from transmission case (10).
 - Use small end of J 28458 over top of connector and twist to release four tabs while at the same time pulling harness connector from the transmission case.
12. TCC solenoid valve with wiring harness (65) from transmission case (10).

 Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 in this section

1. TCC solenoid with wiring harness (65) to transmission case (10).
2. Pass-through electrical connector to transmission case (10).
3. TCC solenoid bolts/screws (51).
4. Pressure control solenoid (377) retainer (373) and bolt/screw (378).

 Tighten

- TCC solenoid bolts/screws (51) to 11 N.m (97 lb. in.).
 - Pressure control solenoid bolt/screw (378) to 11 N.m (97 lb. in.).
5. TCC PWM Solenoid (396) to control valve body.
 6. TCC PWM Solenoid retainer (379).
 7. Component electrical connectors.
 8. 1-2 accumulator piston (61) to the accumulator cover (62).

 Important

- Piston legs must face toward the case when installed.
9. 1-2 accumulator springs (59 and 59A) onto piston (61).
 10. 1-2 accumulator cover (62) and bolts/screws (57 and 58).

 Tighten

- Bolts/screws (57 and 58) to 11 N.m (97 lb. in.).
11. Wiring harness connector to transmission pass-through connector.
 12. Oil pan and oil filter. Refer to "Changing Fluid and Oil Filter" in this section.
 13. Warm-up, three way catalytic converter and catalytic converter heat shield. Refer to SECTION 6F.

TRANSMISSION REMOVAL AND INSTALLATION

Figures 9, 10 and 26 through 29

If transmission is being removed for repair, refer to section 7A-14A for diagnosis prior to removing transmission.

NOTICE: Automatic transmission oil cooler flushing must be performed when an automatic transmission is removed for service. The flushing procedure should be performed after the removal of the old transmission and before the installation of the overhauled or replacement transmission. Failure to flush the system may cause damage to the system and its components.

Tools Required:
J 21366 Converter Holding Strap

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Transmission fluid level indicator (851).
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Propeller shaft. Refer to SECTION 4A.
5. Electrical connectors from transmission and vehicle speed sensor.
 - Position electrical harness away from transmission to prevent damage to harness or connectors.
6. Steering column shift control linkage from transmission. Refer to "Steering Column Shift Control Linkage" in this section.
7. Transmission converter cover bolts/screws (854) and cover (855) from transmission.
8. If transmission converter is being reused, mark position of flywheel-to-converter to maintain original balance during assembly.
9. Flywheel bolts/screws (857).
 - Discard flywheel bolts/screws (857).
10. Support transmission using transmission jack.
11. Loosen catalytic converter-to-intermediate pipe bolts/screws to allow for pivot.
12. Transmission mount nut (840) and washer (864).
13. Transmission support bolts/screws (841).
14. Transmission support (859) from vehicle.
15. Transmission mount bolts/screws (892), washers (891), mount (890) and shims (893).
16. Catalytic converter support bracket from transmission. Refer to SECTION 6F.
17. Lower transmission to access oil cooler upper and lower pipes.

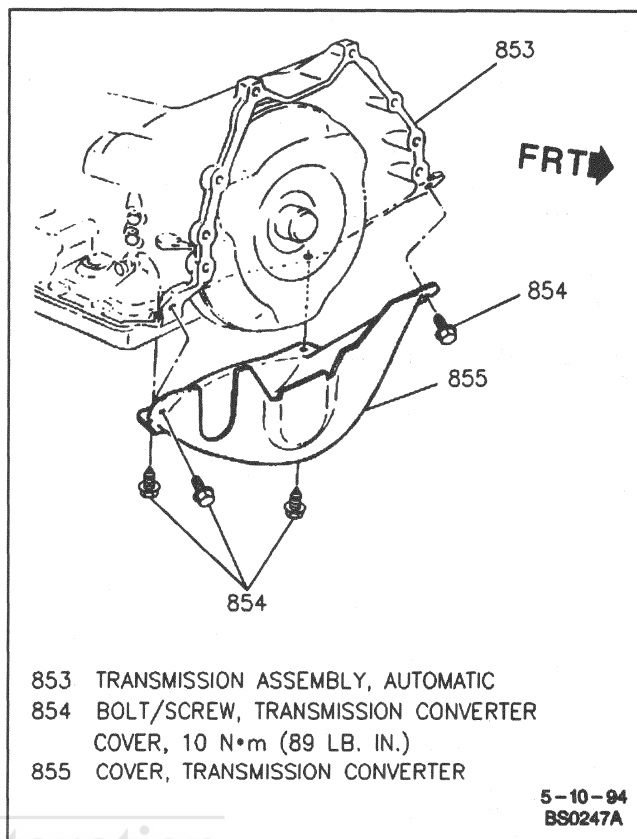


Figure 26 - Transmission Converter Cover

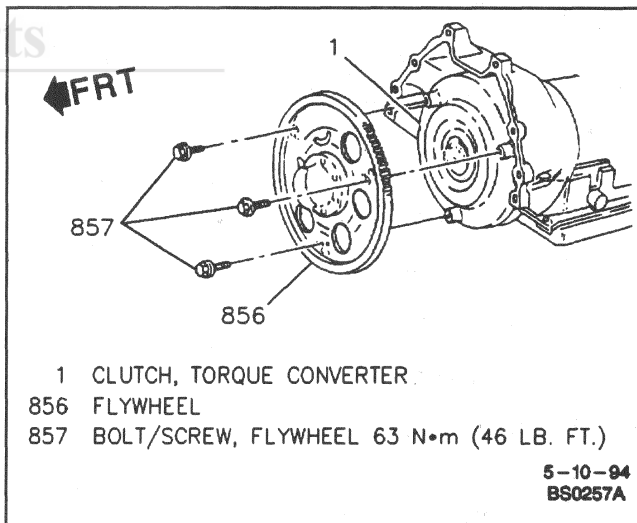
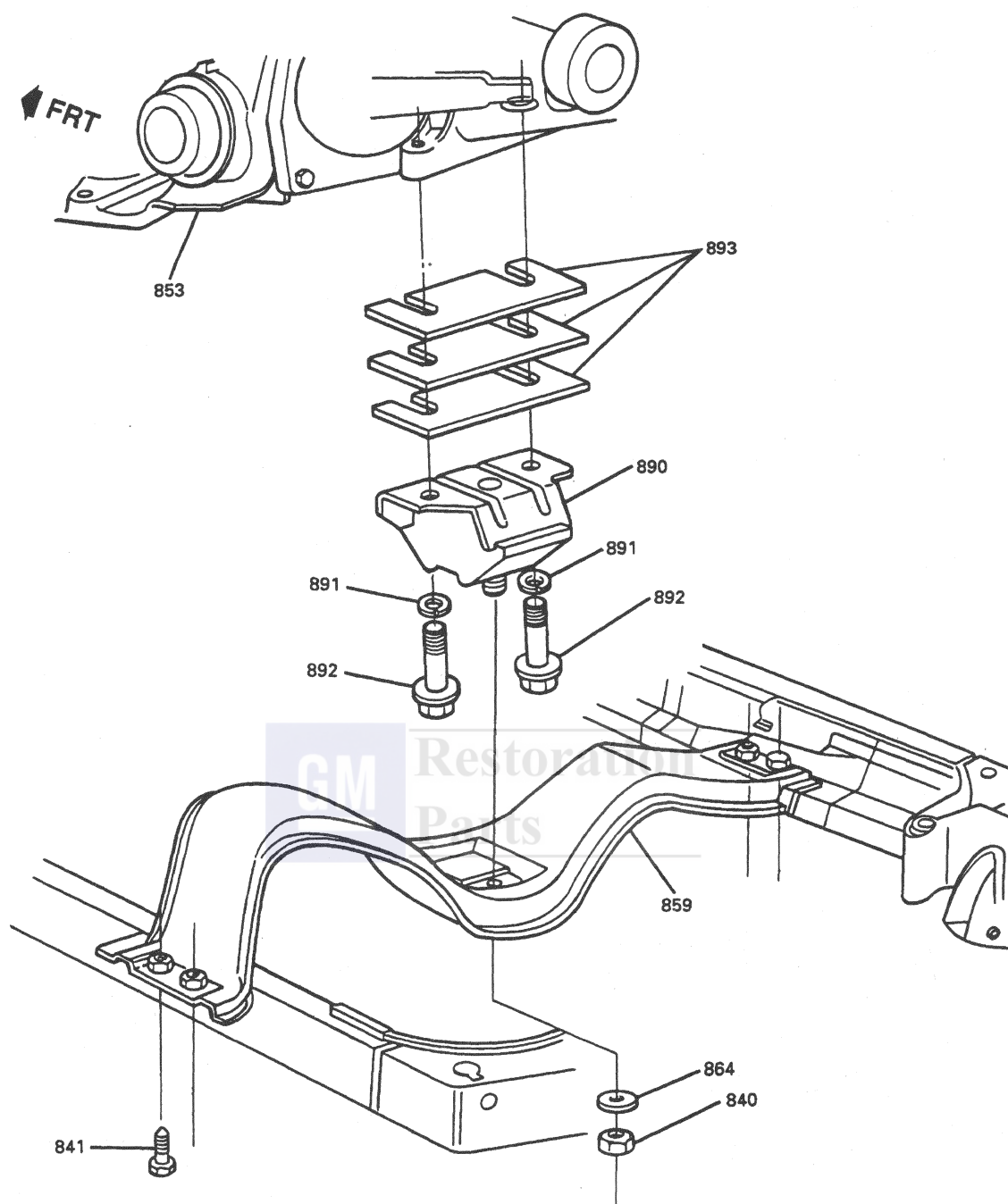


Figure 27 - Torque Converter to Flywheel

18. Fill tube bolt/screw (849).
19. Place drain pan under transmission.
20. Fill tube (850) from transmission.
 - Plug transmission.
21. Oil cooler upper and lower pipes from transmission.
 - Plug all openings.
22. Support engine with suitable tool.
23. Transmission bolts/screws (866).
24. Attach J 21366 to transmission to retain transmission converter.



- 840 NUT, TRANSMISSION MOUNT
- 841 BOLT/SCREW, TRANSMISSION SUPPORT
- 853 TRANSMISSION, AUTOMATIC
- 859 MEMBER, TRANSMISSION SUPPORT
- 864 WASHER, TRANSMISSION MOUNT
- 890 MOUNT, TRANSMISSION
- 891 WASHER, TRANSMISSION MOUNT
- 892 BOLT/SCREW, TRANSMISSION MOUNT
- 893 SHIM, TRANSMISSION MOUNT

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Figure 28 - Transmission Mount

7A-30 AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

25. Lower transmission carefully to avoid damaging accelerator control cable, any pipes or shift control linkage.



Clean

- Transmission oil cooler. Refer "Transmission Oil Cooler Flushing Procedure" in this section.



Install or Connect

NOTICE: Refer to "Notice" on page 7A-1 of this section.

1. Raise transmission until alignment pins on engine align with alignment pin holes in transmission.
2. Remove J 21366.
3. Transmission bolts/screws (866).



Tighten

- Transmission bolts/screws (866) to 47 N.m (35 lb. ft.).
4. Remove engine support.
 5. Oil cooler upper and lower pipes to transmission.



Tighten

- Oil cooler upper and lower pipe fittings to 21 N.m (15 lb. ft.).
6. Fill tube (850) to transmission.

7. Fill tube bolt/screw (849).



Tighten

- Fill tube bolt/screw (849) to 47 N.m (35 lb. ft.).
8. Raise transmission to provide clearance for transmission support member (859).
 9. Transmission support member (859) into position.
 10. Transmission support bolts/screws (841).



Tighten

- Transmission support bolts/screws (841) to 34 N.m (25 lb. ft.).
11. Shims (893), mount (890), washers (891) and transmission mount bolts/screws (892).



Tighten

- Transmission mount bolts/screws (892) to 47 N.m (35 lb. ft.).
12. Transmission mount nut (840) and washer (864).



Tighten

- Transmission mount nut (840) to 41 N.m (30 lb. ft.).
13. Catalytic converter-to-intermediate pipe bolts/screws.



Tighten

- Catalytic converter-to-intermediate pipe bolts/screws to 34 N.m (25 lb. ft.).
14. Remove transmission jack.
 15. New flywheel bolts/screws (857).
 - A. Observe marks made during disassembly and align in original position.
 - B. Make sure weld nuts on torque converter clutch are flush with flywheel.
 - C. Test torque converter clutch for freedom of rotation.
 - D. Remove retaining compound from first three threads of new flywheel bolts/screws (857).
 - E. Finger tighten three flywheel bolts/screws (857), then tighten to specification.



Tighten

- Flywheel bolts/screws (857) to 63 N.m (46 lb. ft.).
 - Retighten first flywheel bolt/screw (857) tightened to specification.
16. Catalytic converter support bracket. Refer to SECTION 6F.
 17. Cover (855) and cover bolts/screws (854).



Tighten

- Cover bolts/screws (854) to 10 N.m (89 lb. in.).

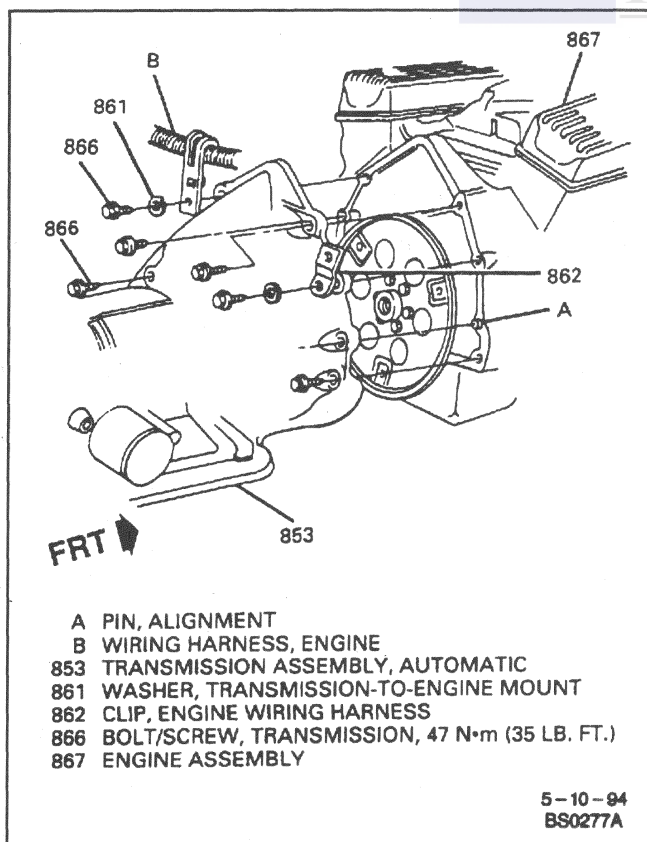


Figure 29 - Transmission to Engine

18. Steering column shift control linkage to transmission. Refer to "Steering Column Shift Control Linkage" in this section.
19. Electrical leads and retaining clips.
20. Propeller shaft. Refer to SECTION 4A.
21. Lower vehicle.
22. Transmission fluid level indicator (851).

23. Battery negative cable.



Adjust

1. Shift linkage. Refer to "Steering Column Shift Control Linkage Adjustment" in this section.
2. Fluid level.
 - Fill transmission with DEXRON® III to the "COLD" fluid level reading.
 - Perform transmission fluid level checking procedure. Refer to "Transmission Fluid Level Checking Procedure" in this section.

SPECIFICATIONS

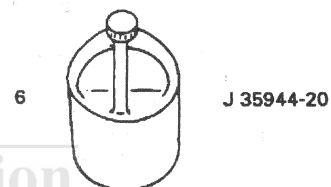
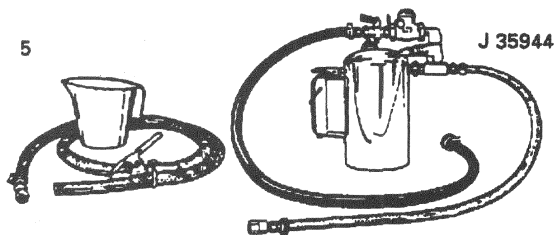
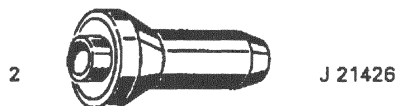
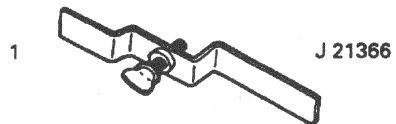
GENERAL SPECIFICATIONS

- Automatic (HYDRA-MATIC 4L60-E) Fluid Refill Capacity
- Bottom Pan Removal 4.7 liters (5.0 qt.)
- Complete Overhaul (with new 298 mm torque converter) 10.6 liters (11.0 qt.)

FASTENER TIGHTENING SPECIFICATIONS

1-2 Accumulator Cover Bolt/Screw.....	11 N.m (97 lb. in.)
Automatic Transmission Range Selector Lever Nut.....	27 N.m (20 lb. ft.)
Backup Lamp Switch Bolt/Screw.....	2 N.m (18 lb. in.)
Case Extension-to-Case Bolt/Screw.....	35 N.m (26 lb. ft.)
Control Valve Body Bolt/Screw.....	11 N.m (97 lb. in.)
Converter Clutch Solenoid Valve Bolt/Screw.....	11 N.m (97 lb. in.)
Flywheel Bolt/Screw.....	63 N.m (46 lb. ft.)
Forward Accumulator Cover Bolt/Screw.....	11 N.m (97 lb. in.)
Manual Detent Spring Bolt/Screw.....	24 N.m (18 lb. ft.)
Oil Cooler Pipe Retainer Bolt/Screw.....	1.9 N.m (17 lb. in.)
Oil Cooler Upper and Lower Pipe Fitting.....	21 N.m (15 lb. ft.)
Oil Cooler Upper and Lower Pipe-to-Radiator Fitting.....	23 N.m (17 lb. ft.)
Oil Pan Bolt/Screw.....	16 N.m (12 lb. ft.)
Pressure Control Solenoid Retainer Bolt/Screw.....	11 N.m (97 lb. in.)
Pressure Switch Bolt/Screw.....	11 N.m (97 lb. in.)
Transmission Bolt/Screw.....	47 N.m (35 lb. ft.)
Transmission Converter Cover Bolt/Screw.....	10 N.m (89 lb. in.)
Transmission Fluid Filler Tube Bolt/Screw.....	47 N.m (35 lb. ft.)
Transmission Mount Bolt/Screw.....	47 N.m (35 lb. ft.)
Transmission Mount Nut.....	41 N.m (30 lb. ft.)
Transmission Range Selector Lever Equalizer Lever Bracket Bolt/Screw.....	21 N.m (16 lb. ft.)
Transmission Range Selector Rod Swivel Bolt/Screw.....	28 N.m (21 lb. ft.)
Transmission Support Bolt/Screw.....	34 N.m (25 lb. ft.)
Vehicle Speed Sensor Retaining Bolt/Screw.....	11 N.m (97 lb. in.)

SPECIAL TOOLS



- 1 CONVERTER HOLDING STRAP
2 OUTPUT SHAFT SLEEVE AND CASE EXTENSION OIL SEAL INSTALLER
3 POWER PISTON SEAL PROTECTOR AND DIAPHRAGM RETAINER INSTALLER
4 SERVO COVER DEPRESSOR
5 OIL COOLER AND LINE FLUSHER "TRANSMISSION"
6 COOLER FLUSHING FLUID

SECTION 8B

LIGHTING SYSTEMS AND HORNS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fastener that require a replacement after removal. General Motors will also call out the fasteners that require thread locker or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and system.

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GENERAL DESCRIPTION

HALOGEN BULBS

Headlamp capsules of all vehicles and the spotlamp for police and taxi vehicles contain halogen gas.

CAUTION: Halogen bulbs contain a gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn off the lamp switch and allow the bulb to cool before changing bulbs. Leave the switch off until bulb change is complete.
- Always wear eye protection when changing a halogen bulb.
- Handle the bulb only by its base. Avoid touching the glass.
- Do not drop or scratch the bulb. Keep moisture away.
- Place the used bulb in the new bulb's carton and dispose of it properly. Keep halogen bulbs out of the reach of children.

EXTERIOR LIGHTING

The exterior lighting system includes the headlamp capsules, front parking and turn signal lamps, rear taillamps, backup lamps, rear license lamp, front sidemarker and cornering lamps, rear sidemarker lamps, rear compartment courtesy lamp (sedan), underhood lamp and the highmount stoplamp. It also includes all associated wiring, controls and related hardware for these lamps.

Backup Lamps

The backup lamps are part of the taillamp on the Chevrolet or the rear fascia on the Buick. The backup lamps are activated when the backup lamp and transmission position sensor switch is shifted to the "REVERSE" position. Refer to SECTION 7A for service of the switch.

Daytime Running Lamps

(Canadian Only)

All Canadian vehicles are equipped with daytime running lamps. The daytime running lamp system includes a solid state module, a relay and a light sensor. The system lights "LO" beam headlamps at reduced intensity when the ignition switch is in the "RUN" position during daylight. The daytime running lamp system is designed to light the "LO" beam headlamps at full intensity, and the parking lamps and taillamps when low light conditions are present.

Front Cornering Lamp

Cornering lamps provide extra light in the direction the vehicle is turning. When either the headlamps or parking lamps are on, turning on the turn signal causes the cornering lamp in the direction of the turn to light. The cornering lamps do not blink.

Front Parking Lamp

The front parking lamps are housed within the headlamp capsule. The front parking lamps can be turned on by turning the headlamp switch clockwise to the first position indicated by the parking lamp symbol, for Chevrolet. For Buick, pull headlamp knob out to first position.

Front Sidemarker Lamp

The front sidemarker lamps will come on when the headlamps or parking lamps are on. The front sidemarker lamps also have reflectors: they will shine when struck by light, whether or not the vehicle's lamps are on.

If the headlamp switch or parking lamps are off when a turn is signaled, the appropriate front sidemarker lamp will flash in unison with the front turn signal lamp on the same side. If the headlamps or parking lamps are on when a turn is signaled, the front sidemarker lamp and front turn signal lamp flash alternately.

Front Turn Signal Lamp

When the turn signals are activated, the appropriate front parking lamp flashes to signal a turn. The turn signal works only when the ignition switch is in "RUN" and the hazard flashers are turned "OFF."

The turn signals are controlled by the turn signal lever on the left side of the steering column. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever will return to horizontal and the turn signals will stop flashing.

For changing lanes or shallow turns where the steering wheel does not turn far enough to cancel the signal, move the turn signal lever only to the first detent and hold it there. When the lever is released, it will return to horizontal and the turn signal will cancel. For more information, refer to SECTION 8A.

A tone alarm is incorporated into the turn signal electrical circuit. The tone alarm sounds if the turn signal is left on for more than 0.8 km (0.5 mile). The tone alarm will stay on for 2.4 km (1.5 miles) unless the turn signal is turned off.

Hazard Lamp Flasher

The hazard warning flasher is part of the turn signal circuit. The hazard warning switch is on the right side of the steering column. Pressing in on the hazard warning switch button causes the front and rear turn signal lamps and the front sidemarker lamps to flash. Pulling on the hazard warning switch knob will turn off the hazard warning flashers.

The hazard warning flashers will work with the ignition switch in any position. When the hazard warning flashers are "ON," the turn signals do not work. The hazard lamp flasher is in the convenience center, behind the instrument panel to the left of the steering column. For information on the hazard warning switch, refer to SECTION 3F.

Headlamp Capsules

The headlamp capsules are controlled by the headlamp switch on the left side of the instrument panel. They will come on with the ignition switch in any position.

Headlamp low beam and high beam are controlled by the headlamp dimmer switch lever on the left side of the steering column. When the headlamps are on, pulling the lever toward the driver until the switch clicks changes the lamps from low beam to high beam, or from high beam to low beam. An indicator lamp on the center instrument cluster will come on when the high-beam headlamps are on.

The headlamps must be aimed for proper illumination of the road. Headlamp aim should be checked whenever a new headlamp capsule is installed or service or repairs to the front end area may have disturbed the headlamp capsule or its mountings.



Important

- Some state and local laws specify requirements for headlamp aim: these laws must be followed.

High-Mount Stoplamp

The high-mount stoplamp is in the center of the rear window panel between the rear seatback and the rear window in sedans. For wagons, it is located in the bottom center of the end gate window. It will come on

whenever the brake pedal is pushed down. The lamp is powered separately from the rear taillamps through a circuit in the stoplamp switch.

Opera Lamps

(Buick Sedan)

Opera lamps are mounted on the roof rear quarter upper panel. These lamps will light when the headlamp switch is in the "PARK" or "ON" position.

Rear Compartment Courtesy Lamp

(Sedan)

This lamp will come on whenever the rear compartment lid is opened, even if the headlamps or parking lamps are not on.

Rear Compartment Lid Lamps

(Police)

The rear compartment lid lamp system consists of two 4-inch red lensed single faced lamps, a warning lamp flasher and a mercury switch all mounted to the rear compartment lid inner panel. Powered by the rear compartment courtesy lamp wiring, the lamps are activated by the mercury switch when the rear compartment lid is opened. The warning lamp flasher causes the lamps to flash alternately.

Rear License Lamp

The rear license lamp will come on when the headlamps or parking lamps are on. The license lamp is mounted above the license plate.

Rear Sidemarker Lamps

The rear sidemarker lamps are part of the taillamp. The rear sidemarker lamps will come on when the headlamps or parking lamps are on. The rear sidemarker lamps also have reflectors: they will shine when struck by light, whether or not the vehicle's lamps are on.

Rear Window Panel Lamps

(Police)

The rear window panel lamp system consists of two 4-inch, red lensed lamps and two 30 amp BOSCH® relays. These relay controlled lamps function as auxiliary turn signals and stoplamps. The lamps are mounted to the rear window panel trim. The relays are mounted in the rear compartment, on the left side inner brace.

Spotlamp

(Police and Taxi)

Pillar mounted spotlamps are available on police and taxi equipped vehicles. Each lamp contains a 50 watt independently fused halogen bulb.

8B-4 LIGHTING SYSTEMS AND HORNS

Taillamps

The taillamps, stoplamps, and turn signal lamps are part of the taillamp.

Turning on either the headlamps or parking lamps will turn on the taillamps. When the brake pedal is pushed down, the taillamps glow brighter to serve as stoplamps.

The turn signals are controlled by the turn signal lever on the left side of the steering column. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever will return to neutral and the turn signals will stop flashing. If the brake pedal is held down when a turn is signaled, one side will flash and the other will stay on brightly.

For changing lanes or shallow turns where the steering wheel does not turn far enough to cancel the signal, move the lever only to the first detent. When the lever is released, it will return to neutral and the turn signals will cancel.

Turn Signal Lamp Flasher

The turn signal lamp flasher is in the convenience center, behind the instrument panel to the left of the steering column.

Twilight Sentinel

The twilight sentinel option provides automatic on-off control of the headlamps. It will also keep the lamps turned on for a preselected period of time after the ignition is turned "OFF." For further information, refer to SECTION 9C.

Underhood Lamp

The underhood lamp will come on when the hood is raised, whether or not the parking lamps or headlamps are on.

INTERIOR LIGHTING

For information on warning/indicator lamps, instrument cluster lamps, etc., refer to SECTION 8C. For circuit information, refer to SECTION 8A.

Ashtray Lamp

The ashtray lamp is mounted on the ashtray retainer in the instrument panel. It lights when the headlamps are on and the ashtray is opened.

Courtesy Lamps

Courtesy lamps are located in the lower part of each front door and under both sides of the instrument panel. They will come on when any door is opened or when the interior lamps are turned on. To turn on the courtesy lamps, rotate the "INTERIOR LIGHTS" thumbwheel switch on the Chevrolet, located as part of the headlamp switch, to its full "UP" position. For Buick, rotate headlamp knob counterclockwise until lights click on. Rotating the thumbwheel switch or headlamp knob also controls the instrument panel lamps and their intensity.

Dome and Reading Lamps

The dome lamp on the Chevrolet is on the roof between the front seats. It will come on when a door is opened, or when the inside lamps are turned on. To turn on the inside lamps, rotate the "INTERIOR LIGHTS" thumbwheel switch full "UP."

The police vehicle may be equipped with a secondary dome lamp located on the headlining panel between the sunshades. This lamp has its own switch and does not come on with the courtesy lamps.

The front reading lamps are part of the inside rearview mirror. Push the switch to turn a reading lamp on or off, when the doors are closed. With the doors opened, the reading lamps are always on. The rear reading lamps are located in the roof rail courtesy and reading lamps. They can be turned on by pressing the switch on the lamp.

For more information on the dome and reading lamps, refer to SECTION 10-2 and SECTION 10-9.

Instrument Panel Compartment Lamp

The instrument panel compartment lamp lights when the instrument panel compartment door is opened.

Rear Compartment Lamps

(Wagon)

These lamps are part of the back body pillar assist handles. The lamps will come on when the end gate is opened or by turning the switch on.

Vanity Mirror

The vanity mirror lamps light when the passenger side sunshade is lowered and the mirror cover door is raised. The lamps turn off when the mirror cover door is closed.

HEADLAMP SWITCH

Rotating the headlamp switch clockwise on the Chevrolet or pulling out the headlamp knob on the Buick turns on the headlamps, parking lamps, sidemarker lamps and instrument panel lamps. If the switch is on when the ignition switch is off, a warning tone will sound as a reminder to turn the lamps off.

HORNS

Pushing the pads on the lower left or right hand center of the steering wheel sounds the horns by closing the horn relay. The horns use a solenoid-operated diaphragm to generate sound. For wiring and circuit information refer to SECTION 8A.

DIAGNOSIS

For wiring diagrams and other diagnosis information on properly repairing wiring harnesses, connectors, etc., refer to SECTION 8A.

LIGHTING SYSTEM TROUBLESHOOTING

Most lighting problems are caused by loose connectors, open or shorted wiring, burned-out bulbs, bad switches, an inadequate ground or blown fuses. Check these items first and then refer to SECTION 8A.

HORNS

If the horns do not blow, or blow constantly, follow the diagnostic procedures in SECTION 8A.

Horn Tone Poor

1. Horn tone poor - tighten horn bolts/screws in mounting area, or correct poor connections or ground.
2. Low-pitched moan - sounds like "mooring." Caused by current too high. Adjust current. See "Horns" under "On-Vehicle Service" in this section.
3. Weak tone - current too low. Correct poor connections or ground, or adjust current. See "Horns" under "On-Vehicle Service" in this section.
4. Weak, strained tone - remove foreign object in horn.
5. Harsh vibration - bend bracket so horn is touching sheet metal.

ON-VEHICLE SERVICE

When replacing a part that requires a special procedure (such as a lens and housing sealed together), follow the instructions normally included in the replacement parts package.

When removing a part that requires special sealing items (such as sealing washers), be sure to reinstall those items when replacing the part. Also, if

any body sealing items (grommets, etc.) are disturbed, be sure to repair them so the passenger compartment remains properly sealed.

Take care to prevent waterleaks if sealing surfaces are disturbed. Damaged gaskets must be replaced. If necessary, use sealer (body caulking compound or equivalent) in critical areas or any area where the gasket doesn't seal properly.

CAUTION: Before removing or installing any electrical unit(s), disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or its components.

EXTERIOR LIGHTING

Backup Lamps

To replace a backup lamp bulb, refer to "Taillamps" in this section.

Front Parking and Turn Signal Lamp Bulb Replacement

(Except Buick Sedan)

Figure 1

 Remove or Disconnect

1. Electrical connector from headlamp capsule (17) by twisting counterclockwise.
2. Bulb (4) from electrical connector.

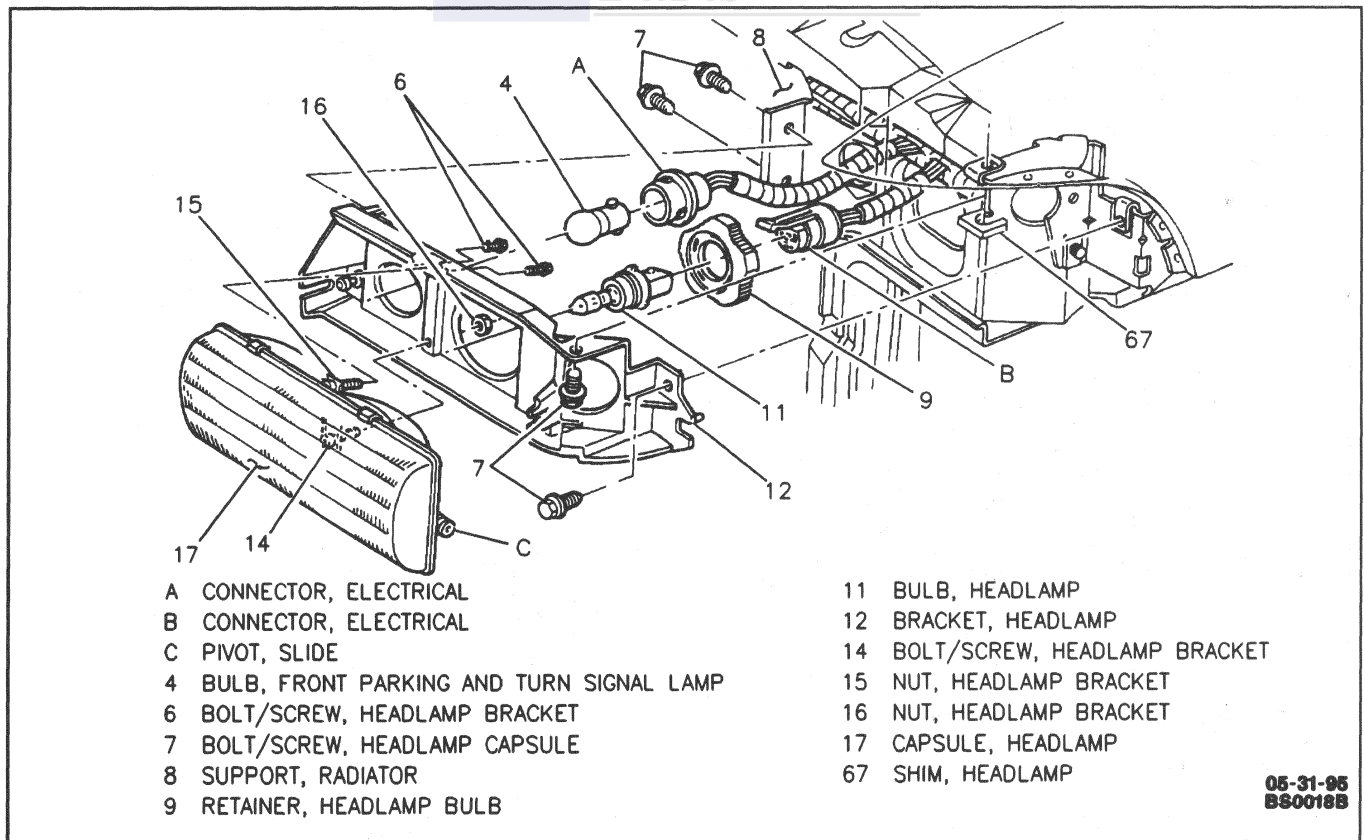


Figure 1 - Headlamp Capsule

8B-6 LIGHTING SYSTEMS AND HORNS

Install or Connect

1. Bulb (4) to electrical connector.
2. Electrical connector to headlamp capsule (17) by twisting clockwise.

Front Parking and Sidemarkers Lamp Bulb Replacement

(Buick Sedan)

Figure 2

Remove or Disconnect

1. Bolt/screw attaching lamp (73) to headlamp bracket.
2. Forward lamp wiring harness connector from front parking and sidemarkers lamp connector.
3. Lamp (73) from headlamp bracket.
 - Disengage spring clip and pull forward.
4. Electrical connector from lamp.
5. Bulb from electrical connector.

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulb into electrical connector, if removed.
2. Electrical connector into lamp (73).
3. Lamp (73) into headlamp bracket.
 - Engage spring clip.
4. Forward lamp wiring harness connector to front parking and sidemarkers lamp connector.
5. Bolt/screw attaching lamp (73) to headlamp bracket.

Tighten

- Bolt/screw to 2.3 N.m (20 lb. in.).

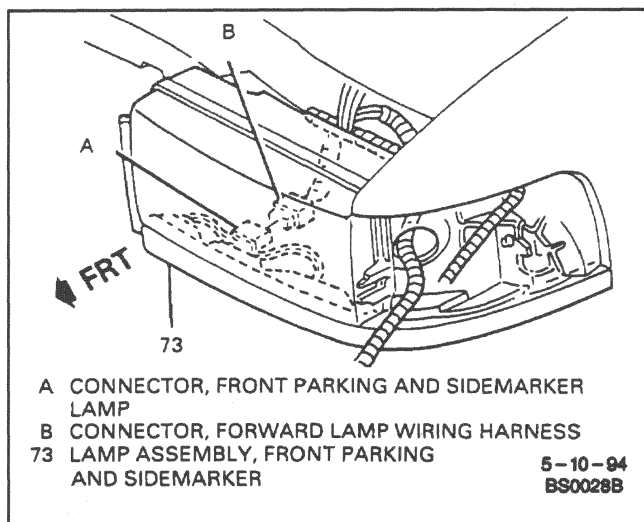


Figure 2 - Front Parking and Sidemarkers Lamps-
(Buick Sedan)

Front Sidemarkers and Cornering Lamp Bulb Replacement

(Except Buick Sedan)

Figure 3

Remove or Disconnect

1. Bolt/screw (22) from bracket (12).
2. Lamp (36) by pulling forward.
3. Electrical connectors from lamp (36).
4. Bulb (38 or 39), as necessary, from electrical connectors.

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulb (38 or 39), as necessary, to electrical connectors.
2. Electrical connectors to lamp (36).

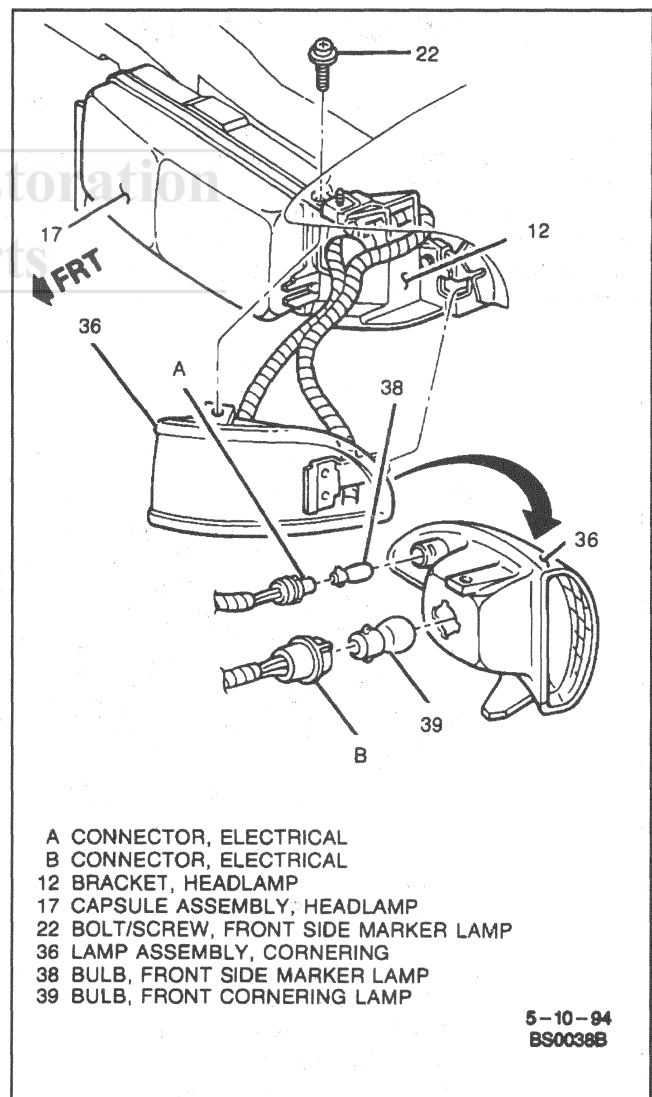


Figure 3 - Front Sidemarkers and Cornering Lamps-
(Except Buick Sedan)

3. Lamp (36).
4. Bolt/screw (22) to bracket (12).

 Tighten

- Bolt/screw (22) to 1.3 N.m (12 lb. in.).

Front Turn Signal and Cornering Lamp Bulb Replacement

(Buick Sedan)

Figure 4

 Remove or Disconnect

1. Bolt/screw (74) from bracket (75).
2. Lamp (76) by pulling forward.
3. Electrical connectors from lamp (76).
4. Cornering lamp bulb (77) or parking and turn signal lamp bulb (78) from electrical connectors.

 Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Cornering lamp bulb (77) or parking and turn signal lamp bulb (78) from electrical connectors.
2. Electrical connectors to lamp (76).
3. Lamp (76).
4. Bolt/screw (74) to bracket (75).

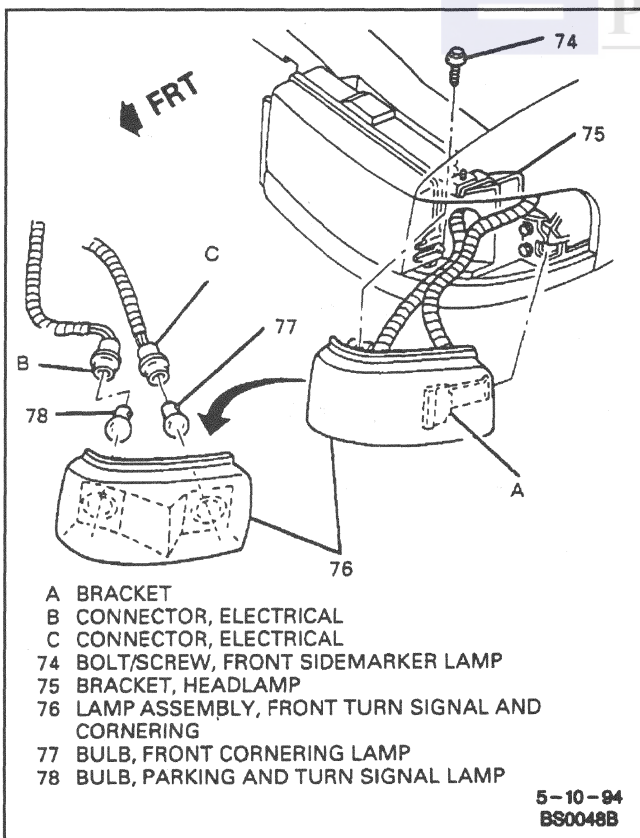


Figure 4 - Front Turn Signal and Cornering Lamps-(Buick Sedan)

 Tighten

- Bolt/screw (74) to 1.3 N.m (12 lb. in.).

HAZARD LAMP FLASHER

Figure 5

 Remove or Disconnect

- Hazard lamp flasher (66) by pulling from convenience center.

 Install or Connect

- Hazard lamp flasher (66) to convenience center.

HEADLAMP CAPSULES

Bulb Replacement

Figure 1

CAUTION: Refer to CAUTION under "Halogen Bulbs" in this section.

 Remove or Disconnect

1. Retainer (9) from headlamp capsule (17) by twisting counterclockwise.
2. Bulb (11) from headlamp capsule (17).
3. Bulb (11) from electrical connector.

 Install or Connect

1. Bulb (11) to electrical connector.
2. Bulb (11) to headlamp capsule (17).
3. Retainer (9) to headlamp capsule (17) by twisting clockwise.

Composite Capsule Replacement

 Remove or Disconnect

1. Front sidemarkers and cornering lamp. Refer to "Front Sidemarkers and Cornering Lamps" (Except Buick Sedan) in this section.
2. Front turn signal and cornering lamp. Refer to "Front Turn Signal and Cornering Lamps (Buick Sedan)" in this section.
3. Front parking and sidemarkers lamp. Refer to "Front Parking and Sidemarkers Lamps (Buick Sedan)" in this section.
4. Electrical connector from headlamp capsule (17).
5. Retainer (9) from headlamp capsule (17).
6. Bulb (11) from headlamp capsule (17).
7. Nut (16) from bolt/screw (14).
8. Two bolts/screws (6) from nut (15) behind bracket (12).
9. Headlamp capsule (17) from bracket (12).
 - By pulling forward and disengaging slide pivots from slots in bracket (12).

8B-8 LIGHTING SYSTEMS AND HORNS

Install or Connect

1. Headlamp capsule (17) to bracket (12).
 - Be sure slide pivots are engaged into bracket (12).
2. Two bolts/screws (6) to nut (15) behind bracket (12).
3. Nut (16) to bolt/screw (14).
4. Bulb (11) to headlamp capsule (17).
5. Retainer (9) to headlamp capsule (17).
6. Electrical connector to headlamp capsule (17).
7. Front sidemarker and cornering lamp. Refer to "Front Sidemarker and Cornering Lamps" (Except Buick Sedan) in this section.
8. Front turn signal and cornering lamp. Refer to "Front Turn Signal and Cornering Lamps (Buick Sedan)" in this section.
9. Front parking and sidemarker lamp. Refer to "Front Parking and Sidemarker Lamps (Buick Sedan)" in this section.

Important

- When replacing headlamp capsule and/or bracket, headlamp aiming should be adjusted. Refer to "Headlamp Aiming" in this section.

HEADLAMP BRACKET REPLACEMENT

Remove or Disconnect

1. Headlamp capsule. Refer to "Composite Headlamp Capsule Replacement" in above procedure.
2. Four bolts/screws (7).
3. Shim (67), if present.
4. Bracket (12).
 - Remove two J-nuts from bracket (12) for reuse, if replacing bracket (12).

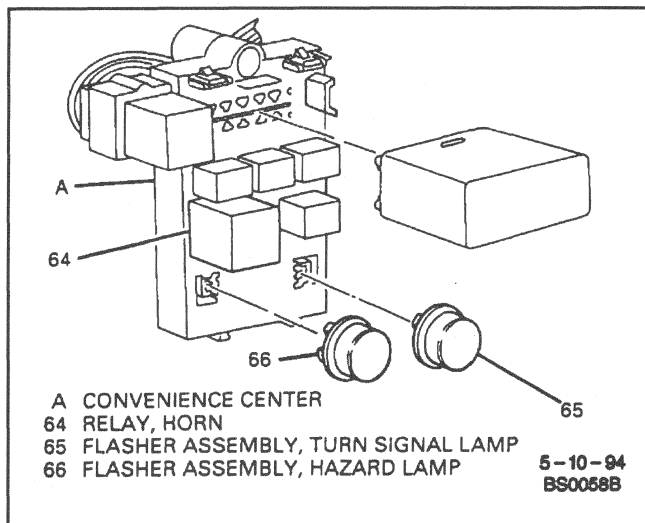


Figure 5 - Hazard and Turn Signal Lamp Flashers-(Typical)

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bracket (12).
 - Install two J-nuts on bracket (12), if removed.
2. Shim (67).
 - Necessary if gap between fender and bracket is greater than 1 mm (1/32 inch).
3. Four bolts/screws (7).

Tighten

- Bolts/screws (7) to 5 N·m (44 lb. in.).
4. Headlamp capsule. Refer to "Composite Headlamp Capsule Replacement" in above procedure.

HEADLAMP AIMING

Figures 6 and 7

Horizontal aim is corrected by an adjusting screw on the outer side of the headlamp capsule. Vertical aim is corrected by an adjusting screw in the top center.

Visual Aiming Equipment

If visual aiming equipment is used, it must give results equivalent to those obtained using the screen method described in the following procedure.

The equipment must be in proper working order, and used in accordance with the manufacturer's instructions. The aiming equipment, using a photoelectric cell or cells to determine aim, should also have a visual screen upon which the beam pattern is projected proportional to its appearance and aim on a screen at twenty-five feet. This screen should be plainly visible to the operator, and should have horizontal and vertical reference lines to allow for visual appraisal of the headlamp beam.

Headlamp Aiming By Screen Method

It is desirable to have a specific aiming area in a darkened location. This area should be large enough to accommodate the vehicle, plus an additional 25 feet measured from the face of the headlamp capsules to the front of the visual screen.

- The floor on which the vehicle rests must be flat with the bottom of the screen. If the floor is not level, then compensation must be made.
- The aiming screen should be 5 feet high by 12 feet wide with a matte white surface, well shaded from outside light, and properly adjusted to the floor on which the vehicle stands. The screen must be provided with a vertical center line, two laterally adjustable vertical tapes, and a vertically adjustable horizontal tape.

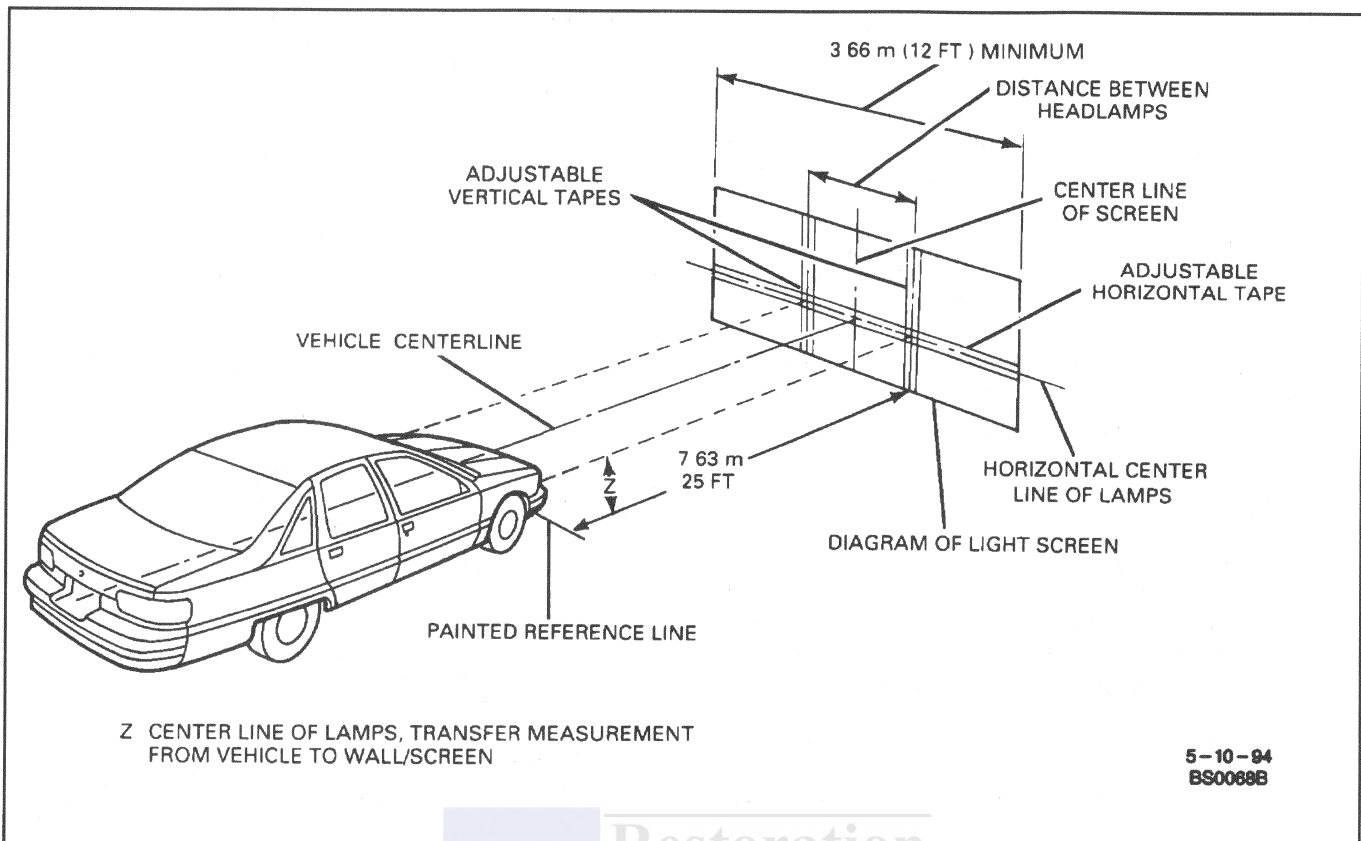


Figure 6 - Visual Headlamp Aiming Preparation

! Important

- For each vehicle checked, the horizontal line or tape on the screen must be adjusted. Vehicles of the same model and year will have different standing height for the capsules.
 - Provisions should be made for moving the screen, so that it can be aligned parallel with the rear axle. This will allow for a horizontal line drawn perpendicular from the center line of the screen to pass through the center point between the two capsules.
 - Once the screen has been set up in a permanent location, a reference line is to be painted on the floor to identify the proper location of the capsules when they are being aimed (Figure 7).
 - If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having clear uninterrupted area approximately 6 feet high by 12 feet wide, finished with a washable non-gloss white paint.
1. Prepare vehicle for checking beam aim as follows:
 - A. Completely assemble all components on vehicle.
 - B. Fuel load to be 1/2 tank or less.
 - Only other load in vehicle is the driver.
 - C. Position vehicle so it is square with aiming screen, and with the headlamp capsules directly over reference line which has been painted on floor.

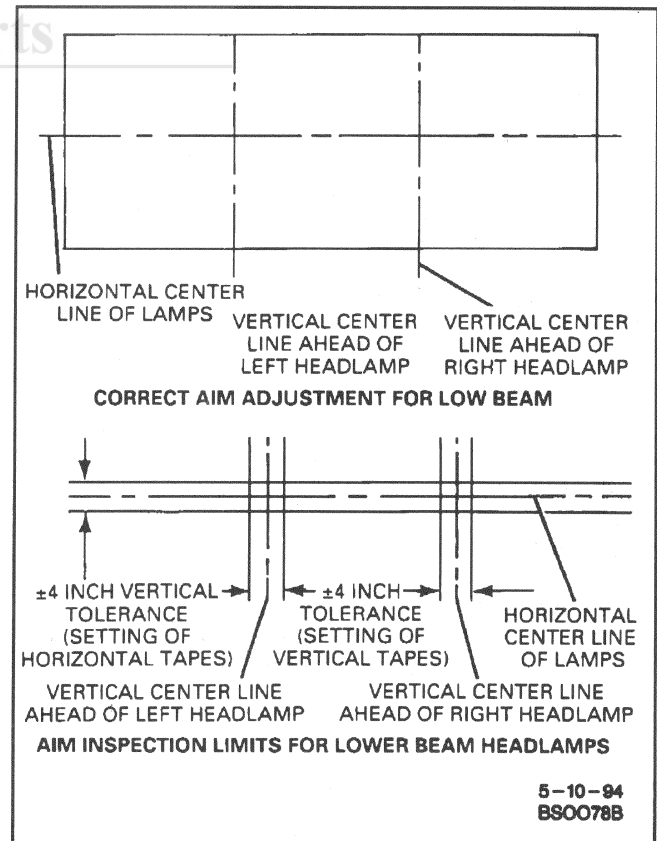


Figure 7 - Visual Headlamp Aim Adjustment and Limits

8B-10 LIGHTING SYSTEMS AND HORNS

D. Locate vertical center line on aiming screen so that it is in line with center of vehicle. This can be done by sighting through center of rear window and over hood (Figure 7).

E. Mark center of front and rear windows with narrow tape. Use these "sights" to locate center of vehicle.

- Move the vehicle or the screen until the center line of the screen comes into alignment with these two points.

F. Close doors.

G. Rock vehicle sideways to stabilize suspension.

2. Switch headlamps on to low beam, and observe left and top edges of high intensity zone on screen.

Adjust

- Horizontal aim using horizontal adjusting screw, if left edge is more than:
 - 102 mm (4 inches) RIGHT of straight ahead.
 - 102 mm (4 inches) LEFT of straight ahead.
- Vertical aim using vertical adjusting screw, if top edge is more than:
 - 102 mm (4 inches) ABOVE the horizontal line.
 - 102 mm (4 inches) BELOW the horizontal line.

HIGH-MOUNT STOPLAMP BULB REPLACEMENT

(Chevrolet Sedan)

Figures 8, 9 and 10

For replacement of high-mount stoplamp (Except Buick Sedan), refer to SECTION 10-8. For Buick Sedan refer to the following procedure in this section.

Remove or Disconnect

1. Bulb (2) and electrical connector from under rear window panel (1), through rear compartment.
 - Twist electrical connector 1/4 turn counterclockwise to unlock.
2. Bulb (2) from electrical connector.

Install or Connect

1. Bulb (2) into electrical connector.
2. Bulb (2) and electrical connector into rear window panel (1), through rear storage compartment.
 - Twist electrical connector 1/4 turn clockwise to lock.

(Wagons)

Remove or Disconnect

1. Two bolts/screws (63) from high-mount stoplamp.
2. Bulbs from socket.

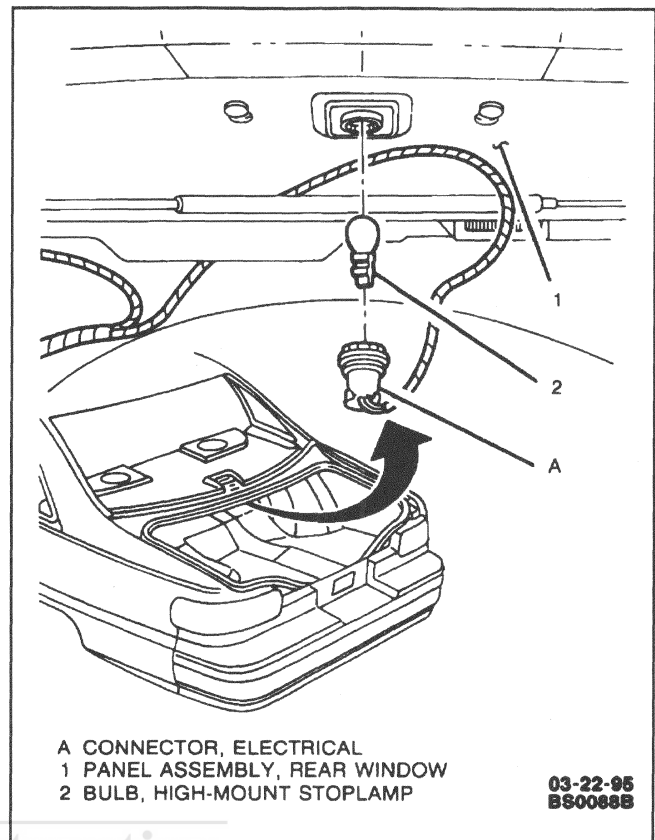


Figure 8 - High-Mount Stoplamp-(Chevrolet Sedan)

Install or Connect

1. Bulbs into socket.
2. Two bolts/screws (63) into high-mount stoplamp.

(Buick Sedan)

Figure 9

Remove or Disconnect

1. Cover (81) from stoplamp (80).
 - Unclip from rear window panel (82) and stoplamp (80).
 - Remove bulb, if necessary.
2. Bolts/screws (79) attaching stoplamp (80) to rear window panel (82).
3. Electrical connector.
4. Stoplamp (80).

Install or Connect

1. Stoplamp (80).
2. Electrical connector.
3. Bolts/screws (79) attaching stoplamp (80) to rear window panel (82).
 - Loosely attach bolts/screws (79) and pull stoplamp (80) rearward.

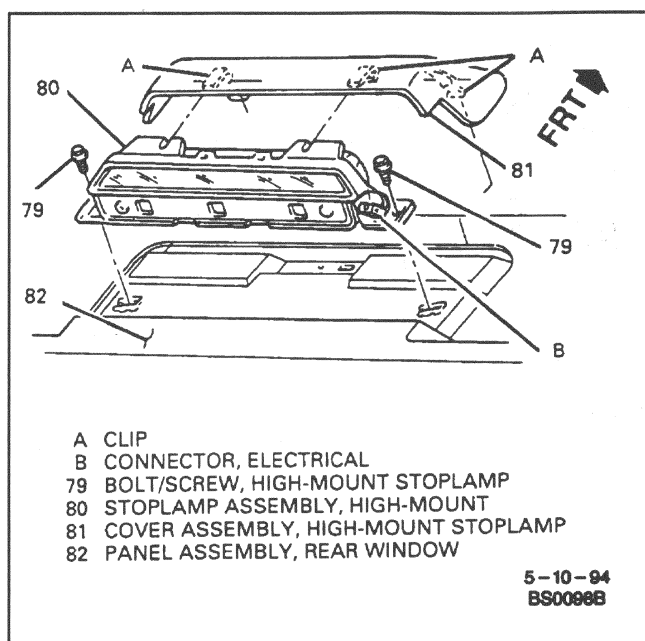


Figure 9 - High-Mount Stoplamp-(Buick Sedan)



Tighten

- Bolts/screws (79) to 1.5 N.m (13 lb. in.).
- 4. Replace bulbs, if removed.
- 5. Cover (39) to stoplamp (38).
 - Snap clips into stoplamp (38) then to rear window panel (40).

OPERA LAMPS

(Buick Sedan)

Figure 11



Remove or Disconnect

1. Reposition rear compartment trim to access nut (86 or 87).
2. Nut (86 or 87) from bezel stud.
3. Quarter upper trim. Refer to SECTION 10-7.
4. Nut (86 or 87) from bezel stud.
5. Opera lamp (84) from underbody.
6. Electrical connector.
7. Washers (85) from bezel stud.
8. Opera lamp (84) from bezel (83).



Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Opera lamp (84) to bezel (83).
2. Washers (85) to bezel studs.
3. Electrical connector.
4. Opera lamp (84) to body.
5. Nuts (86 or 87) to bezel studs.

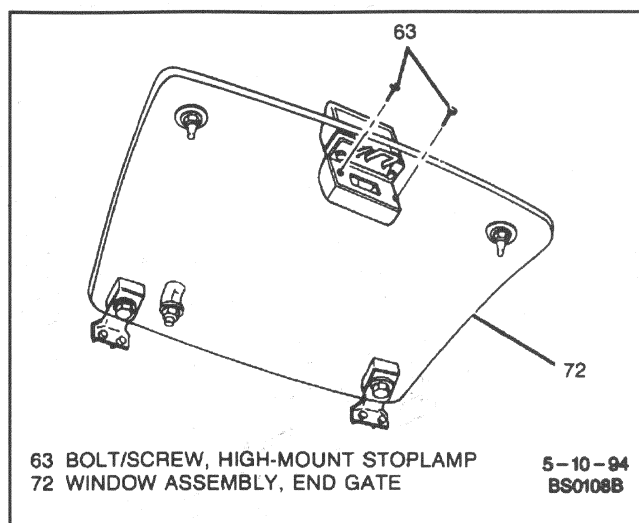


Figure 10 - High-Mount Stoplamp-(Wagon)



Tighten

- Nuts (86 or 87) to 3 N.m (27 lb. in.).
- 6. Quarter upper trim. Refer to SECTION 10-7.
- 7. Reposition rear compartment trim.

REAR COMPARTMENT COURTESY LAMP

(Sedan)

Lamp Replacement

Figure 12



Remove or Disconnect

1. Bolt/screw (41) holding lamp (44).
2. Lamp (44).
3. Electrical connector.



Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Electrical connector.
2. Lamp (44).
3. Bolt/screw (41) to lamp (44).



Tighten

- Bolt/screw (41) to 2 N.m (18 lb. in.).

Bulb Replacement



Remove or Disconnect

- Bulb (45) from lamp (44).



Install or Connect

- Bulb (45) into lamp (44).

8B-12 LIGHTING SYSTEMS AND HORNS

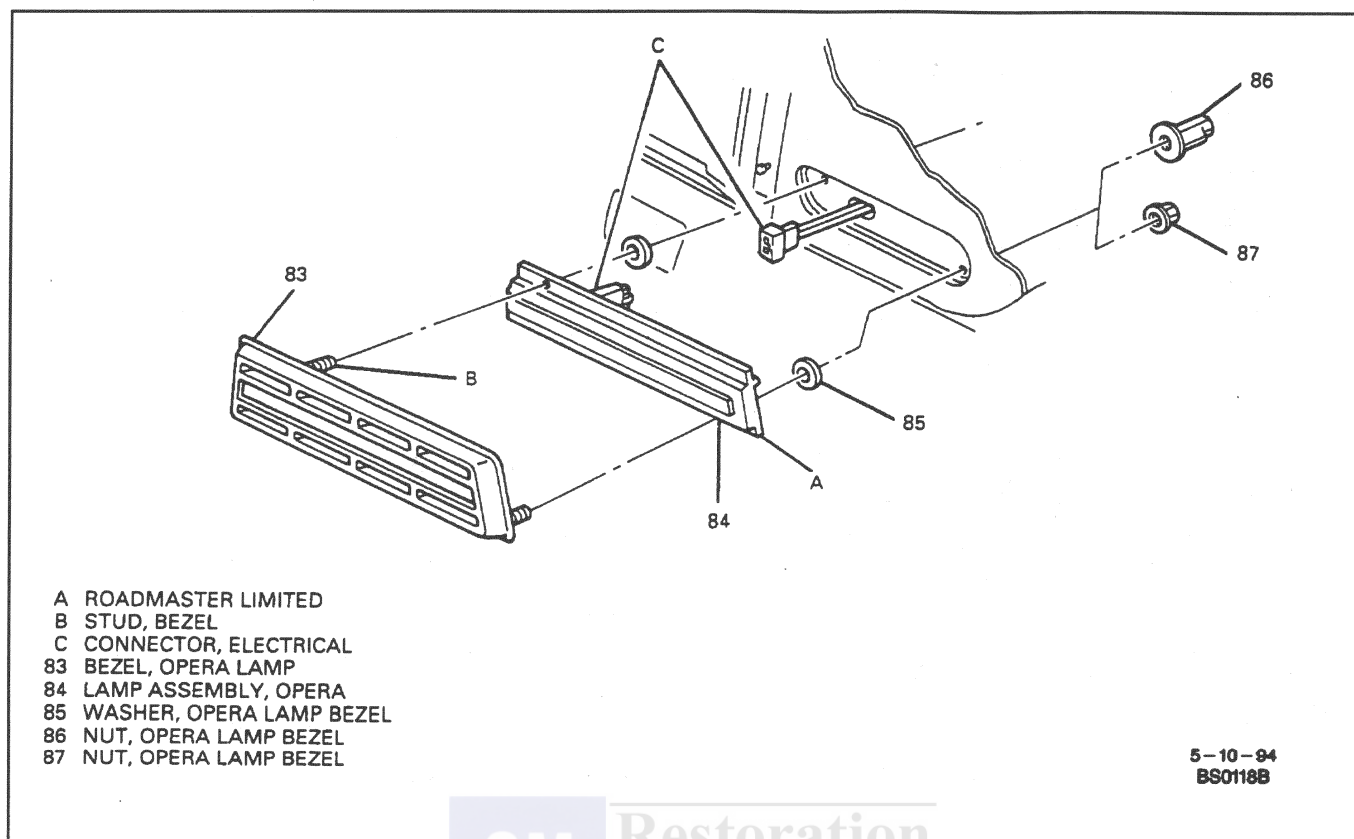


Figure 11 - Opera Lamp-(Buick Sedan)

REAR COMPARTMENT LID LAMPS (POLICE)

Lamp Replacement

Figure 13

↔ Remove or Disconnect

1. Electrical connector.
2. Bolts/screws (100) attaching bracket to rear compartment lid.
3. Bracket with attached lamp (105 or 106) from rear compartment lid.

→ Install or Connect

1. Bracket with attached lamp (105 or 106) to rear compartment lid.
2. Bolts/screws (100) attaching bracket to rear compartment lid.
3. Electrical connector.

Lens and Bulb Replacement

↔ Remove or Disconnect

1. Lens retaining clip.
2. Lens.
3. Bulb.

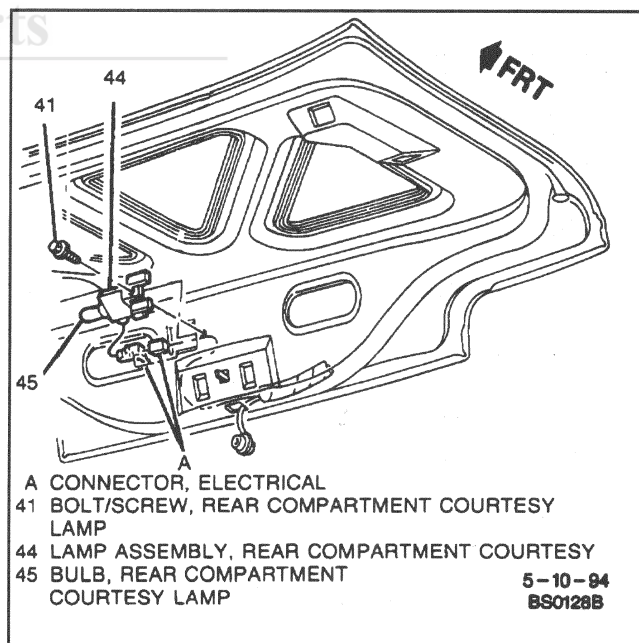


Figure 12 - Rear Compartment Courtesy Lamp-(Sedan)

→ Install or Connect

1. Bulb.
2. Lens.
3. Lens retaining clip.

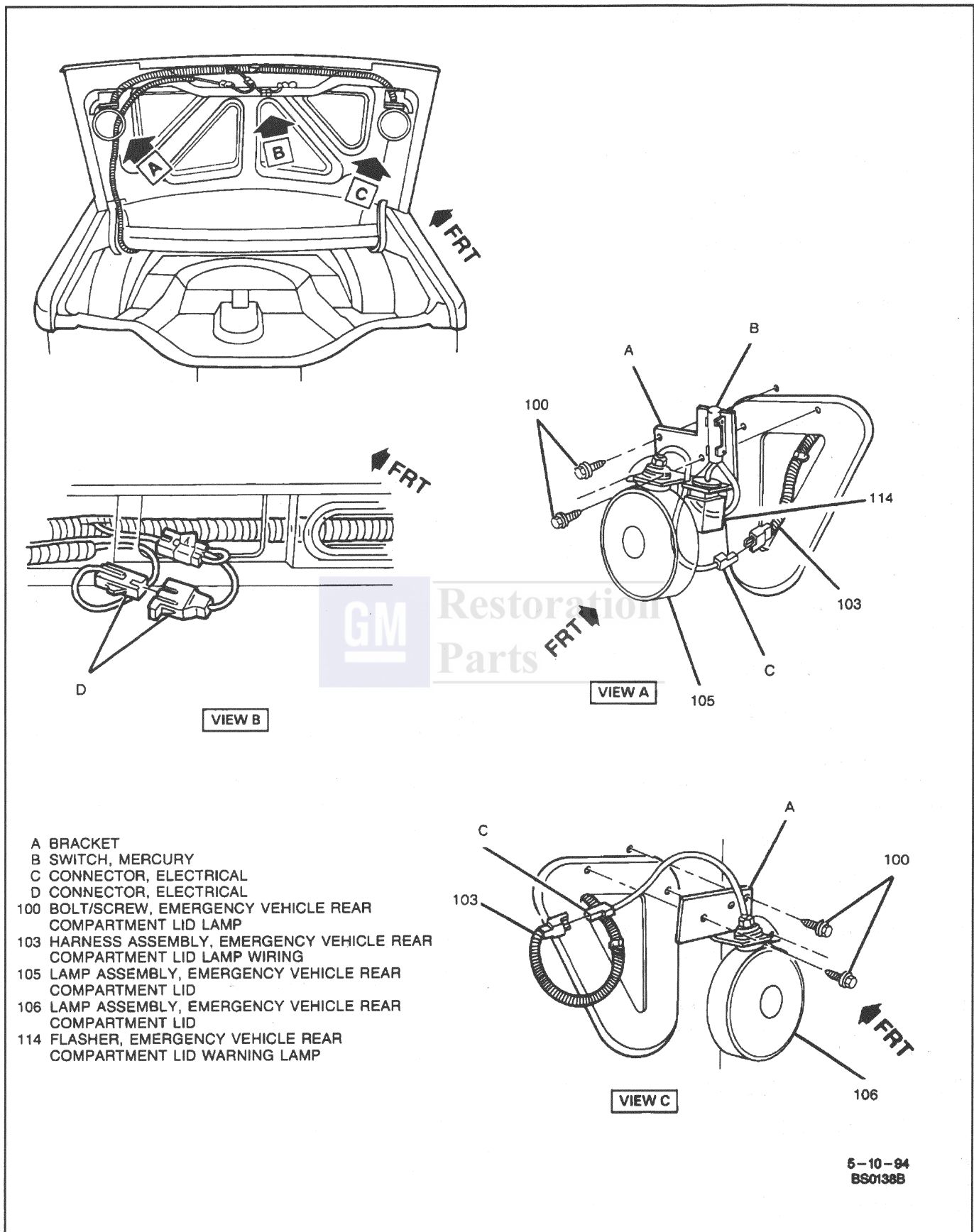


Figure 13 - Rear Compartment Lid Lamps-(Police)

REAR LICENSE LAMP BULB REPLACEMENT

(Sedan)

Figure 14

Remove or Disconnect

1. Two bolts/screws (21) from lamp (20).
2. Lamp (20) from rear compartment lid.
3. Electrical connector from lamp (20).
4. Bulb (19) from electrical connector.

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulb (19) to electrical connector.
2. Electrical connector into lamp (20).
3. Lamp (20) to rear compartment lid.
4. Two bolts/screws (21) to lamp (20).

Tighten

- Bolts/screws (21) to 1.3 N.m (12 lb. in.).

(Wagon)

For replacement of rear license lamp molding, refer to SECTION 10-8.

Remove or Disconnect

1. Two bolts/screws attaching lens to molding.
2. Lamp from molding.
3. Bulb from lamp.
4. Repeat steps 1, 2, and 3 for second bulb, if necessary.

Install or Connect

1. Bulb into lamp.
2. Lamp into molding.
3. Two bolts/screws attaching lens to molding.
4. Repeat steps 1, 2, and 3 for second bulb, if necessary.

REAR SIDEMARKER LAMPS

To replace a rear sidemarker lamp bulb, refer to "Taillamps" in this section.

REAR WINDOW PANEL LAMPS (POLICE)

Lamp Replacement

Figure 15

Remove or Disconnect

1. Rear seat cushion and seatbacks. Refer to SECTION 10-10.
2. Electrical connector.

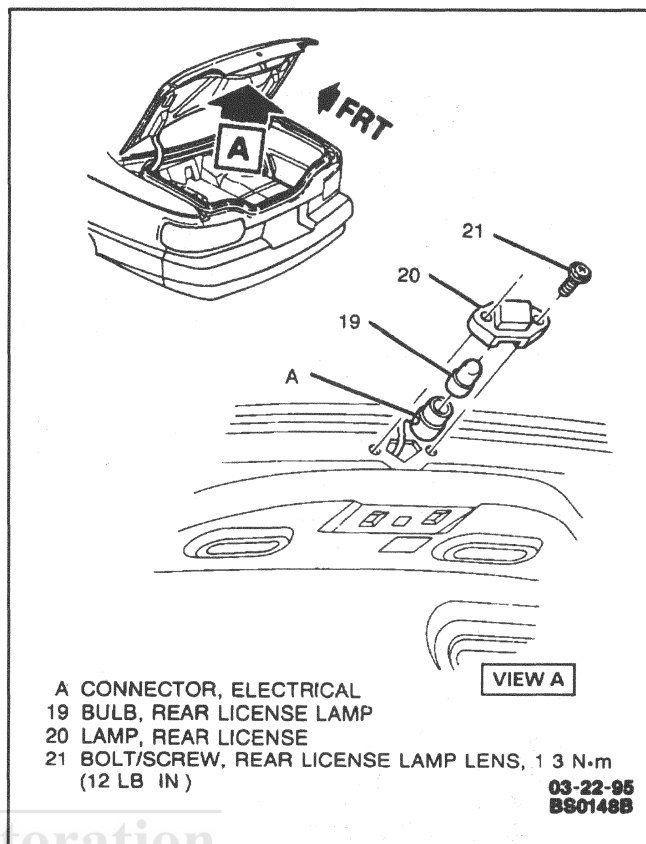


Figure 14 - Rear License Lamp-(Sedan)

3. Bolts/screws (110) attaching bracket (111) to rear window panel (1).
4. Bracket (111) with attached lamp (108).

Install or Connect

1. Bracket (111) with attached lamp (108).
2. Bolts/screws (110) attaching bracket (111) to rear window panel (1).
3. Electrical connector.
4. Rear seat cushion and seatbacks. Refer to SECTION 10-10.

Lens and Bulb Replacement

Remove or Disconnect

1. Lens retaining clip.
2. Lens.
3. Bulb.

Install or Connect

1. Bulb.
2. Lens.
3. Lens retaining clip.

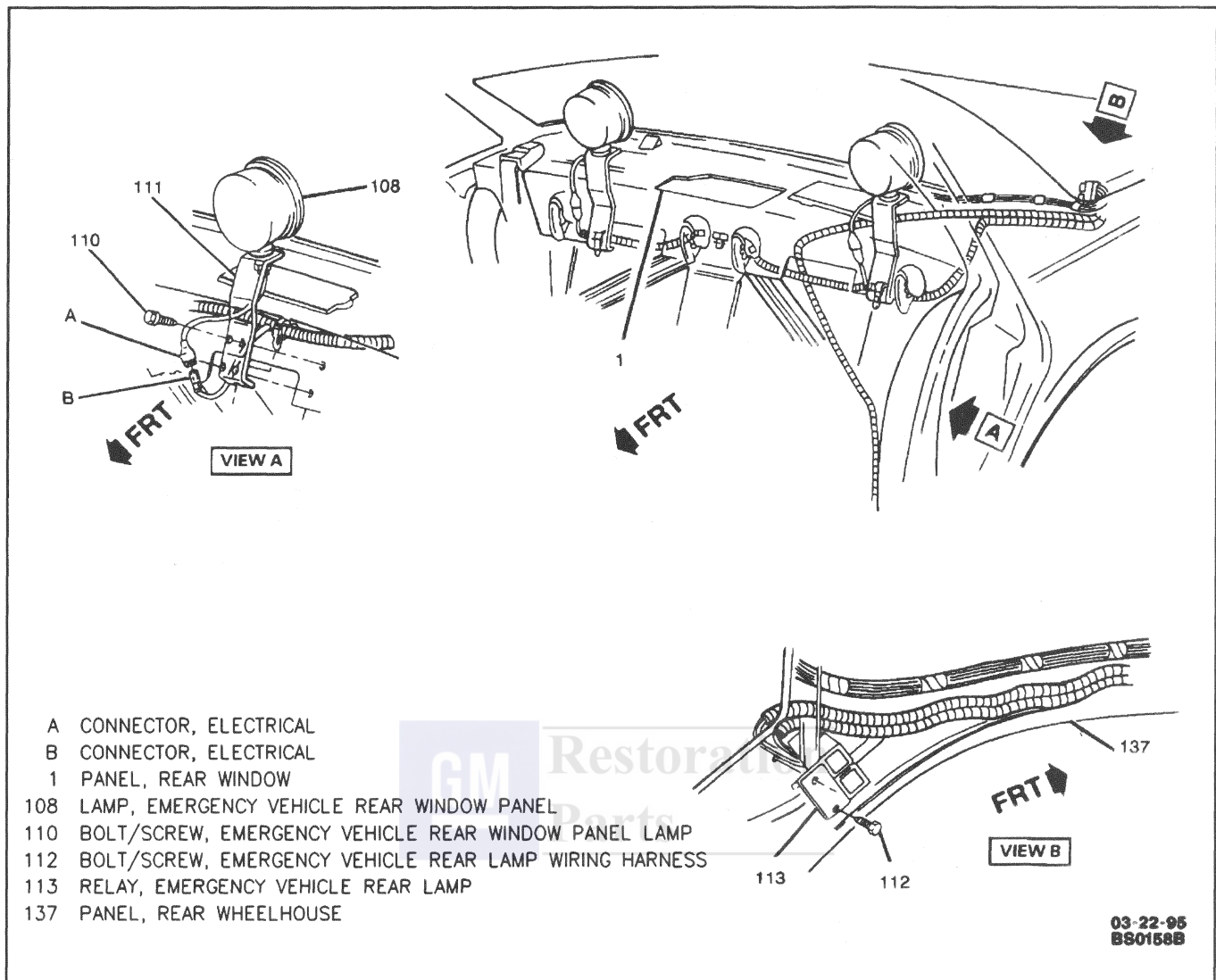


Figure 15 - Rear Window Panel Lamps-(Police)

SPOTLAMP (POLICE AND TAXI)

Figure 16

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in Section 0A.

1. Battery negative cable.
2. Screw (129) from wedge key nut.
3. Wedge key nut from handle (130).
4. Handle (130) from the outer tube shaft.
5. Collar (131).
6. Wire clip (132).
7. Escutcheon (133).
8. Electrical connector.
9. Bracket clamp screw (127) from bracket (124).
10. Spotlamp (120) and shaft by pulling out of bracket (124).

11. Bolts/screws (123) attaching bracket (124), gasket (125) and opening cover (126) to "A" pillar.
12. Bracket (124), gasket (125) and opening cover (126) from "A" pillar.

Install or Connect

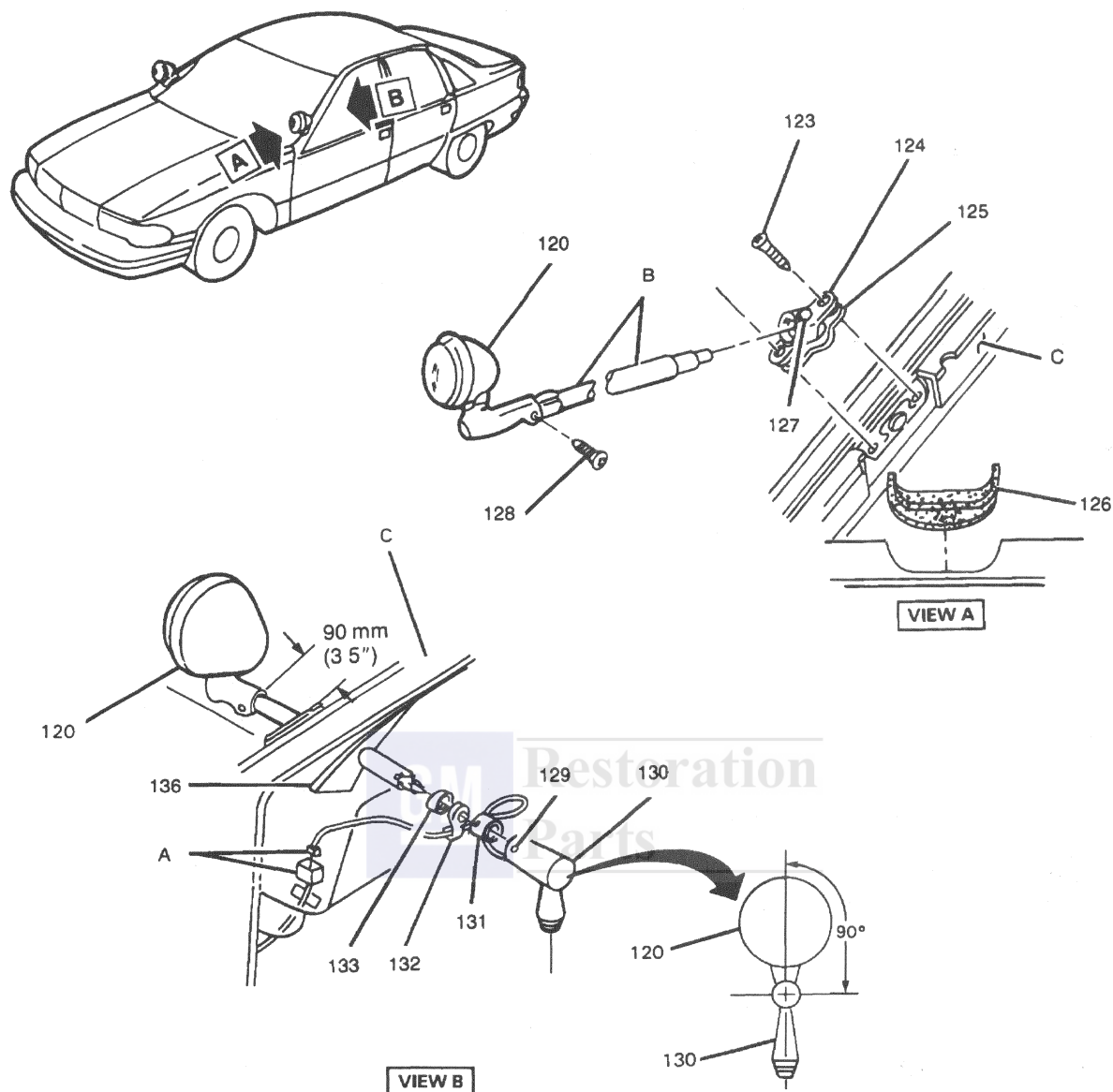
NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bracket (124), gasket (125) and opening cover (126) to "A" pillar.
2. Bolts/screws (123) attaching bracket (124), gasket (125) and opening cover (126) to "A" pillar.

Tighten

- Bolts/screws (123) to 1.7 N.m (15 lb. in.).
3. Position spotlamp (120) and shaft in bracket (124) with a 90 mm (3.5 inch) spacing between spotlamp (120) and bracket (124).

8B-16 LIGHTING SYSTEMS AND HORNS



- | | |
|--|---|
| A CONNECTOR, ELECTRICAL | 128 SCREW, SPOTLAMP HEAD CLAMPING 3.3 N·m (29 LB IN) |
| B SHAFT, SPOTLAMP | 129 SCREW, SPOTLAMP WEDGE 6 N·m (53 LB IN) |
| C "A" PILLAR | 130 HANDLE, SPOTLAMP |
| 120 SPOTLAMP ASSEMBLY | 131 COLLAR, SPOTLAMP |
| 123 BOLT/SCREW, SPOTLAMP 17 N·m (15 LB IN) | 132 CLIP, SPOTLAMP WIRE |
| 124 BRACKET, SPOTLAMP MOUNTING | 133 ESCUTCHEON, SPOTLAMP |
| 125 GASKET, SPOTLAMP | 136 MOLDING ASSEMBLY, WINDSHIELD GARNISH |
| 126 COVER, SPOTLAMP | |
| 127 SCREW, SPOTLAMP BRACKET CLAMP 10 N·m (89 LB IN) | |

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Figure 16 - Spotlamp-(Police and Taxi)

4. Rotate spotlight (120) to upright position with spotlight (120) pointing forward.
5. Bracket clamp bolt/screw (127) to bracket (124).
 - Tighten bracket clamp bolt/screw (127) just enough to hold spotlight (120) firmly in upright position.
6. Escutcheon (133), wire clip (132) and collar (131) onto shaft and tighten collar setscrew securely.
 - Must be installed after windshield garnish molding. Refer to SECTION 10-9.
7. Adjust spotlight head clamping screw (128) to permit spotlight (120) to rotate on shaft using slight force.
8. Check spotlight wedge key to assure that internal key notch is aligned with handle hole to permit passage of spotlight outer tube shaft.
9. Electrical connector.
10. Handle (130) onto shaft and engage two detents.
 - A. Rotate handle (130) slowly until inner key engages with inner tube shaft slot.
 - B. Then rotate handle (130) until outer tube shaft engages outer key with parkstop-backstop notch in outer tube shaft.
 - C. After detents are engaged, position handle (130) downward and vertically aligned with spotlight head axis.
11. Wedge key nut to secure handle (130) to shaft.
12. Bolt/screw (129) into wedge key nut.



Tighten

- Bolt/screw (129) to 6 N.m (53 lb. in.).
13. Battery negative cable.

Spotlamp Bulb

CAUTION: Refer to **CAUTION** under “Halogen Bulbs” in this section.

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in Section 0A.



Remove or Disconnect

1. Battery negative cable.
2. Spotlight bezel retaining screw.
3. Spotlight bulb and bezel from spotlight housing.
4. Electrical connectors.
5. Spotlight bulb from bezel.



Install or Connect

1. Spotlight bulb into bezel.
2. Electrical connectors.
3. Spotlight bulb and bezel into spotlight housing.
4. Spotlight bezel retaining screw.
5. Battery negative cable.

Spotlamp Switch



Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in Section 0A.

1. Battery negative cable.
2. Switch cover retaining screws.
3. Switch cover.
 - Cut wire at switch.



Install or Connect

1. Splice wires and solder.
2. Switch cover.
3. Switch cover retaining screws.
4. Battery negative cable.

Spotlamp Travel Adjustment

Figure 16



Adjust

- Spotlight travel.
 - A. Loosen bracket clamp bolt/screw (127).
 - B. Grasp the spotlight (120) and rotate it slowly inboard until shaft contacts parkstop.
 - C. Slowly rotate spotlight (120) outboard to a position 5 degrees past vertical, so backstop is in motion and outer tube shaft is forced to rotate.
 - D. Tighten bracket clamp bolt/screw (127) enough to prevent outer shaft tube from rotating while spotlight (120) is moving between stop positions.
 - E. Rotate spotlight head inboard to position parkstop so as to prevent spotlight (120) from coming in contact with body components.
 - F. The parkstop of shaft must be positioned, so that spotlight (120) can be rotated on its axis and clear nearest body components by 13 mm to 0.5 mm (0.50 inch to 0.02 inch).
 - G. When parkstop has been set, tighten bracket clamp screw (127) to prevent spotlight shaft from being rotated.



Tighten

- Bracket clamp bolt/screw (127) to 10 N.m (89 lb. in.).
- H. Adjust spotlight head clamping bolt/screw (128) to allow easy rotation of spotlight (120) on shaft, but it must hold spotlight (120) in any adjusted position between parkstop and backstop. (Total motion of spotlight head is approximately 90 degrees).



Tighten

- Head clamping bolt/screw (128) to 3.3 N.m (29 lb. in.).

8B-18 LIGHTING SYSTEMS AND HORNS

TAILLAMP BULB REPLACEMENT

Figures 17 through 20

Take care to prevent waterleaks if sealing surfaces are disturbed. Damaged gaskets must be replaced. If necessary, use sealer (body caulking compound or equivalent) in critical areas or any area where gasket doesn't seal properly.

(Chevrolet Sedan)

Remove or Disconnect

1. Convenience net retainers (23).
2. Bolt/screw (25).
3. Taillamp (24) from vehicle.
4. Electrical connectors, as necessary, from taillamp (24).
5. Bulbs (31 through 33), as necessary, from electrical connectors.
6. Rosebud clips from taillamp (24), if replacing taillamp (24).

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Rosebud clips to taillamp (24), if replacing taillamp (24).

2. Bulbs (31 through 33), as necessary, to electrical connectors.
3. Electrical connectors, as necessary, from taillamp (24).
4. Taillamp (24) to vehicle.
5. Bolt/screw (25).

Tighten

- Bolt/screw (25) to 5 N.m (44 lb. in.).

6. Convenience net retainers (23).

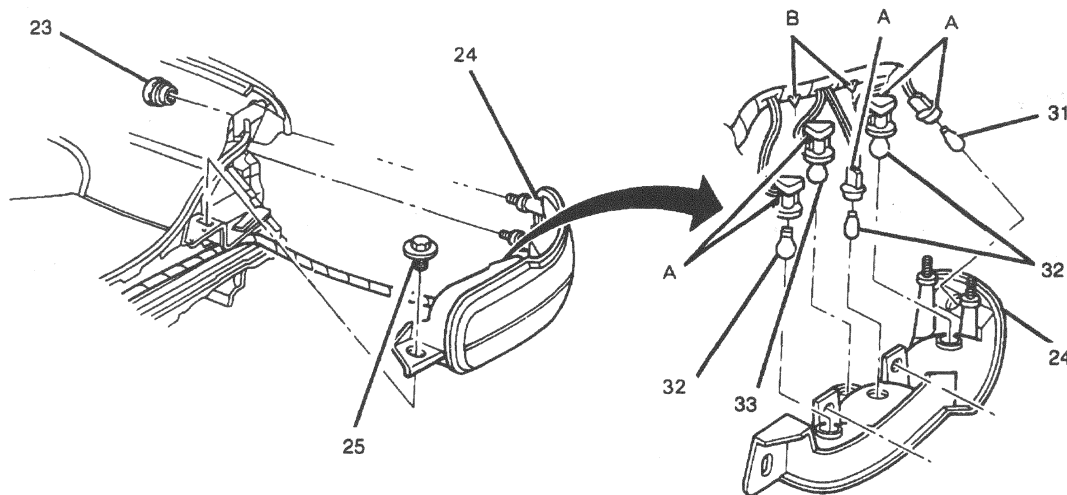
Tighten

- Convenience net retainers (23) to 2.5 N.m (22 lb. in.).

(Buick Sedan)

Remove or Disconnect

1. Reposition rear compartment trim.
2. Nuts (88).
3. Taillamp (93) from vehicle.
4. Electrical connectors, as necessary, from taillamp (95).
5. Bulbs (89 through 92), as necessary, from electrical connectors.



A CONNECTOR, ELECTRICAL
B CLIP, ROSEBUD
23 RETAINER, CONVENIENCE NET 2.5 N.m (22 LB. IN.)
24 TAILLAMP
25 BOLT/SCREW, TAILLAMP 5 N.m (44 LB. IN.)

31 BULB, REAR SIDE MARKER LAMP
32 BULB, TAILLAMP
33 BULB, BACKUP LAMP

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Figure 17 - Taillamps-(Chevrolet Sedan)

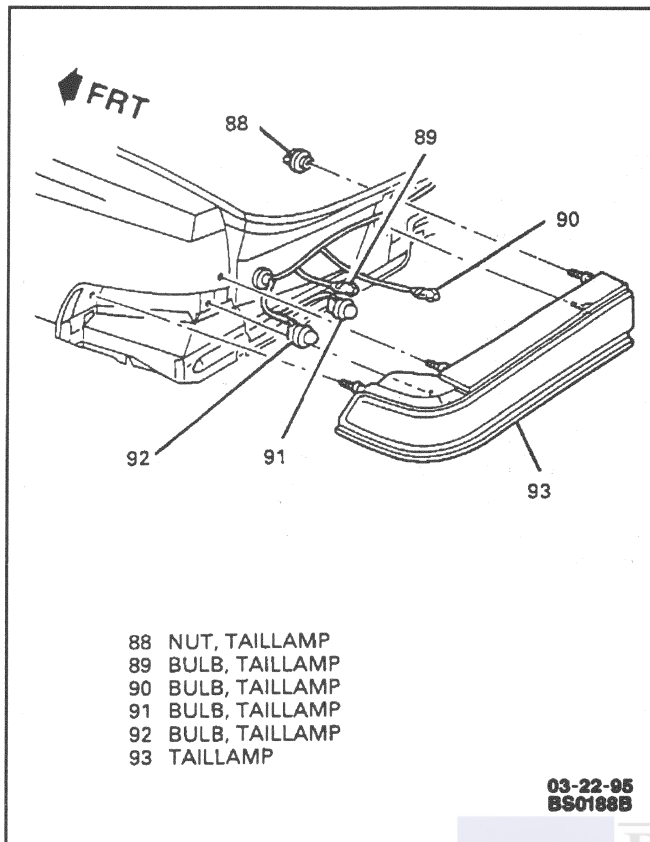


Figure 18 - Taillamps-(Buick Sedan)

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulbs (89 through 92), as necessary, to electrical connectors.
2. Electrical connectors, as necessary, to taillamp (93).
3. Taillamp (93) to vehicle.
4. Nuts (88).

Tighten

- Nuts (88) to 5 N.m (44 lb. in.).
5. Reposition rear compartment trim.

(Wagon)

Remove or Disconnect

1. Open end gate window and lower end gate.
2. Trim panels. Refer to SECTION 10-7.
3. Nut (68).
4. Two bolts/screws (69).
5. Taillamp (70 or 71) from vehicle.
6. Electrical connectors from taillamp (70 or 71).
7. Bulb (31, 32 or 33), as necessary, from electrical connectors.

NOTICE: Refer to "Notice" on page 8B-1 of this section.

Install or Connect

1. Bulb (31, 32, or 33), as necessary, into electrical connectors.
2. Electrical connectors into taillamp (70 or 71).
3. Taillamp (70 or 71) to vehicle.
4. Two bolts/screws (69).

Tighten

- Bolts/screws (69) to 2 N.m (18 lb. in.).
5. Nut (68).

Tighten

- Nut (68) to 5 N.m (44 lb. in.).
6. Trim panels. Refer to SECTION 10-7.
 7. Raise end gate and close end gate window.

BACKUP LAMPS

Bulb Replacement

For Chevrolet or Buick refer to "Taillamps" in this section

(Buick Sedan)

Remove or Disconnect

1. Electrical connector from lamp (115).
2. Bulb (114) from electrical connector.

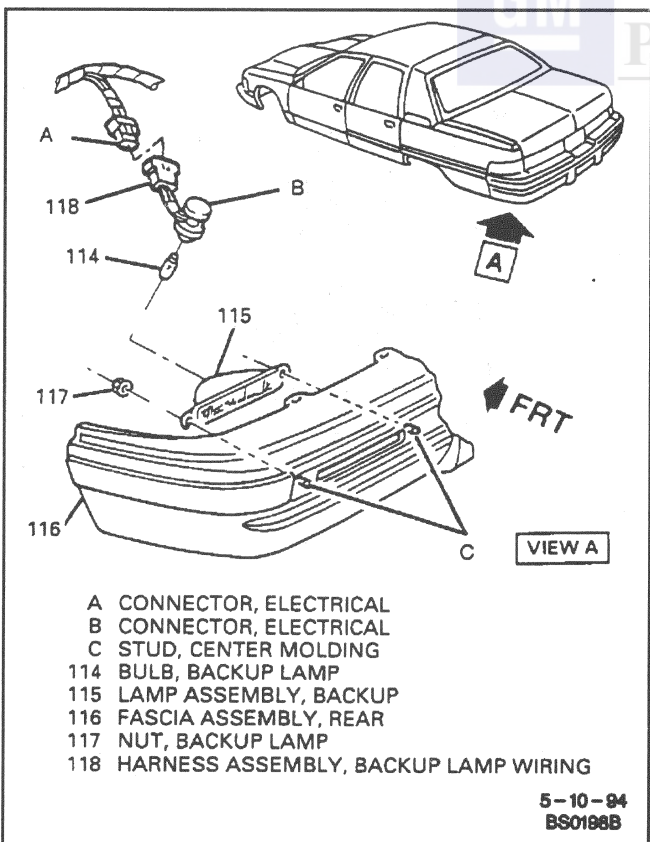
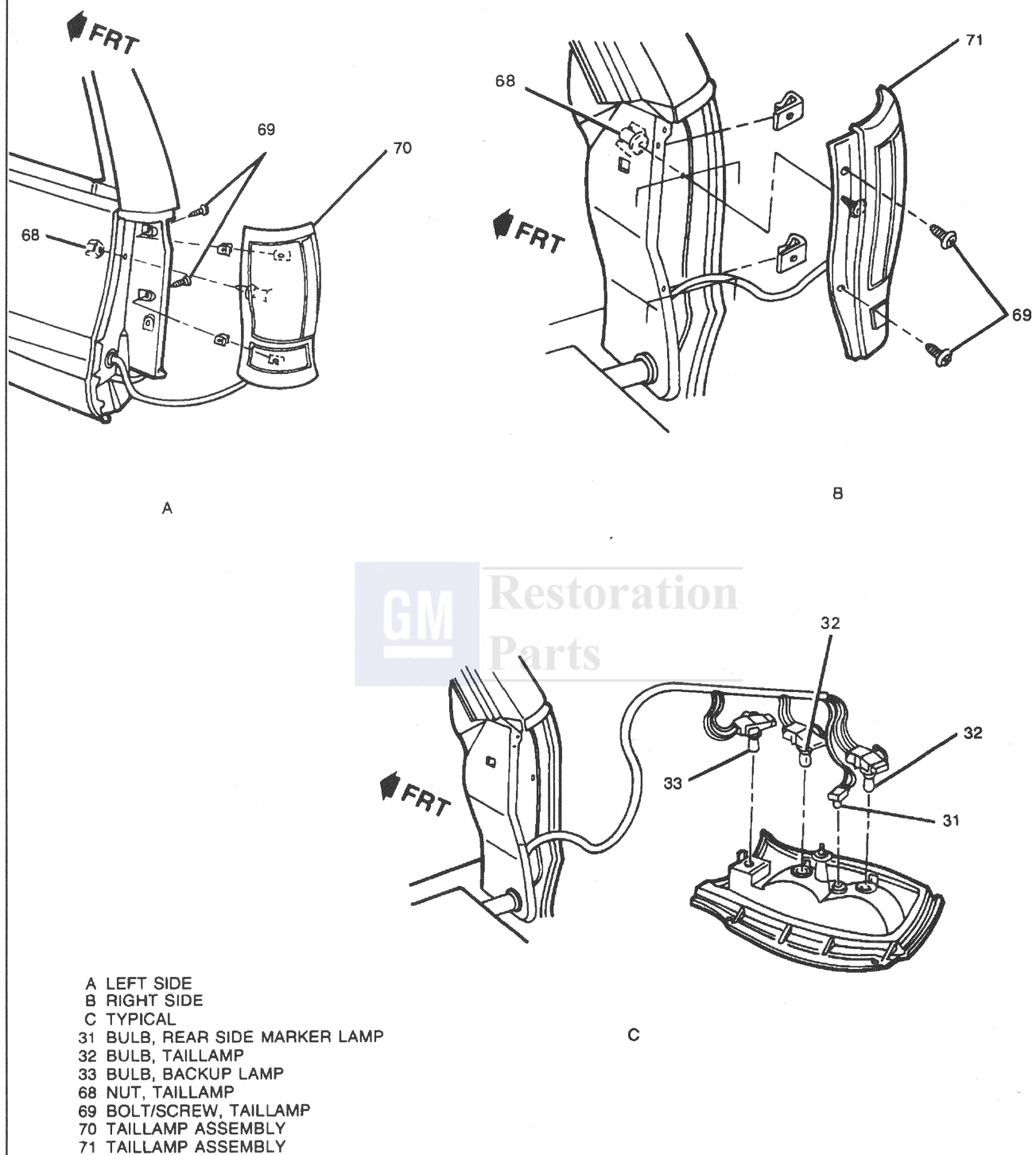


Figure 19 - Backup Lamp-(Buick Sedan)



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Figure 20 - Taillamps-(Wagon)

Install or Connect

1. Bulb (114) into electrical connector.
2. Electrical connector to lamp (115).

Lamp Replacement

Remove or Disconnect

1. Electrical connector from lamp (115).
2. Rear fascia. Refer to SECTION 10-4.
3. Nuts (117) attaching lamp (115) to center molding stud.
4. Lamp (115) from rear fascia (116).

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Lamp (115) to rear fascia (116).
2. Nuts (117) attaching lamp (115) to center molding stud.

Tighten

- Nuts (117) to 4 N.m (35 lb. in.).
3. Rear fascia. Refer to SECTION 10-4.
 4. Electrical connector to lamp (115).

TURN SIGNAL LAMP FLASHER

Figure 5

Remove or Disconnect

- Turn signal lamp flasher (65) from convenience center.

Install or Connect

- Turn signal lamp flasher (65) to convenience center.

WARNING LAMP FLASHER

Remove or Disconnect

- Warning lamp flasher (114) from connector.

Install or Connect

- Warning lamp flasher (114) into connector.

UNDERHOOD LAMP

Lamp Replacement

Figure 21

Remove or Disconnect

1. Electrical connector.
2. Rivets (48), using drill and 1/8-inch drill bit.
3. Underhood lamp (46).

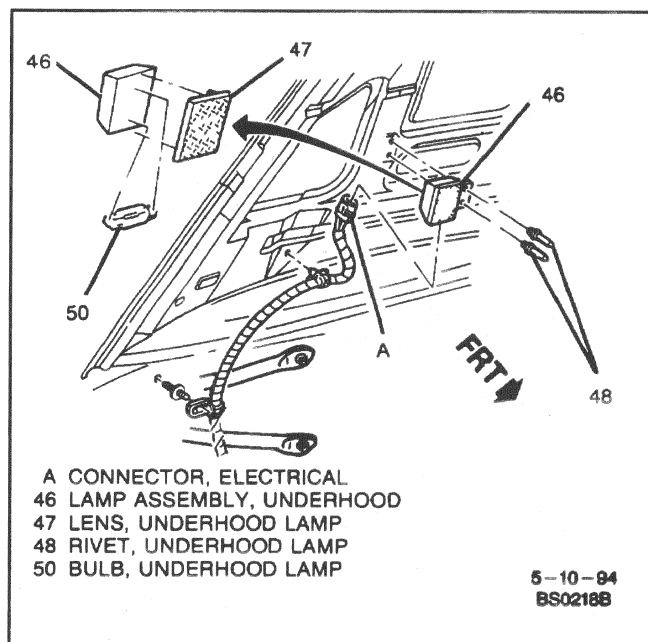


Figure 21 - Underhood Lamp

Install or Connect

1. Underhood lamp (46).
2. Rivets (48).
3. Electrical connector.

Bulb Replacement

Remove or Disconnect

1. Lens (47).
2. Bulb (50).

Install or Connect

1. Bulb (50).
2. Lens (47).

INTERIOR LIGHTING

For information on warning/indicator lamps, instrument cluster lamps, etc., refer to SECTION 8C. For circuit information, refer to SECTION 8A.

Ashtray Lamp Bulb Replacement

Figure 22

Remove or Disconnect

1. Ashtray (51).
2. Electrical connector from ashtray lamp connector by twisting electrical connector clockwise and pulling it out.
3. Bulb (53) by twisting counterclockwise.

Install or Connect

1. Bulb (53).
2. Electrical connector to ashtray lamp connector.
3. Ashtray (51).

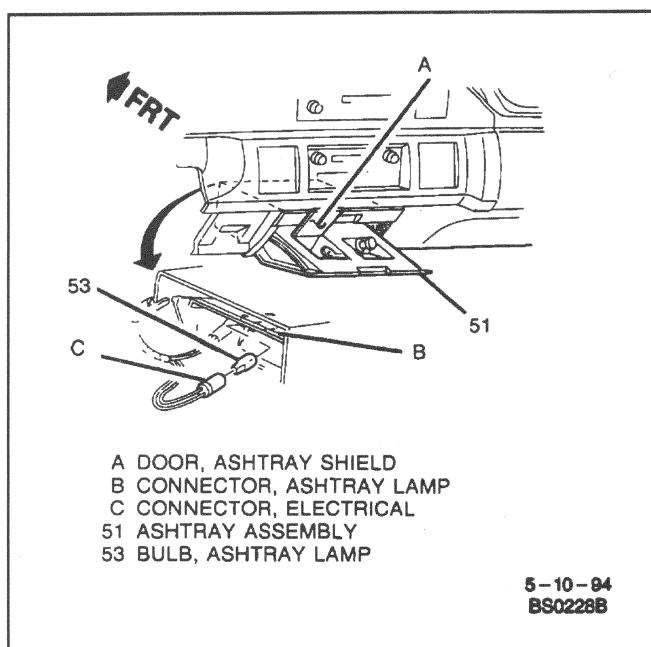


Figure 22 - Ashtray Lamp Replacement-(Typical)

Front Door Courtesy Lamps

Remove or Disconnect

1. Lens from front side door left/right trim.
2. Bulb from electrical connector.

Install or Connect

1. Bulb into electrical connector.
2. Lens to front side door left/right trim.

Instrument Panel Courtesy Lamps

Figure 23

Remove or Disconnect

1. Instrument panel sound insulator panel, if necessary. Refer to SECTION 8C.
2. Bolt/screw (97) attaching lamp (96) to instrument panel carrier.
3. Bulb (95) from lamp (96).

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulb (95) to lamp (96).
2. Bolt/screw (97) attaching lamp (96) to instrument panel carrier.

Tighten

- Bolt/screw (97) to 1.9 N-m (17 lb. in.).
3. Instrument panel sound insulator panel, if necessary. Refer to SECTION 8C.

Dome Lamp Bulb Replacement (Chevrolet)

Remove or Disconnect

1. Lens.
 - Carefully insert small screwdriver between housing and lens at front or rear (at sides, if police or taxi vehicle) to disengage and remove.
2. Bulb from terminal clips.

Install or Connect

1. Bulb to terminal clips.
2. Lens.
 - A. Engage front edge of lens to dome lamp housing.
 - B. Carefully squeeze lens to engage rear edge of lens.
 - Carefully squeeze sides of lens, for police or taxi vehicle, to engage edge of lens.

LAMP REPLACEMENT

For replacement of dome lamp assembly, refer to SECTION 10-9.

Front Reading Lamps Bulb Replacement

CAUTION: Electrochromic material may irritate eyes and skin. In case of contact, take the following action: Eye contact -rinse thoroughly with water. Skin contact - wash with soap and water. If ingested - consult a physician immediately.

Remove or Disconnect

1. Inside rearview mirror lamp housing bolt/screw.
2. Inside rearview mirror lamp housing.
3. Inside rearview mirror lamp bulb.

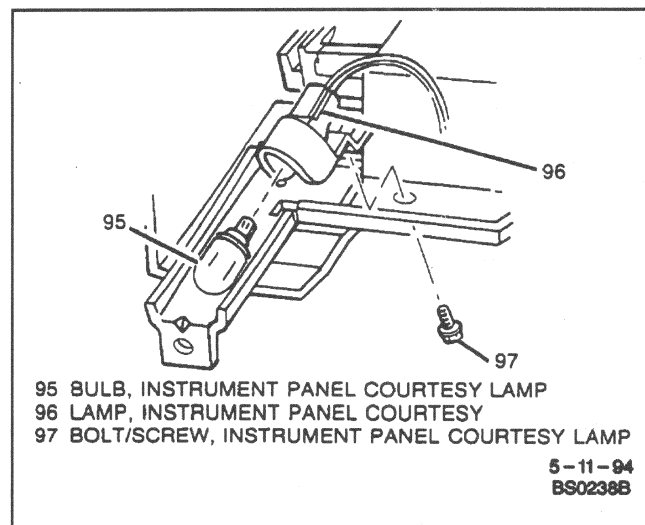


Figure 23 - Instrument Panel Courtesy Lamp-(Typical)

Install or Connect

1. New inside rearview mirror lamp bulb.
2. Inside rearview mirror lamp housing.
3. Inside rearview mirror lamp housing bolt/screw.
 - Tighten securely.

Roof Rail Courtesy and Reading Lamp Bulb Replacement

Remove or Disconnect

1. Bolt/screw attaching roof rail courtesy and reading lamp to roof rail.
2. Electrical connector.
3. Bezel from lamp.
 - Insert a screwdriver in access hole to disengage.
4. Lens carrier from back housing.
 - Insert screwdriver between back housing and lens carrier to disengage.
5. Lamp socket from lens carrier.
6. Bulb from lamp socket.

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Bulb into lamp socket.
2. Lens socket into lens carrier.
3. Lens carrier into back housing.
 - Snap into place.
4. Lamp to bezel.
 - Carefully snap into place.
5. Electrical connector.
6. Bolt/screw attaching roof rail courtesy and reading lamp to roof rail.

Instrument Panel Compartment Panel Compartment Lamp Bulb Replacement

Remove or Disconnect

1. Retainer attaching switch to instrument panel carrier.
2. Bulb from switch.

Install or Connect

1. Bulb into switch.
2. Retainer with attached switch into instrument panel carrier.
 - Gently snap into place.

Rear Compartment Lamps (Wagon)

BACK BODY PILLAR ASSIST HANDLE LAMPS

Remove or Disconnect

1. Lens.
 - Insert a small screwdriver into top of lens to disengage from handle and remove.
2. Bulb from socket.

Install or Connect

1. Bulb into socket.
2. Lens.
 - Insert bottom of lens into handle and then snap into place.

Vanity Mirror Bulb Replacement

Remove or Disconnect

1. Lamp lens.
 - Insert a small screwdriver at bottom edge of lamp lens to unsnap.
2. Bulb.

Install or Connect

1. Bulb.
2. Lamp lens.
 - Insert top of lamp lens and snap in bottom.

HORNS

Current Adjustment

Figure 24

Current draw for a horn while operating should be 4.5 to 5.5 amperes at 11.5 to 12.5 volts. High current (more than 20 amperes) indicates an overheated winding or shorted horn; replace the horn. A current reading of about 18 amperes means contact points are not opening; adjust horn current.

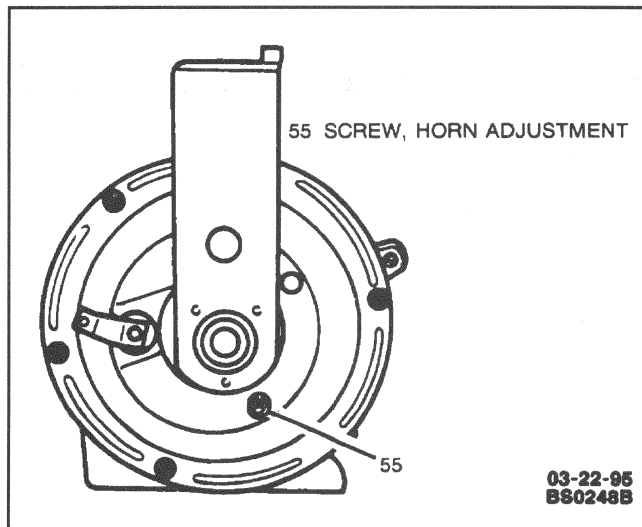


Figure 24 - Horn Adjustment

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8B-24 LIGHTING SYSTEMS AND HORNS

No current reading indicates a broken connection or an open circuit due to a broken lead or overheated horn. An overheated horn must be replaced. No current reading may also mean contact points are open: adjust horn.

Adjust

1. Increase current - turn adjustment screw (55) clockwise.
2. Decrease current - turn adjustment screw (55) counterclockwise.
3. Current adjustments should be made 1/4 turn (90 degrees) at a time.

Horn Replacement

Figure 25

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in Section 0A.

1. Battery negative cable.
2. Bolts/screws (56) from horns (57 or 58).
3. Electrical connectors from horns (57 or 58).
4. Horns (57 or 58).

Install or Connect

NOTICE: Refer to "Notice" on page 8B-1 of this section.

1. Electrical connectors to horns (57 or 58).
2. Horns (57 or 58).
3. Bolts/screws (56) to horns (57 or 58).

Tighten

- Bolts/screws (56) to 17 N.m (13 lb. ft.).
4. Battery negative cable.

Horn Relay

Figure 5

The horn relay is in the convenience center, behind the instrument panel to left of the steering column.

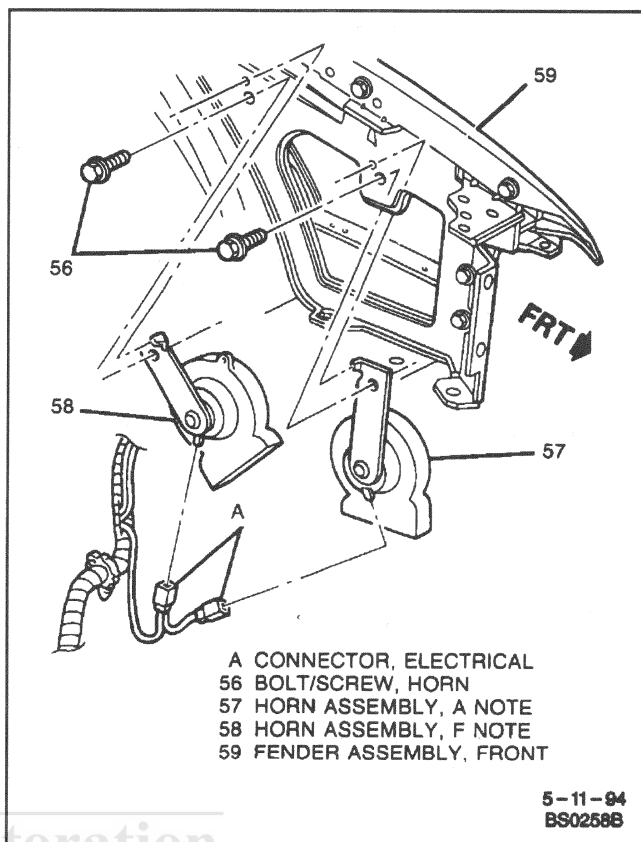


Figure 25 - Horn Mounting-(Typical)

Remove or Disconnect

- Horn relay (64) from convenience center.

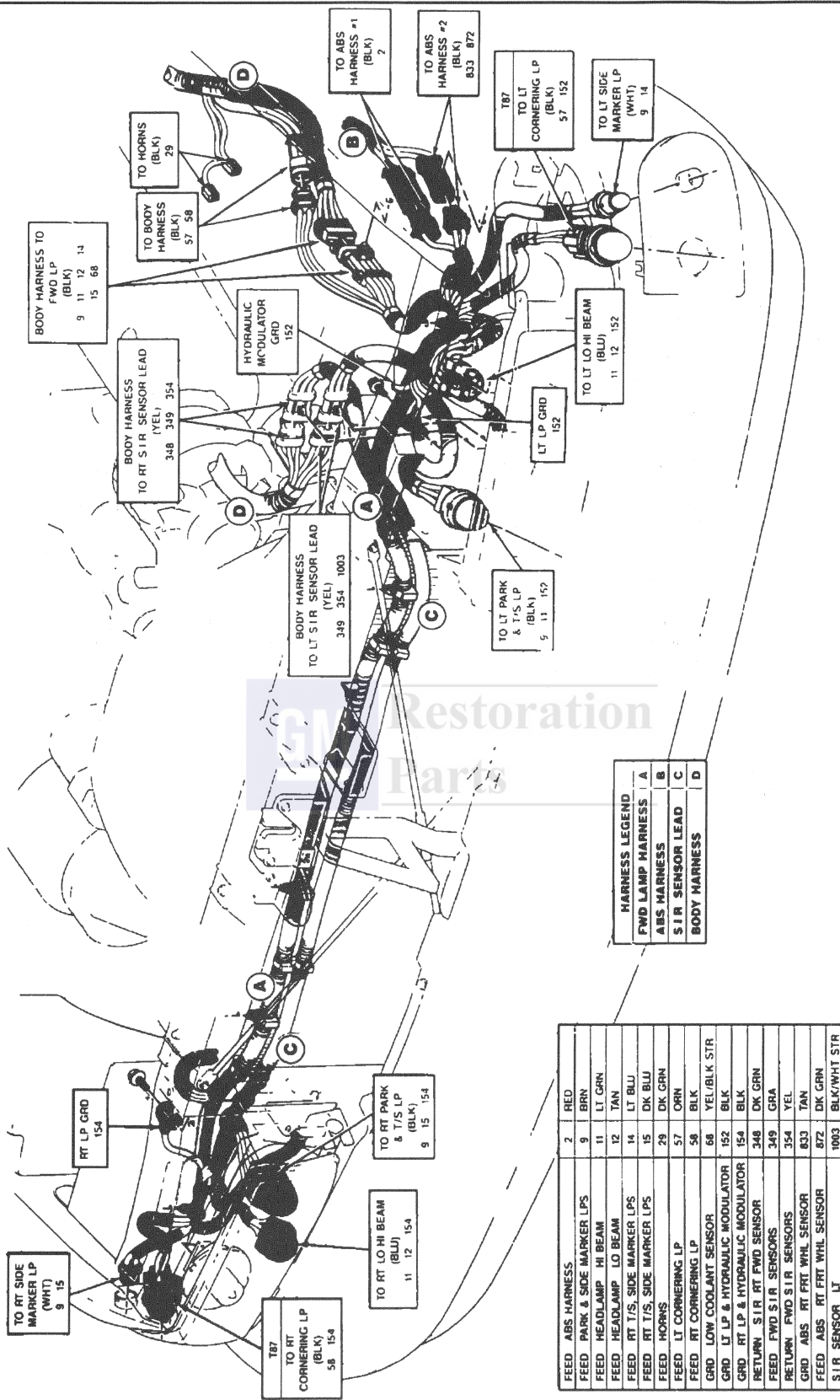
Install or Connect

- Horn relay (64) into convenience center.

FRONT LAMP WIRING HARNESS

Refer to Figures 26 and 27 in this section. For police vehicles, refer to Figure 28 in this section.

ENGINE COMPARTMENT WIRING
FRONT END

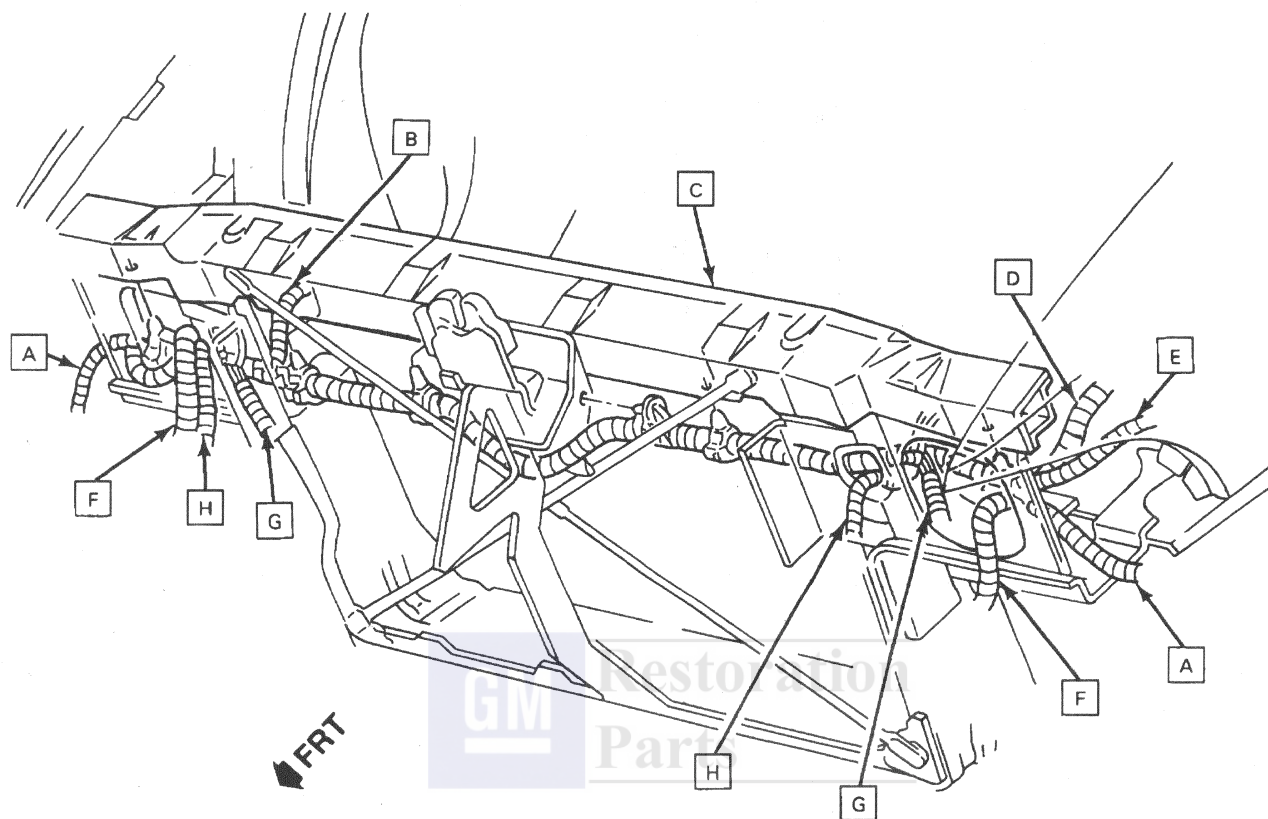


HARNES LEGEND	
FWD LAMP HARNES	A
ABS HARNES	B
S I/R SENSOR LEAD	C
BODY HARNES	D

FEED ABS HARNES	2	RED
FEED PARK & SIDE MARKER LPS	9	BRN
FEED HEADLAMP HI BEAM	11	LT GRN
FEED HEADLAMP LO BEAM	12	TAN
FEED RT T/S, SIDE MARKER LPS	14	LT BLU
FEED RT T/S, SIDE MARKER LPS	15	DK BLU
FEED HORNS	29	DK GRN
FEED LT CORNERING LP	57	ORN
FEED RT CORNERING LP	58	BLK
GRD LOW COOLANT SENSOR	66	YEL/BLK STR
GRD LT LP & HYDRAULIC MODULATOR	152	BLK
GRD RT LP & HYDRAULIC MODULATOR	154	BLK
RETURN S I/R RT FWD SENSOR	348	DK GRN
FEED FWD S I/R SENSORS	349	GRA
RETURN FWD S I/R SENSORS	354	YEL
GRD ABS RT FRT WHL SENSOR	833	TAN
FEED ABS RT FRT WHL SENSOR	872	DK GRN
S I/R SENSOR LT	1003	BLK/WHIT STR

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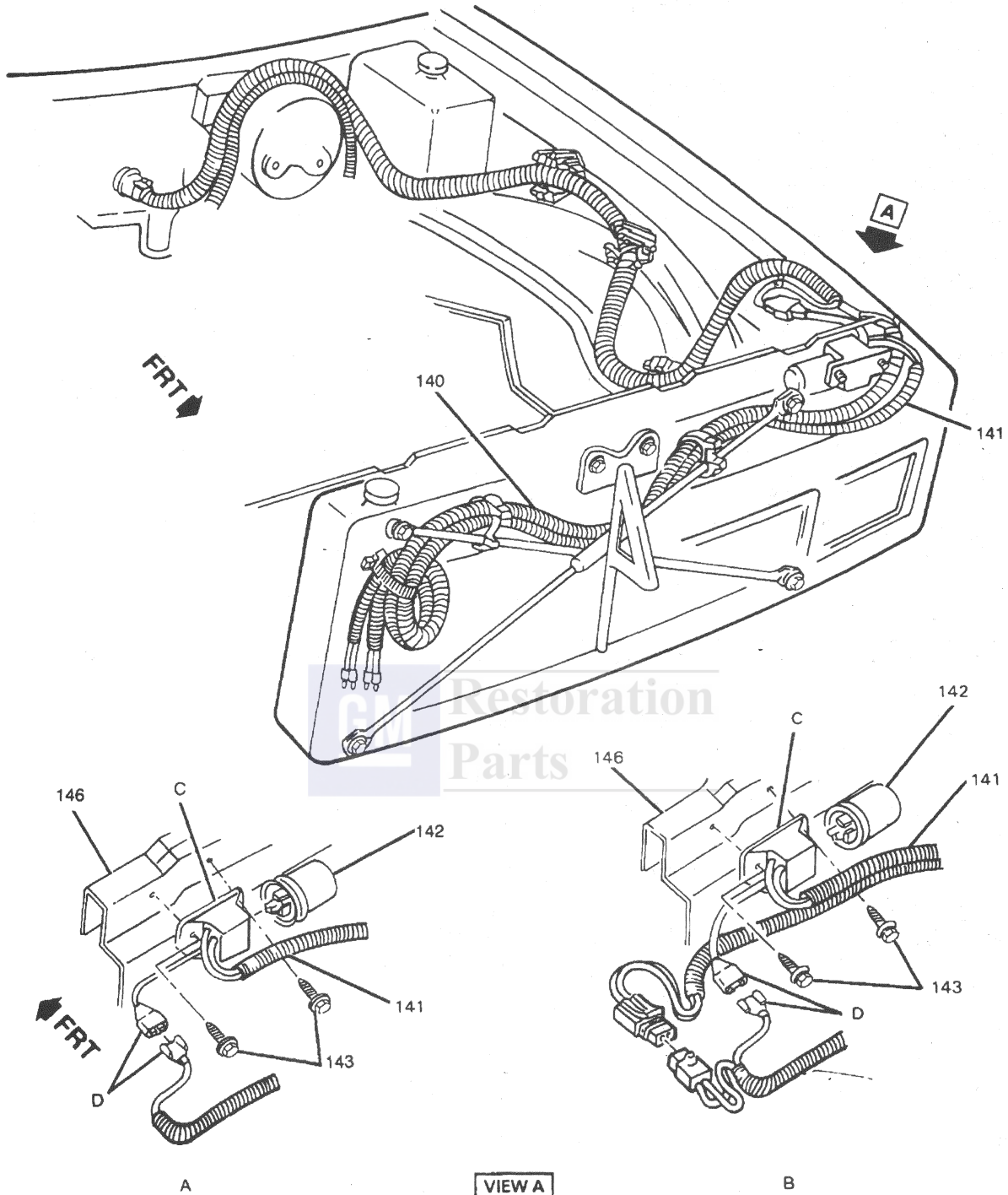
Figure 26 - Front Lamp Wiring Harness-(Except Buick Sedan)



- A TO CORNERING LAMP
- B TO RIGHT WHEEL SPEED SENSOR
- C RADIATOR SUPPORT
- D TO BODY HARNESS
- E TO ABS HARNESS
- F TO HEADLAMP
- G TO TURN SIGNAL LAMP
- H TO PARK/SIDEMARKER LAMPS

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Figure 27 - Front Lamp Wiring Harness-(Buick Sedan)



- A WITHOUT SPEAKER HARNESS ASSEMBLY
 B WITH SPEAKER HARNESS ASSEMBLY
 C MODULE, FLASHER
 D CONNECTOR, ELECTRICAL
 140 HARNESS ASSEMBLY, EMERGENCY VEHICLE FRONT
 SPEAKER WIRING EXTENTION

- 141 FLASHER ASSEMBLY, EMERGENCY VEHICLE FRONT
 LAMP WIRING
 142 FLASHER ASSEMBLY, EMERGENCY VEHICLE FRONT
 LAMP
 143 BOLT/SCREW, EMERGENCY VEHICLE FRONT LAMP
 FLASHER
 146 FENDER ASSEMBLY, FRONT (INNER)

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Figure 28 - Front Lamp Wiring Harness-(Police)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Backup Lamp Nut (Buick Sedan).....	4 N·m (35 lb. in.)
Bracket Clamp Screw (Police and Taxi).....	10 N·m (89 lb. in.)
Convenience Net Retainer (Sedan).....	2.5 N·m (22 lb. in.)
Front Parking and Sidemarkers Lamp Bolt/Screw (Buick Sedan).....	2.3 N·m (20 lb. in.)
Front Sidemarkers Lamp Bolt/Screw.....	1.3 N·m (12 lb. in.)
Head Clamping Screw (Police and Taxi).....	3.3 N·m (29 lb. in.)
Headlamp Capsule Bolt/Screw.....	5 N·m (44 lb. in.)
High-Mount Stoplamp Bolt/Screw.....	1.5 N·m (13 lb. in.)
Horn Bolt/Screw.....	17 N·m (13 lb. ft.)
Instrument Panel Courtesy Lamp Bolt/Screw.....	1.9 N·m (17 lb. in.)
Opera Lamp Nut (Buick Sedan).....	3 N·m (27 lb. in.)
Rear Compartment Courtesy Lamp Bolt/Screw (Sedan).....	2 N·m (18 lb. in.)
Rear License Lamp Lens Bolt/Screw (Sedan).....	1.3 N·m (12 lb. in.)
Spotlamp Bolt/Screw (Police and Taxi).....	1.7 N·m (15 lb. in.)
Spotlamp Wedge Screw (Police and Taxi).....	6 N·m (53 lb. in.)
Taillamp Bolt/Screw (Sedan).....	5 N·m (44 lb. in.)
Taillamp Bolt/Screw (Wagon).....	2 N·m (18 lb. in.)
Taillamp Nut (Wagon).....	5 N·m (44 lb. in.)

BULB USAGE CHART

Exterior Lamps	Trade No.	Interior Lamps	Trade No.
Backup	2057	Ashtray	168
Cornering	2057	Back Body Pillar Assist Handle	
Front Parking (Buick Sedan)	194	(Wagon)	194
Front Parking and Turn Signal	2057NA	Cluster Illumination	PC194
Headlamp (Halogen)	9004	Courtesy	
High Mount Stoplamp		Door (Chevrolet)	562
Sedan (Chevrolet)	2357	Door (Buick)	563
Sedan (Buick)	1141	Roof Rail Rear	
Wagon	577	Dome	
Rear Compartment Courtesy (Sedan)	920	Sedan	561
Rear Compartment Lid (Police)	1156	Police and Taxi	1156
Rear License		Instrument Panel Compartment	194
Sedan	194	Headlamp Switch	73
Wagon	24	Reading (Front)	192
Rear Window Panel (Police)	1156	Side Window Switch Flood Lamp	37
Side Marker, Front	24	Vanity Mirror	7065
Side Marker, Rear	194	Warning/Indicator	PC161
Spotlamp (Halogen) (Police and Taxi)	H7635		
Taillamp	2057		
Underhood	562		

SECTION 8C

INSTRUMENT PANEL AND GAGES

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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8C-2 INSTRUMENT PANEL AND GAGES

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GENERAL DESCRIPTION

CONTROLS

AM/FM STEREO AND CLOCK RADIO

Refer to SECTION 9A.

HEATER AND AIR CONDITIONING CONTROL

Refer to SECTION 1B1 or SECTION 1C.

CONVENIENCE CENTER

The convenience center is part of the body wiring harness. It is attached to a bracket located on the cowl below the instrument panel to the left of the steering column.

The audio alarm, hazard lamp flasher and turn signal lamp flasher are attached to the convenience center.

For diagnosis of the convenience center and components, refer to SECTION 8A.

FUSE BLOCK

The fuse block is a part of the body wiring harness. It is attached by a bracket on the left front hinge pillar and is accessed through a removable panel on the instrument panel.

For diagnosis, refer to SECTION 8A.

INSTRUMENT PANEL

The instrument panel is a structure that encloses and provides support for compartments, instrument cluster, controls, gages, modules and switches necessary for the safe and convenient operation and use of the vehicle.

The instrument panel is attached to the left and right-hand hinge pillars with rigid support provided by the hinge pillar tie bar (Chevrolet) or by metal brackets which are an integral part of the air distributor (Buick). A sound insulator panel conceals components under the instrument panel and provides a finished appearance.

Both the Chevrolet and Buick instrument panels have a passenger inflator module (air bag) located above the instrument panel compartment (glove box). Refer to SECTION 9J for more information.

An impact absorbing pad covers the top of the instrument panel. Trim plates accent the appearance of the face of the instrument panel.

Vehicles equipped with twilight sentinel or Canadian vehicles equipped with daytime running lamps (DRL) have a headlamp automatic control ambient light sensor installed at the bottom of the windshield defroster nozzle grille which is attached to the upper trim pad. Vehicles equipped with automatic air conditioning have a sunload temperature sensor which is mounted in the same location.

Specifications	8C-35
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The heater and air conditioning module is attached to the cowl. Air ducts connect the case outlets to a floor outlet, windshield defroster nozzle, side window defogger outlets and a high-level air outlet at the center and at each end of the instrument panel. The air distributor is concealed behind the instrument panel.

The steering column is clamped in place at the left side of the instrument panel. Below and to both sides of the steering column is an instrument panel driver knee bolster and deflector.

Instrument Cluster

The instrument cluster is centered above the steering column in the instrument panel. The instrument cluster contains gages and indicators that provide the driver with vehicle performance information.

(Chevrolet)

Gages in the instrument cluster include a fuel gage, an engine coolant temperature gage, an oil pressure gage and a voltmeter. A digital speedometer and digital trip odometer are also included.

The instrument cluster has indicator lamps for headlamp high-beam symbol, turn signal directional indicator arrows and lamps for illumination.

The cluster also contains warning indicator lamps including: "CHANGE OIL," "PASS KEY FAULT," "CHECK GAGE," "LOW" coolant symbol, "LOW" washer fluid symbol, "LOW" fuel symbol, ABS symbol, "LOW OIL LEVEL," "CHECK" engine symbol, "DOOR OPEN," "AIR BAG," "BRAKE" disc symbol, parking brake symbol, fasten seat belt symbol, hazard symbol, "GATE AJAR," if equipped.

(Buick)

Gages in the instrument cluster include a fuel gage, and an engine coolant temperature gage. An analog speedometer and trip odometer are included.

The instrument cluster has indicator lamps for the headlamp high-beam symbol, turn signal directional indicator arrows, and lamps for illumination.

The cluster also contains warning lamps including: "GATE AJAR," if equipped, "PASS KEY," "LOW COOLANT LEVEL," "HOT" temperature symbol, "LOW OIL LEVEL," "CHANGE OIL," "LOW WASH FLUID," "OIL" pressure symbol, fasten seat belt symbol, "VOLTS" battery symbol, "SERVICE ENGINE SOON," "AIR BAG," "LOW FUEL," "BRAKE" parking brake and disc brake symbols, and the ABS symbol "ANTILOCK."

Electric power is directed to the appropriate lamps and gages of the instrument cluster by a flexible printed circuit attached to the back of the instrument cluster case. Two multiple connectors join the printed circuit to the instrument panel wiring harness. The two multiple connectors and the twist-in bulb sockets help to hold the printed circuit to the back of the instrument cluster.

The instrument cluster is non-serviceable, except as noted in this section, and must be replaced as a unit.

When an instrument cluster is replaced, it is required by law that the odometer reading of the replacement unit be set to register the same mileage as the prior odometer. If the same mileage cannot be set, it is also required by law that the replacement odometer be set at zero and a label be installed on the driver's door frame showing the previous odometer reading and the date of replacement. Refer to "Odometer Repair Notice Label" in this section.

Gages

ENGINE COOLANT TEMPERATURE GAGE

The coolant temperature sending unit is mounted to the engine at a point where it is exposed to the coolant being circulated through the engine cooling passages. The sending unit contains a temperature-sensitive variable resistor that senses and reacts to coolant temperature. Resistance decreases as temperature increases.

When electric power is supplied to the engine coolant temperature gage, a current flows through the gage to the variable resistor and then to ground at the engine. The position of the gage pointer is determined by the strength of the current flowing through the gage. When the engine coolant is cold, resistance is high, the current flow is low, and the pointer indicates a cold reading. As coolant temperature increases, the resistance of the sending unit resistor decreases and the pointer moves toward the center of the gage. Prolonged driving or idling in very hot weather may cause the pointer to move beyond this point. An overheat condition exists if the pointer goes into the red zone at the upper limit of the scale.

Dial calibrations go far above the normal boiling point of water 100° C (212° F) because the cooling system is pressurized. The increase in pressure also increases the boiling temperature of the coolant, permitting it to reach temperatures above those possible with a non-pressurized system without boiling. The higher operating temperature of the cooling system that results gives greater cooling efficiency and other benefits.

FUEL GAGE

The fuel gage sending unit is mounted on the top surface of the fuel tank. The fuel level sender itself consists of a float that rides on the surface of the fuel in the tank, and a variable resistor controlled by the float arm. When electric power is supplied to the fuel gage, current flows through the gage to the variable resistor and then to ground. The position of the gage pointer is determined by the strength of the current flowing through the gage.

If the tank is full, the resistance of the variable resistor is high (90 ohms) and the current flow through the gage is at a minimum. This causes the pointer to indicate the "F" mark on the gage dial.

If the fuel level is low, the resistance of the variable resistor also is low and current flow through the gage is high. This causes the pointer to show a low fuel level reading. Intermediate fuel levels cause the pointer to indicate the corresponding position between "F" and "E."

OIL PRESSURE GAUGE

(Chevrolet)

The oil pressure gage indicates the pressure of the lubricating oil flow provided by the engine oil pump. The oil pressure gage sending unit is a variable resistor mounted to the engine block so it will sense the oil pressure in a main oil passage just downstream from the engine oil pump. When electric power is supplied to the gage, current flows through the gage to the resistor in the sending unit and then to ground at the engine block. The position of the oil pressure gage pointer is determined by the strength of the current flowing through the gage.

When oil pressure is low, the resistance of the sending unit also is low and current flow through the gage is high. This causes the gage indicator needle to show a low pressure reading. As oil pressure increases, the resistance of the sending unit resistor also increases and current flow through the gage is reduced. Under normal conditions, the oil pressure reading should be between 138 and 414 kPa (20 and 60 psi). Engine oil pressure never should fall below a reading of 28 kPa (4 psi), even at idle.

VOLTMETER

(Chevrolet)

The voltmeter is an instrument that shows the voltage of the vehicle electrical system and indicates the ability of the charging system to keep the battery charged. The voltmeter is wired in parallel with other circuits in the vehicle.

When the engine is running, the voltmeter indicates charging system voltage. If the engine is not running and the ignition switch is in the "RUN" or "START" position, the voltmeter will show battery voltage. The voltmeter can be used as a first step in diagnosing many electrical problems. Battery voltage drop can be seen while the engine is cranking. After the engine is running, generator output voltage is indicated.

It is normal for the voltmeter to read between 11 and 13 volts during extended idle or just after starting. As the electrical load is increased, or in stop-and-go driving, the pointer may rotate temporarily to the bottom of the scale. A voltmeter reading continuously below 11 volts or above 16 volts indicates an electrical system problem.

8C-4 INSTRUMENT PANEL AND GAGES

Speedometer

Both the digital and analog speedometers do not have speedometer cables. The source of speed information is a small permanent magnet alternating current generator called a Vehicle Speed Sensor (VSS), mounted on the transmission. The shaft of the VSS fits into a pinion gear at the transmission output shaft in the same manner as the speedometer cable of a mechanical speedometer system. When the transmission output shaft rotates, the VSS shaft also rotates and turns the permanent magnet near a coil within the VSS. This generates an alternating current in the coil with a frequency that is proportional to the speed of the vehicle.

The alternating current from the VSS is sent to the Powertrain Control Module (PCM). The PCM modifies the current to a series of direct current pulses at a frequency proportional to the speed of the vehicle. These pulses form a vehicle speed signal that is transmitted to the instrument cluster and cruise control module.

For analog speedometers, a solid state circuit uses the speed signal to regulate the distribution of current from the fuse block to two electromagnetic coils at right angles to each other near the base of the speedometer pointer pivot. At the base of the speedometer pointer pivot is a magnet that is acted upon by the magnetic fields of the two coils. The relative strength of the two magnetic fields determines the position of the magnet and accordingly, the position of the speedometer pointer.

Pulses from the solid state circuit also are used to drive a small electric stepper motor. The stepper motor turns the numbered wheels of the odometer and the trip odometer. The numbered wheels are geared so when any one wheel completes a revolution, the next wheel to the left is turned one-tenth of a revolution. Every tenth of a revolution advances the displayed number by one unit. The trip odometer can be reset to zero at any time so the driver can record the distance traveled from any selected starting point.

For digital speedometers, the instrument cluster displays a digital readout proportional to the vehicle speed signal pulse. The odometer's mileage information is stored in nonvolatile memory circuits within the cluster. This information is retained in these circuits even if power is lost to the cluster. Trip odometer information is stored in volatile memory circuits and will be lost whenever battery power to the cluster is lost.

INSTRUMENT PANEL SWITCHES

Accessory Switch

(Chevrolet)

The English/metric switch is located at the center of the instrument panel to the left of the AM/FM stereo and clock radio. The English/metric switch converts the speedometer's digital display to either miles or kilometers per hour. The switch also resets the digital trip odometer.

The instrument panel and interior lamp and multifunction switch (if equipped) is located to the right of the AM/FM stereo and clock radio. The top switch is a rear compartment lid release switch. The bottom switch turns off cluster illumination lamps.

(Wagon)

The accessory switch controls the operation of the rear wiper and washer. The switch will also unlock or lock the end gate and unlock the end gate window.

On vehicles equipped with power door locks, only the end gate window can be unlocked by the accessory switch.

Headlamp and Instrument Panel Lamp Dimmer Switch

The headlamp and instrument panel lamp dimmer switch has a headlamp switch and a dimmer control.

The headlamp switch controls headlamps, parking and sidemarker lamps, taillamps, interior lamps and instrument panel lamps. The dimmer control regulates the intensity of instrument panel illumination. For more information, refer to SECTION 8B.

The headlamp and instrument panel lamp dimmer switch may also contain a twilight sentinel switch and a headlamp switch indicator lamp, if the vehicle is equipped with a twilight sentinel option. For more information, refer to SECTION 9C.

Rear Compartment Lid Release Switch

(Chevrolet)

The optional rear compartment lid release switch is mounted to the instrument panel and can be accessed by opening the instrument panel compartment door.

For police and taxi vehicles, the lid release switch is mounted to the headlamp and instrument panel lamp dimmer switch or the accessory switch panel.

When the lid release switch is pressed, voltage is applied to the rear compartment lid release solenoid releasing the rear compartment lid latch.

(Buick)

The rear compartment lid release switch is located near the parking brake release lever. There is also a rear compartment lid release enable switch which can be accessed by unlocking and opening the instrument panel compartment door. The rear compartment lid release enable switch provides security by denying use of the rear compartment lid release switch unless the enable switch is on.

When the switch is off, current flow to the rear compartment lid release solenoid is interrupted, and the rear compartment lid release switch is disabled.

Rear Window Defogger Switch

The rear window defogger switch is part of the heater and air conditioning control and controls the rear window defogger and heated outside rearview mirrors, if equipped.

The heater and air conditioning control contains an internal timer to control the time the internal contacts are closed. When the ignition switch is turned to "RUN" and the rear window defogger switch is turned to "ON" for the first time, the defog cycle lasts 10 minutes (further operation will result in 5 minute defog cycles). The defog cycle is reset to 10 minutes when the ignition switch is turned to "OFF" and back to "RUN".

WARNING/INDICATOR LAMPS

Cluster Indicator Lamps

"DOOR OPEN" INDICATOR LAMP

The optional "Door Open" indicator lamp will flash when either rear side door is open but not if the door is ajar.

"GATE AJAR" INDICATOR LAMP (WAGON)

The "GATE AJAR" indicator lamp comes on to warn the driver when the end gate is not closed.

Voltage is applied through the fuse block to the indicator lamp and then to the gate ajar switch.

When the end gate is opened as a door, the gate ajar switch closes, providing a path to ground, and the indicator lamp comes on. Once the end gate is closed, the switch opens and the indicator lamp goes out.

FASTEN SAFETY BELTS INDICATOR LAMP

The fasten safety belts indicator lamp will always go on for 4 to 8 seconds whenever the ignition switch is in "RUN," "BULB TEST" or "START," when the driver's seat belt is buckled.

If the seat belt remains unbuckled, the fasten safety belt indicator lamp and audio alarm remain on indefinitely.

For more information, refer to "Warning/Audio Alarm" in this section or SECTION 10-11.

"HIGH BEAM" INDICATOR LAMP

Refer to SECTION 8B.

TURN SIGNAL INDICATOR LAMPS

The left or right turn indicator lamp will illuminate when the multifunction lever on the left side of the steering column is moved to signal a turn. The turn/hazard switch in the steering column receives an on-and-off flashing current from the fuse block and the turn signal flasher unit in the convenience center when the ignition switch is in the "RUN," "START" or "BULB TEST" position. The turn/hazard switch routes the current to circuits that feed the left or right front turn signal lamp, left or right rear tail/stop/turn

signal lamps when the multifunction lever is moved. The circuit to the left or right front turn signal lamp, and cornering and sidemarker lamps has a branch that feeds the appropriate turn indicator lamp in the instrument cluster, causing it to flash when the exterior lamps are indicating a turn.

When the hazard warning button on the right side of the steering column is pressed in, the left and right front turn signal lamps, cornering and sidemarker lamps and rear tail/stop/turn signal lamps all flash, and both turn signal indicator lamps in the instrument cluster flash. Power for the hazard warning system reaches the turn/hazard switch from the fuse block and the hazard flasher in the convenience center. Power is supplied with the ignition switch in any position. When the hazard warning system is flashing, the turn signal circuits are inoperative.

Cluster Warning Lamps

ABS WARNING LAMP

Refer to SECTION 5 and SECTION 5E1.

"BRAKE" WARNING LAMP

Refer to SECTION 8A.

"VOLTS" WARNING LAMP

Refer to SECTION 6D3.

"AIR BAG" WARNING LAMP

The "AIR BAG" warning lamp will light to warn the driver of a potential Supplemental Inflatable Restraint (SIR) system problem that could prevent the proper deployment of the air bags in an accident. When the ignition switch is first turned on, the lamp will flash seven times to verify proper operation of the lamp circuit and the Sensing and Diagnostic Module (SDM). The lamp also will flash SIR trouble codes to aid diagnosis when the designated Data Link Connector (DLC) is grounded with the ignition on. In addition, a Scan Tool can be used to read trouble codes remaining in the "history" memory of the SDM and to clear all "history" codes after repair. For additional information, including service precautions, refer to SECTION 9J.

"OIL" PRESSURE INDICATOR LAMP

(Buick)

The "OIL" pressure indicator lamp comes on to warn the driver when the engine oil pressure is low. Battery voltage is applied to one side of the bulb. A ground path is provided by the engine oil pressure switch, which closes when the oil pressure is below 28 kPa (4 psi). This tests the bulb when the ignition switch is turned on to start the engine. After the engine starts and normal oil pressure builds up, the engine oil pressure switch opens and the "OIL" pressure indicator lamp goes out.

8C-6 INSTRUMENT PANEL AND GAGES

"SERVICE ENGINE SOON" or "CHECK ENGINE" INDICATOR LAMP

The "SERVICE ENGINE SOON" or "CHECK ENGINE" indicator lamp in the instrument cluster will come on during engine starting to serve as a bulb and system check. It should go off after the engine starts unless a problem has been detected by the system.

The powertrain control module (PCM) performs a continual self-diagnosis of certain control functions and causes the "SERVICE ENGINE SOON" or "CHECK ENGINE" lamp to remain on when the engine is running if a problem is detected. The "SERVICE ENGINE SOON" or "CHECK" engine lamp may remain on for only ten seconds if the problem is an intermittent one. In any event, the PCM will store in memory a (4) digit diagnostic trouble code if a problem is detected. Refer to SECTION 6E3 for more information.

COOLANT "HOT" INDICATOR LAMP

(Buick)

The coolant "HOT" indicator lamp comes on to warn the driver of high coolant temperature.

With the ignition switch in "RUN," "BULB TEST" or "START," voltage from the fuse block is applied to the coolant "HOT" indicator lamp. In "BULB TEST" or "START," the lamp is grounded through the ignition switch so that the bulb can be tested. In "RUN," current through the bulb can be grounded through the coolant temperature switch. The switch closes when the coolant temperature exceeds 128°C (262°F) and the lamp glows.

"CHECK GAGE" WARNING LAMP

(Chevrolet)

The "CHECK GAGE" warning lamp will light to warn the driver to check the oil pressure gage, engine coolant temperature gage and the voltmeter.

When lit, the "CHECK GAGE" lamp indicates that one or more of these gages shows an abnormal operating range or condition.

"LOW COOLANT LEVEL" INDICATOR

A magnetic float in the coolant recovery reservoir rises and falls with the coolant level. A serviceable reed type switch (mounted in the bottom of the reservoir) senses the floating magnet. When the float (magnet) position gets low in the reservoir, the reed switch contacts are pulled together, switch grounds and the "LOW COOLANT LEVEL" lights. The "LOW COOLANT LEVEL" indicator does not light during bulb check when the ignition switch is initially turned "ON".

"LOW FUEL" INDICATOR

When the fuel level drops to approximately 1/8 of a tank, the instrument cluster will ground the "LOW FUEL" indicator, completing the circuit, thus illuminating the indicator.

"LOW OIL LEVEL" INDICATOR

The "LOW OIL" indicator ground is controlled by the PCM. To check for a low oil condition, the PCM checks the oil level sensor after the ignition switch has been turned to "OFF" or "LOCK" position.

The PCM checks for a low oil condition 32 minutes after the ignition switch is turned to "OFF" or "LOCK," if the previous ignition cycle was less than 12 minutes. If the previous ignition cycle was longer than 12 minutes, the PCM checks for a low oil condition 3 minutes after the ignition switch is turned to "OFF" or "LOCK."

When the PCM detects a low oil level condition, the PCM grounds the "LOW OIL LEVEL" indicator for the duration of the next ignition cycle.

"LOW WASHER FLUID" INDICATOR

The windshield washer solvent tank has a switch which closes when the washer solvent level becomes low. Voltage is applied to the "LOW WASHER FLUID" indicator. The switch provides ground, the circuit is completed and the indicator lights.

"PASS KEY" INDICATOR

Refer to SECTION 9D.

WARNING/AUDIO ALARM

The audio alarm module sounds a chime to bring attention to one or more of several conditions. These conditions are:

1. The lights are on and the ignition switch is not in "RUN," "BULB TEST," or "START".
2. The ignition key is in the ignition switch when the driver's door is open.
3. The seat belt is unbuckled when the ignition switch is in "RUN," "BULB TEST," or "START".
4. The turn signal has been on for more than a half mile. Voltage is applied at all times through the fuse block to power the solid state audio alarm module.

IGNITION KEY WARNING

Whenever the key is in the ignition switch and the driver's door is open, the module is grounded. This sounds the alarm.

FASTEN SEAT BELT WARNING

With the ignition switch in "RUN," "BULB TEST," or "START," voltage is applied through the fuse block to the audio alarm module. With the driver's seat belt unbuckled, the module is grounded through the seat belt switch. The "FASTEN SEAT BELTS" indicator always goes on for 4 to 8 seconds when seat belts are buckled, but remains on when the seat belts are not buckled. The fasten seat belts alarm, however, only sounds if the seat belt is unbuckled and the ignition switch is in "RUN," "BULB TEST" or "START."

LIGHTS-ON WARNING

When the headlamp switch is in "HEAD" or "PARK" position, voltage is applied to the audio alarm module. When the ignition switch is in "RUN," "BULB TEST" or "START," voltage is applied through the fuse block to the module. These two voltages are sensed and the alarm is not sounded.

When the ignition switch is not in "RUN," "BULB TEST" or "START," the module loses voltage. The audio alarm module senses the change. If voltage is still available, it is applied to sound the alarm. The alarm can be turned off by turning the headlamp switch to "OFF". The module no longer senses voltage from the headlamp switch, so the alarm does not sound.

DIAGNOSIS

For diagnosis of instrument panel, cluster electrical systems, including individual wire color information, and applicable precautions for testing solid state electronic devices and systems, refer to SECTION 8A.

ON-VEHICLE SERVICE

It may be necessary to color coat some replacement components before installing them in the vehicle. For information regarding this procedure, refer to SECTION 10-1.

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The Sensing and Diagnostic Module (SDM) can maintain sufficient voltage to cause a deployment for up to ten seconds after the ignition switch is turned to "OFF" or the storage battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

DISABLING THE SIR SYSTEM**Remove or Disconnect**

1. Turn steering wheel so vehicle's tire and wheels are pointing straight ahead.
2. Turn ignition switch to "LOCK" and remove key.
3. "AIR BAG" fuse from instrument panel fuse block.
4. Left hand instrument panel sound insulator, if "Buick".

5. Connector Position Assurance (CPA) and both yellow two-way SIR harness connectors near base of steering column.

**Important**

- With the "AIR BAG" fuse removed and ignition switch in "RUN," the "AIR BAG" warning lamp will be lit. This is normal operation and does not indicate an SIR system malfunction.

ENABLING THE SIR SYSTEM**Install or Connect**

1. Turn ignition switch to "LOCK" and remove key.
2. Both yellow two-way SIR harness connectors near base of steering column and corresponding Connector Position Assurance (CPA).
3. "AIR BAG" fuse to instrument panel fuse block.
4. Left hand instrument panel sound insulator, if "Buick".
5. Turn ignition switch to "RUN" and verify that "AIR BAG" warning lamp flashes seven times and then turns off. If warning lamp does not work as described, refer to SECTION 9J.

NOTICE: The instrument panel and cluster contain Electrostatic Discharge (ESD) sensitive parts. When handling an electronic part that is identified as being ESD sensitive, the service technician should follow the guidelines in SECTION 0A. Following these guidelines will reduce any possible electrostatic charge buildup on the service technician's body and the electronic part.

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

NOTICE: When handling an electronic part that has an ESD-sensitive sticker, refer to SECTION 0A. Follow these guidelines to reduce any possible build-up of electrostatic charge:

- Do not open the package until time to install the part.
- Avoid touching electrical terminals of the part.
- Before removing the part from its package, ground the package to a known good ground on the vehicle.
- Always touch a known good ground before handling the part. This should be repeated while handling the part. Do it more often after sliding across the seat, sitting down from a standing position, or walking a distance.

8C-8 INSTRUMENT PANEL AND GAGES

Not all parts that can be damaged by ESD have an ESD label. Components that can be damaged by ESD are:

- AM/FM stereo and clock radio
- Antilock brake system EBCM
- Automatic day/night mirror
- Heater and air conditioning control
- Instrument cluster
- Sensing and diagnostic module (SDM)
- Supplemental inflatable restraint (SIR)
- Twilight sentinel module
- Warning/indicator, audio alarm (chime module)

FRONT FLOOR CONSOLE

Figure 1

Remove or Disconnect

1. Retainer (2) from knob (1).
 - Pry out retainer.
2. Knob (1).

3. Trim plate (3)

- A. Place gear selector in "Neutral" with parking brake on.
- B. Unseat clips on forward edge of trim plate (3).
- C. Lift forward edge and unseat rear tabs.
- D. Disconnect shift indicator bulb.

4. Bolts/screws (4).

- Lift liner to expose forward bolts/screws.

5. Console (5).

Install or Connect

NOTICE: Refer to "NOTICE" on page 8C-1 of this section.

1. Console (5).

Tighten

- Bolts/screws (6) to 6 N.m (53 lb. in.).
2. Reinsert liner to cover bolts/screws (4).
 3. Trim plate (3).

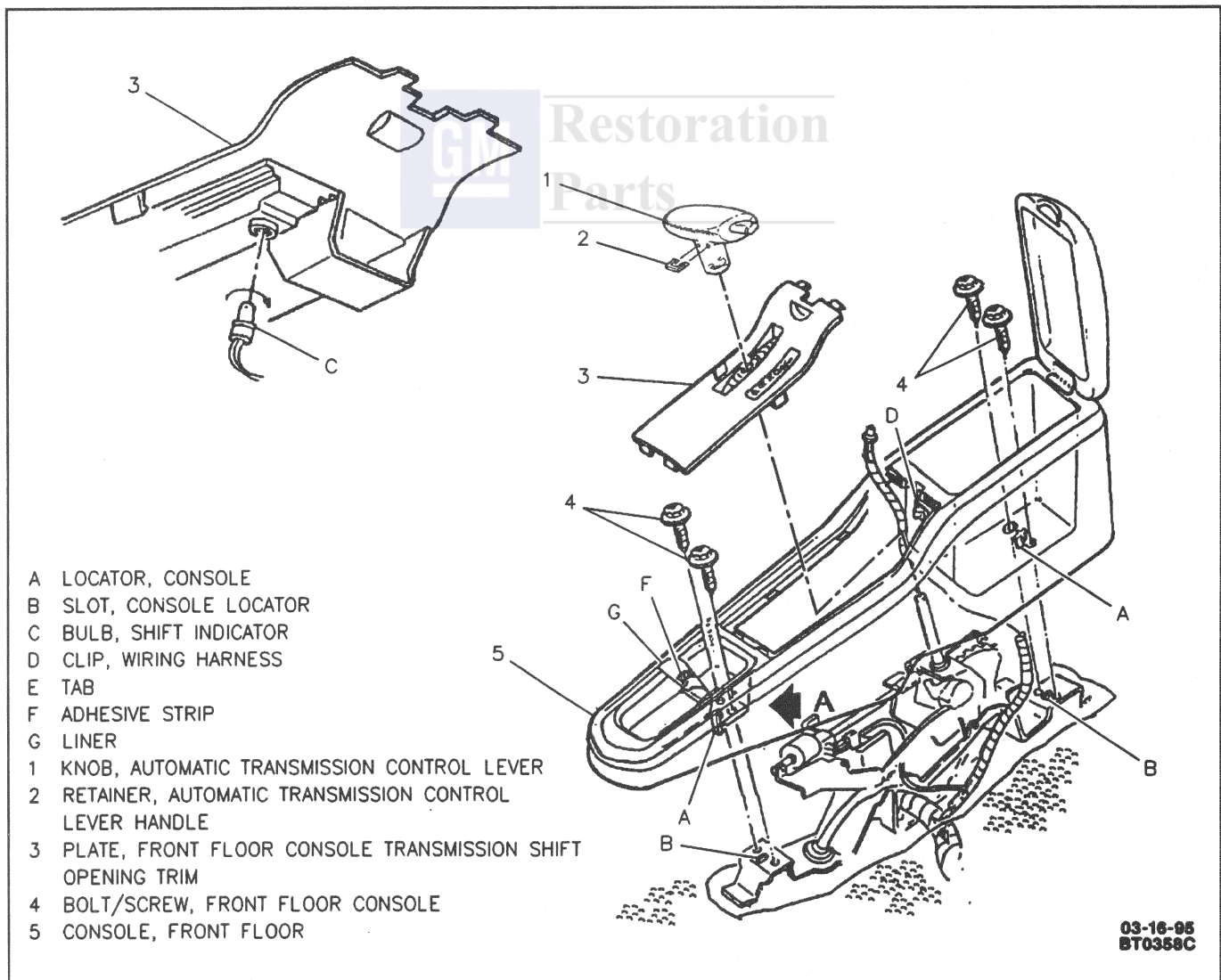


Figure 1 - Front Floor Console

- A. Place gear selector in "Neutral" with parking brake on.
- B. Shift indicator bulb.
- C. Align rear tabs, shifter plate.
- D. Seat front tabs, shifter plate.
4. Knob (1).
5. Retainer (2) to knob (1).

INSTRUMENT PANEL - COMPARTMENTS

Ashtray and Cigarette Lighter

Figure 2

Remove or Disconnect

1. Four bolts/screws (3) attaching ashtray (1) to instrument panel.
 - Pull ashtray (1) out to expose bolts/screws (3).
2. Ashtray (1) from instrument panel.
3. Ashtray lamp connector from ashtray (1).
 - Replace bulb, if required.
4. Lighter connector from ashtray (1).
5. Lighter (2) from ashtray (1).

Install or Connect

NOTICE: Refer to "NOTICE" on page 8C-1 of this section.

1. Lighter (2) to ashtray (1).
2. Lighter connector to ashtray (1).
3. Ashtray lamp connector to ashtray (1).
4. Ashtray (1) to instrument panel.
5. Four bolts/screws (3) attaching ashtray (1) to instrument panel.

Tighten

- Bolts/screws (3) to 1.9 N-m (17 lb. in.).

Instrument Panel Compartment

The instrument panel compartment and door is serviced as an assembly. The lock and lamp are also serviceable. The lamp switch is part of the body wiring harness. Refer to SECTION 8B to service the lamp.

Instrument Panel Compartment Door

Figure 3

Remove or Disconnect

1. Three bolts/screws (7) attaching hinge to instrument panel.
2. Open instrument panel compartment door (6).
3. Instrument panel compartment door (6) from instrument panel.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Align instrument panel compartment door (6) to instrument panel.
2. Close instrument panel compartment door (6).
3. Three bolts/screws (7) attaching hinge to instrument panel.

Tighten

- Bolts/screws (7) to 1.9 N-m (17 lb. in.).

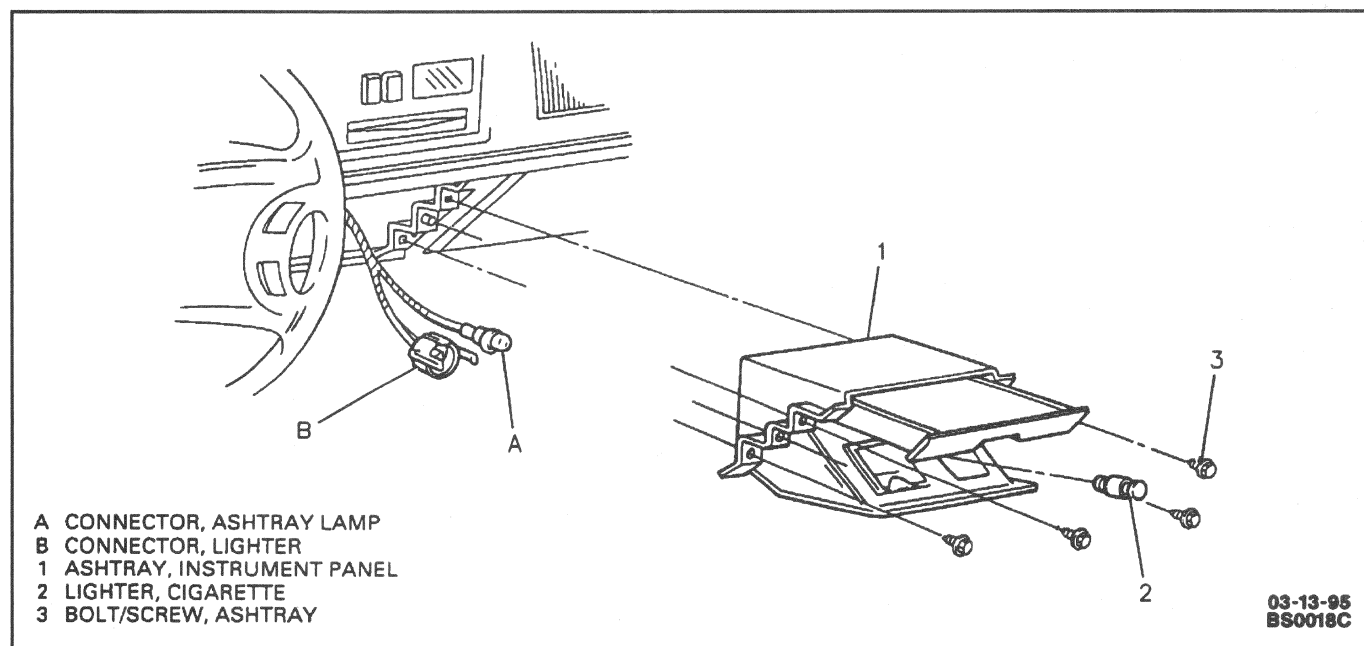


Figure 2 - Ashtray and Cigarette Lighter - (Typical)

8C-10 INSTRUMENT PANEL AND GAGES

Instrument Panel Compartment Door Latch and Lock Cylinder

Figure 3

↔ Remove or Disconnect

1. Open compartment door.
2. Bolts/screws (8) from door latch.
3. Lock cylinder (5) from door latch.
 - A. Turn lock cylinder (5) to lock position and remove key.
 - B. Place latch in lock position.
 - C. Using awl or paper clip, depress tumbler slightly through hole at base of cylinder housing.
 - D. Insert key and turn to unlock position.
 - E. Lift door latch handle and remove lock cylinder (5).

→→ Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Lock cylinder (5).
 - A. Place latch in lock position.
 - B. Insert key and lock cylinder (5) into latch.
 - C. Lift door latch handle.
 - D. Turn key to unlock position and remove.
2. Bolts/screws (8) attaching latch to instrument panel compartment door (6).

⌚ Tighten

- Bolts/screws (8) to 1.9 N·m (17 lb. in.).

INSTRUMENT PANEL - TRIM PLATES AND PANELS

Instrument Panel Cluster Trim Plate

(Chevrolet)

Figure 4

↔ Remove or Disconnect

1. Bolts/screws (11) attaching instrument panel cluster trim plate (10) to upper trim pad.
2. Unsnap instrument panel cluster trim plate (10) from instrument panel lower trim plate.

→→ Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Align locating features of cluster trim plate (10) with lower trim plate.
2. Snap cluster trim plate (10) to lower trim plate.

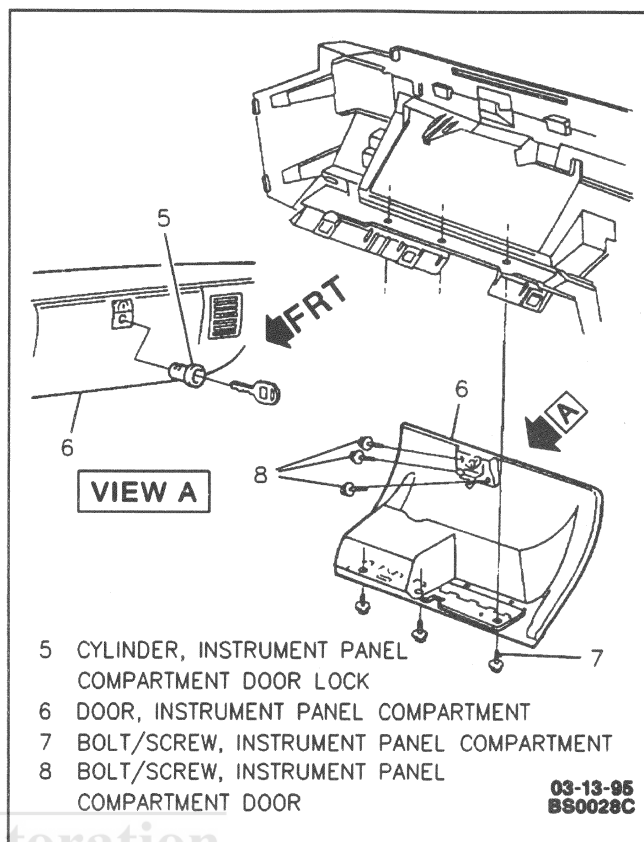


Figure 3 - Instrument Panel Compartment - (Typical)

3. Bolts/screws (11) through cluster trim plate (10) into upper trim pad.

⌚ Tighten

- Bolts/screws (11) to 1.9 N·m (17 lb. in.).

Instrument Panel Nameplates

Figure 5

Use a small screwdriver to gently pry out nameplates from instrument panel trim plate. Replacement nameplates can be snapped into place on the trim plate.

Instrument Panel Upper Trim Pad

Figures 6 and 7

When servicing the upper trim pad, do not attempt to open the passenger SIR cover. If air bag has been deployed, do not attempt to reseal cover. Upper trim pad must be replaced.

→→ Install or Connect

1. Disable the SIR. Refer to "Disabling the SIR System" in this section.
2. If Chevrolet, instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

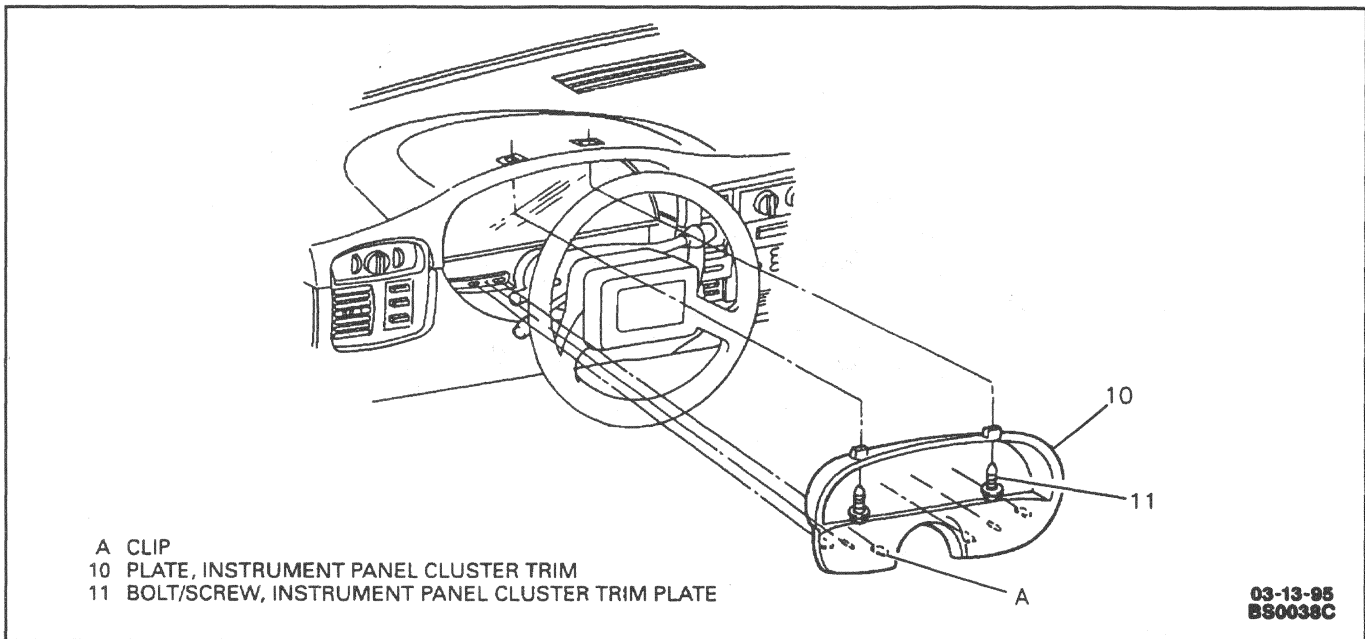


Figure 4 - Instrument Panel Cluster Trim Plate - (Chevrolet)

3. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
4. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.
5. Side window defogger grilles (15 or 25), if necessary.
6. Bolts/screws (19 or 26) securing upper trim pad (16 or 22) to instrument panel.
7. Carefully lift upper trim pad (16 or 22) up and away from dash panel and disengage clips.

NOTICE: For Chevrolet, when removing upper trim pad, ensure that left-hand side window defroster duct, mounted underneath upper trim pad, does not catch on bolt/screw which secures upper left corner of instrument panel carrier to hinge pillar tie bar. Minor damage to defroster duct may result if it is forced against this bolt/screw. In the event of this occurrence, do not attempt to service defroster duct as it will continue to function easily within specification.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Align and engage upper trim pad clips to dash panel.
2. Seat upper trim pad (16 or 22) using locating features on instrument panel.
 - Ensure that ambient light and sunload temperature sensors are accessible through defroster nozzle grille opening.
3. Bolts/screws (19 or 26) securing upper trim pad (16 or 22) to instrument panel.



Tighten

- Bolts/screws (19 or 26) to 1.9 N·m (17 lb. in.).
4. Side window defogger grilles (15 or 25), if removed.
 5. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.

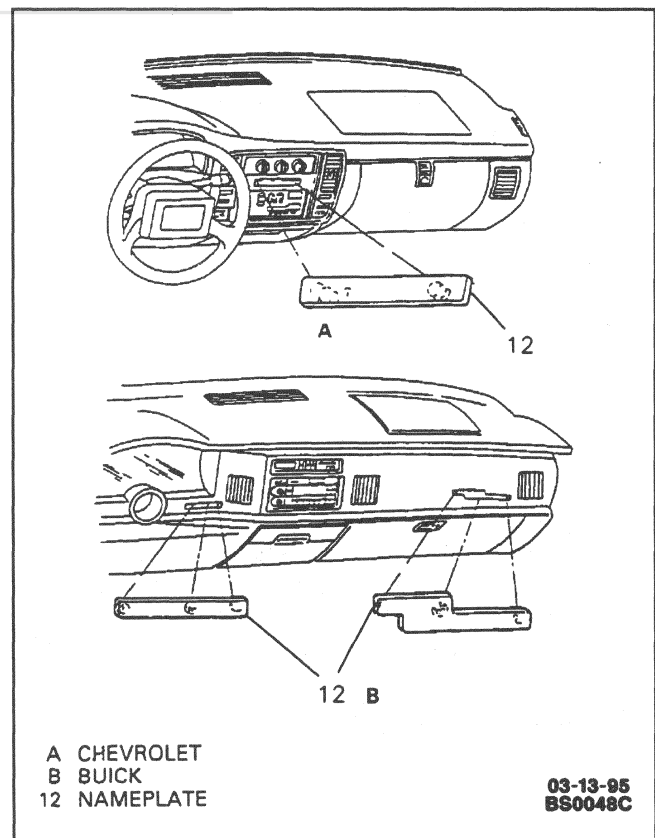


Figure 5 - Instrument Panel Nameplates

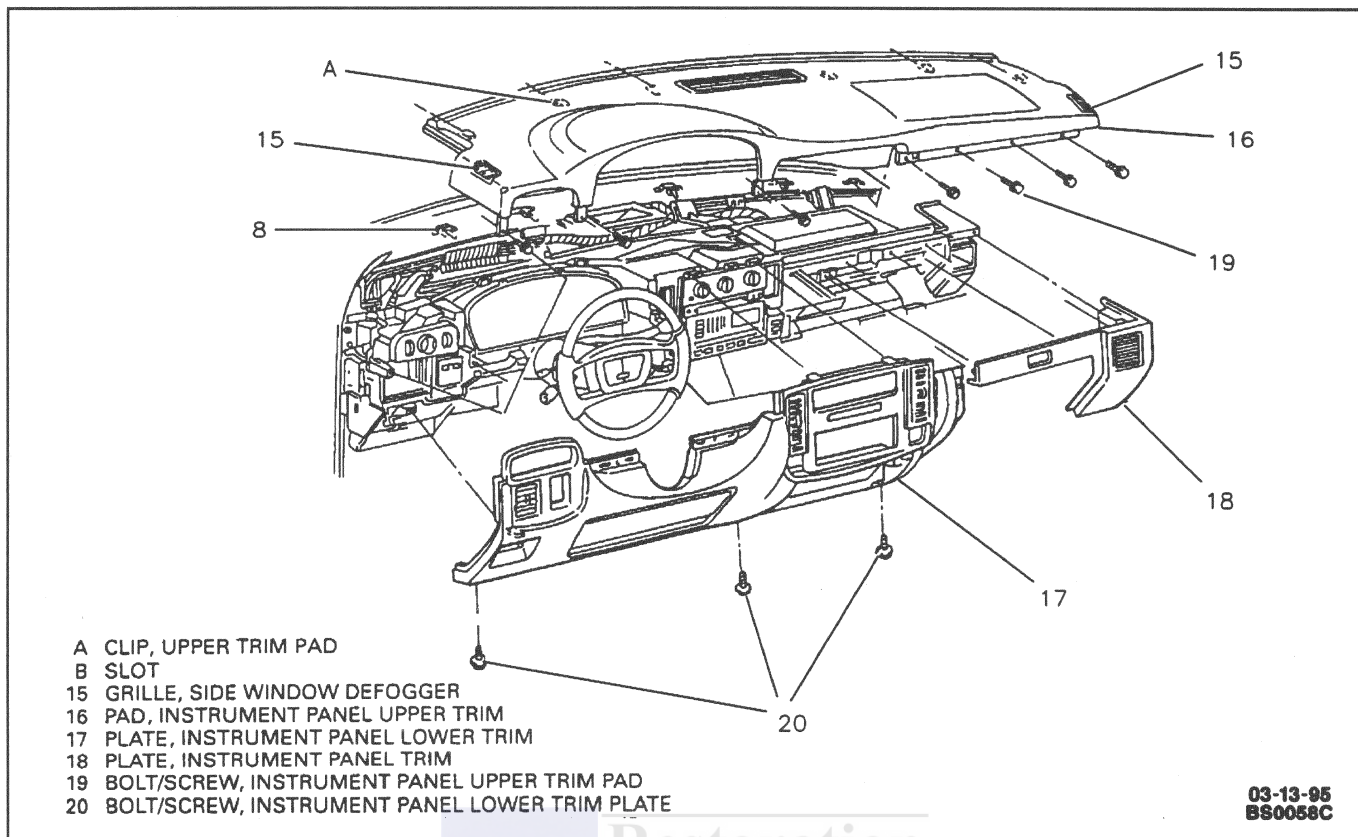


Figure 6 - Upper Trim Pad, Lower and Right-Hand Trim Plates - (Chevrolet)

6. If Chevrolet, instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
7. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
8. Enable SIR. Refer to "Enabling the SIR System" in this section.

Instrument Panel Lower Trim Plate

(Chevrolet)

Figure 6

Remove or Disconnect

1. Instrument panel cluster trim plate. Refer to "Instrument Panel Cluster Trim Plate" in this section.
2. Ashtray, if replacing trim plate (17). Refer to "Ashtray and Cigarette Lighter" in this section.
3. Bolts/screws (20) attaching bottom of instrument panel lower trim plate (17) to instrument panel.
4. Unsnap instrument panel lower trim plate (17) from instrument panel.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Align instrument panel lower trim plate (17) with locator pins on instrument panel.
2. Snap instrument panel lower trim plate (17) into instrument panel.
3. Bolts/screws (20) attaching bottom of lower trim plate to instrument panel.

Tighten

- Bolts/screws (20) to 1.9 N.m (17 lb. in.).
4. Ashtray, if removed. Refer to "Ashtray and Cigarette Lighter" in this section.
 5. Instrument panel cluster trim plate. Refer to "Instrument Panel Cluster Trim Plate" in this section.

Instrument Panel Trim Plate

(Buick)

Figure 7

Remove or Disconnect

1. Bolts/screws (27) attaching trim plate (23) to upper trim pad (22).
2. Unsnap clips on trim plate (23) from instrument panel.
3. Trim plate (23).

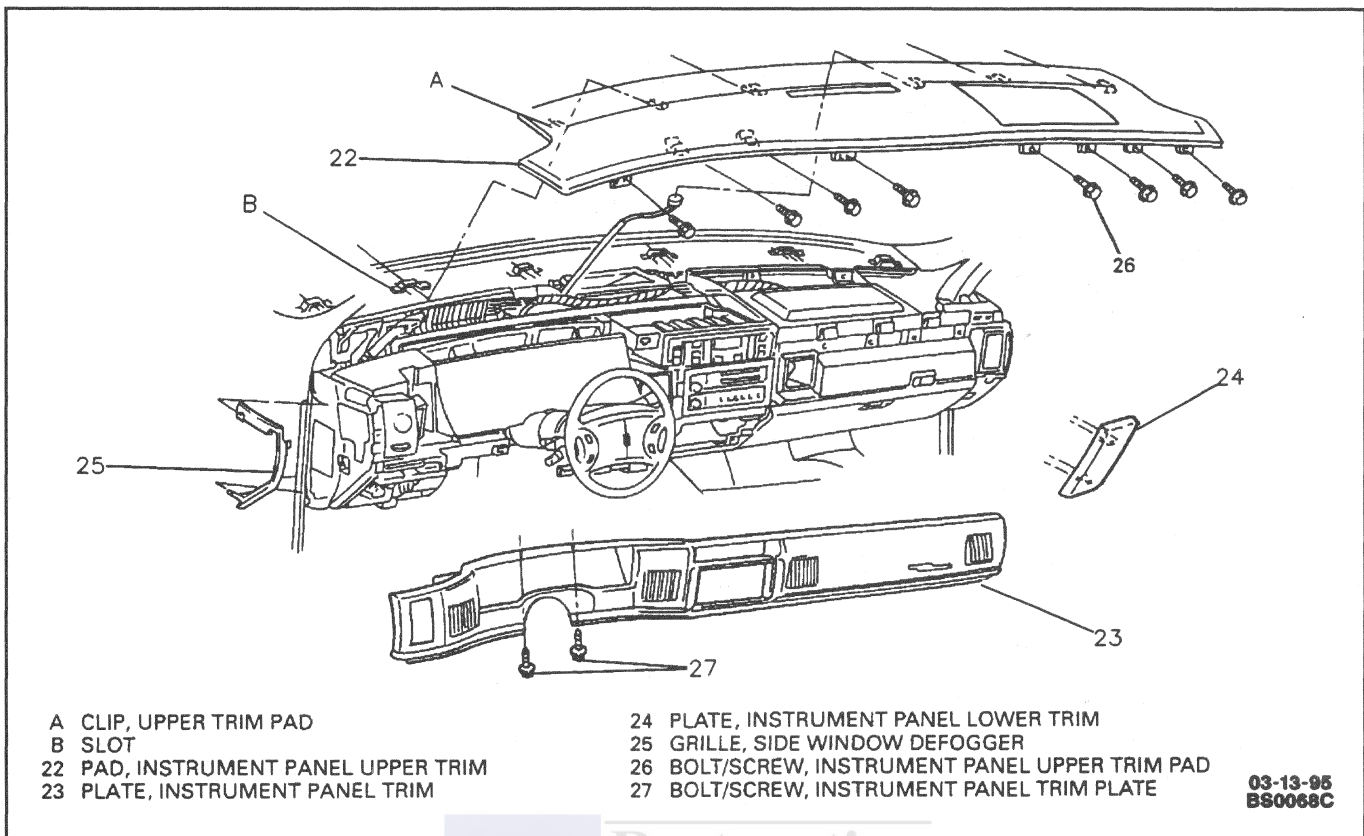


Figure 7 - Upper Trim Pad, Lower and Right-Hand Trim Plates - (Buick)

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Align locator pins and clips on trim plate (23) to instrument panel.
 - Press firmly to fully engage clips.
2. Bolts/screws (27) attaching trim plate (23) to upper trim pad (22).

Tighten

- Bolts/screws (27) to 1.9 N.m (17 lb. in.).

Instrument Panel Right-Hand Trim Plate

Figures 6 and 7

Remove or Disconnect

1. Open instrument panel compartment door.
2. Unsnap clips on trim plate (18 or 24).
3. Trim plate (18 or 24).

Install or Connect

1. Align clips on trim plate (18 or 24) to instrument panel.
 - Press firmly to fully engage clips.
2. Close instrument panel compartment door.

Instrument Panel Steering Column Opening Filler

(Chevrolet)

Figure 8

Remove or Disconnect

1. Bolts/screws (32) attaching steering column opening filler (30) to lower trim plate (17).
2. Steering column opening filler (30).
 - Lower steering column opening filler (30) so that tabs on filler (30) clear lower trim plate (17).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Steering column opening filler (30) to instrument panel lower trim plate (17) by inserting tabs into place on lower trim plate (17).
2. Bottom of steering column opening filler (30) to base of lower trim plate (17) using locator pins.
3. Bolts/screws (32) attaching steering column opening filler (30) to lower trim plate (17).

Tighten

- Bolts/screws (32) to 1.9 N.m (17 lb. in.).

8C-14 INSTRUMENT PANEL AND GAGES

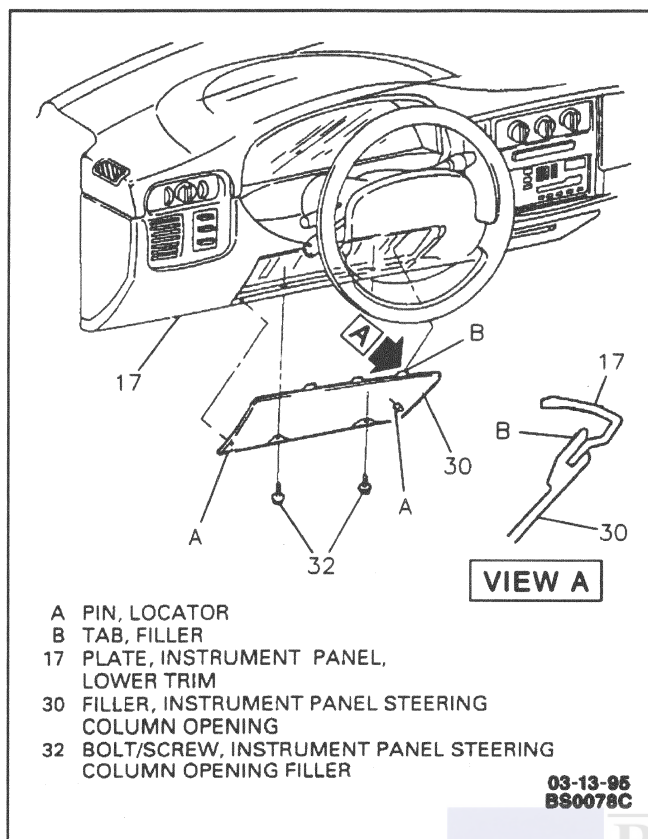


Figure 8 - Instrument Panel Steering Column Opening Filler - (Chevrolet)

(Buick)

Figure 9

Remove or Disconnect

1. Unsnap clips on steering column opening filler (35) from instrument panel.

Install or Connect

1. Align locator clip on steering column opening (35) to instrument panel.
2. Snap clips on steering column opening filler (35) to instrument panel.

WINDSHIELD DEFROSTER NOZZLE GRILLE

Figure 10

Remove or Disconnect

1. Unsnap grille (36) from upper trim pad.
2. Sunload temperature sensor (38) from grille (36), if equipped.
3. Headlamp automatic control ambient light sensor (39), if equipped.

Install or Connect

1. Headlamp automatic control ambient light sensor (39), if removed.

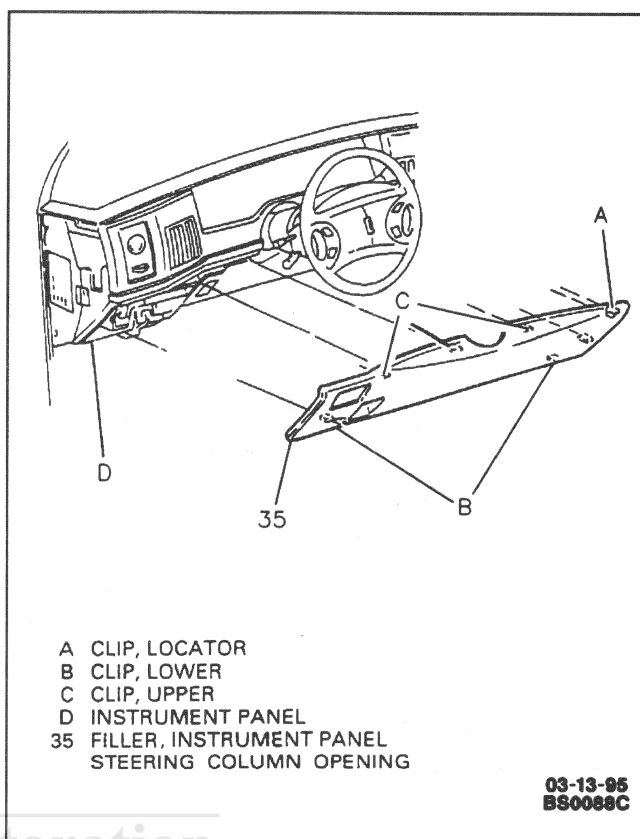


Figure 9 - Instrument Panel Steering Column Opening Filler - (Buick)

2. Sunload temperature sensor (38) to grille (36), if removed.
3. Snap grille (36) into place on upper trim pad.

INSTRUMENT PANEL DRIVER KNEE BOLSTER AND DEFLECTOR

Figure 11

Remove or Disconnect

1. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
2. Four bolts/screws (42) attaching bolster (40) to deflector (41).
3. Bolster (40).
4. Four bolts/screws (43) attaching deflector (41) to tie bar.
5. Deflector (41).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Deflector (41).
2. Four bolts/screws (43) attaching deflector (41) to tie bar.

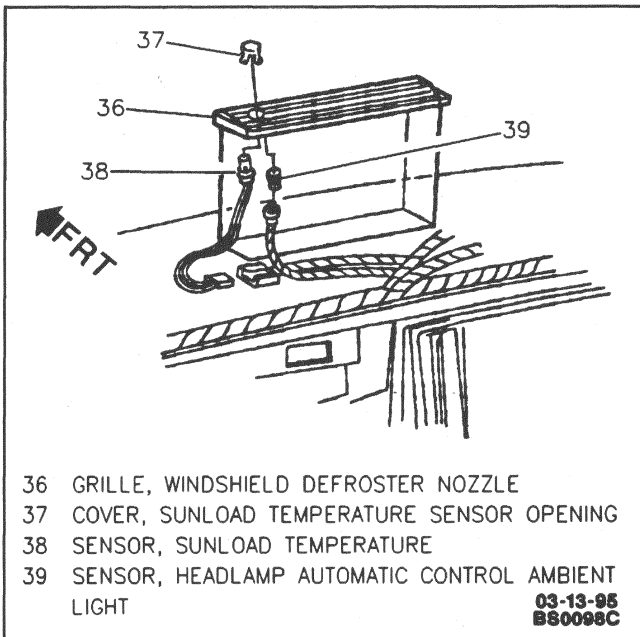


Figure 10 - Windshield Defroster Nozzle Grille - (Typical)

 Tighten

- Bolts/screws (43) to 10 N.m (89 lb. in.).
- 3. Align bolster (40) to deflector (41).
- 4. Four bolts/screws (42).

 Tighten

- Bolts/screws (42) to 10 N.m (89 lb. in.).

5. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.

INSTRUMENT PANEL INSULATOR (RIGHT SIDE)

(Chevrolet and Buick)

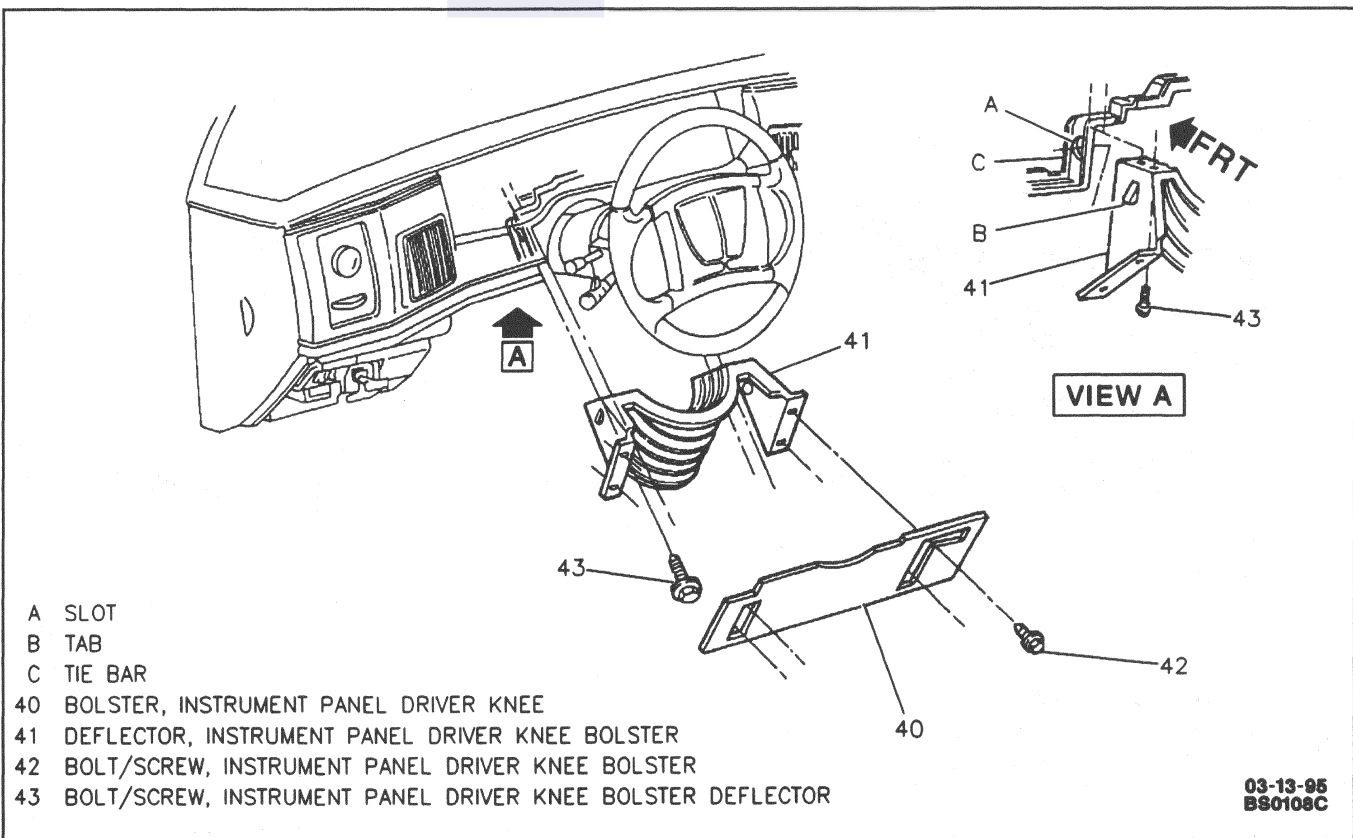
Figure 12

 Remove or Disconnect

1. Unsnap clips on insulator (46) from bottom of instrument panel and pull rearward.
2. Insulator (46).

 Install or Connect

1. Align locator on insulator (46) with hole in cowl.
2. Align slot in insulator (46) with stud on instrument panel lower brace.
3. Snap clips on insulator (46) to instrument panel.



- A SLOT
B TAB
C TIE BAR
40 BOLSTER, INSTRUMENT PANEL DRIVER KNEE
41 DEFLECTOR, INSTRUMENT PANEL DRIVER KNEE BOLSTER
42 BOLT/SCREW, INSTRUMENT PANEL DRIVER KNEE BOLSTER
43 BOLT/SCREW, INSTRUMENT PANEL DRIVER KNEE BOLSTER DEFLECTOR

Figure 11 - Instrument Panel Driver Knee Bolster and Deflector - (Typical)

8C-16 INSTRUMENT PANEL AND GAGES

INSTRUMENT PANEL INSULATOR (LEFT SIDE)

(Buick)

Figure 12

↔ Remove or Disconnect

1. Wing-nut on accelerator pedal.
2. Unsnap three clips on insulator and pull down.

→ Install or Connect

1. Align insulator hole with Stud on accelerator pedal.
2. Attach wing nut.
3. Insert three molding clips into slots in I/P and snap in place.

INSTRUMENT PANEL - CONTROLS, GAGES AND SWITCHES

AM/FM Stereo and Clock Radio

(Chevrolet)

Figure 13

↔ Remove or Disconnect

1. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

2. Bolts/screws (49) attaching radio (48) to instrument panel.
3. Radio (48) slowly from instrument panel.
4. Instrument panel harness connector and antenna cable from radio (48).

→ Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel harness connector and antenna cable to radio (48).
2. Align locator pins on instrument panel with holes on radio bracket.
3. Bolts/screws (49) attaching radio (48) to instrument panel.

⌚ Tighten

- Bolts/screws (49) to 1.9 N.m (17 lb. in.).
4. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

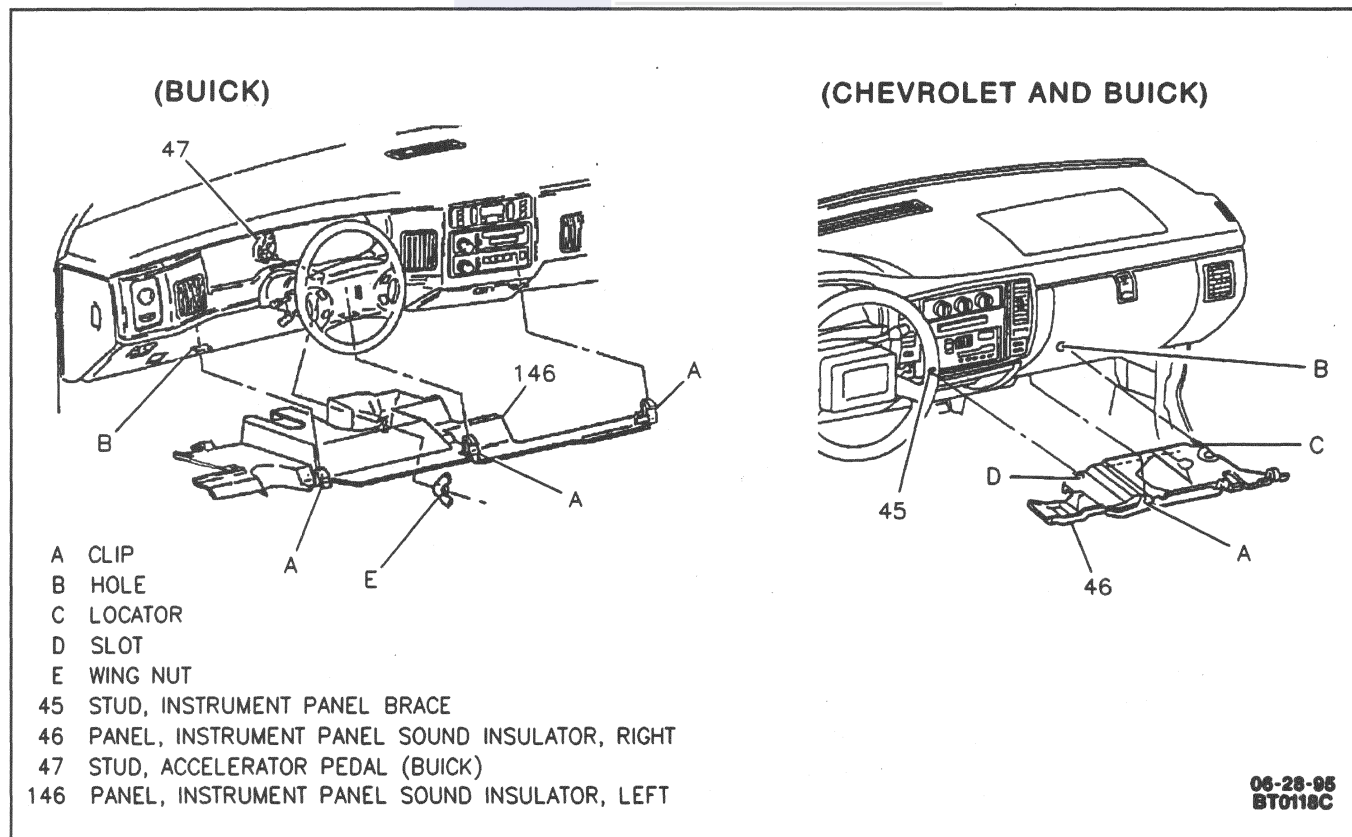


Figure 12 - Instrument Panel Insulators

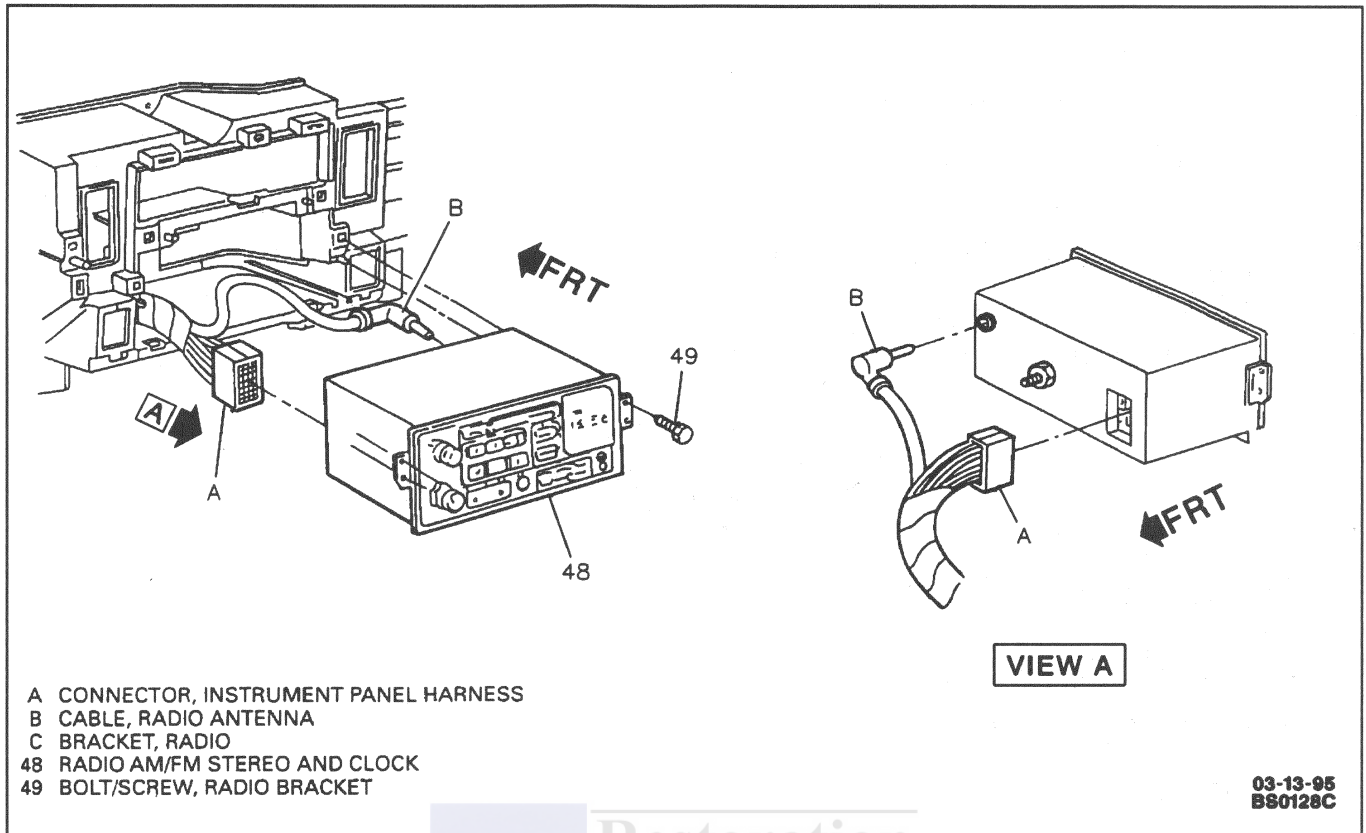


Figure 13 - AM/FM Stereo and Clock Radio - (Chevrolet)

(Buick)

Figure 14

Remove or Disconnect

1. Instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
2. Bolts/screws (54) attaching radio brackets (50) to instrument panel.
3. Radio (52) slowly from instrument panel.
4. Instrument panel harness connector and antenna cable from radio (52).
5. Radio nuts (56) and left and right-hand radio brackets (50) from radio (52).
6. Bolts/screws (53) from left and right sides of radio (52), if necessary.
7. Bolt/screw (53) with retainer (57) attached from rear of radio (52), if necessary.
8. Bolt/screw (55) attaching radio rear bracket (51) to instrument panel, if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Bolts/screws (55) attaching radio rear bracket (51) to instrument panel, if removed.

Tighten

- Bolts/screws (55) to 1.9 N·m (17 lb. in.).

2. Bolts/screws (53) with retainer (57) attached to rear of radio (52).

Tighten

- Bolts/screws (53) to 1.9 N·m (17 lb. in.).

3. Bolt/screw (53) to left side of radio (52). Repeat on right side.

Tighten

- Bolts/screws (53) to 1.9 N·m (17 lb. in.).

4. Left and right-hand brackets (50) to radio (52) with nuts (56).

Tighten

- Nuts (56) to 2.8 N·m (25 lb. in.).

5. Instrument panel harness connector and antenna cable to radio (40).

6. Radio (52).

A. Align retainer (51) at rear of radio (52) with hole in radio rear bracket (51).

B. Align locator pins on instrument panel with holes in left and right-hand radio brackets (50).

7. Bolts/screws (54) attaching radio brackets (50) to instrument panel.

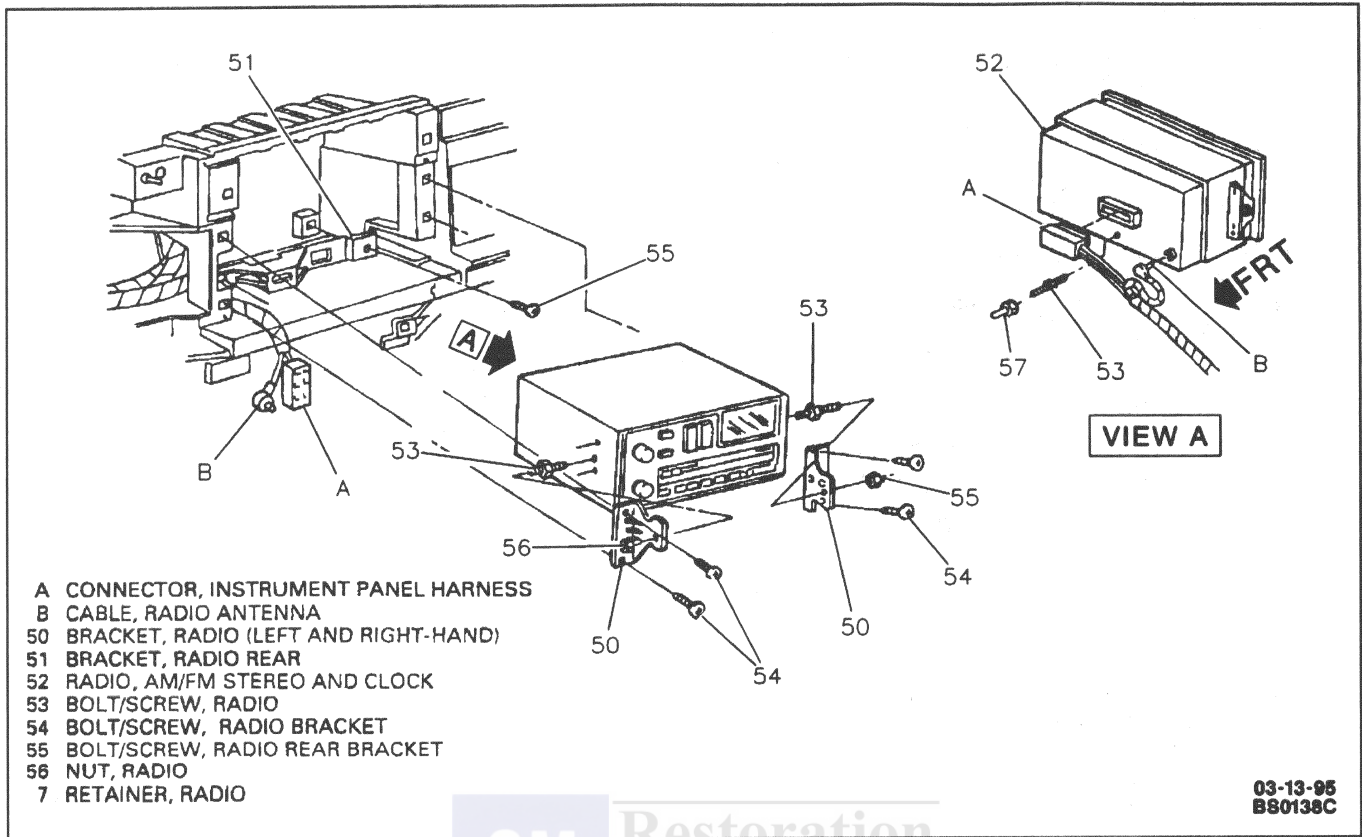


Figure 14 - AM/FM Stereo and Clock Radio - (Buick)



Tighten

- Bolts/screws (54) to 1.9 N.m (17 lb. in.).

8. Instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.



Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

INSTRUMENT CLUSTER

Figure 15



Remove or Disconnect

1. If Chevrolet, instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
2. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
3. Four bolts/screws (61) attaching cluster (60) to instrument panel.
4. Unclip shift indicator cable from steering column.
5. Gently pull cluster (60) from instrument panel harness connectors.
6. Instrument cluster lamp bulbs (62) when necessary.

1. Replace instrument cluster lamp bulbs when necessary.

- PC 161 (except cluster illumination)
- PC 194 (cluster illumination)

2. Cluster (60) to instrument panel.

- Align cluster (60) with instrument panel harness connectors and seat firmly.

3. Shift indicator cable.



Adjust

- Shift indicator cable. Refer to SECTION 3F.

4. Four bolts/screws (61) attaching cluster assembly (60) to instrument panel.



Tighten

- Bolts/screws (61) to 1.9 N.m (17 lb. in.).

5. If Chevrolet, instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

6. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.

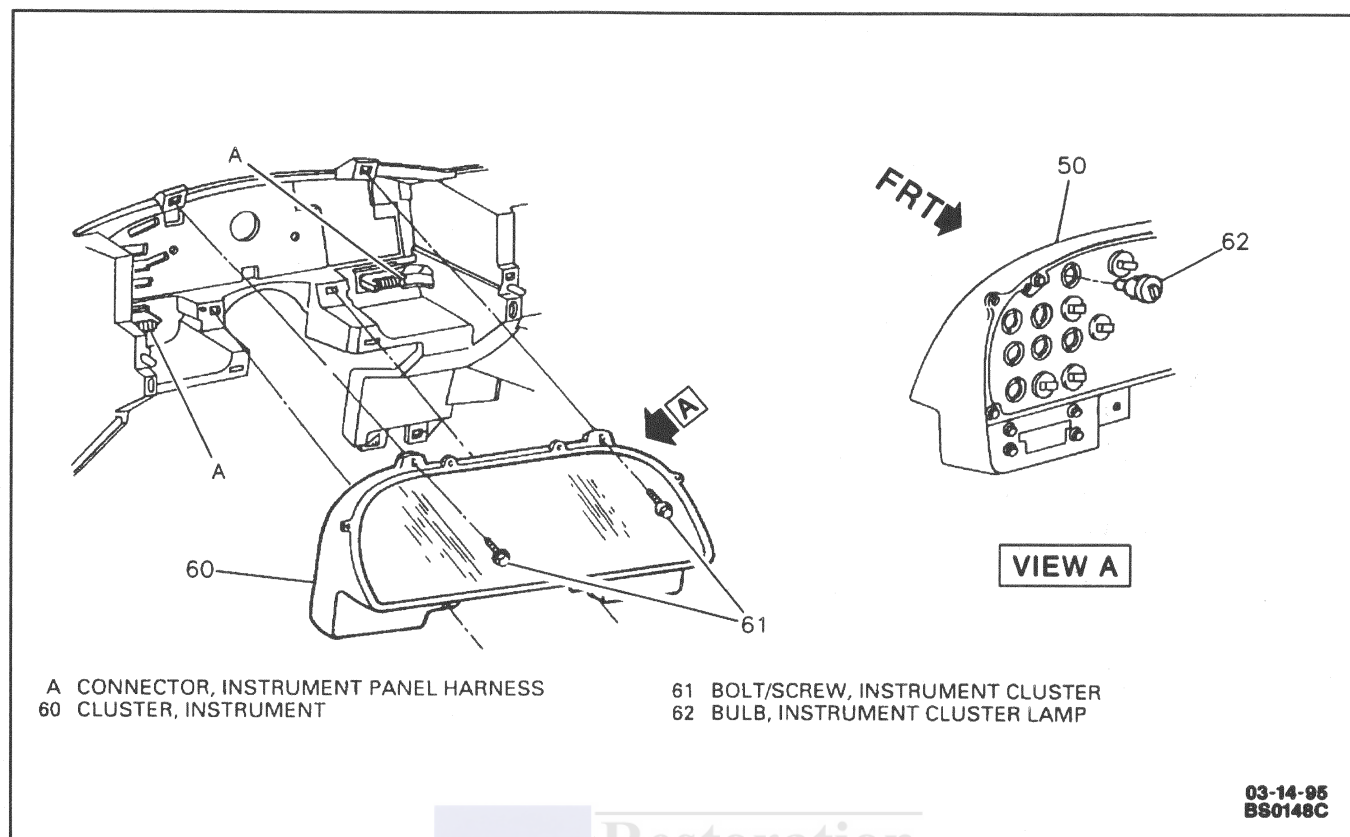


Figure 15 - Instrument Cluster and Instrument Cluster Lamps - (Typical)

ODOMETER REPAIR NOTICE LABEL**Figure 16****! Important**

- When replacing an instrument cluster, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires that the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous reading and the date of replacement.
- A copy of the label must be retained in compliance with the retention requirements specified in the "Guidelines for General Motors Odometer Policy."

↔ Install or Connect

1. Clean area around the left B-pillar where label is to be attached.
 - Label area is to be clean and free from plastisol or any foreign material that could affect adhesion of label.
2. Properly fill out all necessary information on label.
 - Sign and date label.
3. Remove backing and attach label to left B-pillar.

ACCESSORY SWITCH PANEL

(Chevrolet)

Figure 17**↔ Remove or Disconnect**

1. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
2. Unsnap switches (65 and 66) from housing on instrument panel.
3. Cigarette lighter and housing, if equipped.
4. Instrument panel harness connectors.

↔ Install or Connect

1. Instrument panel harness connectors.
2. Align switches (65 and 66) with appropriate housing on instrument panel using locators.
3. Snap switches (65 and 66) in place.
4. Cigarette lighter and housing, if equipped.
5. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

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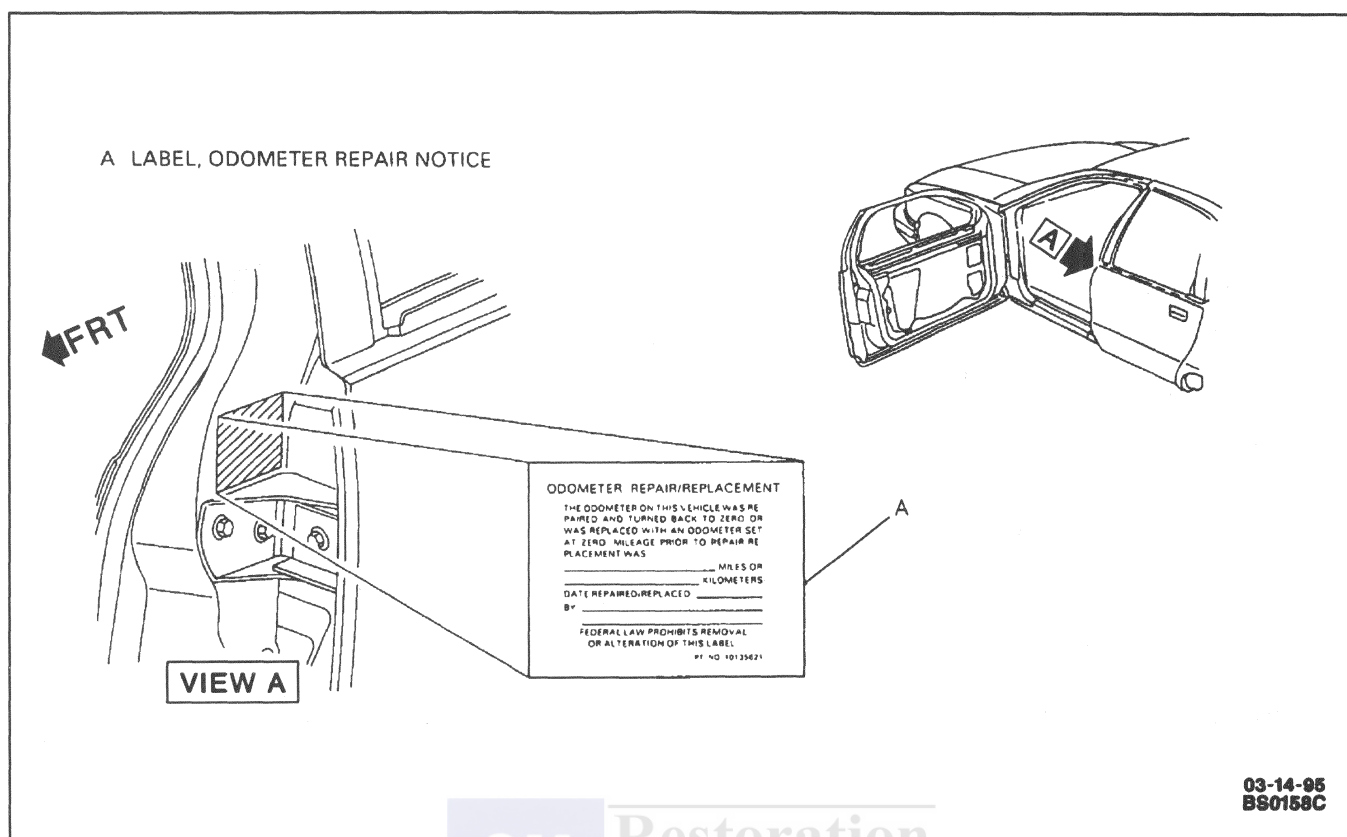


Figure 16 - Odometer Repair Notice Label - (Typical)

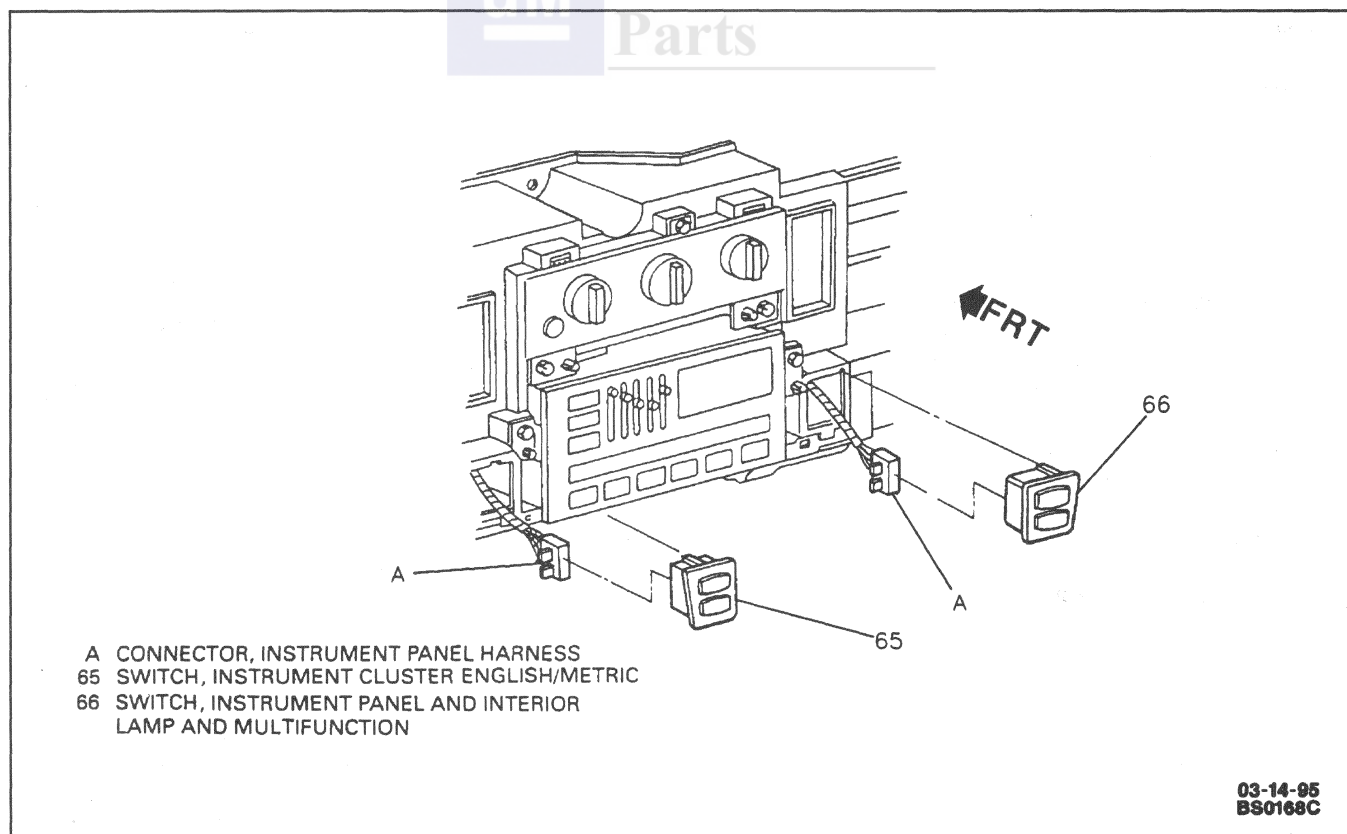


Figure 17 - Accessory Switch Panel - (Chevrolet)

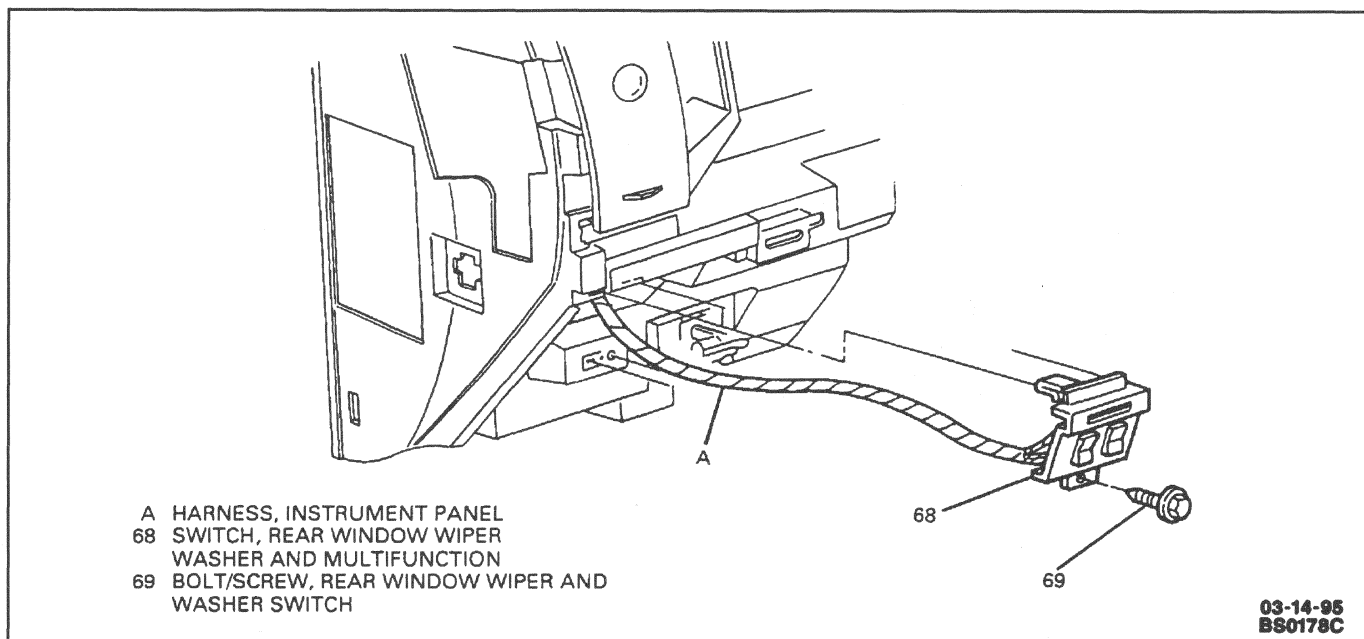


Figure 18 - Accessory Switch Panel - (Buick Wagon)

(Chevrolet Wagon)

Refer to "Headlamp, Instrument Panel Lamp and Accessory Switch Panel and Compartment" in this section.

(Buick Wagon)

Figure 18

Remove or Disconnect

1. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
2. Bolt/screw (69) attaching switch (68) to instrument panel.
3. Switch (68) from instrument panel.
4. Instrument panel harness connector from switch (68).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel harness connector to switch (68).
2. Switch (68) to instrument panel.
3. Bolt/screw (69) attaching switch (68) to instrument panel.

Tighten

- Bolt/screw (69) to 1.9 N.m (17 lb. in.).
4. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.

Headlamp, Instrument Panel Lamp and Accessory Switch Panel and Compartment

(Chevrolet)

Figure 19

Remove or Disconnect

1. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
2. Bolt/screw (74) attaching headlamp switch panel (71) to instrument panel.
3. Unsnap headlamp switch panel (71) from instrument panel.
4. Headlamp connector, dimmer connector and twilight sentinel connector, if equipped.
5. Wagon switches and accessory switch panel (72) from behind headlamp switch panel (71), if equipped.
6. Instrument panel compartment (70) from behind headlamp switch panel (71), if equipped.
7. Instrument panel harness connector from rear compartment lid release switch (73), if equipped.

- Unsnap switch (73) from behind housing.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel harness connector to rear compartment lid release switch (73), if removed.
2. Instrument panel compartment (70) to headlamp switch (71), if removed.

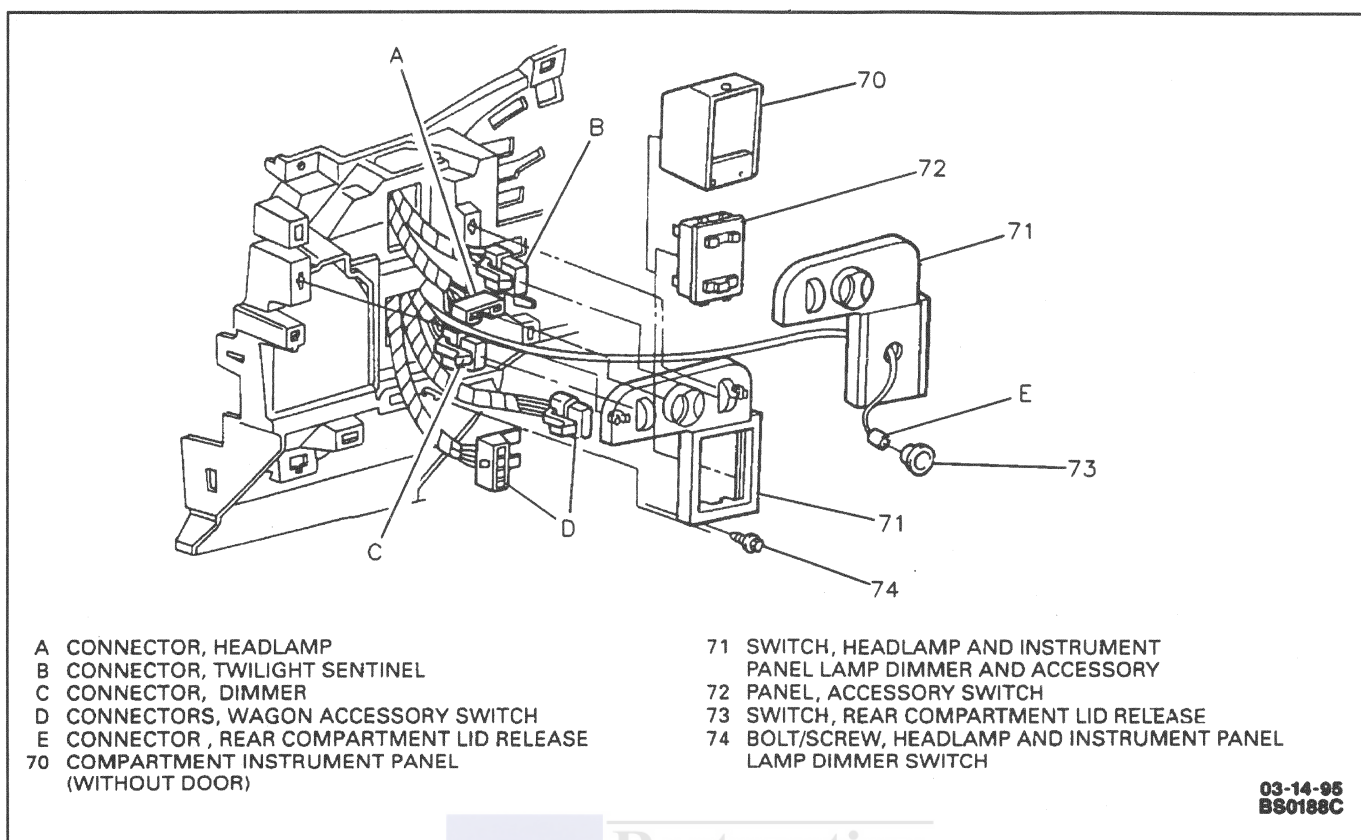


Figure 19 - Headlamp, Instrument Panel Lamp and Accessory Switch Panel and Compartment - (Chevrolet)

3. Wagon switches to accessory switch panel (72), if removed.
4. Headlamp connector, dimmer connector and twilight sentinel connector, if removed.
5. Align locator pin on instrument panel with hole in bottom of headlamp switch (71).
6. Snap clips on switch (71) to slots on instrument panel.
7. Bolt/screw (74) securing headlamp switch (71) to instrument panel.
4. Bolt/screw (81) attaching switch housing (78) to instrument panel.



Tighten

- Bolt/screw (74) to 1.9 N.m (17 lb. in.).

8. Instrument panel lower trim plate including instrument panel cluster trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.

(Buick)

Figure 20



Remove or Disconnect

1. Fuse block access door.
2. Instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
3. Headlamp switch knob (79) with shaft from switch (80).
 - To release shaft, press button on top of switch (80) firmly and remove shaft.



Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel harness connector to switch (80).
2. Align switch (80) with hole in instrument panel.
3. Screw in headlamp switch bezel (77).
4. Lamp connector and twilight sentinel connector, if equipped.
5. Align clips on switch housing (78) to instrument panel and snap into place.
6. Bolt/screw (81) attaching switch housing (78) to instrument panel.



Tighten

- Bolt/screw (81) to 1.9 N.m (17 lb. in.).

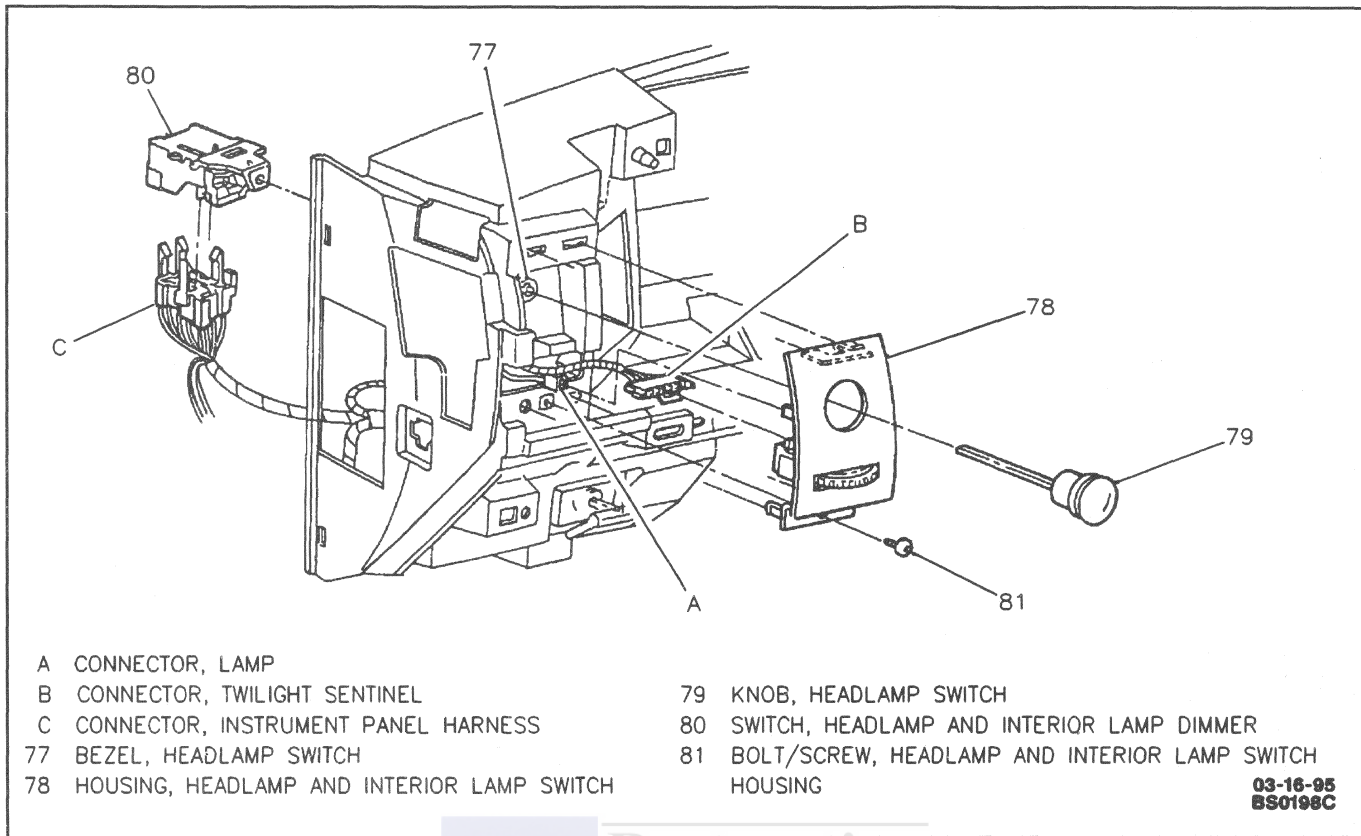


Figure 20 - Headlamp and Instrument Panel Lamp Dimmer Switch - (Buick)

7. Insert headlamp switch knob (79) with shaft into switch (80) and snap in place.
8. Instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
9. Fuse block access door.

Instrument Panel Lamp Dimmer

(Chevrolet)

Figure 21

Remove or Disconnect

1. Instrument panel harness connector (not shown).
2. Bolts/screws (84) attaching lamp dimmer (83) to instrument panel lower reinforcement.
3. Lamp dimmer (83).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Lamp dimmer (83) to instrument panel lower reinforcement.
2. Bolts/screws (84).

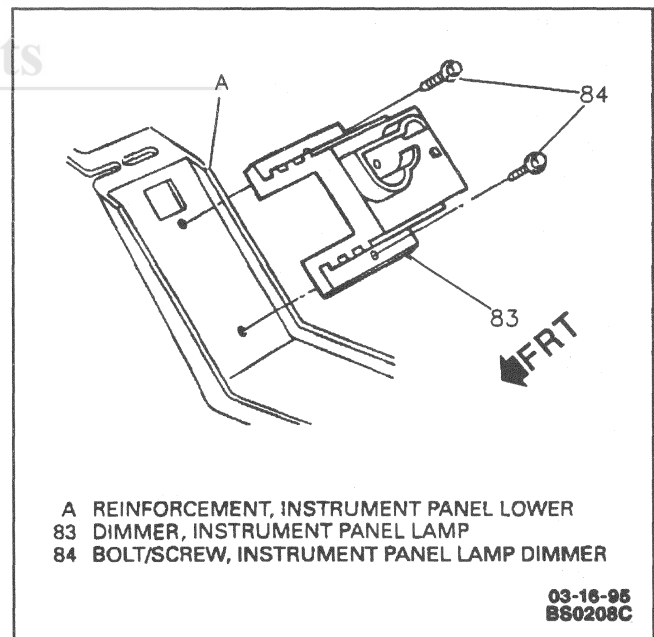


Figure 21 - Instrument Panel Lamp Dimmer - (Chevrolet)

Tighten

- Bolts/screws (84) to 1.9 N.m (17 lb. in.).
- 3. Instrument panel harness connector (not shown) to lamp dimmer (83).

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REAR COMPARTMENT LID RELEASE SWITCH

(Chevrolet Sedan)

Figure 22

↔ Remove or Disconnect

1. Rear compartment lid release switch (85).
 - Reach behind switch (85), squeeze tabs and push forward.
2. Instrument panel harness connector from switch (85).

↔ Install or Connect

1. Instrument panel harness connector from switch (85).
2. Align rear compartment lid release switch (85) to hole in instrument panel and snap into place.

(Chevrolet Police and Taxi Vehicles)

Refer to "Headlamp, Instrument Panel Lamp and Accessory Switch Panel and Compartment" in this section.

(Buick Sedan)

Figure 23

↔ Remove or Disconnect

1. Steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.

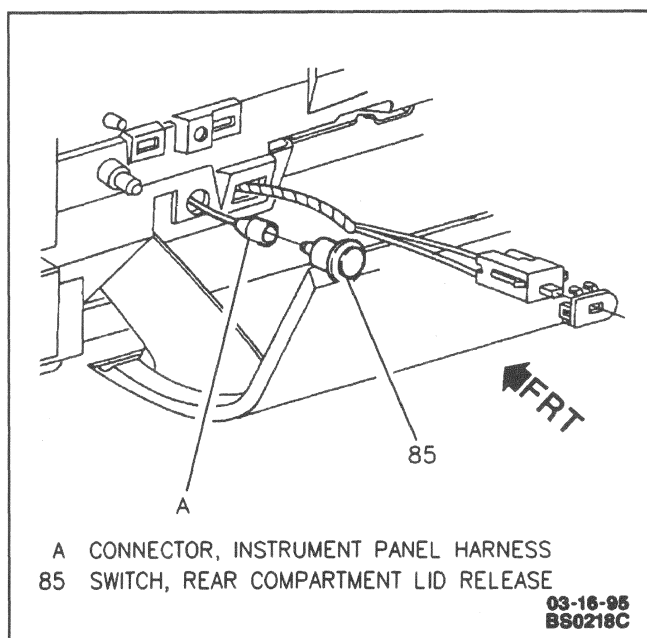


Figure 22 - Rear Compartment Lid Release Switch - (Chevrolet Sedan)

2. Bolt/screw (89) attaching switch bezel (86) to instrument panel.
3. Unsnap top of switch bezel (86) from instrument panel.
4. Instrument panel harness connector from switch (88).
5. Lamp (87) from switch bezel (86).
6. Unsnap switch (88) from switch bezel (86).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Snap switch (88) into switch bezel (86).
2. Lamp (87) to switch bezel (86).
3. Instrument panel harness connector to switch (88).
4. Align switch bezel (86) and snap top into place on instrument panel.
5. Bolt/screw (89) attaching switch bezel (86) to instrument panel.

⌚ Tighten

- Bolt/screw (89) to 1.9 N-m (17 lb. in.).
6. Steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.

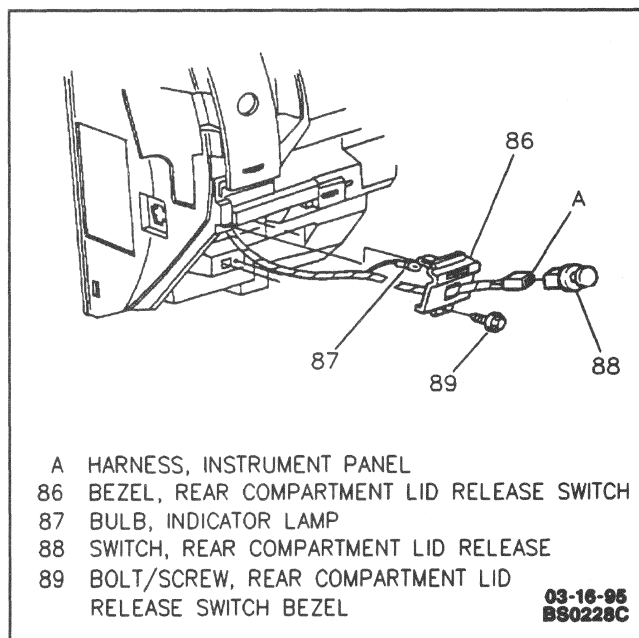


Figure 23 - Rear Compartment Lid Release Switch - (Buick Sedan)

Rear Compartment Lid Release Enable Switch

(Buick Sedan)

Figure 24

Remove or Disconnect

1. Open instrument panel compartment door (6).
2. Rear compartment lid release enable switch (91).
 - Use screwdriver to compress tabs on sides of switch (91) and slide forward.
3. Instrument panel harness connector from switch (91).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel harness connector to switch (91).
2. Snap rear compartment lid release enable switch (91) into place on instrument panel.

INSTRUMENT PANEL CARRIER

For Chevrolet, the instrument panel carrier attaches to the hinge pillar tie bar. The hinge pillar tie bar provides rigid support for the instrument panel and passenger inflator module. The air distributor is also attached to the hinge pillar tie bar.

For Buick, the instrument panel carrier attaches to the air distributor which, in turn, provides rigid support for the instrument panel and passenger inflator module. The air distributor attaches to the hinge pillars through the use of brackets which are an integral part of the air distributor.

If it is only necessary to disconnect the instrument panel carrier from the air distributor without removing all the components, refer to "Instrument Panel Carrier Disconnect" procedure immediately following "Instrument Panel Carrier Replacement."

Instrument Panel Carrier Replacement

Figures 25 and 26

Important

- When installing a new instrument panel carrier, do not remove the support rib located in the steering column opening until after it is attached to the hinge pillar tie bar for Chevrolet or the air distributor for Buick. The support rib will provide stability and facilitate alignment of locator pins.

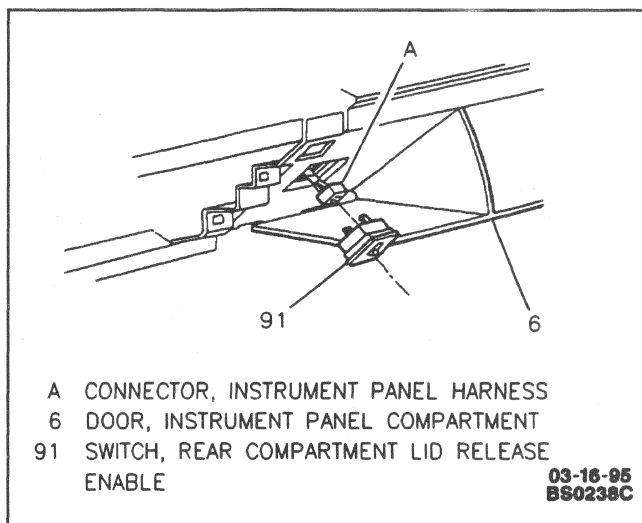


Figure 24 - Rear Compartment Lid Release Enable Switch - (Buick Sedan)

Remove or Disconnect

CAUTION: Refer to "Caution" on page 8C-1 of this section.

1. Disable SIR. Refer to "Disabling the SIR System" in this section.
2. Ashtray and cigarette lighter. Refer to "Ashtray and Cigarette Lighter" in this section.
3. Instrument panel compartment door. Refer to "Instrument Panel Compartment Door" in this section.
4. Instrument panel cluster trim plate, if Chevrolet. Refer to "Instrument Panel Cluster Trim Plate" in this section.
5. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.
6. If Chevrolet, instrument panel lower trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
7. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
8. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.
9. Instrument panel right-hand trim plate. Refer to "Instrument Panel Right-Hand Trim Plate" in this section.
10. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
11. Instrument panel driver side knee bolster and deflector. Refer to "Instrument Panel Driver Knee Bolster and Deflector" in this section.

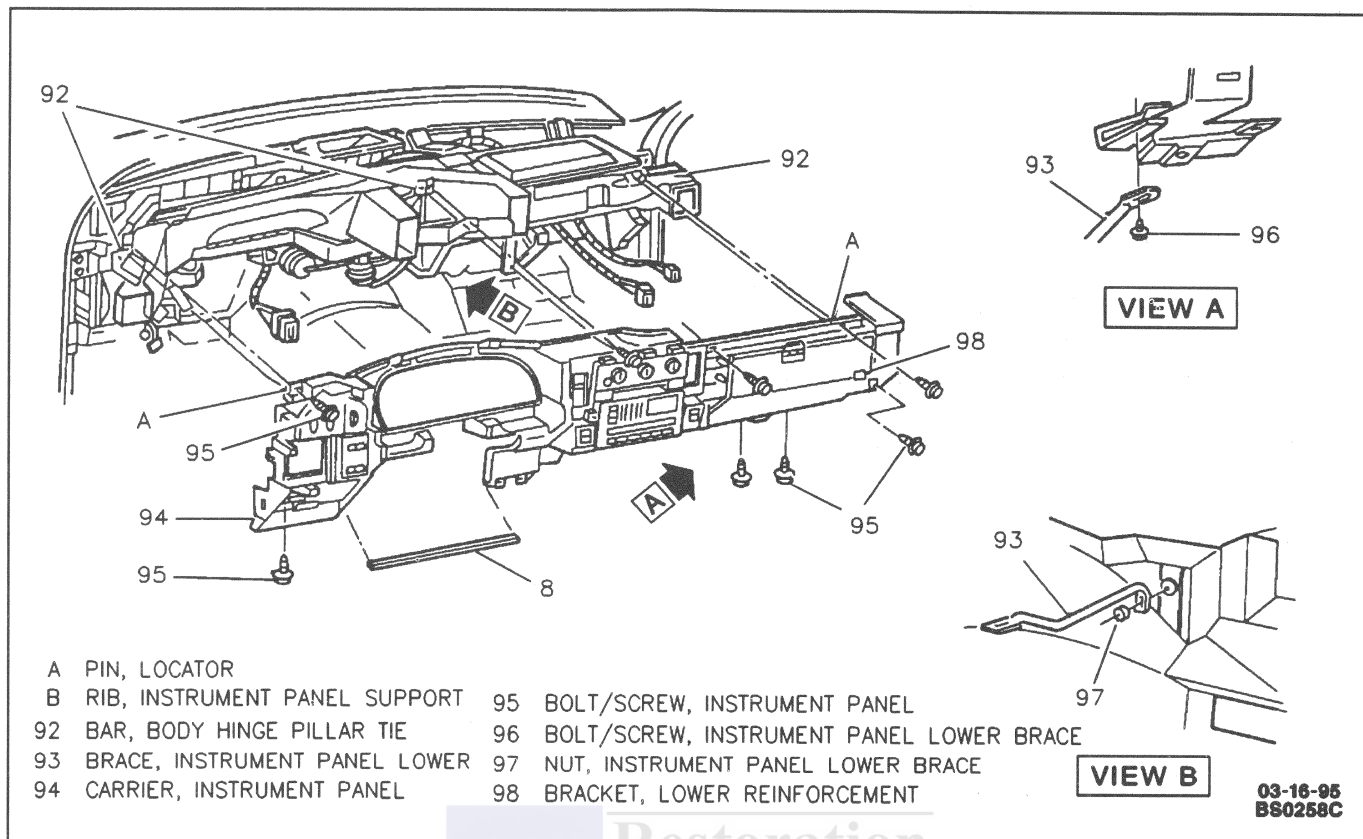


Figure 25 - Instrument Panel Carrier - (Chevrolet)

NOTICE: Remove stoplamp switch before fully lowering the steering column. Failure to do so may cause the stoplamp switch to become damaged or thrown out of adjustment resulting in a malfunctioning stoplamp switch or premature brake wear.

12. Stoplamp switch. Refer to SECTION 5.
13. Instrument panel sound insulator panel. Refer to "Instrument Panel Sound Insulator Panel" in this section.
14. AM/FM stereo and clock radio. Refer to "AM/FM Stereo and Clock Radio" under "On-Vehicle Service" in this section.
15. Instrument cluster. Refer to "Instrument Cluster" under "On-Vehicle Service" in this section.
16. Accessory switch panels. Refer to "Accessory Switch Panel" in this section.
17. Headlamp, instrument panel lamp and accessory switch panel and compartment. Refer to "Headlamp, Instrument Panel Lamp and Accessory Switch Panel and Compartment" in this section.
18. Instrument panel lamp dimmer. Refer to "Instrument Panel Lamp Dimmer" in this section.
19. Rear compartment lid release switch. Refer to "Rear Compartment Lid Release Switch" under "On-Vehicle Service" in this section.
20. Rear compartment lid release enable switch, if Buick. Refer to "Rear Compartment Lid Release Enable Switch" in this section.

21. Engine oil change reset switch. Refer to "Engine Oil Change Reset Switch" under "On-Vehicle Service" in this section.
22. Passenger SIR inflator module. Refer to SECTION 9J.
23. Inside air temperature sensor, if equipped. Refer to SECTION 1C.
24. Parking brake release handle. Refer to SECTION 5F.
25. Completely lower steering column. Refer to SECTION 3F.
26. Fifty-six way, ten way and eight way instrument panel harness connectors located just right of the steering column.
27. Temperature valve electric actuator and vacuum solenoid valve electrical connectors for Buick, temperature control cable at module for Chevrolet.
28. Instrument panel harness and antenna cable connectors at right hinge pillar.
29. Bolts/screws (96) and nut (97) attaching instrument panel lower brace (93) to carrier and dash panel.
30. Instrument panel lower brace (93).
31. Instrument panel carrier (94 or 100).
 - If Chevrolet, remove bolts/screws (95) attaching carrier (94) to hinge pillar tie bar (92).
 - If Buick, remove bolts/screws (101) and bolts/screws (103) attaching carrier (100) to air distributor (102).

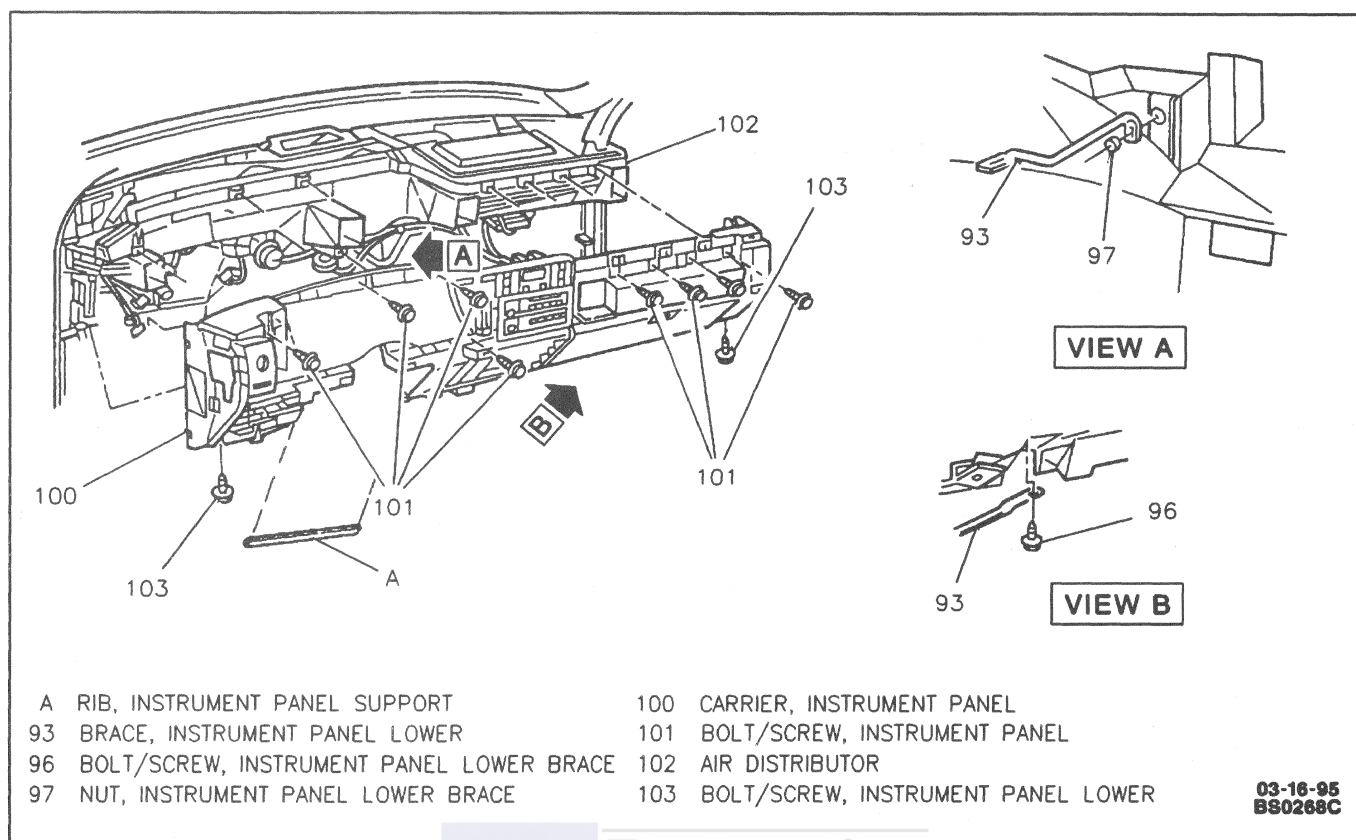


Figure 26 - Instrument Panel Carrier - (Buick)

32. Instrument panel wiring harness from instrument panel. Refer to "Instrument Panel Wiring Harness" in this section.

- Note instrument panel wiring harness routing before removal.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

- Instrument panel wiring harness to carrier (94 or 100). Refer to "Instrument Panel Wiring Harness" in this section.
- Instrument panel carrier (94 or 100).
 - If Chevrolet:
 - Align and engage four locator pins on carrier (94) to slots on hinge pillar tie bar (92).
 - Bolts/screws (95) attaching carrier to hinge pillar tie bar (92).
 - Bolt/screw (95) through lower reinforcement bracket (98) to right-hand hinge pillar.

Tighten

- Bolts/screws (95) to 10 N.m (89 lb. in.).
- If Buick:
 - Align and engage carrier to locator pins on air distributor.
 - Bolts/screws (101) attaching upper area of carrier to air distributor (102).

Tighten

- Bolts/screws (101) to 10 N.m (89 lb. in.).
- C. Bolts/screws (103) to secure lower area of instrument panel carrier (100).

Tighten

- Bolts/screws (103) to 1.9 N.m (17 lb. in.).
- Instrument panel lower brace (93).
 - Nut (97) attaching lower brace (93) to cowl.

Tighten

- Nut (97) to 10 N.m (89 lb. in.).
- Bolt/screw (96) attaching lower brace (93) to carrier (94 or 100).

Tighten

- Bolt/screw (96) to 10 N.m (89 lb. in.).
- Instrument panel harness and antenna cable connectors at right hinge pillar.
 - Temperature valve electric actuator and vacuum solenoid valve electrical connectors for Buick, temperature control cable at module for Chevrolet.
 - Fifty-six way, ten way and eight way instrument panel harness connectors located just right of the steering column.
 - Raise steering column. Refer to SECTION 3F.
 - Parking brake release handle. Refer to SECTION 5F.

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11. Inside air temperature sensor, if removed. Refer to SECTION 1C.
12. Passenger SIR inflator module. Refer to SECTION 9J.
13. Engine oil change reset switch. Refer to "Engine Oil Change Reset Switch" under "On-Vehicle Service" in this section.
14. Rear compartment lid release switch. Refer to "Rear Compartment Lid Release Switch" under "On-Vehicle Service" in this section.
15. Rear compartment lid release enable switch, if Buick. Refer to "Rear Compartment Lid Release Enable Switch" in this section.
16. Instrument panel lamp dimmer. Refer to "Instrument Panel Lamp Dimmer" in this section.
17. Headlamp, instrument panel lamp and accessory switch panel and compartment. Refer to "Headlamp, Instrument Panel Lamp and Accessory Switch Panel" in this section.
18. Instrument cluster. Refer to "Instrument Cluster" under "On-Vehicle Service" in this section.
19. Accessory switch panel. Refer to "Accessory Switch Panel" in this section.
20. AM/FM stereo and clock radio. Refer to "AM/FM Stereo and Clock Radio" under "On-Vehicle Service" in this section.
21. Instrument panel sound insulator panel. Refer to "Instrument Panel Sound Insulator Panel" in this section.
22. Stoplamp switch. Refer to SECTION 5.
23. Instrument panel driver knee bolster and deflector. Refer to "Instrument Panel Driver Knee Bolster and Deflector" in this section.
24. Instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
25. Instrument panel right-hand trim plate. Refer to "Instrument Panel Right-Hand Trim Plate" in this section.
26. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.
27. If Chevrolet, instrument panel lower trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section. 28 If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
28. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.
29. Instrument panel cluster trim plate, if Chevrolet. Refer to "Instrument Panel Cluster Trim Plate" in this section.
30. Instrument panel compartment door. Refer to "Instrument Panel Compartment Door" in this section.
31. Ashtray and cigarette lighter. Refer to "Ashtray and Cigarette Lighter" in this section.
32. Enable SIR. Refer to "Enabling the SIR System" in this section.

Instrument Panel Carrier Disconnect

Figures 25 and 26

Refer to the following procedure to disconnect and reconnect the carrier for other than carrier replacement. This procedure may be used when removal of all components on the instrument panel is not necessary, i.e.; heater and air conditioning module replacement.

Remove or Disconnect

CAUTION: Refer to "Caution" on page 8C-1 of this section.

1. Disable SIR. Refer to "Disabling the SIR System" in this section.
2. Instrument panel cluster trim plate, if Chevrolet. Refer to "Instrument Panel Cluster Trim Plate" in this section.
3. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.
4. If Chevrolet, instrument panel lower trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
5. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
6. Instrument panel right-hand trim plate. Refer to "Instrument Panel Right-Hand Trim Plate" in this section.
7. If Buick, instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
8. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.
9. Instrument panel driver knee bolster and deflector. Refer to "Instrument Panel Driver Knee Bolster and Deflector" in this section.

NOTICE: Remove stoplamp switch before fully lowering the steering column. Failure to do so may cause the stoplamp switch to become damaged or thrown out of adjustment resulting in a malfunctioning stoplamp switch or premature brake wear.

10. Stoplamp switch. Refer to SECTION 5.
11. Instrument panel sound insulator panel. Refer to "Instrument Panel Sound Insulator Panel" in this section.
12. Passenger inflator module. Refer to SECTION 9J.
13. Inside air temperature sensor. Refer to SECTION 1C.
14. Parking brake release handle. Refer to SECTION 5F.
15. Completely lower steering column. Refer to SECTION 3F.

16. Fifty-six way, ten way and eight way instrument panel harness connectors located just right of the steering column.
17. Temperature valve electric actuator and vacuum solenoid valve electrical connectors for Buick, or temperature control cable at module for Chevrolet.
18. Instrument panel harness and antenna cable connectors at right hinge pillar.
19. Bolts/screws (96) and nut (97) attaching instrument panel lower brace (93) to carrier and dash panel.
20. Instrument panel lower brace (93).
21. Instrument panel carrier (94 or 100).
 - If Chevrolet, remove bolts/screws (95) attaching carrier (94) to hinge pillar tie bar (92).
 - If Buick, remove bolts/screws (101) and bolts/screws (103) attaching carrier (100) to air distributor assembly (102).



Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Instrument panel carrier (94 or 100).
 - If Chevrolet:
 - A. Align and engage four locator pins on carrier (94) to slots on hinge pillar tie bar (92).
 - B. Bolts/screws (95) attaching carrier (94) to hinge pillar tie bar (92).
 - C. Bolt/screw (95) through lower reinforcement bracket (98) to right-hand hinge pillar.



Tighten

- Bolts/screws (95) to 10 N.m (89 lb. in.).
- If Buick:
 - A. Align and engage carrier to locator pins on air distributor.
 - B. Bolts/screws (101) attaching upper area of carrier to air distributor (102).



Tighten

- Bolts/screws (101) to 10 N.m (89 lb. in.).
- C. Bolts/screws (103) to secure lower area of instrument panel carrier (100).



Tighten

- Bolts/screws (103) to 1.9 N.m (17 lb. in.).
2. Instrument panel lower brace (93).
 3. Nut (97) attaching lower brace (93) to cowl.



Tighten

- Nut (97) to 10 N.m (89 lb. in.).
4. Bolts/screws (96) attaching lower brace (93) to carrier.



Tighten

- Bolts/screws (96) to 10 N.m (89 lb. in.)
5. Instrument panel harness and antenna cable connectors at right hinge pillar.
 6. Temperature valve electric actuator and vacuum solenoid valve electrical connectors for Buick, or temperature control cable at module for Chevrolet.
 7. Fifty-six way, ten way and eight way instrument panel harness connectors located just right of the steering column.
 8. Raise steering column. Refer to SECTION 3F.
 9. Parking brake release handle. Refer to SECTION 5F.
 10. Inside air temperature sensor. Refer to SECTION 1C.
 11. Passenger inflator module. Refer to SECTION 9J.
 12. Instrument panel sound insulator panel. Refer to "Instrument Panel Sound Insulator Panel" in this section.
 13. Stoplamp switch. Refer to SECTION 5.
 14. Instrument panel driver knee bolster and deflector. Refer to "Instrument Panel Driver Knee Bolster and Deflector" in this section.
 15. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.
 16. If Buick, instrument panel steering column opening filler. Refer to "Instrument Panel Steering Column Opening Filler" in this section.
 17. If Chevrolet, instrument panel lower trim plate. Refer to "Instrument Panel Lower Trim Plate" in this section.
 18. If Buick, instrument panel trim plate. Refer to "Instrument Panel Trim Plate" in this section.
 19. Instrument panel right-hand trim plate. Refer to "Instrument Panel Right-Hand Trim Plate" in this section.
 20. If Chevrolet, instrument panel cluster trim plate. Refer to "Instrument Panel Cluster Trim Plate" in this section.
 21. Windshield defroster nozzle grille. Refer to "Windshield Defroster Nozzle Grille" in this section.
 22. Enable SIR. Refer to "Enabling the SIR System" in this section.

Instrument Panel Wiring Harness

Refer to Figure 27 for Chevrolet and Figure 28 for Buick when referencing instrument panel wiring harness routing.

ACCESSORY WIRING HARNESS

(Police Vehicles)

Refer to Figure 29 for accessory wiring harness routing.

8C-30 INSTRUMENT PANEL AND GAGES

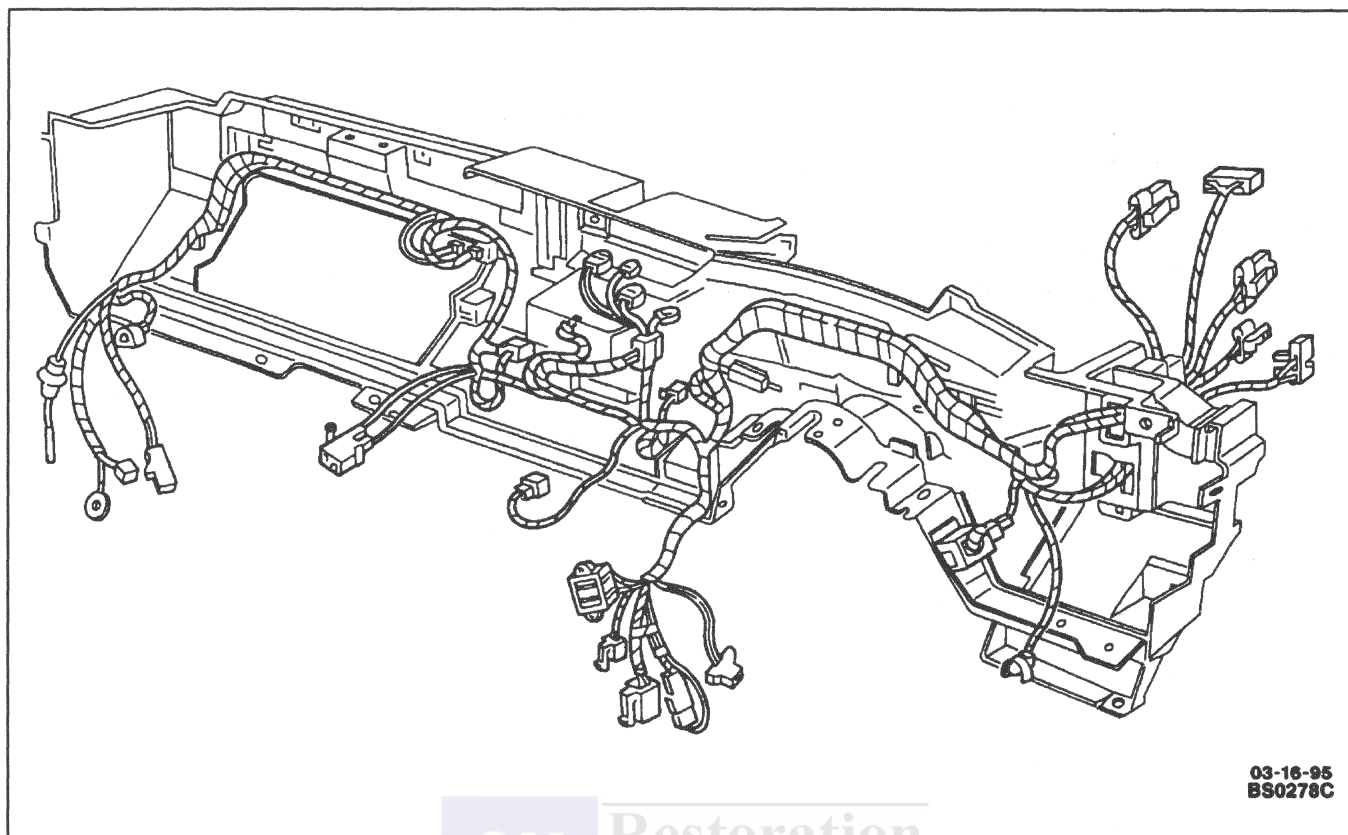


Figure 27 - Instrument Panel Wiring Harness - (Chevrolet)

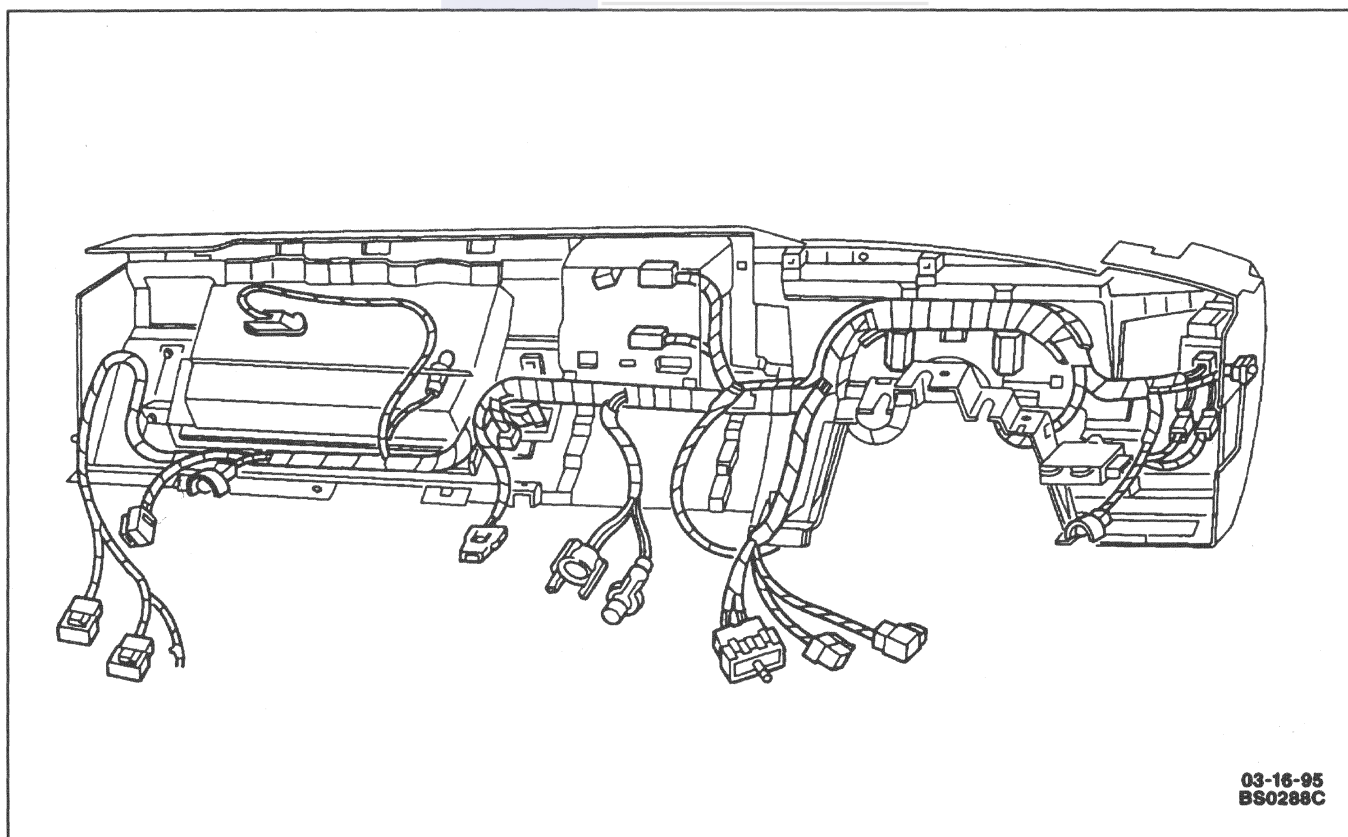
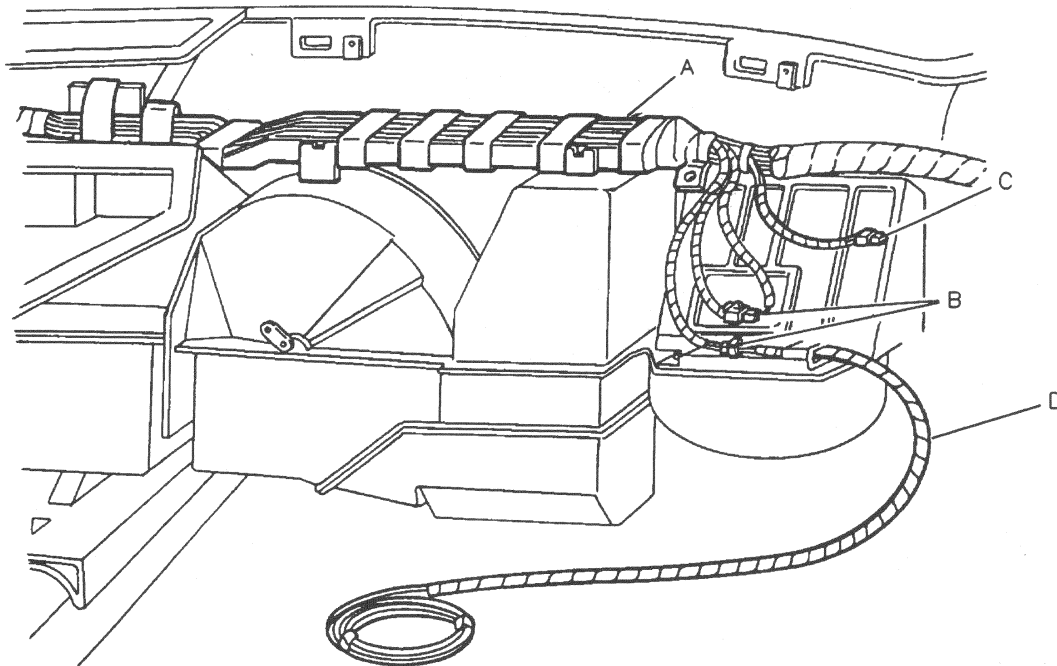


Figure 28 - Instrument Panel Wiring Harness - (Buick)



A CONDUIT, BODY HARNESS
B CONNECTOR, ACCESSORY WIRING HARNESS
C CONNECTOR, SIR
D HARNESS, ACCESSORY WIRING

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Figure 29 - Accessory Wiring Harness - (Police Vehicles)

WARNING/INDICATOR, AUDIO ALARMS AND FLASHERS

Figure 30

↔ Remove or Disconnect

1. Audio alarm (110) from convenience center.
2. Turn signal lamp flasher (111).
3. Hazard Lamp flasher (112).

→→ Install or Connect

1. Turn signal lamp flasher (111).
2. Hazard Lamp flasher (112).
3. Audio alarm (110).

3. Bolts/screws (117) attaching air distributor (116) to hinge pillar tie bar (92).
- Move air distributor (116) clear from SIR support brackets and support center bracket.
4. Bolts/screws (118) attaching hinge pillar tie bar (92) to left and right-hand hinge pillars.
5. Carefully lift tie bar (92) to clear stud from steering column bracket.

VENTILATION, HEAT AND AIR CONDITIONING DUCTS

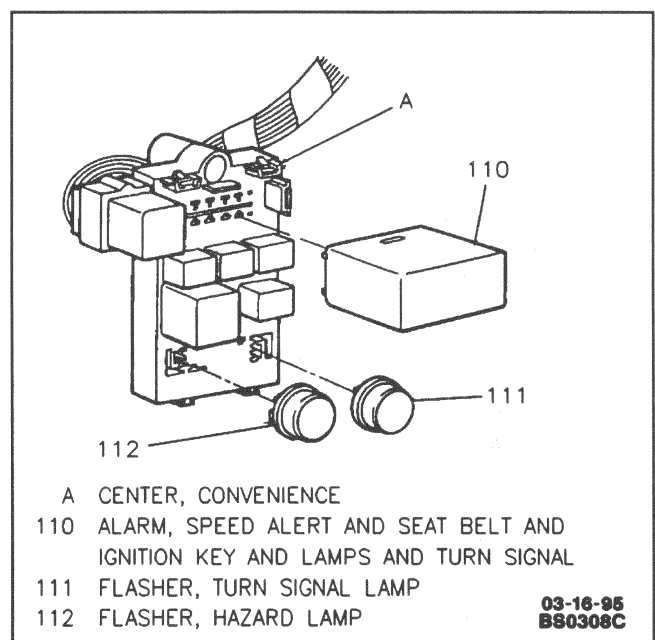
Air Distributor

(Chevrolet)

Figure 31

↔ Remove or Disconnect

1. Instrument panel carrier. Refer to "Instrument Panel Carrier" in this section.
2. Nut (119) securing hinge pillar tie bar (92) to steering column bracket.



A CENTER, CONVENIENCE
110 ALARM, SPEED ALERT AND SEAT BELT AND IGNITION KEY AND LAMPS AND TURN SIGNAL
111 FLASHER, TURN SIGNAL LAMP
112 FLASHER, HAZARD LAMP

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Figure 30 - Warning/Indicator, Audio Alarms and Flashers

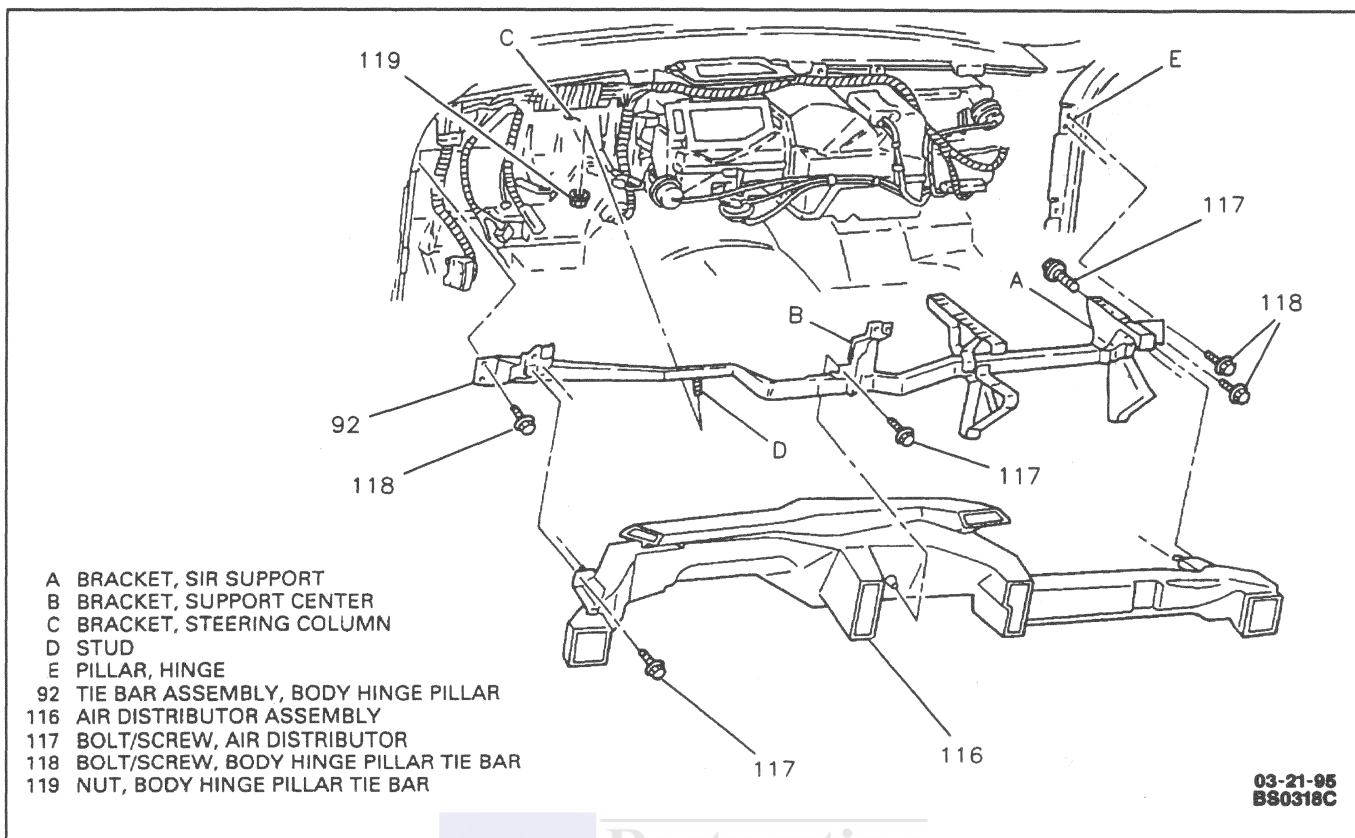


Figure 31 - Air Distributor and Hinge Pillar Tie Bars - (Chevrolet)

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Hinge pillar tie bar (92).
 - A. Align and insert stud into slot in steering column bracket.
 - B. Nut (119) to stud.

Tighten

- Nut (119) to 10 N.m (89 lb. in.).
- C. Align bolt/screw (118) to lower right hole of tie bar (92).
 - D. Remaining bolts/screws (118).

Tighten

- Bolts/screws (118) to 10 N.m (89 lb. in.).
2. Air distributor (116) to hinge pillar tie bar (92).
 - A. Position air distributor (116) behind support center bracket and inside SIR support brackets.
 - B. Install bolts/screws (117) attaching air distributor (116) to SIR support right-hand bracket and hinge pillar tie bar (92).

Tighten

- Bolts/screws (117) to 10 N.m (89 lb. in.).
3. Instrument panel carrier. Refer to "Instrument Panel Carrier" in this section.

(Buick)

Figure 32

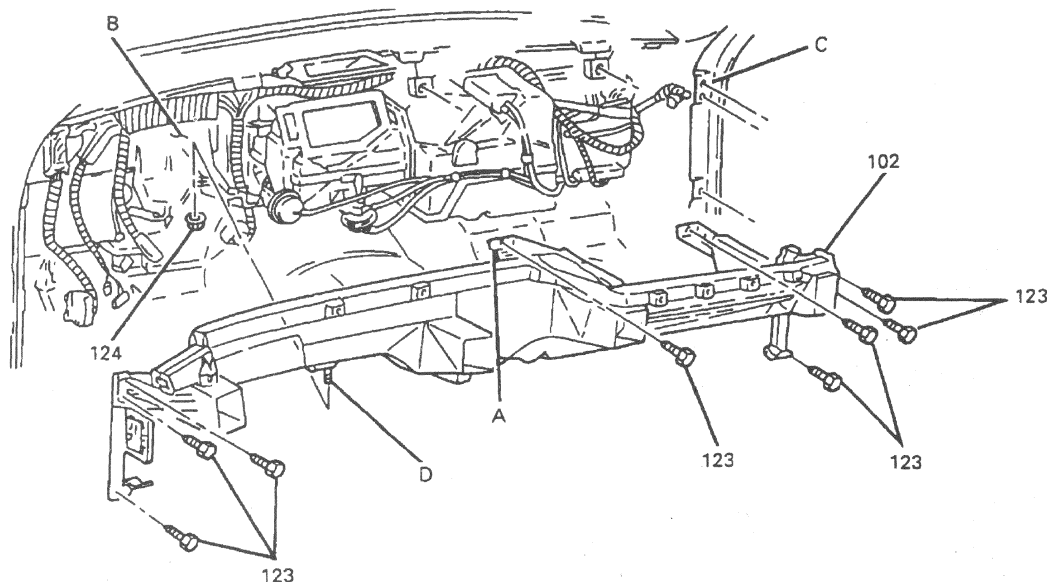
Remove or Disconnect

1. Instrument panel carrier. Refer to "Instrument Panel Carrier" in this section.
2. Air distributor (102).
 - A. Two bolts/screws (123) securing SIR support brackets to dash panel.
 - B. Six bolts/screws (123) attaching air distributor (102) to left and right-hand hinge pillars.
 - C. Nut (124) securing air distributor (102) to steering column bracket.
3. Carefully lift air distributor (102) to clear stud from steering column bracket.

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Air distributor (102).
 - A. Align and insert stud into hole in steering column bracket.
 - B. Align right-hand support bracket upper slot with upper hole in right-hand hinge pillar.
 - C. Bolt/screw (123) into upper hole in right-hand hinge pillar.



- A BRACKET, SIR SUPPORT
 B BRACKET, STEERING COLUMN
 C PILLAR, HINGE
 D STUD
 102 DISTRIBUTOR, AIR
 123 BOLT/SCREW, AIR DISTRIBUTOR
 124 NUT, AIR DISTRIBUTOR

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Figure 32 - Air Distributor - (Buick)



Tighten

- Bolt/screw (123) to 10 N.m (89 lb. in.).
- D. Remaining bolts/screws (123) attaching air distributor (102) to left and right-hand hinge pillars.



Tighten

- Bolts/screws (123) to 10 N.m (89 lb. in.).
- E. Two bolts/screws (123) securing SIR support brackets to dash panel.



Tighten

- Bolts/screws (123) to 10 N.m (89 lb. in.).
- F. Nut (124) securing air distributor (102) to steering column bracket.



Tighten

- Nut (124) to 10 N.m (89 lb. in.).
2. Instrument panel carrier. Refer to "Instrument Panel Carrier" in this section.

Floor Air Outlet

Figure 33



Remove or Disconnect

1. Bolt/screw (131) attaching outlet (132) to evaporator module (130).
2. Outlet (132).



Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Outlet (132).
2. Bolt/screw (131) attaching outlet (132) to evaporator module (130).



Tighten

- Bolt/screw (131) to 1.5 N.m (13 lb. in.).

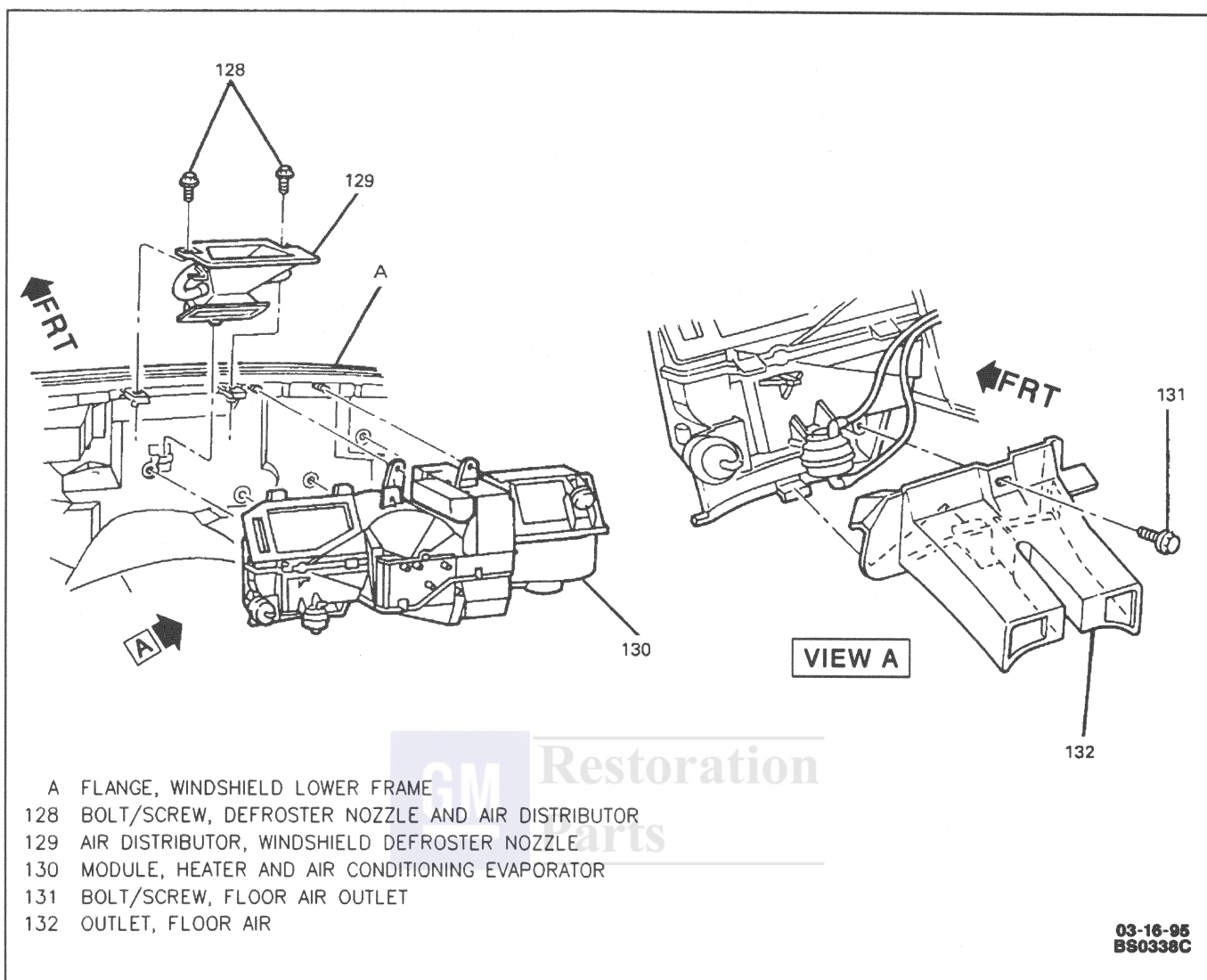


Figure 33 - Windshield Defroster Nozzle and Floor Air Outlets

Windshield Defroster Nozzle

Figure 33

Remove or Disconnect

1. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.
2. Two bolts/screws (128) attaching air distributor (129) to flange.
3. Air distributor (129).

Install or Connect

NOTICE: Refer to "Notice" on page 8C-1 of this section.

1. Air distributor (129).
2. Two bolts/screws (128) attaching air distributor (129) to flange.

Tighten

- Bolts/screws (128) to 1.9 N.m (17 lb. in.).
3. Instrument panel upper trim pad. Refer to "Instrument Panel Upper Trim Pad" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accessory Switch Panel Bolt/Screw (Lower).....	1.9 N-m (17 lb. in.)
Air Distributor Bolt/Screw	1.9 N-m (17 lb. in.)
Air Distributor Nut.....	10 N-m (89 lb. in.)
Ashtray Bolt/Screw.....	1.9 N-m (17 lb. in.)
Body Hinge Pillar Tie Bar Bolt/screw.....	10 N-m (89 lb. in.)
Body Hinge Pillar Tie Bar Nut.....	10 N-m (89 lb. in.)
Defroster Nozzle and Air Distributor Bolt/Screw.....	1.9 N-m (17 lb. in.)
Floor Air Outlet Bolt/Screw.....	1.5 N-m (13 lb. in.)
Headlamp and Instrument Panel Lamp Dimmer Switch Bolt/Screw.....	1.9 N-m (17 lb. in.)
Headlamp and Interior Lamp Switch Housing Bolt/Screw	1.9 N-m (17 lb. in.)
Instrument Cluster Bolt/Screw	1.9 N-m (17 lb. in.)
Instrument Panel Bolt/Screw (Buick).....	10 N-m (89 lb. in.)
Instrument Panel Bolt/Screw (Chevrolet).....	10 N-m (89 lb. in.)
Instrument Panel Cluster Trim Plate Bolt/Screw	1.9 N-m (17 lb. in.)
Instrument Panel Compartment Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Compartment Door Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Driver Knee Bolster Bolt/Screw	10 N-m (89 lb. in.)
Instrument Panel Driver Knee Bolster Deflector Bolt/Screw.....	10 N-m (89 lb. in.)
Instrument Panel Lamp Dimmer Bolt/Screw	1.9 N-m (17 lb. in.)
Instrument Panel Lower Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Lower Brace Bolt/Screw	10 N-m (89 lb. in.)
Instrument Panel Lower Brace Nut.....	10 N-m (89 lb. in.)
Instrument Panel Lower Trim Plate Bolt/Screw	1.9 N-m (17 lb. in.)
Instrument Panel Steering Column Opening Filler Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Trim Plate Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Upper Trim Pad Bolt/Screw.....	1.9 N-m (17 lb. in.)
Instrument Panel Wiring Harness Diagnostic Connector Bolt/Screw	1.9 N-m (17 lb. in.)
Radio Bolt/Screw.....	1.9 N-m (17 lb. in.)
Radio Bracket Bolt/Screw	1.9 N-m (17 lb. in.)
Radio Nut.....	2.8 N-m (25 lb. in.)
Radio Rear Bracket Bolt/Screw.....	1.9 N-m (17 lb. in.)
Rear Compartment Lid Release Switch Bezel Bolt/Screw.....	1.9 N-m (17 lb. in.)
Rear Window Wiper and Washer Switch Bolt/Screw	1.9 N-m (17 lb. in.)
Steering Column Capsule Nut.....	27 N-m (20 lb. ft.)
Steering Column Guide Bracket Bolt/Screw.....	25 N-m (18 lb. ft.)

REPLACEMENT BULBS

Cluster Illumination.....	PC 194
Warning/Indicator Lamps.....	PC 161



SECTION 8E

WINDSHIELD WIPER/WASHER SYSTEM

NOTICE: Refer to battery disconnect caution in Section 0A.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paint, grease, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

Figure 1

The windshield wiper/washer system consists of a permanent-magnet, depressed-park wiper motor assembly, a transmission assembly, wiper arm and blade assemblies, a washer pump mounted on a washer solvent container and a wiper/washer switch assembly (Figure 1).

The wiper/washer system is a pulse-type (delay). Pulse timing and demand wash functions are controlled electronically.

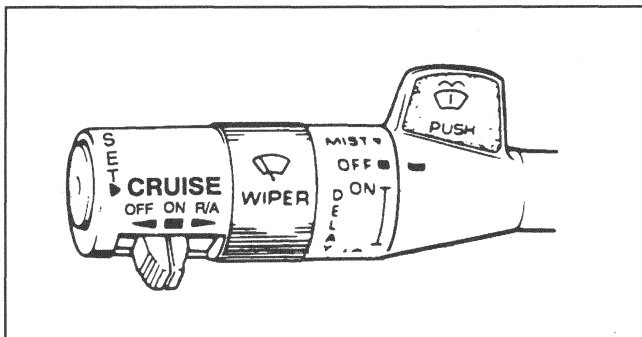


Figure 1 — Wiper/Washer Switch Assembly

SYSTEM OPERATION

Figure 2

Wiper Operation

In addition to the features of a standard (non-pulse) wiper system (mist, low and high speeds), the pulse-type windshield wiper/washer system includes an operating mode in which the wipers make single sweeps with an adjustable time interval between sweeps. The time interval is controlled by a solid-state timer in the wiper motor cover assembly. The duration of the delay interval is determined by the delay rheostat in the wiper/washer switch assembly.

The wiper motor is protected by a circuit breaker. If the wipers are blocked (by snow or ice, for example), the circuit breaker will open the circuit. The circuit breaker resets automatically when it cools.

8E-2 WINDSHIELD WIPER/WASHER SYSTEM

Pulse Operation

With the wiper switch in "DELAY" (pulse), battery voltage is applied to the wiper motor cover assembly at connector C1 terminal "F" through the PNK wire. Voltage also is applied to connector C1 terminal "B" through the GRY wire.

The variable resistance set by the pulse delay resistor of the wiper/washer switch assembly is used by the wiper motor cover circuitry to determine the delay time between sweeps.

Low-Speed Operation

In the "LO" position, the wiper switch applies battery voltage to the wiper motor cover assembly at connector C1 terminal "C" through the DK GRN wire and to connector C1 terminal "B" through the GRY wire.

Wiper motor cover circuitry supplies power from connector C1 terminal "A" through the YEL jumper wire to connector C2 terminal "B" to the wiper motor.

High-Speed Operation

In the "HI" position, the wiper switch applies battery voltage to the wiper motor cover assembly at connector C1 terminal "C" through the DK GRN wire and to connector C1 terminal "B" through the GRY wire.

The wiper motor cover assembly supplies power from connector C1 terminal "A" through the YEL jumper wire to connector C2 terminal "B" to the wiper motor. The wiper motor also has voltage applied from the wiper/washer switch assembly to connector C2 terminal "A" through the PPL wire to a separate armature brush for high-speed operation.

Park-Position Operation

When turned "OFF" from any position, the wipers complete the last sweep and park. When the wiper switch is in "OFF," the wiper motor cover assembly has battery voltage applied to connector C1 terminal "C" through the DK GRN wire and connector C1 terminal "F" through the PNK wire. The wiper motor cover circuitry controls power through the park relay to connector C1 terminal "A" through the YEL jumper wire to connector C2 terminal "B" to the wiper motor, which runs until the park relay is opened.

The park relay is controlled both electronically and mechanically. The relay is held closed mechanically until the wipers reach the park position and "wiper request" is no longer present. Whenever "wiper request" is present, the relay is held closed electronically.

Washer Operation

When the washer switch is pressed, the wipers operate at low speed using the same circuit operation as low speed, or the same as high speed only if "HI" speed is selected.

When the washer switch is held ON, the wiper motor assembly will keep the washer pump ON only as long as the washer switch is held ON. If the wipers had been in "DELAY," "LO" or "HI," they would return to that operation after the wash cycle. If not, they then return to park position after approximately three sweeps.

Mist Operation

When the wiper switch is moved to MIST and released, the wipers make one sweep at low speed and return to park position. The circuit operation is the same as that of low speed.

DIAGNOSIS

COMPONENT LOCATIONS

- Refer to Figure 4 for a list of component locations.

TROUBLESHOOTING HINTS

Figure 2

- Make the following checks before beginning System Diagnosis.
 1. Check fuse 10. If open, check CKT 143 for short to ground.
 2. If washer does not operate, check that:
 - Washer solvent container is filled.
 - Hoses are correctly attached.
 - Hoses are not cut, kinked or pinched.
 - Nozzles are not clogged.
 - Connector seal at washer pump is not damaged or missing.
 3. If washer does not operate and wipers run in "HI" only (low speed inoperative), check CKT 91 for open.
 4. Check for binding or broken wiper transmission assembly.
 5. Check for missing or damaged connector seal at wiper motor assembly.
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the Wiper/Washer System Check (Figure 5), then refer to the Symptom Table (Figure 6) for the appropriate diagnostic procedures.

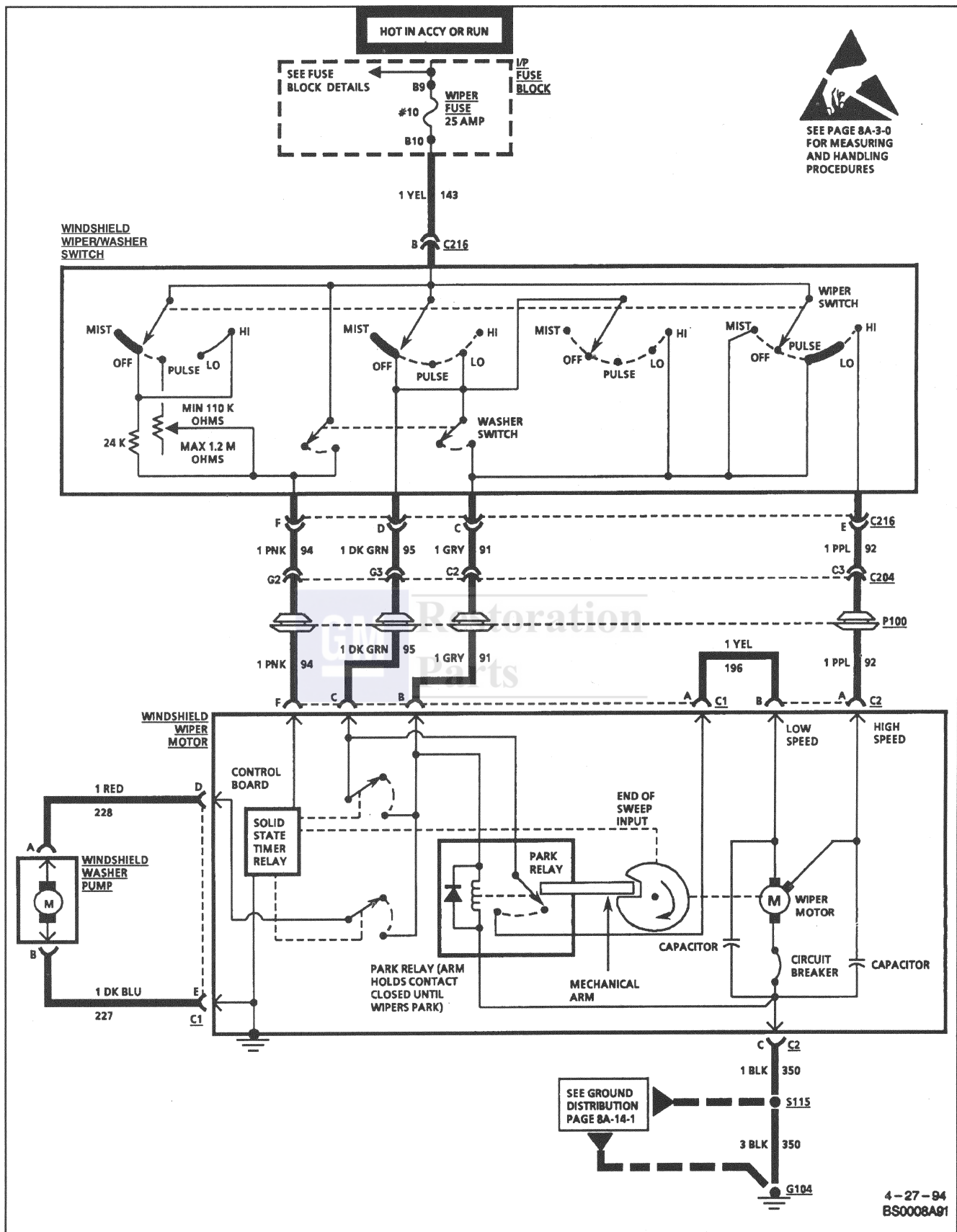


Figure 2 — Windshield Wiper/Washer System Electrical Schematic

8E-4 WINDSHIELD WIPER/WASHER SYSTEM

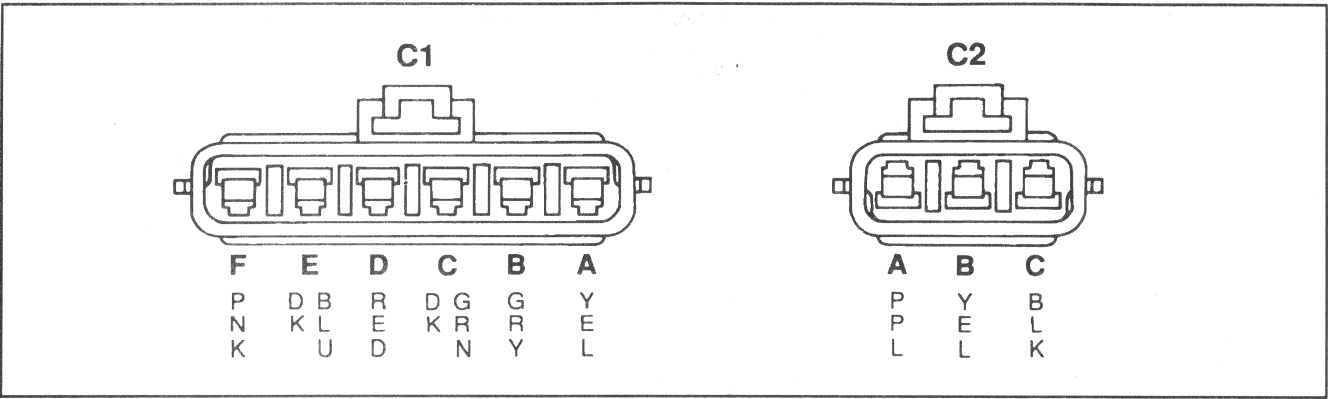


Figure 3 — Wiper Motor Wiring Harness Connectors

COMPONENT	LOCATION
I/P Fuse Block	Mounted to LH I/P, accessible with LH front door open
Windshield Washer Pump	Attached to washer fluid reservoir
Windshield Wiper Motor	RH rear engine compartment
Windshield Wiper and Windshield Washer Switch	Part of multifunction lever on steering column
C204 (37 cavities)	Body harness to engine harness, right of I/P, between blower motor and I/P compartment
C216 (7 cavities)	Windshield wiper/washer switch connector to body harness, attached to steering column
G104	Engine compartment front of LH cylinder head
P100	RH I/P, forward of blower motor
S115	Engine harness, approx. 14 cm from #8 fuel injector breakout

Figure 4 — Component Locations

WINDSHIELD WIPER/WASHER SYSTEM 8E-5

ACTION	NORMAL OPERATION
[1] • Turn ignition switch to "RUN." • Press washer switch ON.	Wipers operate at "LO" speed. Washer sprays windshield as long as washer switch is held in ON position. After releasing switch, washer stops and wipers return to park position after approximately 3 sweeps.
[2] • Turn wiper switch to "DELAY" (pulse mode).	Wipers make one complete sweep, then pause for 1 to 25 seconds before making the next sweep. The pause time is adjusted by turning the wiper switch through the delay range.
[3] • Wiper switch in "DELAY." • Press washer switch ON.	Washer sprays windshield as long as washer switch is held ON. Wipers run at low speed while spraying and continue until washer switch is released. Wipers then return to pulse operation.
[4] • Turn wiper switch to "LO."	Wipers run continuously at low speed.
[5] • Turn wiper switch to "HI."	Wipers run continuously at faster speed.
[6] • Turn wiper switch to "OFF."	Wipers return to park position at low speed.
[7] • Turn wiper switch to "MIST," then release.	Wipers make one complete sweep, then return to park position.

Figure 5 — Wiper/Washer System Check

SYMPTOM	PROCEDURE	PAGE
Wipers do not operate in any mode.	Chart 1	8E-6
Wipers run at high speed only (low speed inoperative).	Chart 2	8E-7
Wipers run at low speed only (high speed inoperative).	Chart 3	8E-7
Wipers run intermittently in low- or high-speed settings.	Chart 4	8E-8
Wipers will not turn off.	Chart 5	8E-8
Wipers cycle in and out of park position after wipers are shut off.	Chart 6	8E-9
Pulse delay operates incorrectly or not at all.	Chart 7	8E-9
Washer will not operate.	Chart 8	8E-10
Washer will not shut off.	Chart 9	8E-10

Figure 6 — Symptom Table

8E-6 WINDSHIELD WIPER/WASHER SYSTEM

CHART 1
WIPERS DO NOT OPERATE IN ANY MODE

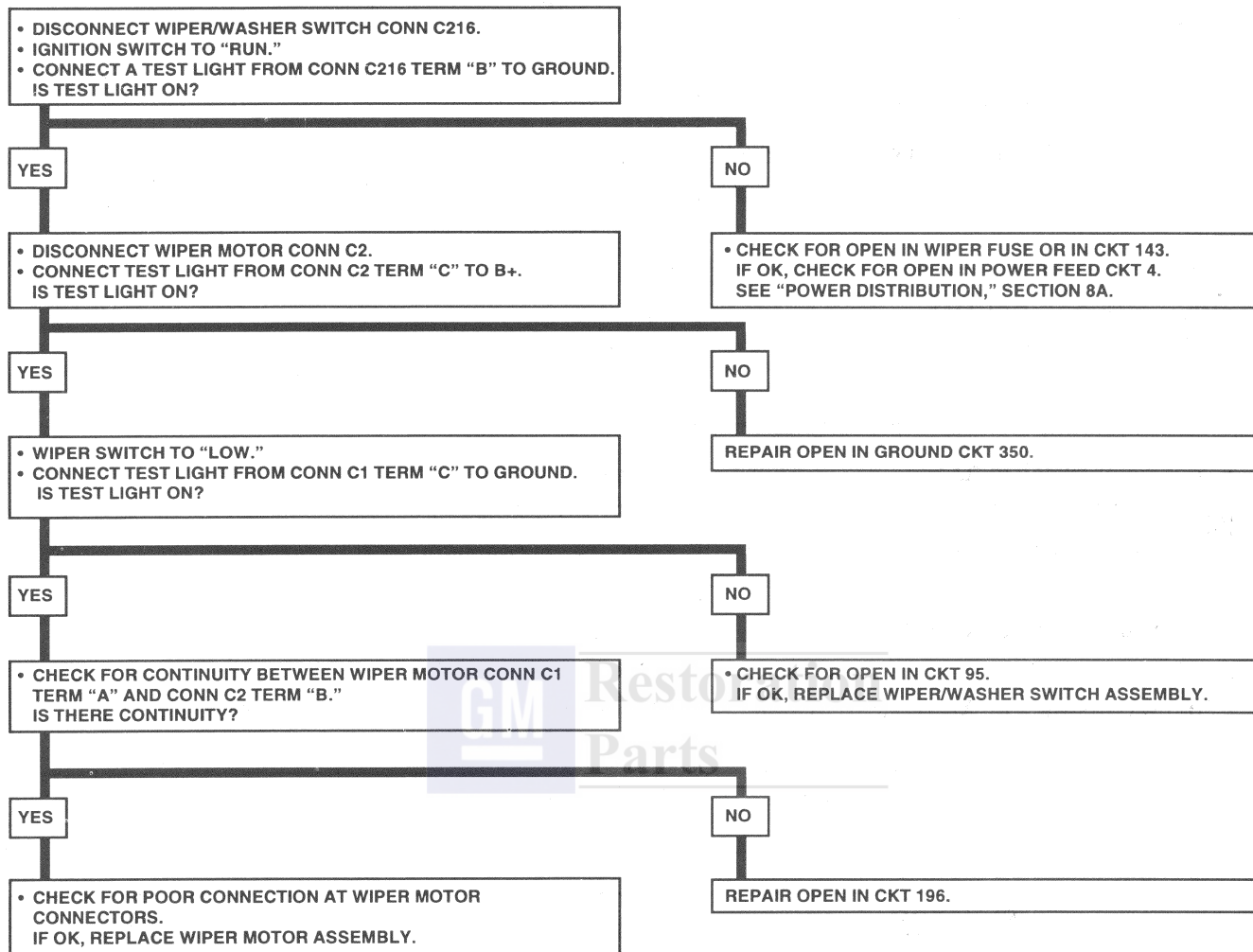


CHART 2
WIPERS RUN AT HIGH SPEED ONLY
(LOW SPEED INOPERATIVE)

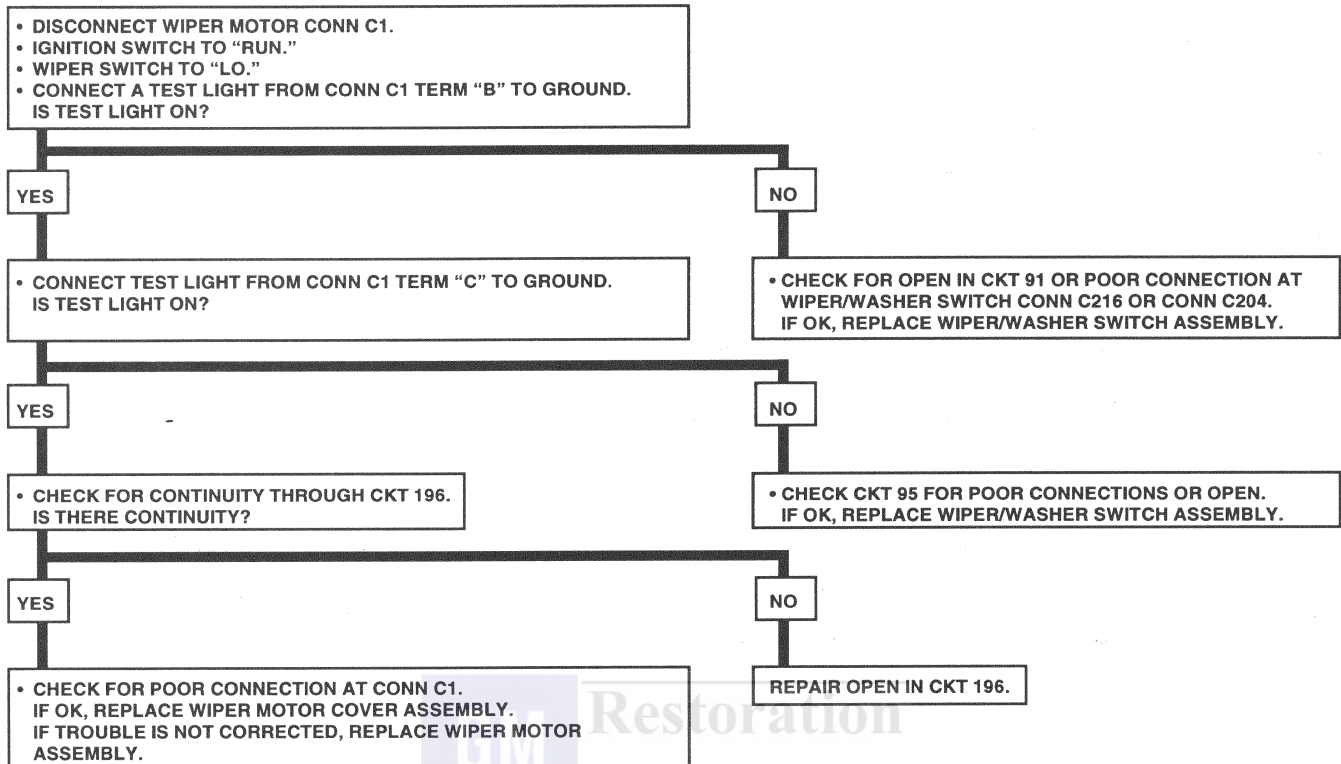
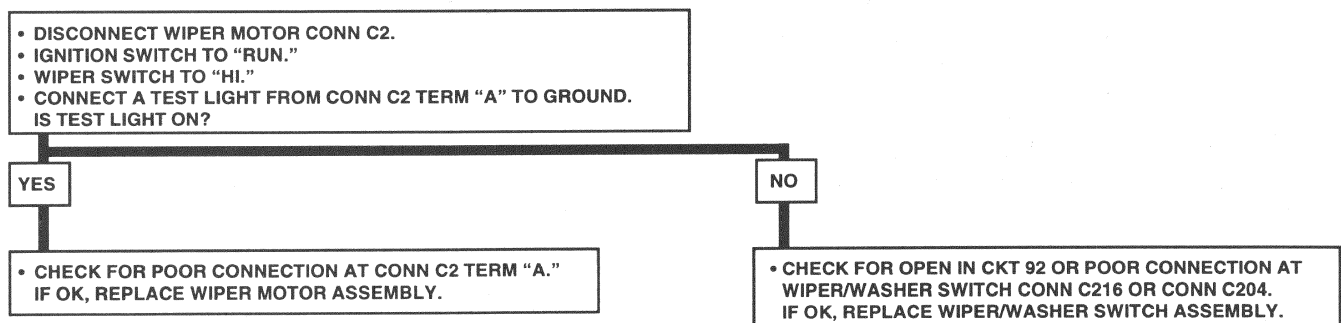


CHART 3
WIPERS RUN AT LOW SPEED ONLY
(HIGH SPEED INOPERATIVE)



8E-8 WINDSHIELD WIPER/WASHER SYSTEM

CHART 4
WIPERS RUN INTERMITTENTLY IN LOW OR HIGH SPEED SETTINGS

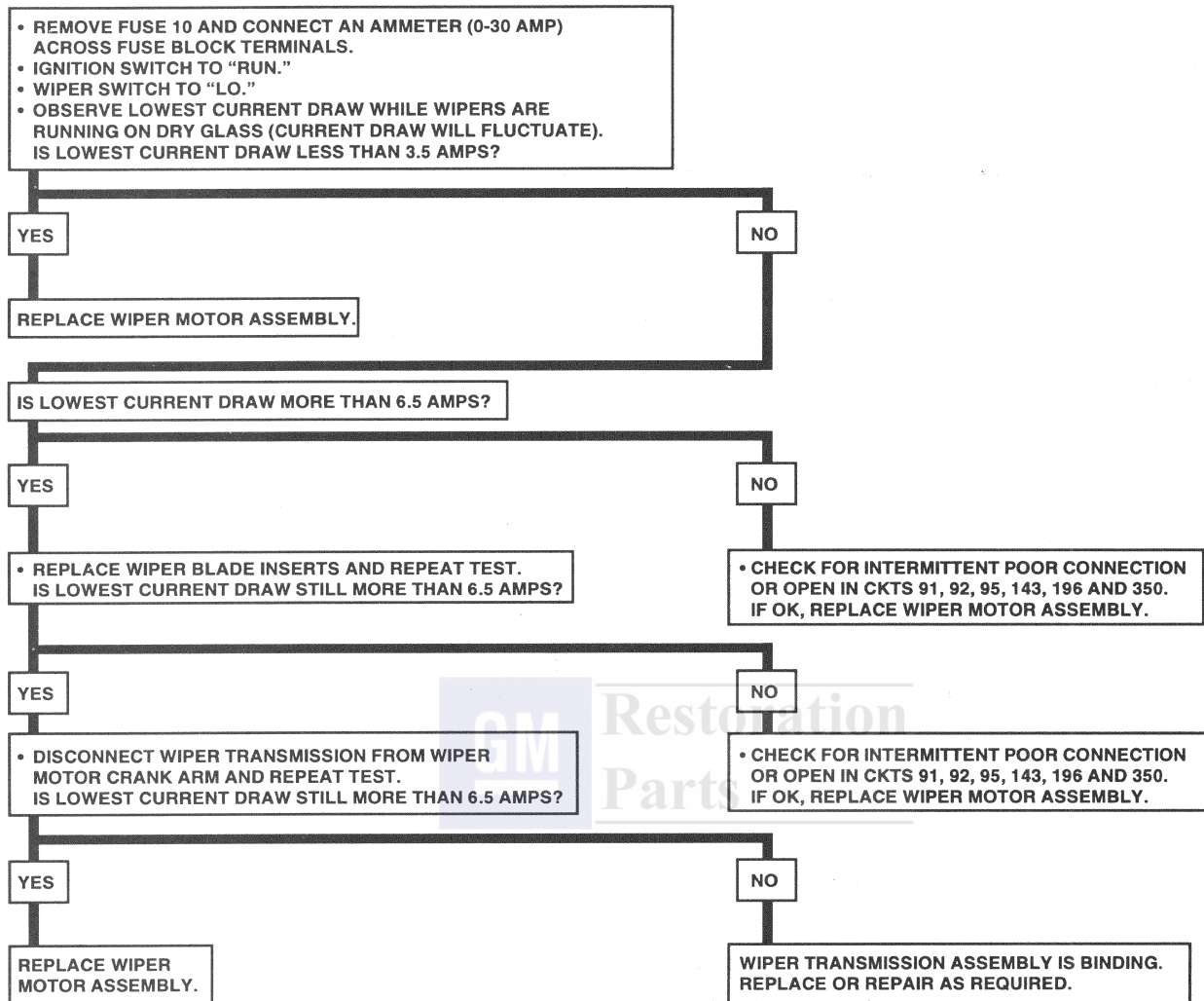


CHART 5
WIPERS WILL NOT TURN OFF

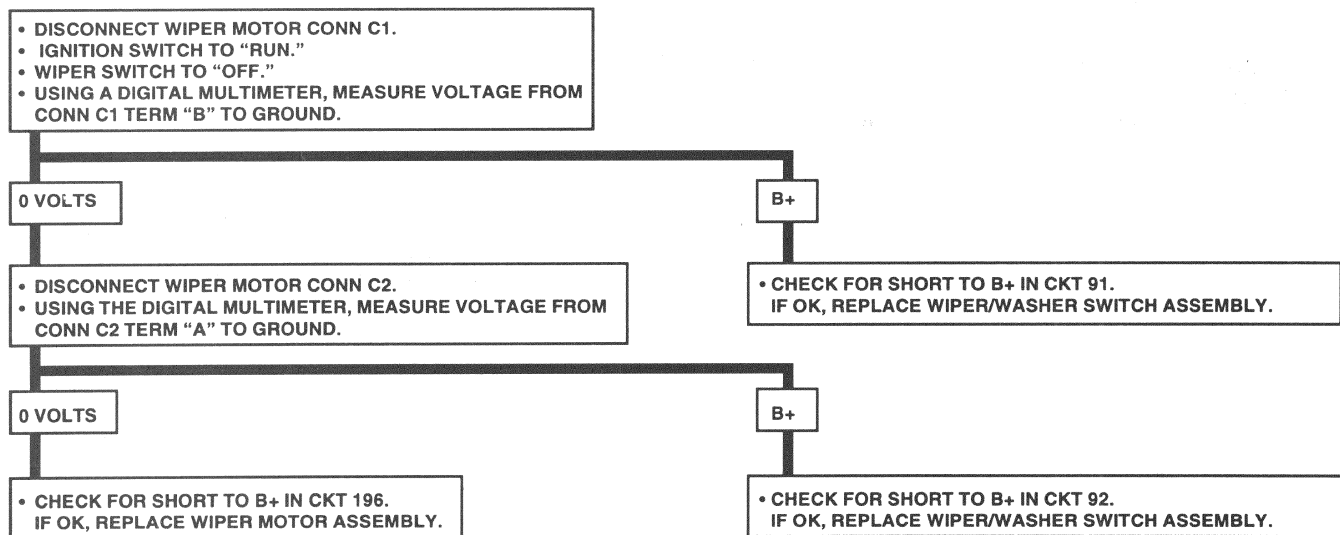


CHART 6
WIPERS CYCLE IN AND OUT OF PARK POSITION AFTER WIPERS ARE SHUT OFF

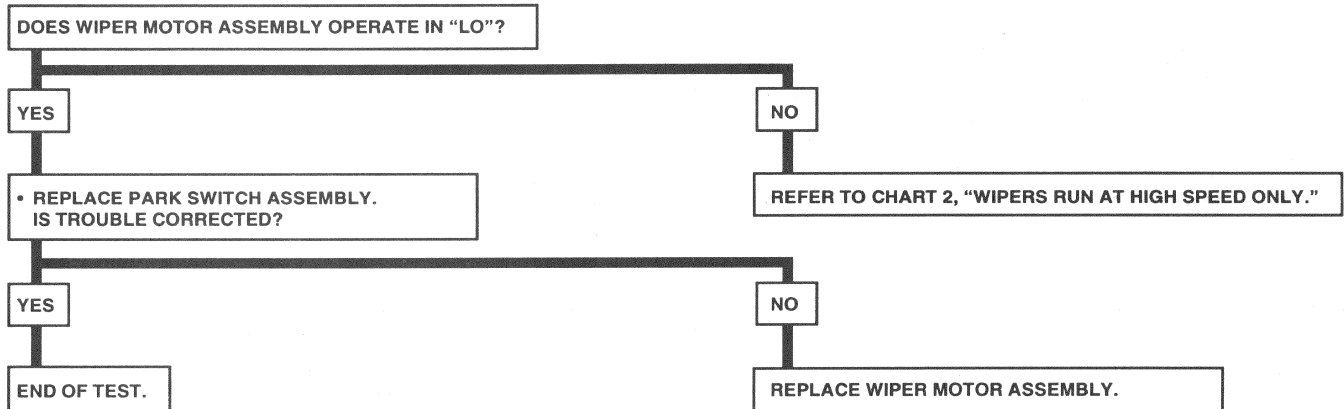
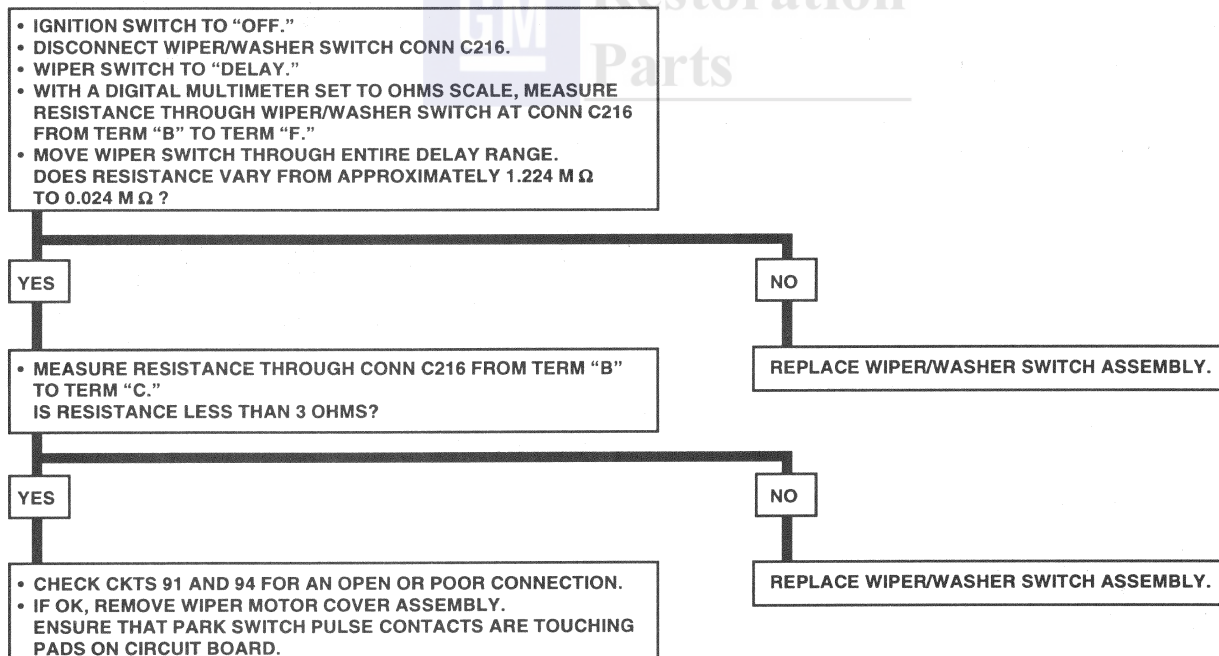


CHART 7
PULSE DELAY OPERATES INCORRECTLY OR NOT AT ALL



8E-10 WINDSHIELD WIPER/WASHER SYSTEM

CHART 8
WASHER WILL NOT OPERATE

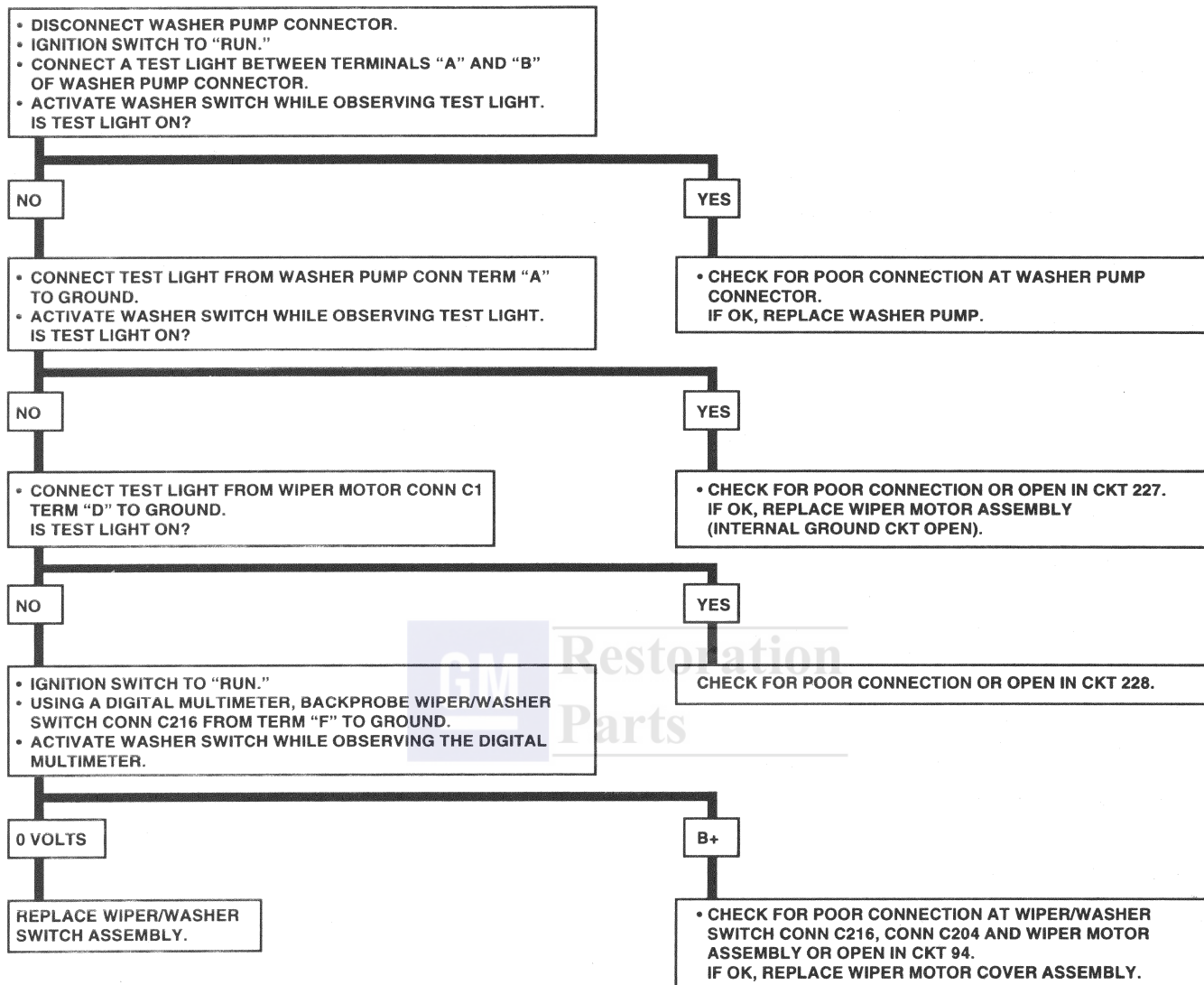
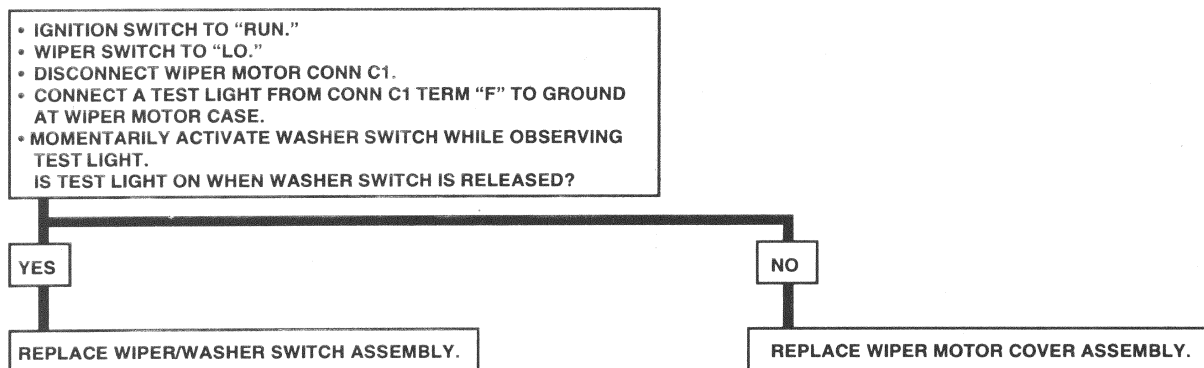


CHART 9
WASHER WILL NOT SHUT OFF



ON-VEHICLE SERVICE**WASHER PUMP REPLACEMENT****Figure 7****Remove or Disconnect**

1. Negative battery cable. Refer to SECTION 0A.
2. Washer solvent.
3. Electrical connector(s) and washer hose (4).
4. Washer solvent container (1) attaching parts.
5. Washer solvent container (1).
6. Windshield washer pump (3) from container.

Install or Connect

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

1. Windshield washer pump (3) in washer solvent container (1).

Important

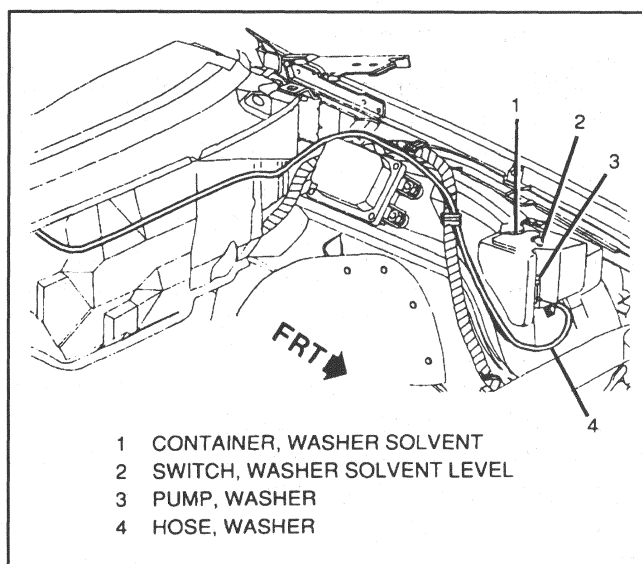
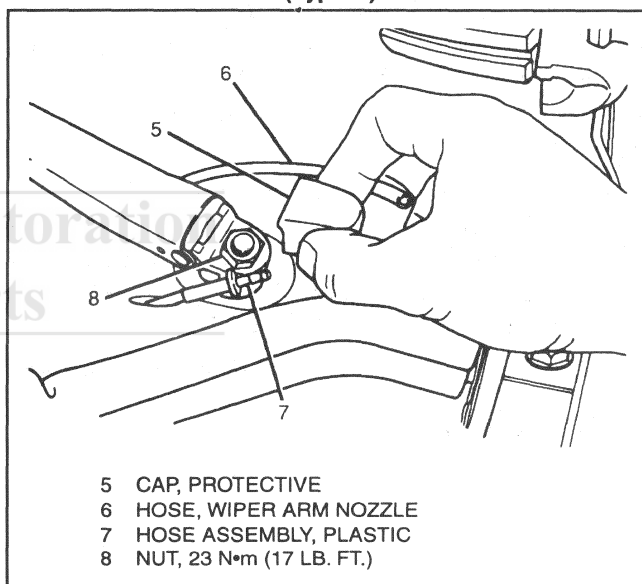
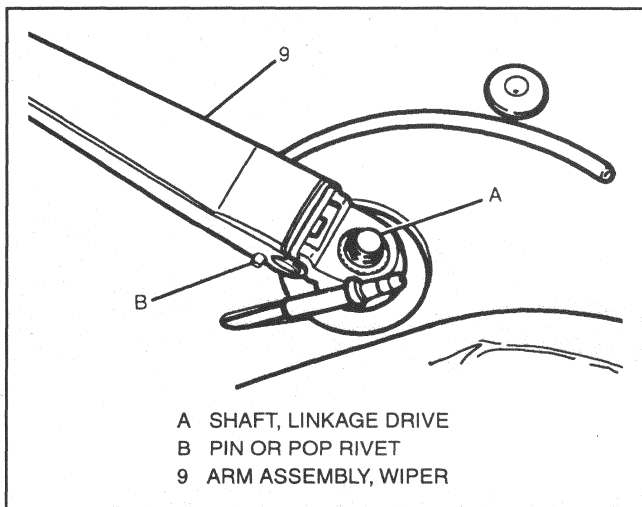
- Make sure windshield washer pump is pushed all the way into the container seal.
2. Washer solvent container (1) and attaching parts.
 3. Electrical connector(s) and washer hose (4).
 4. Washer solvent.
 5. Negative battery cable. Refer to SECTION 0A.

WIPER ARM ASSEMBLY REPLACEMENT**Figures 8 through 12****Remove or Disconnect**

1. Wiper arm nozzle hose (6, Figure 8) from plastic hose assembly connector (7).
2. Protective cap (5).
3. Lift wiper arm assembly (9, Figure 9) and insert a suitable pin or pop rivet (B, pivot prevention pin) completely through the two holes located next to pivot of arm.
4. Nut (8, Figure 8).
5. Wiper arm assembly (9, Figure 9) from linkage drive shaft (A, Figure 9) using a battery terminal puller.

Clean

- Knurls of linkage drive shaft (C, Figure 10) with a suitable wire brush.
6. Wiper blade assembly, if required. Refer to "Wiper Blade Assembly Replacement."

**Figure 7 — Washer Pump(s) and Solvent Container (Typical)****Figure 8 — Wiper Arm Hose, Cap and Nut Removal (Typical)****Figure 9 — Pin or Pop Rivet Insertion (Typical)**

8E-12 WINDSHIELD WIPER/WASHER SYSTEM

Install or Connect

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

1. Wiper blade assembly, if removed. Refer to "Wiper Blade Assembly Replacement."
2. Pivot prevention pin (B, Figure 9), if removed.
3. Wiper arm assembly (9, Figure 9) on linkage drive shaft (A, Figure 9), with inboard surface of wiper arm assembly (9, Figure 11) 25mm (1 in.) below stop surface of park ramp (D, Figure 11).
4. Wiper arm nozzle hose (6, Figure 8) to plastic hose assembly connector (7, Figure 8).
5. Remove pivot prevention pin (B, Figure 9) from wiper arm assembly (9, Figure 9).
6. New nut (8, Figure 8).

Tighten

- Nut (8) to 23 N·m (17 lb. ft.).

7. Lift replaced wiper arm assembly (9, Figure 11) over park ramp (D, Figure 11).

Inspect

- Run wipers and check for correct wipe pattern. LH blade tip should wipe to a limit of 21.3-92.3 mm (0.75-3.50 in.) from outside edge of glass. RH blade should overlap into LH wipe pattern as shown in Figure 12.
- Shut off wipers and check for proper park position.

8. Protective cap (5, Figure 8).

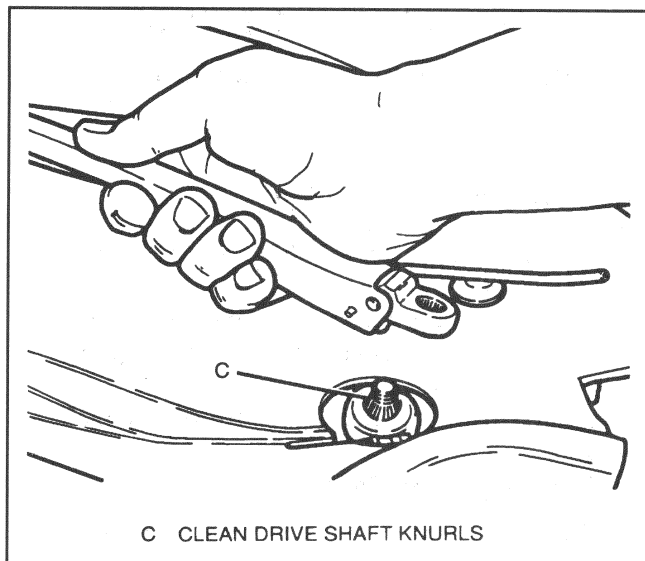


Figure 10 — Wiper Arm Assembly Removal

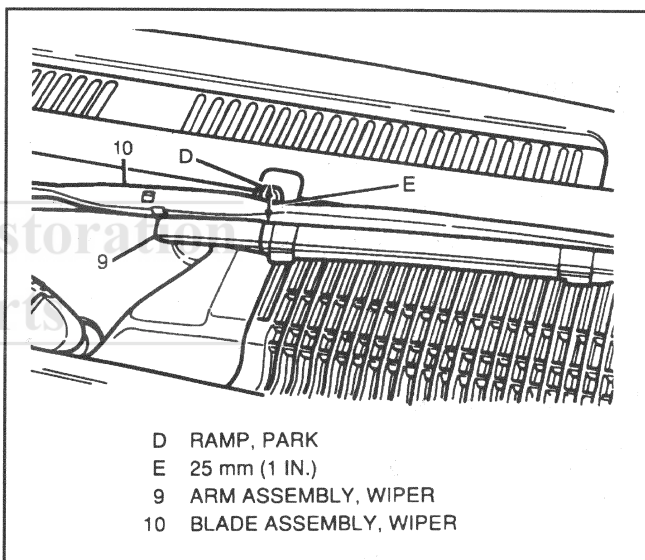


Figure 11 — Wiper Arm and Blade Assembly Installation (Typical)

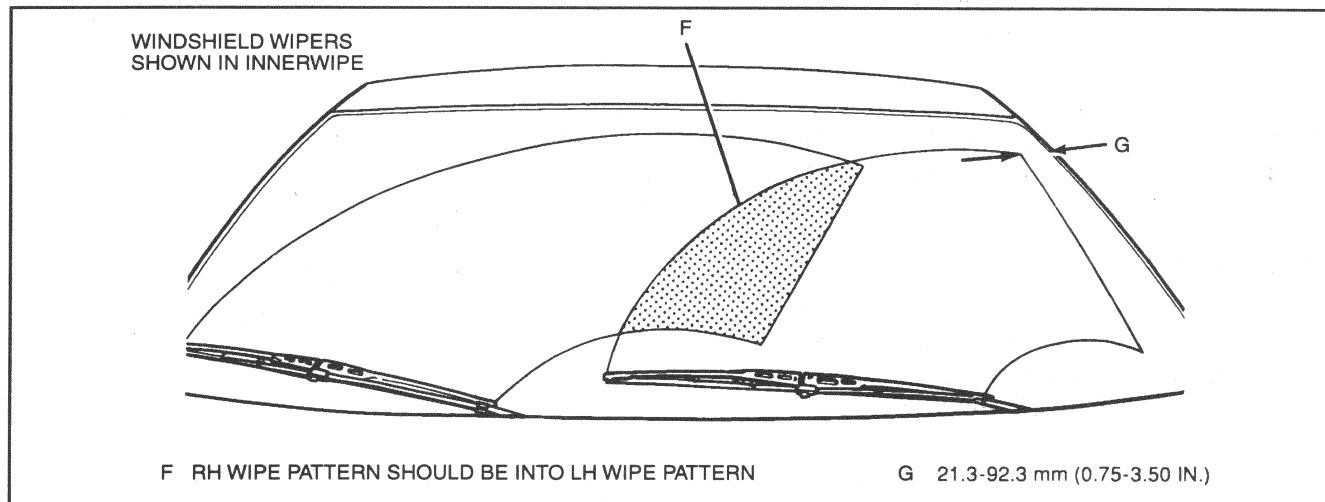


Figure 12 — Blade Wiper Pattern Check

WIPER BLADE ASSEMBLY REPLACEMENT

Figure 13

Remove or Disconnect

1. If wiper arm assembly (9) has not been removed, run wiper to mid-wipe position.
2. Lift blade release latch (H).
3. Wiper blade assembly (10) from wiper arm assembly (9).

Install or Connect

Important

- Use only 22-inch beam-type blade assemblies.

1. Wiper blade assembly (10).
2. Park wipers if at mid-wipe position.

WIPER BLADE ELEMENT REPLACEMENT

Figure 13

Important

- To prevent possible windshield damage, the blade assembly should be removed from the wiper arm assembly to replace the blade element.
- If a blade element is removed, it must be replaced.

Remove or Disconnect

1. Wiper blade assembly. Refer to "Wiper Blade Assembly Replacement."
2. Insert a small coin between edge of blade superstructure (J) and blade element (11) beside claw (K, View A). Press slowly until blade element clears one side of claw set (K).
3. Blade element from other claw sets (K).

Install or Connect

1. Blade element (11) into claws (K), starting with second set from outer end (View B).
2. Engage blade element (11) into one side of remaining claw set (K) and, with a rocking motion, push blade element (11) upward until it snaps into place (View C).
3. Wiper blade assembly. Refer to "Wiper Blade Assembly Replacement."

PLASTIC HOSE ASSEMBLY REPLACEMENT

Figures 13 and 14

Remove or Disconnect

1. RH wiper arm nozzle hose (6, Figure 13) from plastic hose assembly (7, Figure 14).
2. LH wiper arm and blade assembly. Refer to "Wiper Arm Assembly Replacement."
3. LH cowl vent screen (M).
4. Washer hose (4) from plastic hose assembly (7).
5. Plastic hose assembly (7) from LH cowl vent screen (M).

Install or Connect

1. Plastic hose assembly (7) into the two clips of LH cowl vent screen (M).

Important

- Be sure that LH connector of plastic hose assembly is inserted through cutout in screen near left clip so that wiper arm nozzle hose end, when connected, will be on top of screen. Also, the two flanges on the plastic hose assembly must engage cutout in LH screen.
2. Washer hose (4) to plastic hose assembly (7).
 3. LH cowl vent screen (M).
 4. LH wiper arm and blade assembly. Refer to "Wiper Arm Assembly Replacement."
 5. RH wiper arm nozzle hose (6, Figure 13) to plastic hose assembly (7, Figure 14).

WINDSHIELD WASHER

Figures 12 and 13

A correctly operating windshield wiper/washer system has a spray pattern that cleans 75% of the wipe pattern (Figure 12) within ten wiper cycles. If a wiper arm washer nozzle (12, Figure 13) becomes plugged, apply air pressure. If nozzle remains plugged, the nozzle must be replaced.

VIEW A

VIEW B

VIEW C

Restoration
Parts

SEE VIEWS A, B, AND C

6 HOSE, WIPER ARM NOZZLE
9 ARM ASSEMBLY, WIPER
10 BLADE ASSEMBLY, WIPER
11 BLADE ELEMENT, WIPER
12 NOZZLE, WASHER

H LATCH RELEASE
J SUPERSTRUCTURE, BLADE
K CLAW, WIPER BLADE ASSEMBLY

Figure 13 — Wiper Blade Assembly and Insert Replacement

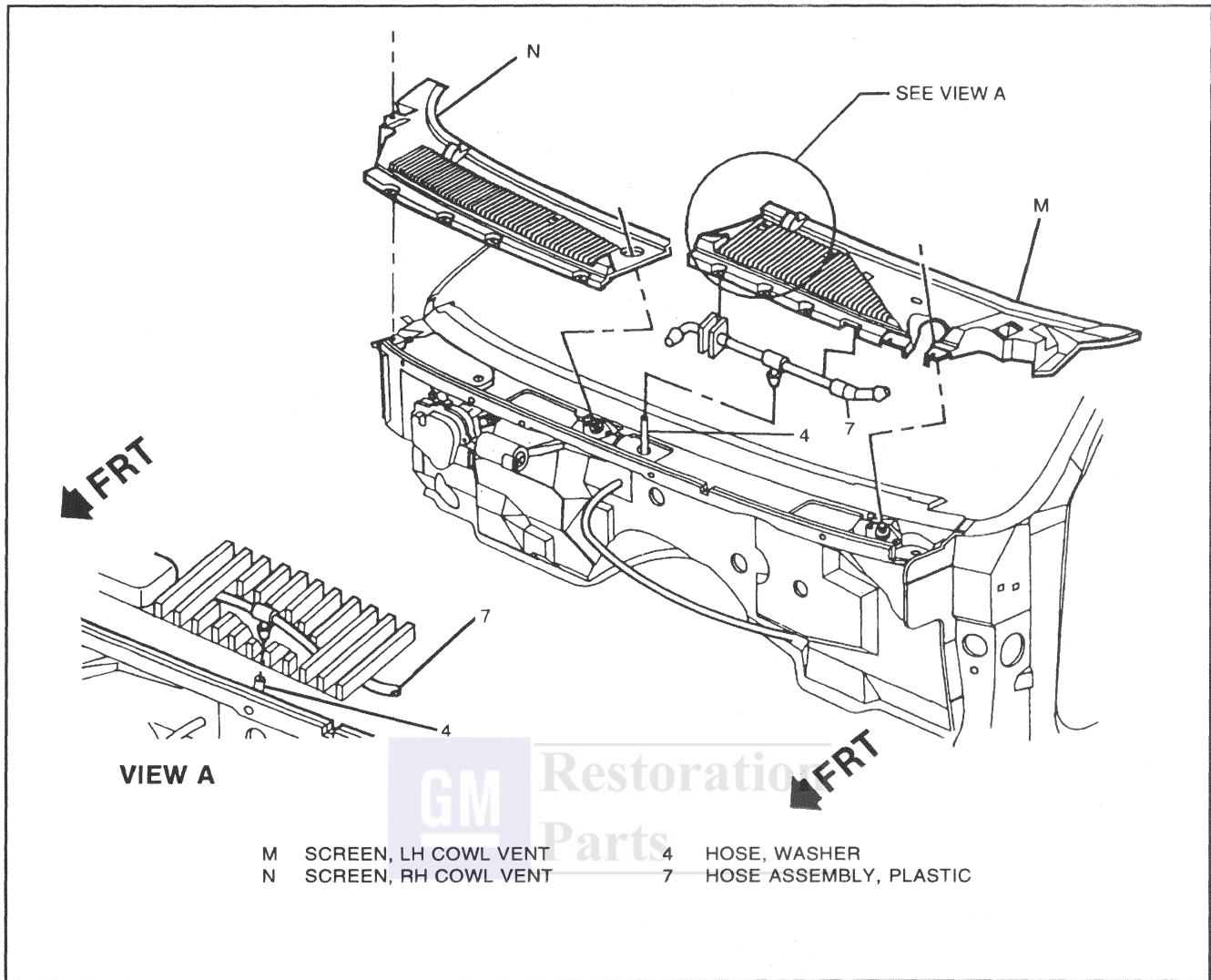


Figure 14 — Cowl Vent Screens and Plastic Hose Assembly

WIPER MOTOR ASSEMBLY REPLACEMENT

Figures 14, 15, 16 and 17

↔ Remove or Disconnect

Tool Required:

J 39232 Wiper Linkage Separator

1. Negative battery cable. Refer to SECTION 0A.
2. RH wiper arm and blade assembly. Refer to "Wiper Arm Assembly Replacement."

! Important

- To prevent possible windshield damage, the LH cowl vent screen must be removed before the RH cowl vent screen is removed.
3. LH and RH cowl vent screens (M and N, Figure 14).

4. Two screws (13, Figure 15) and linkage access hole cover (14, Figure 15).
5. Disengage linkage drive link (P, Figure 15) from wiper motor crank arm (Q, Figure 15) using J 39232 (Figure 16).
6. Electrical connectors from wiper motor assembly (15, Figure 15).
7. Three screws (16, Figure 15) and wiper motor assembly (15, Figure 15) from vehicle.

→ Install or Connect

Tool Required:

J 39529 Wiper Linkage Installer

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

1. Wiper motor assembly (15, Figure 15) on vehicle with three screws (16, Figure 15).

8E-16 WINDSHIELD WIPER/WASHER SYSTEM

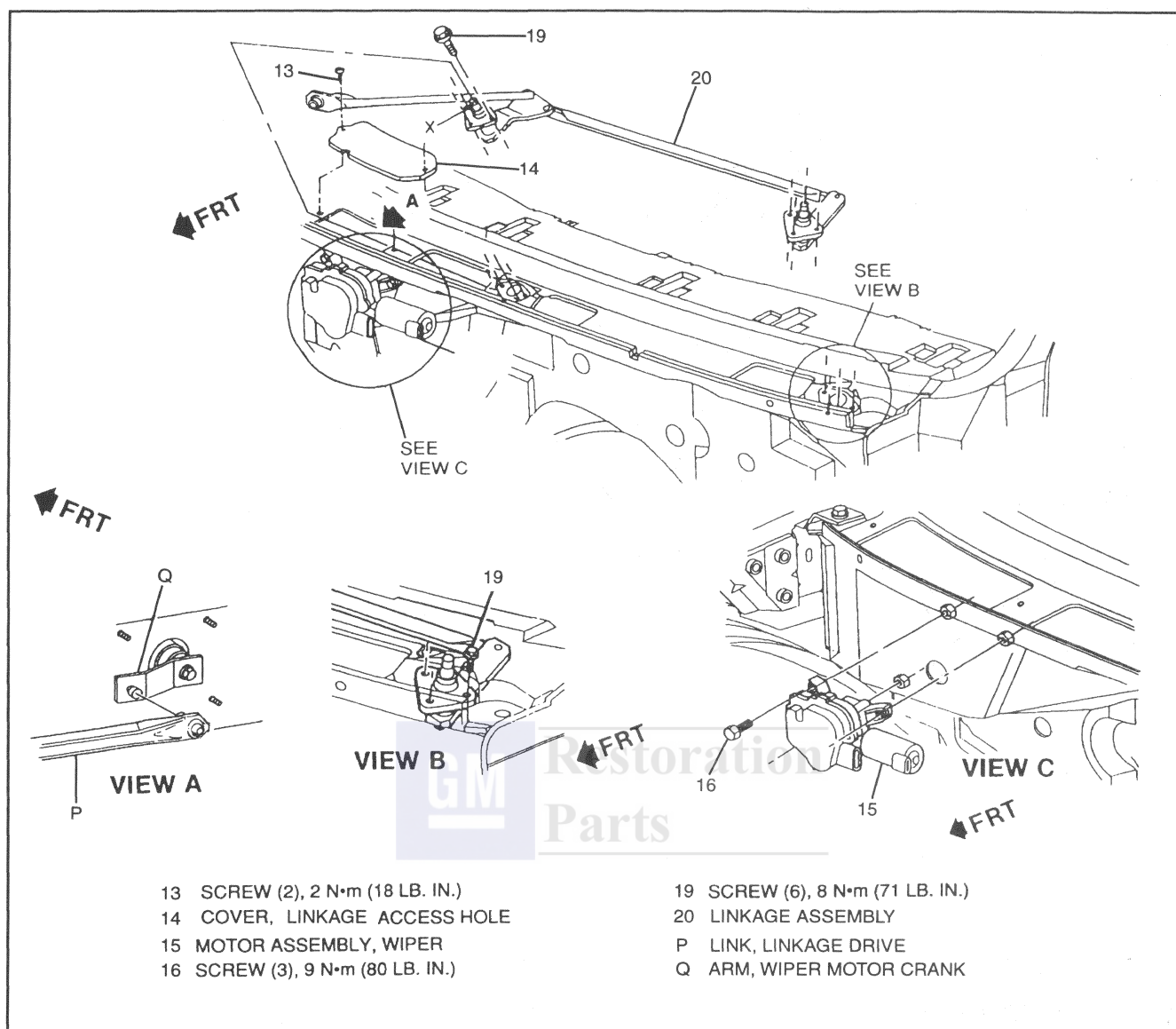


Figure 15 — Wiper Motor and Linkage Assemblies

Tighten

- Screws (16) to 9 N·m (80 lb. in.).
- 2. Electrical connectors to wiper motor assembly (15, Figure 15).
- 3. Linkage drive link (P, Figure 15) to wiper motor crank arm (Q, Figure 15) using J 39529 (Figure 17).
- 4. Linkage access hole cover (14, figure 15) on vehicle with two screws (13, Figure 15).

Tighten

- Screws (13) to 2 N·m (18 lb. in.).

Important

- To prevent possible windshield damage, the RH cowl vent screen must be installed before the LH cowl vent screen is installed.
- 5. RH and LH cowl vent screens (N and M, Figure 14).
- 6. RH wiper arm and blade assembly. Refer to "Wiper Arm Assembly Replacement."
- 7. Negative battery cable. Refer to SECTION 0A.

WIPER MOTOR COVER ASSEMBLY REPLACEMENT

Figure 18

Remove or Disconnect

1. Negative battery cable. Refer to SECTION 0A.
2. Electrical connectors from wiper motor assembly (15).
3. Three screws (17) and wiper motor cover assembly (18) from wiper motor assembly (15).

Install or Connect

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

Important

- Always install cover assembly with wiper motor in park position and drive pin in the open area of the cam.
1. Wiper motor cover assembly (18) on wiper motor assembly (15) with three screws (17).

Tighten

- Screws (17) to 2 N•m (18 lb. in.).
2. Electrical connectors to wiper motor assembly (15).
 3. Negative battery cable. Refer to SECTION 0A.

WIPER LINKAGE ASSEMBLY REPLACEMENT

Figures 14, 15, 16 and 17

Remove or Disconnect

Tool Required:

J 39232 Wiper Linkage Separator

1. Negative battery cable. Refer to SECTION 0A.
2. Wiper arm and blade assemblies. Refer to "Wiper Arm Assembly Replacement."

Important

- To prevent possible windshield damage, the LH cowl vent screen must be removed before the RH cowl vent screen is removed.
3. LH and RH cowl vent screens (M and N, Figure 14).
 4. Washer hose (4, Figure 14) from plastic hose assembly (7, Figure 14).

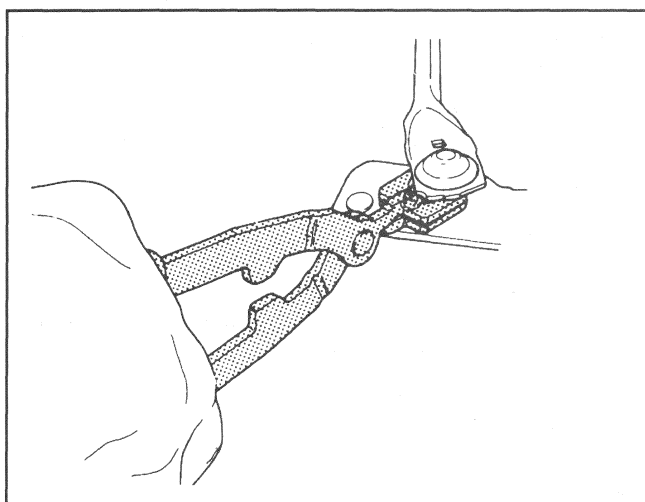


Figure 16 — J 39232 Wiper Linkage Separator (Typical Usage)

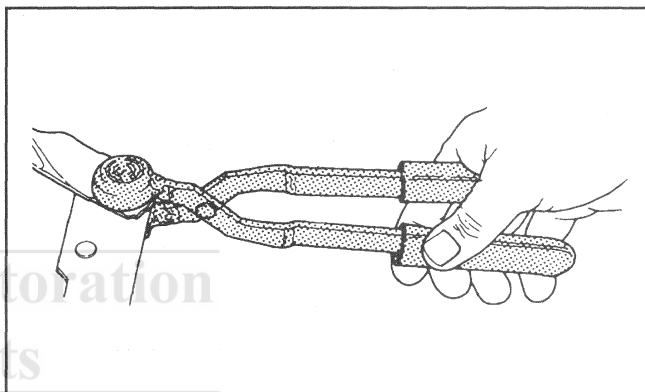


Figure 17 — J 39529 Wiper Linkage Installer (Typical Usage)

5. Two screws (13, Figure 15) and linkage access hole cover (14, Figure 15).
6. Disengage linkage drive link (P, Figure 15) from wiper motor crank arm (Q, Figure 15) using J 39232 (Figure 16).
7. Six screws (19, Figure 15).
8. Wiper linkage assembly (20, Figure 15) by guiding it through access hole in dash panel.

Install or Connect

Tool Required:

J 39529 Wiper Linkage Installer

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

1. Insert left side of wiper linkage assembly (20, Figure 15) through access hole in right side of dash panel drain trough. Then, position RH linkage spindle through access hole in dash panel extension and align with dash panel mounting holes. Hand tighten one screw (19, Figure 15) through hole marked "X" in Figure 15.

8E-18 WINDSHIELD WIPER/WASHER SYSTEM

2. Position LH linkage spindle through access hole in dash panel extension and align with dash panel mounting holes.
3. Three screws (19, Figure 15) in LH spindle.
4. Two remaining screws (19) in RH spindle.



Tighten

- Six screws (19) to 8 N•m (71 lb. in.).
5. Linkage drive link (P, Figure 15) to wiper motor crank arm (Q) using J 39529.
 6. Linkage access hole cover (14, Figure 15) on vehicle with two screws (13).



Tighten

- Screws (13) to 2 N•m (18 lb. in.).
7. Washer hose (4, Figure 14) to plastic hose assembly (7).



Important

- To prevent possible windshield damage, the RH cowl vent screen must be installed before the LH cowl vent screen is installed.
8. RH and LH cowl vent screens (N and M).
 9. Wiper arm and blade assemblies. Refer to "Wiper Arm Assembly Replacement."

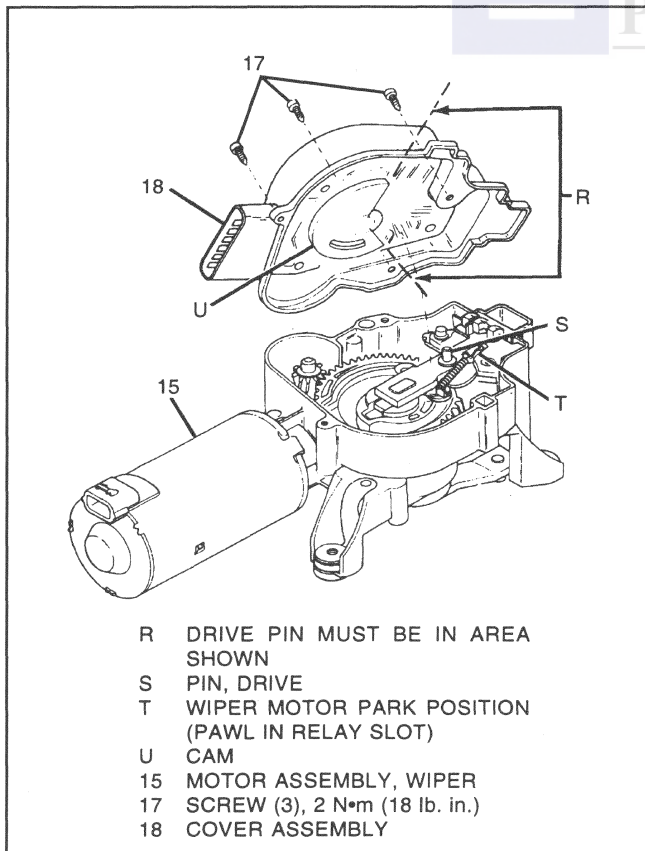


Figure 18 — Wiper Motor Cover Assembly Replacement

WIPER/WASHER SWITCH ASSEMBLY REPLACEMENT

The wiper/washer switch assembly is a non-replaceable component of the multifunction turn signal lever. For lever replacement, refer to "Steering Wheel and Column On-Vehicle Service (SEC. 3F)."

OFF-VEHICLE SERVICE

PARK SWITCH ASSEMBLY REPLACEMENT

Figures 18 and 19



Remove or Disconnect

1. Wiper motor assembly. Refer to "Wiper Motor Assembly Replacement."

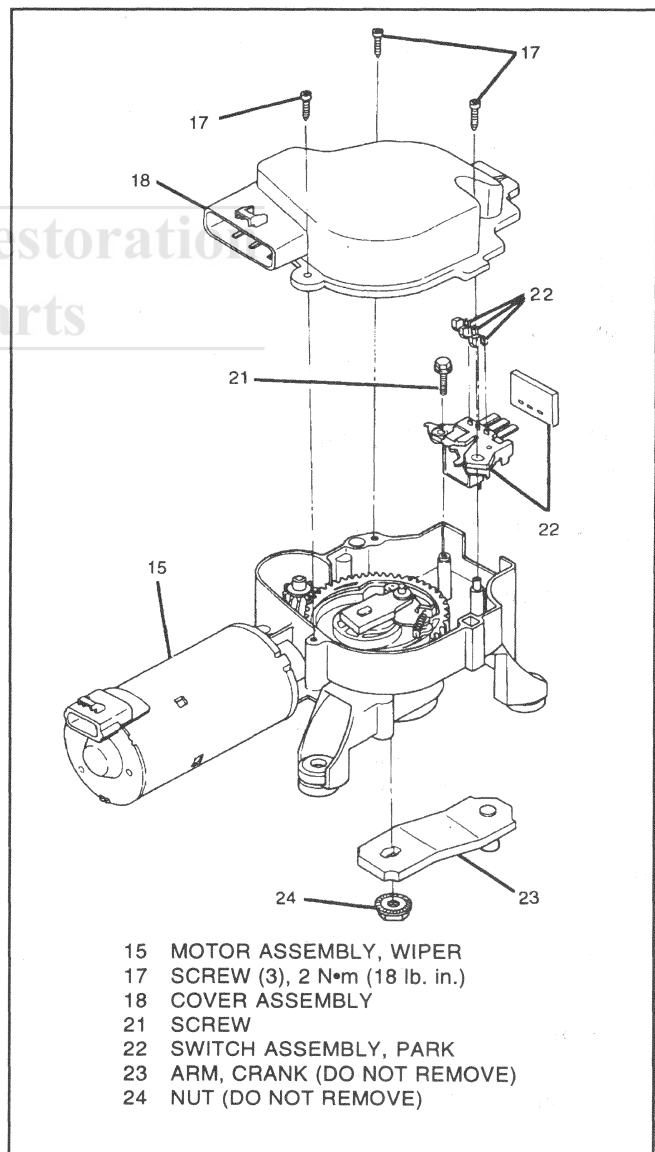


Figure 19 — Wiper Motor Assembly Components

2. Wiper motor cover assembly. Refer to "Wiper Motor Cover Assembly Replacement."

Important

- If wiper motor (15) is in park position (Figure 18), operate wiper motor as required to remove pawl from relay slot.
3. Screw (21, Figure 19) and park switch assembly (22, Figure 19).

Install or Connect

NOTICE: Refer to fastener "Notice" on page 8E-1 of this section.

1. New park switch assembly (22) with screw (21).
2. Operate wiper motor (15, Figure 18) back into park position (pawl in relay slot).
3. Cover assembly (18). Follow "Wiper Motor Cover Assembly Replacement" procedure carefully.
4. Wiper motor assembly. Refer to "Wiper Motor Assembly Replacement."

WIPER CHATTER REPAIR

Some vehicles may exhibit a condition where the windshield wipers chatter and/or wipe unevenly. Several items may contribute to this condition. To completely repair this condition, ALL items listed should be checked and repaired as necessary.

WINDSHIELD GLASS CLEANING

Clean windshield with windshield cleaner, GM PN 1050011 or equivalent. The cleaner used should be one which will not harm paint finish or scratch glass. The glass is clean when water no longer beads, but sheets across entire glass surface.

WIPER BLADE ELEMENT CLEANING

Lift each wiper blade assembly off windshield and clean element with a cloth saturated in full strength washer solvent. Rinse blade assemblies with water.

CAUTION: Avoid prolonged skin contact with washer solvent.

WIPER ARM PRESSURE CHECK

Figure 20

1. Run wipers to mid-wipe position.
2. Remove wiper blade assemblies. Refer to "Wiper Blade Assembly Replacement."
3. Attach a scale (V) to blade attaching pin (W) and measure the force required to lift wiper arm perpendicular to windshield to normal working height (height with blade assembly attached).

4. If the force required is not within the specifications given below, the wiper arm assembly should be replaced.

Tip Pressure — Newtons - 8.3 to 10.1
(Ounces) - (30 to 36)

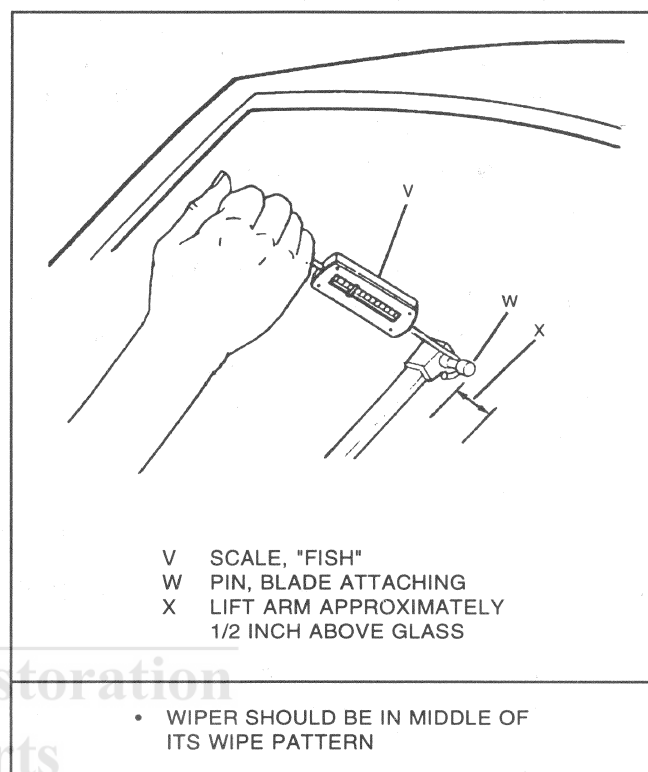


Figure 20 — Wiper Arm Pressure Check

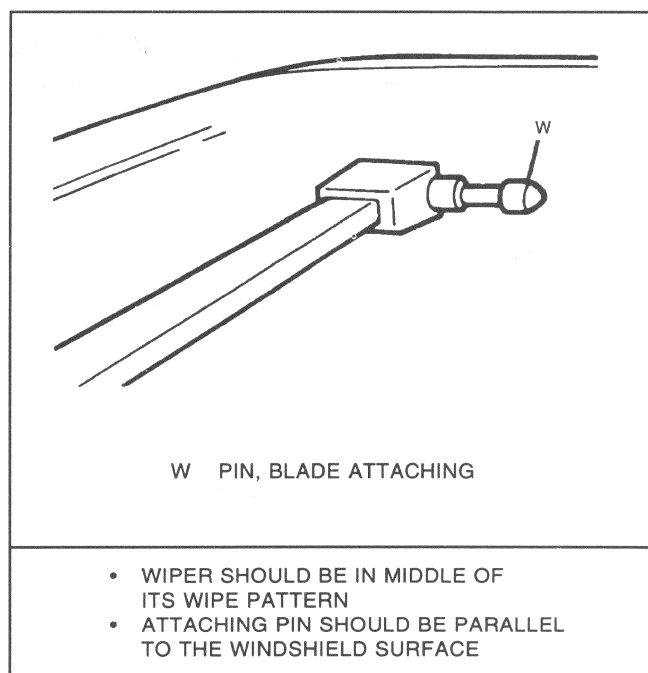


Figure 21 — Blade Assembly Mounting Angle Check

8E-20 WINDSHIELD WIPER/WASHER SYSTEM

BLADE ASSEMBLY MOUNTING ANGLE CHECK

Figure 21

With the wiper arm and blade assemblies in the middle of a wipe stroke, remove the wiper blade assemblies. Visually check that the blade attaching pin (W) on each wiper arm is parallel to the windshield. Replace the wiper arm assembly if necessary.

BLADE ELEMENT SET CHECK

Figure 22

Remove the wiper blade assemblies from the wiper arm assemblies, being careful to note orientation for reassembly. Look down the length of the blade element. The rubber element which contacts the glass must be on the center line of the blade assembly ± 15 degrees. Replace the element if necessary.

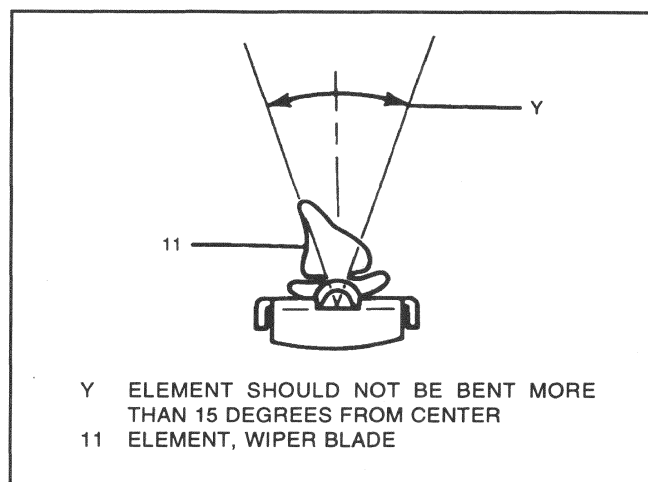


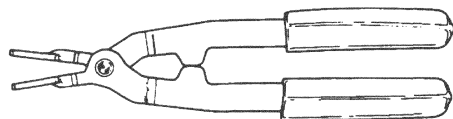
Figure 22 — Blade Element Set Check

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

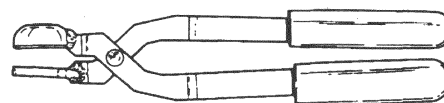
Linkage Access Hole Cover Screws (13)	2 N•m (18 lb. in.)
Linkage Assembly Screws (19)	8 N•m (71 lb. in.)
Wiper Arm Assembly Nuts (8)	23 N•m (17 lb. ft.)
Wiper Motor Assembly Screws (16)	9 N•m (80 lb. in.)
Wiper Motor Cover Assembly Screws (17)	2 N•m (18 lb. in.)

SPECIAL TOOLS



J 39232

WIPER LINKAGE SEPARATOR



J 39529

WIPER LINKAGE INSTALLER

SECTION 8E1

REAR WINDOW WIPER/WASHER SYSTEM

NOTICE: Refer to battery disconnect caution in Section 0A.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paint, grease, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Component Locations	8E1-3	Accessory Switch Replacement	8E1-8
Troubleshooting Hints	8E1-3	Off-Vehicle Service	8E1-8
System Diagnosis	8E1-3	Autopark Module Replacement	8E1-8
On-Vehicle Service	8E1-7	Specifications	8E1-9
Washer Pump Replacement	8E1-7	Fastener Tightening Specifications	8E1-9

GENERAL DESCRIPTION

The rear window wiper/washer system uses a single-speed, permanent-magnet wiper motor assembly (Figure 1) attached to the rear header. A wet wiper arm assembly is attached to the wiper motor assembly and operation is controlled by a dash-mounted wiper/washer switch which is part of the accessory switch. The washer pump is mounted in the outboard cavity of the washer solvent container in the engine compartment.

A plug-in autopark module is a serviceable part of the wiper motor assembly. The module supplies power to the wiper motor to allow the wiper to move to park position if the ignition is turned off while the wiper is operating.

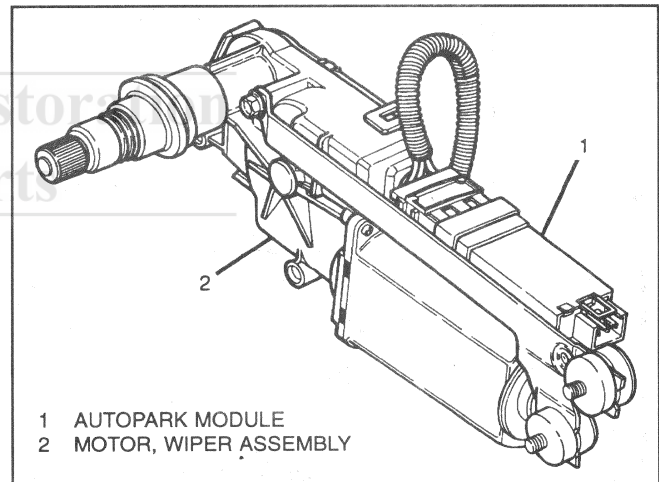


Figure 1 — Rear Window Wiper Motor Assembly

SYSTEM OPERATION

Figure 2

Battery voltage is applied at all times from fuse #36 and CKT 840 to terminal "A" of the wiper motor assembly. With the ignition switch in ACCY or RUN, battery voltage also is applied from fuse #8 and CKT 243 to terminal "B" (Buick) or "F" (Chev) of the wiper/washer switch.

Wiper Operation

When the wiper switch is set to ON, battery voltage is applied to terminal "B" of the liftgate wiper latch switch from CKT 1543. When the rear glass is closed, voltage is applied to terminal "C" of the wiper motor assembly from the liftgate wiper latch switch

and CKT 391. This voltage is used by the wiper motor assembly as a "wiper request," a signal to start wiper motor operation. The power to operate the wiper motor is supplied to the assembly at terminal "A." The ground is connected to terminal "B" from CKT 750. When the wiper motor loses the "wiper request" signal, it will de-energize its internal relay when it detects the wiper to be in park position.

Washer Operation

When the wiper/washer switch is held in the WASH position, it applies battery voltage to terminal "A" of the washer pump from CKT 392, causing the washer pump to start spraying until the wiper/washer switch is released from the WASH position.

8E1-2 REAR WINDOW WIPER/WASHER SYSTEM

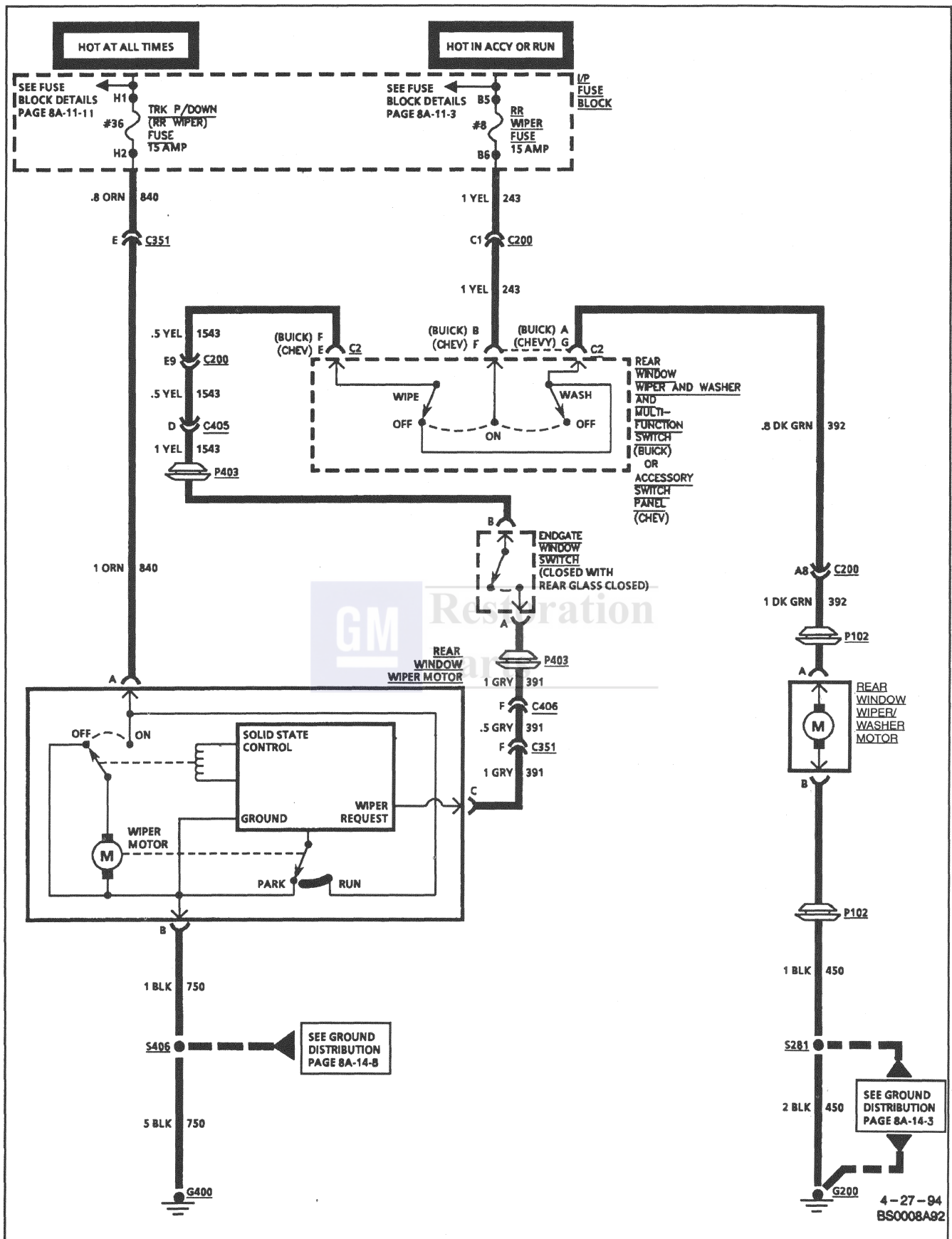


Figure 2 — Rear Window Wiper/Washer System Electrical Schematic

DIAGNOSIS

COMPONENT LOCATIONS

- Refer to Figure 3 for a list of component locations.

TROUBLESHOOTING HINTS

- Make the following checks before beginning System Diagnosis.
- 1. If washer does not operate, check that:
 - Washer solvent container is filled.
 - Hoses are correctly attached.
 - Hoses are not cut, kinked or pinched.
 - Nozzle is not clogged.

- Connector seal at washer pump is not damaged or missing.
- Fuse #8 is not open.
- G200 is clean and tight.

- If wipers do not operate, check that:

- Fuse #36 is not open.
- G400 is clean and tight.

- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the Wiper/Washer System Check (Figure 4) as a guide to normal operation, then refer to the Symptom Table (Figure 5) for the appropriate diagnostic procedures.

COMPONENT	LOCATION
Rear Window Wiper and Washer and Multi-Function Switch (Buick)	Left side of I/P
Accessory Switch Panel (Chev)	Left side of I/P
I/P Fuse Block	Mounted to LH I/P, accessible with LH front door open
Endgate Window Switch	Near center of tailgate
Rear Window Wiper Motor	Attached to rear header
Rear Window Washer Motor	Attached to washer fluid reservoir, in engine compartment
C200 (56 cavities)	Body harness to I/P harness, bolted above accelerator pedal
C351 (6 cavities)	Body harness to rear header harness, near center of LH "D" pillar
C405 (6 cavities)	Body harness to tailgate harness, center of LH "D" pillar
C406	Body harness to tailgate harness, center of LH "D" pillar
G200	Base of LH "A" pillar, behind LH kickpad
G400	Near center of RH "D" pillar
P102	Visible from engine compartment, behind LH wheelhouse
P403	Between tailgate and LH "D" pillar
S281	Body harness, in convenience center, branch, approx. 24 cm from point of breakout
S406	Rear header harness, approx. 17 cm from RH rear window defogger ground breakout

Figure 3 — Component Locations

ACTION	NORMAL OPERATION
- Ignition switch in ACCY or RUN. - Wiper/washer switch to ON.	Wiper runs continuously.
[2] Wiper/washer switch to WASH.	Washer sprays rear window as long as switch is held on WASH. Wiper runs continuously while washer is on.
[3] Wiper/washer switch to OFF.	Wiper completes last stroke and returns to park position.

Figure 4 — Wiper/Washer System Check

8E1-4 REAR WINDOW WIPER/WASHER SYSTEM

SYMPTOM	PROCEDURE	PAGE
Wiper does not operate (washer operates normally) - intermittent condition.	Chart 1	8E1-4
Wiper does not operate (washer operates normally).	Chart 2	8E1-5
Washer does not operate (wiper operates normally).	Chart 3	8E1-6
Wiper and washer do not operate.	Chart 4	8E1-6
Wiper will not turn off.	Chart 5	8E1-6
Washer will not turn off.	Check CKT 392 for short to B+. If OK, replace wiper/washer switch (accessory switch).	

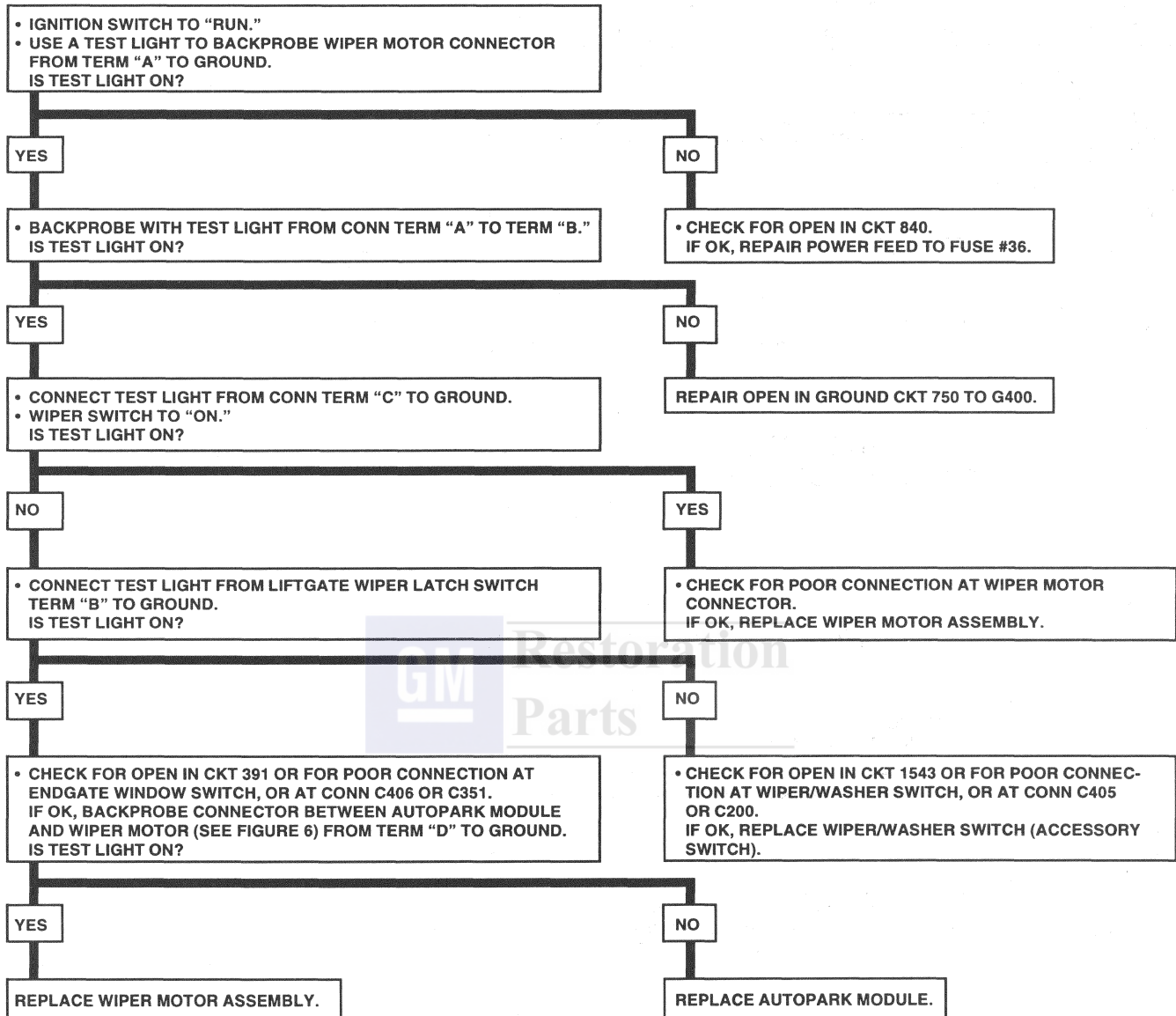
Figure 5 — Symptom Table

CHART 1 WIPER DOES NOT OPERATE (WASHER OPERATES NORMALLY) - INTERMITTENT CONDITION

REPLACE AUTOPARK MODULE.



CHART 2 **WIPER DOES NOT OPERATE (WASHER OPERATES NORMALLY)**



8E1-6 REAR WINDOW WIPER/WASHER SYSTEM

CHART 3 WASHER DOES NOT OPERATE (WIPER OPERATES NORMALLY)

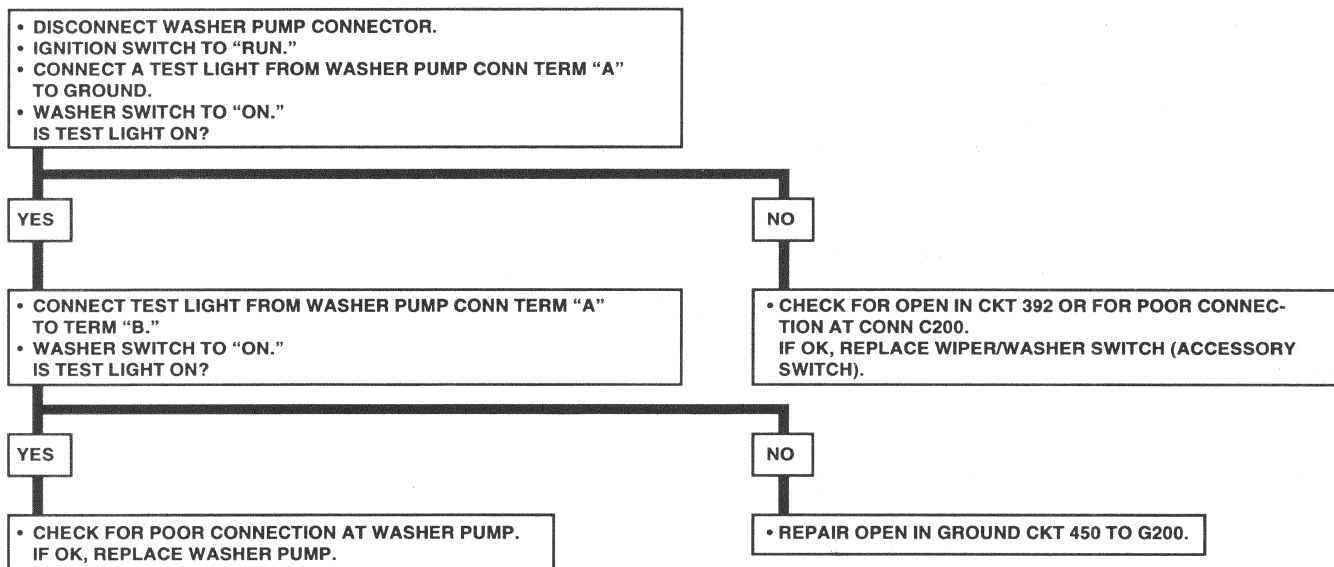


CHART 4 WIPER AND WASHER DO NOT OPERATE

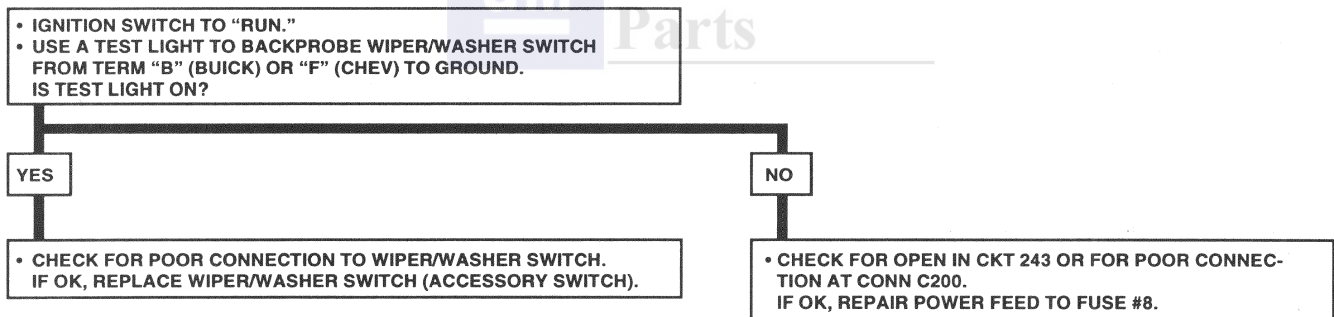
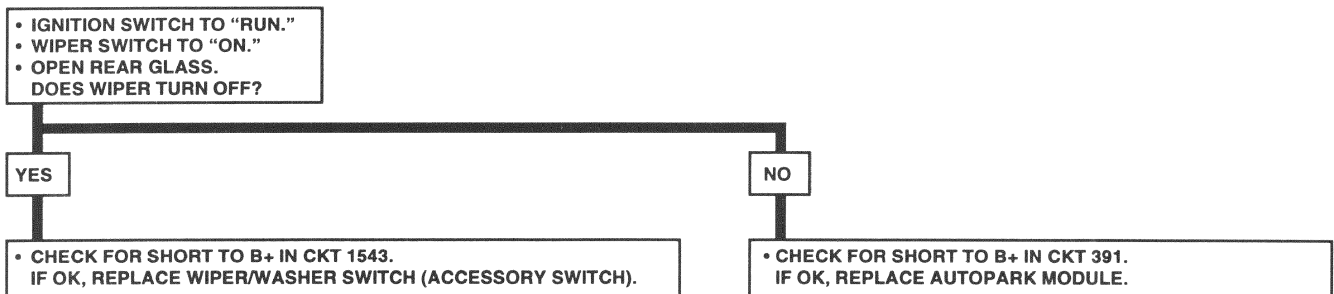


CHART 5 WIPER WILL NOT TURN OFF



ON-VEHICLE SERVICE

WASHER PUMP REPLACEMENT

Figure 6

Remove or Disconnect

1. Negative battery cable.
2. Washer solvent.
3. Electrical connectors and washer hose (6).
4. Washer solvent container (3) attaching parts.
5. Solvent container.
6. Rear window washer pump (5) from solvent container.

Install or Connect

NOTICE: See fastener "Notice" on page 8E1-1 of this section.

1. Washer pump (5) in solvent container (3).

Important

- Make sure washer pump is pushed all the way into the container seal.
2. Solvent container and attaching parts.
 3. Electrical connectors and washer hose (6).
 4. Washer solvent.
 5. Negative battery cable.

WIPER ARM ASSEMBLY REPLACEMENT

Figure 7

Remove or Disconnect

1. Washer hose (7).
2. With wiper arm assembly (8) in park position, lift wiper arm from window and use screwdriver to push retaining latch outward.
3. Wiper arm assembly from wiper motor drive shaft.
4. Wiper blade assembly (10), if required. See "Wiper Blade Assembly Replacement."

Install or Connect

1. Wiper blade assembly (10), if removed. See "Wiper Blade Assembly Replacement."
2. Seat wiper arm assembly (8) in park position (against blade stop) on wiper motor drive shaft, then push in retaining latch.
3. Washer hose (7).

Inspect

- Run wiper and check for proper wipe pattern.
- Turn off wiper and check for correct park position.

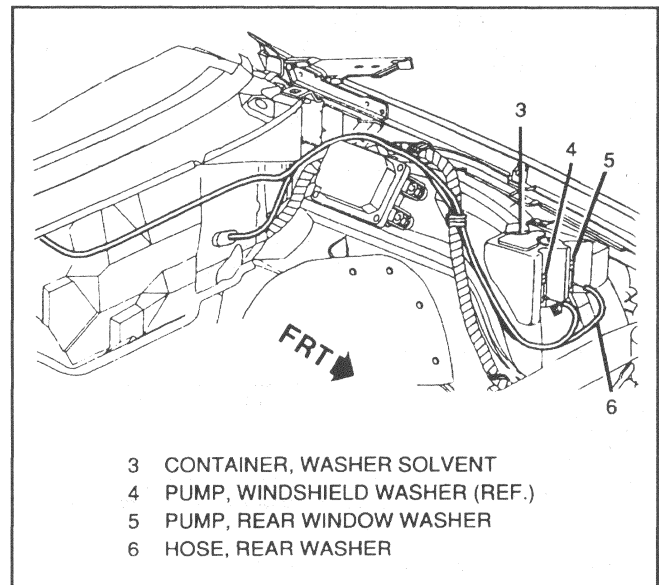


Figure 6 — Washer Pumps and Solvent Container

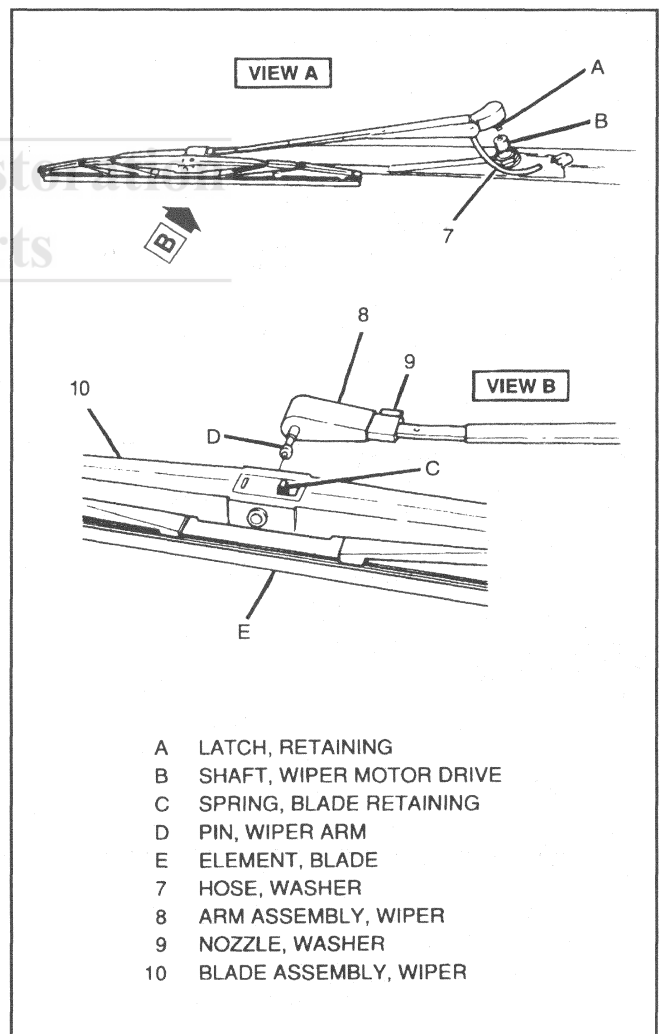


Figure 7 — Wiper Arm and Blade Assembly

8E1-8 REAR WINDOW WIPER/WASHER SYSTEM

WIPER BLADE ASSEMBLY REPLACEMENT

Figure 7

Remove or Disconnect

1. Press down on blade retaining spring and pull blade assembly (10) off wiper arm pin.

Important

- Blade element is not replaceable.

Install or Connect

1. Press down on blade retaining spring and engage blade assembly (10) on wiper arm pin.

WIPER MOTOR ASSEMBLY REPLACEMENT

Figure 8

Remove or Disconnect

1. Negative battery cable.
2. Wiper arm and blade assembly. See “Wiper Arm Assembly Replacement.”
3. Endgate trim panel molding assembly. Refer to ROOF (SECTION 10-9).
4. Nut (11).
5. Electrical connector from wiper motor assembly (13).
6. Two screws (12).
7. Wiper motor assembly (13) from rear header.

Install or Connect

NOTICE: See fastener “Notice” on page 8E1-1 of this section.

1. Wiper motor assembly (13) to rear header with two screws (12).

Tighten

- Screws (12) to 6 N·m (53 lb. in.).

2. Electrical connector to wiper motor assembly.
3. Nut (11).

Tighten

- Nut (11) to 7 N·m (62 lb. in.).

4. Endgate trim panel molding assembly. Refer to ROOF (SECTION 10-9).

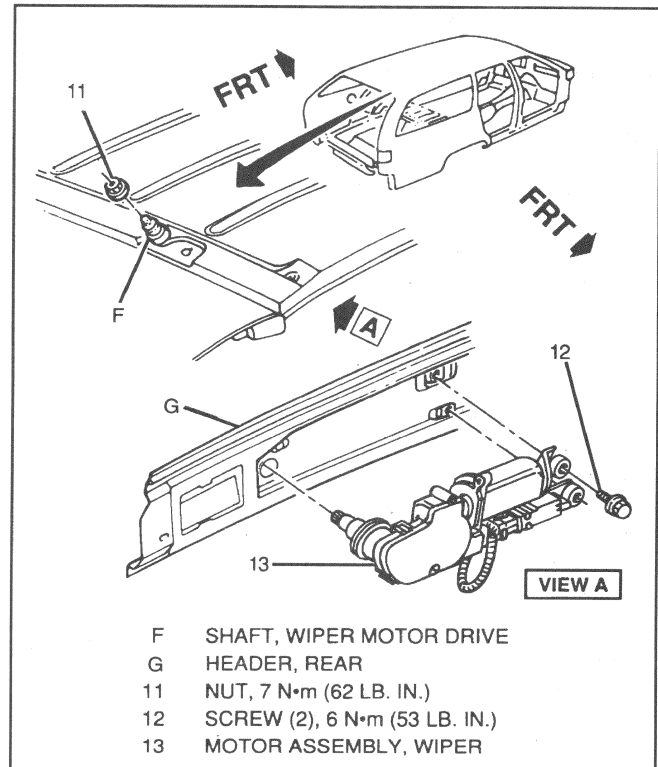


Figure 8 — Wiper Motor Assembly Replacement

5. Wiper arm and blade assembly. See “Wiper Arm Assembly Replacement.”
6. Negative battery cable.

ACCESSORY SWITCH REPLACEMENT

For replacement procedure for the accessory switch, refer to INSTRUMENT PANEL AND GAGES (SECTION 8C).

OFF-VEHICLE SERVICE

AUTOPARK MODULE REPLACEMENT

Figure 1

Remove or Disconnect

1. Wiper motor assembly. See “Wiper Motor Assembly Replacement.”
2. Remove mounting grommet next to autopark module (1).
3. Drill out rivet attaching autopark module (1) to wiper motor (2) mounting bracket.
4. Cut tie strap, then disconnect electrical connector.



Install or Connect

1. Electrical connector.
2. Attach autopark module to wiper motor (2) mounting bracket with suitable screw and nut.
3. Tie strap.
4. Mounting grommet.
5. Wiper motor assembly. See “Wiper Motor Assembly Replacement.”

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Wiper Motor Nut (11)	7 N•m (62 lb. in.)
Wiper Motor Screws (12)	6 N•m (53 lb. in.)





SECTION 9A

AUDIO SYSTEMS

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

All radios have electronic memory for preselected station function.

SPEAKER SYSTEM

There are two front speakers, one in each front side door; and two rear speakers mounted in the rear window panel trim on sedans, and under the body lock pillar trim finish panel on wagons. These speaker locations allow for a full, high fidelity sound.

Standard radio front side door speakers are 4 x 6 inches and 10 ohms. Radio rear speakers are 6 x 9 inches and 10 ohms.

High performance extended range speakers are standard with full ETR® (electronically tuned receiver) systems. All radios on these vehicles have this system.

RADIO FIXED ANTENNA

The fixed antenna is designed to provide good radio omni-directional reception in moderate fringe areas.

9A-2 AUDIO SYSTEMS

RADIO POWER ANTENNA

When the ignition switch is either in the "RUN" or "ACCESSORY" position and the radio is turned on, the antenna will fully extend. The fully extended height is approximately 80 cm (31.5 inches).

When the radio is turned off, the antenna will fully retract completely below the front fender or rear quarter outer panel surfaces.

The three-section mast antenna on Buick sedans, and four-section mast antenna on wagons and Chevrolet sedans are attached to a plastic cable driven up and down by an electric motor. This motor is automatically shut off when the mast is fully extended or retracted. The switching is accomplished by the thrust reaction of the motor armature and worm gear against the drive gear. The thrust reaction trips the reaction switch, interrupting power flow to the motor.

RADIOS

Figures 1 through 6

All 2000-series radios feature ETR tuning, vacuum fluorescent display, AM-FM stereo, seek and scan tuning, and digital clock display. Seven radios are available: three of them are available in Buick, and four of them are available in Chevrolet.

- AM-FM Stereo (UM7).
- AM-FM Stereo Cassette (UM6) with dynamic noise reduction (DNR).
- AM-FM Stereo Cassette (UN6) (Buick).
- AM-FM Stereo Cassette (UL0) (Buick).
- AM-FM Stereo Cassette (UL0) (Chevrolet).
- AM-FM Stereo Compact Disc (UN0) (Chevrolet).
- AM-FM Stereo Compact Disc/Cassette (UP0) (Buick).

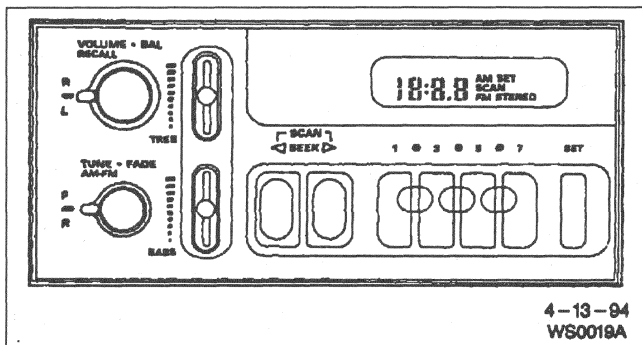


Figure 1 - UM7 Radio - (Chevrolet)

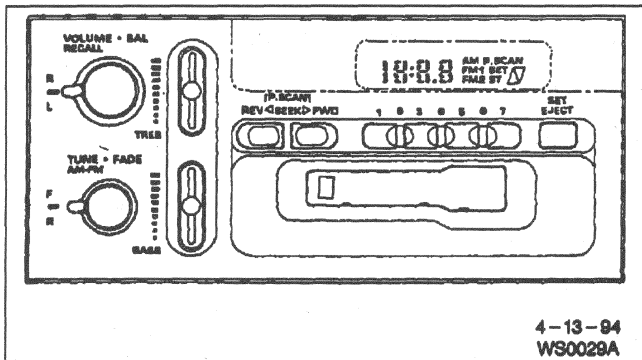


Figure 2 - UM6 Radio - (Chevrolet)

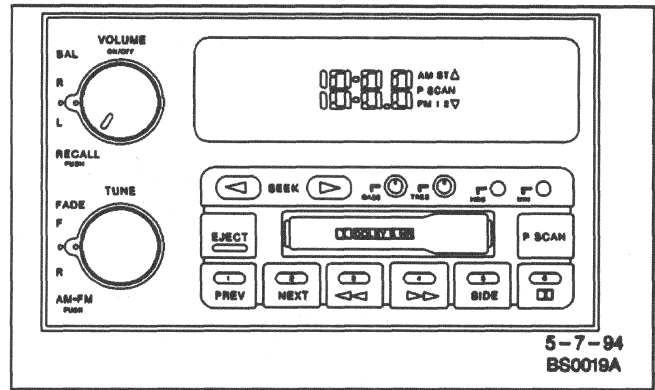


Figure 3 - UN6 Radio - (Buick)

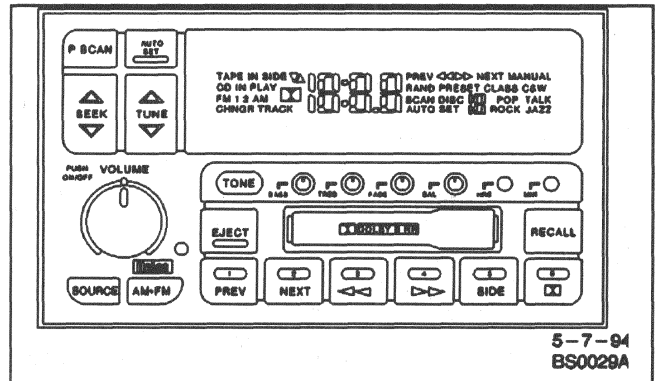


Figure 4 - UL0 Radio - (Buick)

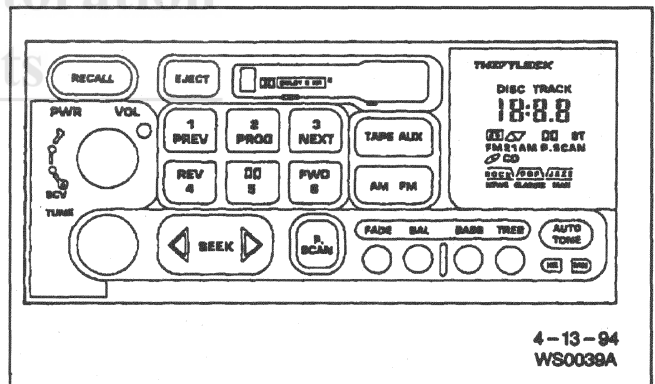


Figure 5 - UL0 Radio - (Chevrolet)

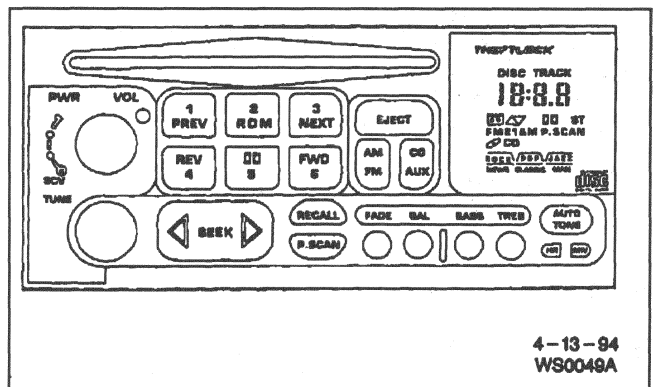


Figure 6 - UN0 Radio - (Chevrolet)

All radios use four speakers: two speakers mounted in the front side doors and two in the rear window panel trim on sedans, and in the body lock pillar trim finish panel on wagons.

FM Stereo

All factory-equipped sound systems with an FM stereo radio will switch to stereo operation whenever an FM stereo broadcast is being received, an indicator in the dial will light. Stereo operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right". Stereo sound is noticeably more realistic to the ear. Although FM is normally static-free, reception can be limited by terrain, atmospheric conditions, station strength and distance from the transmitter. Buildings or other obstructions can cause momentary static, flutter or station swapping. If reception is poor, tuning to a stronger station will bring improvement.

AMAX Stereo Certification

All optional radios are AMAX certified. These receivers can reproduce the fidelity sound now transmitted by all AM stations but not received on all AM radios.

Some improvements are high fidelity, adjustable receiver band width (wide for high fidelity or narrow to cut out any interference), noise cancellation, full stereo sound, new frequencies received and external antenna capability.

The range of most AM stations is greater than FM, especially at night. The longer range, however, can cause stations to interfere with each other. AM is also subject to noise pick-up from storms, power lines, etc. AMAX certification reduces many of these problems.

RADIO CONTROLS

When the radio is first turned on, the frequency will appear on the display for five seconds, and then the display will return to the time display. To recall the frequency, simply push in the upper knob or the "RCL" button while the radio is turned on. The frequency will appear on the display for five seconds. To display the time when the ignition lock cylinder is in the "LOCK" or "OFF" position, simply push the upper knob or "RCL" button. The time will display for five seconds. Then the display will turn blank.

ETR® AM-FM STEREO (UM7)

Radio Operation

CHEVROLET

Figure 1

UPPER KNOB

This knob turns the radio on and off. Turn the knob clockwise to increase volume and counter-clockwise to decrease volume. The control ring behind the knob is the balance control. Turn the ring clockwise to move speaker balance to the right and counter-clockwise to move speaker balance to the left.

LOWER KNOB

Turn the knob to manually select radio stations. Press the knob to choose either the AM or the FM band. The control ring behind the lower knob fades the sound between the front and rear speakers.

BASS AND TREBLE CONTROLS

Slide the treble control up to increase treble and down to decrease treble. Slide the bass control up to increase bass and down to decrease bass.

PUSH BUTTONS

To preset four AM stations and four FM stations:

1. Turn in desired station.
2. Press "Set". Within five seconds, press a station button.
3. Repeat these steps for each push button.

To preset three additional AM stations and three additional FM stations:

1. Tune in desired station.
2. Press "SET". Within five seconds, press any two adjacent buttons.

The radio will tune to the preselected station when the button is pushed. Button pairing allows for seven AM and seven FM stations to be preset for a total fourteen preset stations.

If electrical power is interrupted by a blown fuse or a discharged battery, all stations must be set.

CLOCK

To set the clock display the ignition may be on or off. To set the clock:

1. Push "SET".
2. Within five seconds, push and hold "SCAN" until the correct hour appears.
3. Then press and hold "SEEK" until correct minute appears.

SEEK AND SCAN FEATURE

The UM7 radio has "SEEK" and "SCAN" features for electronic station tuning up and down the band.

Press "SEEK" or "SCAN" and the radio will tune to the next higher or lower station with enough signal strength to be heard clearly, and stay there.

ETR® AM-FM STEREO/CASSETTE (UM6)

Radio Operation

CHEVROLET

Figure 2

UPPER KNOB

This knob turns the radio on and off. Turn the knob clockwise to increase volume and counter-clockwise to decrease volume. The control ring behind the knob is the balance control. Turn the

9A-4 AUDIO SYSTEMS

ring clockwise to move speaker balance to the right and counter-clockwise to move speaker balance to the left. Press the knob to select the other side of the tape when playing a cassette.

LOWER KNOB

Turn the knob to manually select radio stations. When the radio is on and the tape player is off, press the knob to choose either the AM or the FM band.

The control ring behind the lower knob fades the sound between the front and rear speakers.

BASS AND TREBLE CONTROL

Slide the treble control up to increase treble and down to decrease treble. Slide the bass control up to increase bass and down to decrease bass.

PUSH BUTTONS

To preset four AM stations and four FM stations:

1. Turn in desired station.
2. Press "SET". Within five seconds, press a station button.
3. Repeat these steps for each push button.

To preset three additional AM stations and three additional FM stations:

1. Tune in desired station.
2. Press "SET". Within five seconds, press any two adjacent buttons.

The radio will tune to the preselected station when the button is pressed. Button pairing allows for seven AM and seven FM stations to be preset for a total fourteen preset stations.

If electrical power is interrupted by a blown fuse or a discharged battery, all stations must be reset.

CLOCK

To set the clock display on a UM6 radio, the ignition may be on or off. To set the clock:

1. Push "SET".
2. Within five seconds, push and hold "SCAN" until correct hour appears.
3. Then press and hold "SEEK" until correct minute appears.

SEEK AND SCAN FEATURE

The UM6 radios have "SEEK" and "SCAN" features for electronic station tuning up and down the band.

Press "SEEK" or "SCAN" and the radio will tune to the next higher or lower station with enough signal strength to be heard clearly, and stay there.

Cassette Tape Player

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position, and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

To advance the tape, press the (forward) button. To reverse the tape, press the (reverse) button. To resume tape play from fast forward or reverse, press the "STOP-EJECT" button lightly. When the tape reaches the end of a side, it will automatically reverse and play the other side of the tape. To resume listening to the radio or to eject the tape, push the "STOP-EJECT" button.

The cassette player is turned off by ejecting the tape, turning the power knob (upper knob) to the "OFF" position or rotating the ignition lock cylinder to "LOCK," "OFF," or "START". When this occurs, the tape player will either eject the cassette automatically or the internal tape drive and roller will retract automatically. This is to protect the tape player and cassette tape.

For the best operation of the cassette player, do not use cassette tapes longer than 30 minutes per side (60 minutes total, both sides).

TAPE DIRECTION INDICATORS

The direction the tape is being played is indicated by indicator arrows. When the indicator arrow on the left side is on, the tape direction is to the left. When the indicator arrow on the right side is on, the tape direction is to the right.

ETR® AM-FM STEREO/CASSETTE (UN6)

Radio Operation BUICK

Figure 3

POWER

Turn the volume knob to turn radio on and off.

UPPER KNOB

Turn the rotary rocker knob clockwise to increase volume. Turn it counterclockwise to decrease volume. The control ring behind the knob is the balance control. Turn the ring clockwise to move speaker balance to the right and counterclockwise to move speaker balance to the left.

LOWER KNOB

Turn the knob to manually select radio stations. Push the knob to get AM or FM. The control ring behind the lower knob fades the sound between the front and rear speaker assemblies.

STATION PRESET SETTING

To preset six AM stations and six FM stations:

1. Tune in desired station.
2. Depress the desired preset for at least two seconds. The audio will be muted and no channel number will be displayed during this time-out period, after which audio is returned and the channel number is displayed, signaling the new preset frequency has been stored. The display will show frequency and channel number for five seconds after the preset is set.
3. Repeat these steps for each preset.

CLOCK

Clock is set using the hour (HR) and minute (MN) push buttons. There will be an initial delay of two seconds after the first button depression, before the unit will enter the time set mode and the time will advance.

- When the time set mode is entered, the display will show Time Of Day (TOD) along with an "A" (AM) or "P" (PM).
- Depressing HR will cause hours to increase, while depressing MN will cause minutes to increase.

If the electrical power is interrupted by a blown fuse, discharged battery, etc., the clock must be reset.

SEEK AND SCAN FEATURE

These radios have "SEEK" and "SCAN" features for electronic station tuning up and down the band.

SEEK

Pressing "SEEK" button will cause the receiver to seek the next higher or lower station. Audio is muted during the Seek operation.

SCAN

Press and hold "SEEK" for two seconds, "SCAN" will appear in the display. Use "SCAN" to listen to stations for a few seconds. Press "SEEK" again to stop the scanning. Audio is muted during the "SCAN" operation.

"PSCAN"

Press "PSCAN" to listen to each of the preset stations for a few seconds. Press again to stop.

"RCL" (RECALL)

Press upper knob to switch between time and frequency on the display.

Cassette Tape Player

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. When the tape is fully inserted, the radio will turn off and the tape will begin playing. After loading, the cassette player automatically senses the tape cartridge for metal tape or CR02 usage. The appropriate adjustments are made within the player and the cassette is ready to be played.

PROGRAM BUTTON

Press "PROG" to switch from one side of tape to the other.

REVERSE BUTTON

Press "REV" to reverse direction. To stop reverse motion, press "REV" lightly.

FORWARD BUTTON

Press "FWD" to advance tape. To stop forward motion, press "FWD" lightly.

"PREV" (PREVIOUS)

Press "PREV" to find beginning of current selection and resume play from that point. If held or pressed more than once, cassette returns to previous selections.

"NEXT"

Press "NEXT" when you want to hear next selection now (before the present selection is finished).

If held or pressed more than once, cassette advances farther.

"SIDE"

Press "SIDE" to change the side that the tape is playing.

"EJECT"

Push this button to eject the cassette. The radio will resume playing.

ETR® AM-FM STEREO CASSETTE WITH AUTO TONE (UL0)

BUICK

Figure 4

Radio and Cassette Tape Player

Except for the functions described below, the radio and tape player operations of the UL0 are the same as the UN6 ETR® AM-FM STEREO/CASSETTE. Refer to "Radio Operation" and "Cassette Tape Player" for the UN6 in this section.

POWER

Push volume knob to turn radio on and off.

TUNE CONTROL

Press tune button up or down to tune radio stations manually. Frequency will be displayed during tuning.

FADE CONTROL

The "FADE" control is a 270 degree rotary pop-out/pull knob with center detent that is shared with the balance function. The control adjusts the relative volume between the front and rear speakers. The control is operated by first depressing and releasing the knob to the "out" position, then pulling to the fully "extended" position. Rotating the knob clockwise will cause a volume shift from rear to front speakers and conversely, rotating the knob counter-clockwise will cause a volume shift from front to rear speakers. At full rotation in either direction, audio is completely eliminated from the corresponding front or rear channels. Depressing and releasing the knob a second time will return the knob to the "in" position.

9A-6 AUDIO SYSTEMS

BALANCE

The balance (BAL) control is a 270 degree rotary pop-out/ pull knob with center detent that is shared with the "Fade" function. The control adjusts the relative volume between the right and left speakers. The control is operated by first depressing and releasing the knob to the "out" position. Rotating the knob clockwise will cause a volume shift from left to right speakers and conversely, rotating the knob counter-clockwise will cause a volume shift from right to left speakers. At full rotation in either direction, audio will be completely eliminated from the corresponding left or right channels. Depressing and releasing the knob a second time will return the knob to the "in" position. (This control is active in either the "in" or "out" position).

AUTO TONE

The auto tone function allows the choice of treble and bass equalization settings designed for classical, pop, rock, jazz, talk, and country/western stations. "CLASS" will appear on the display when you first press "TONE". Each time you press it, another setting will appear on the display. Press it again after "C & W" appears and "MANUAL" will appear. Tone control will return to the treble and bass knobs. If you use the treble and bass knobs, control will return to them and MANUAL will appear.

"AM-FM"

Press "AM-FM" to switch frequencies.

"RCL" (RECALL)

Press this to switch between time and frequency on the display.

"SOURCE"

Press "Source" to change to the tape function when the radio is on. TAPE with an arrow will appear on the display when the tape is active.

"AUTO SET"

Press "Auto Set" and the system will set the 12 strongest FM or the 6 strongest AM stations on the preset buttons. To return to the stations previously preset, press "Auto Set" again.

ETR® AM-FM STEREO/CASSETTE TAPE PLAYER (UL0)

Radio Operation

CHEVROLET

figure 5

VOLUME KNOB

This knob turns the radio on and off. Rotate knob to control volume.

"SCV" (SPEED-COMPENSATED VOLUME)

Rotate the ring behind the volume knob to automatically compensate for increase in road noise levels at higher speeds. It causes the volume to increase slowly as speed increases. When working properly, the subtle changes in volume should not be noticeable to the driver. "SCV" can be turned off for normal driving.

"AM-FM"

Press "AM-FM" to receive "AM," "FM1," or "FM2". The lighted display shows the selection.

TUNE KNOB

Push the "TUNE" knob to release it. Rotate the knob to choose desired radio stations. Push the knob back in to store it after tuning.

"RECALL"

Press "RECALL" to recall the station being played or the clock display. Press "RECALL" also to display the time when the ignition is off.

"AUTO TONE"

Press "AUTO TONE" to choose preset treble and bass equalization settings designed for "ROCK," "NEWS," "POP," and "CLASSICAL". Each time "AUTO TONE" is pressed, another setting will appear on the display. When "MAN" (manual) appears, control of the tone will be back to the treble and bass knobs.

"SEEK"

Press "SEEK" and the radio will tune to the next higher or lower station and will stay there.

"PSCAN"

Press "PSCAN" to hear each of the preset stations for a few seconds. To stop at a chosen station, press "PSCAN" again.

CLOCK

To set the clock display on the radio:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears. There will be a two-second delay before the clock goes into the time set mode.

PUSH BUTTONS

To preset six AM stations, six FM1 stations, and six FM2 stations:

1. Tune in desired station.
2. Press and hold one of the six push buttons for five seconds. The station will fade out then return when set. The preset station will return whenever that button is pressed.
3. Repeat these steps for each push button.

SPEAKER ADJUSTMENT

Balance Knob: Push "BAL" knob to release it. Turn the knob to move the sound between the right and left speakers. Push the knob back in to store it when not adjusting.

Fade Knob: Push "FADE" knob to release it. Turn the knob to move the sound between the front and rear speakers. Push the knob back in to store it when not adjusting.

BASS AND TREBLE CONTROL

Push the "TREB" knob to release it. Rotate the knob to the right to increase treble and to the left to decrease treble. Push the knob back in to store it when not adjusting.

Push the "BASS" knob to release it. Rotate the knob to the right to increase bass and to the left to decrease bass.

If a station is weak and noisy, rotate the "TREB" knob to the left to reduce the noise.

Cassette Tape Player

The tape player is built to work best with tapes that are 30 minutes long on each side. Tapes longer than that are so thin they may not work well in this player.

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. If you hear nothing or hear just garbled sound, it may not be in squarely. Press "EJECT" to remove the tape and start over. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

Once the tape is playing, use "VOL," "BAL," "FADE," "TREB," "BASS" and "AUTO TONE" just as for the radio. The arrows show which side of the tape is playing.

To rapidly advance the tape, press "FWD" (forward). Press "FWD" again to stop advancing. The radio will play during this operation.

To rapidly reverse the tape, press "REV" (reverse). Press "REV" again to stop the tape reversing. The radio will play during this operation.

To play the next selection, press "NEXT" or "SEEK" (instead of waiting until the current selection is finished). For "NEXT" to work properly, the tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To replay the current selection, press "PREV" or "SEEK". For "PREV" to work properly, the tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To switch from one side of the tape to the other, press the "PROG" (program) knob.

To reduce tape noise, press (Dolby Noise Reduction)® Button.

To stop the tape player, do any of the following:

- Turn the power off or turn the ignition key off. The cassette stays in the player and will resume playing at the point where it stopped.
- Press "AM-FM" to stop playing the cassette and switch to radio. (To switch back to the tape, press "TAPE AUX").
- Press "EJECT" to remove the cassette and switch to radio. "EJECT" will work with the ignition on or off.

ETR® AM-FM STEREO/COMPACT DISC PLAYER (UN0)**Radio Operation****CHEVROLET****Figure 6****UPPER CONTROL**

Push knob to turn radio on or off and to control volume. The control ring behind the knob is the balance control. Turn the ring clockwise to move speaker balance to the right and counterclockwise to move speaker balance to the left.

TUNE KNOB

Push the "TUNE" knob to release it. Rotate the knob to choose desired radio stations. Push the knob back in to store it after tuning.

"SCV" (SPEED-COMPENSATED VOLUME)

Rotate the ring behind the volume knob to automatically compensate for increase in road noise levels at higher speeds. It causes the volume to increase slowly as speed increases. When working properly, the subtle changes in volume should not be noticeable to the driver. "SVC" can be turned off for normal driving.

"AUTO TONE"

Press "AUTO TONE" to choose preset treble and bass equalization settings designed for "ROCK," "NEWS," "POP," and "CLASSICAL". Each time "AUTO TONE" is pressed, another setting will appear on the display. When "MAN" (manual) appears, control of the tone will be back to the treble and bass knobs.

BASS AND TREBLE CONTROL

Push the "TREB" knob to release it. Rotate the knob to the right to increase treble and the left to decrease treble. Push the knob back in to store it when not adjusting.

Push the "BASS" knob to release it. Rotate the knob to the right to increase bass and to the left to decrease bass.

If a station is weak and noisy, rotate the "TREB" knob to the left to reduce the noise.

9A-8 AUDIO SYSTEMS

PUSH BUTTONS

To preset six AM stations and five FM stations, use the following procedure:

1. Tune in desired station.
2. Push "SET". Within five seconds, push one of the five push buttons.
3. Repeat these steps for each push button.

CLOCK

To set the clock display, the ignition lock cylinder must be in the "ACC" or "RUN" position and the radio must be off. To set the clock:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears.

There will be a two-second delay before the clock goes into the time set mode.

SEEK AND SCAN FEATURE

Press "SEEK" or and the radio will tune to the next higher or lower station with enough signal strength to be heard clearly, and stay there.

Push "SEEK" for 2 seconds and the radio will tune to the next higher station with a clear signal and stay there a few seconds. Then it will tune to the next station for a few seconds, and so on. To stop scan, press "SEEK" again.

"RCL" (RECALL)

Press this to switch between time and radio frequency on the display while the radio is on.

When playing a compact disc, press "RCL" button to see the current track number. Press "RCL" again within five seconds to see volume and time elapsed in current track on the display.

Compact Disc Player

With the radio on, insert disc into slot, label side up (player pulls it in). "CD" will appear on the display and track 1 will begin to play. If disc comes back out and "ERR" appears on display, check to see if:

- Disc is upside down.
- Disc is dirty, scratched or wet.
- Too much moisture is in the air.

"PREV" (PREVIOUS)

Press "PREV" to play track again. If held or pressed more than once, the disc will return to previous track. If "PREV" is pressed within eight seconds from start of track, the disc will go to the beginning of the previous track and begin to play. If "PREV" button is pressed after eight seconds into the track, the disc will go to the beginning of the current track and begin to play.

"NEXT"

Press "NEXT" when you want to hear the next track now (before the present track is finished). If "NEXT" is held or pressed more than once, the disc will advance farther.

"FWD" (FORWARD)

Press and hold "FWD" to quickly advance within a track. Release it to resume playing.

"REV" (REVERSE)

Push "REV" and hold it to return quickly to a favorite passage on the disc. Release it to resume playing.

"RDM" (RANDOM)

Press this button and the player chooses a random order of tracks to play. When the final random track has been played, the disc will play the same random selection again. Press "RDM" again for a different selection of tracks.

"COMP" (COMPRESSION)

Push "COMP" to make loud and soft passages more nearly equal in volume.

"ST-PL" (STOP/PLAY)

Press "ST-PL" to stop disc from playing. The radio will resume playing. "ST-PL" will also restart the disc. The disc will resume playing at the point where it stopped.

"EJECT" (EJECT)

Push this to eject the disc and resume radio play.

ETR® AM-FM STEREO/COMPACT DISC/CASSETTE PLAYER (UP0)

(Buick)

Radio Operation

Figure 7

The radio operation of the UP0 radio Refer to "Compact Disc Player" for the UN0 in this section.

Cassette Tape Player

The cassette tape player operation of the UP0 radio is the same as the UL0 ETR® AM-FM STEREO/CASSETTE WITH AUTO TONE. Refer to "Cassette Tape Player" for the UL0 in this section.

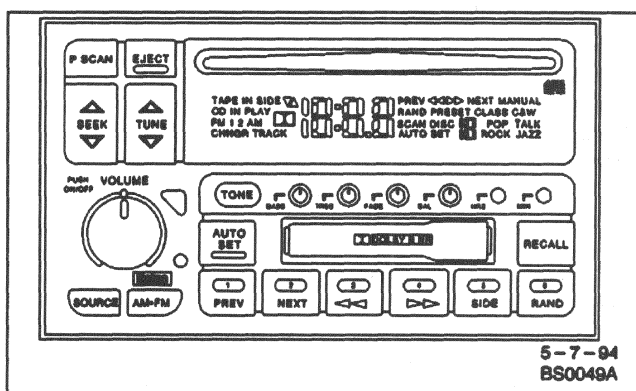


Figure 7 - UP0 Radio - (Buick)

Compact Disc Player

The compact disc player of the UP0 radio is the same as the UN0 (Buick) AM-FM STEREO/COMPACT DISC PLAYER. Refer to "Compact Disc Player" for the UN0 in this section.

THEFTLOCK

The instructions below explain how to enter a security code into the system. If the vehicle loses battery power for any reason, the security code must be entered again before the system will turn on.

1. Write down any number from "000" to "1,999" and keep it in a safe place.
2. Turn ignition to "ACC" or "RUN" position.
3. Turn radio off.
4. Press and hold buttons "1" and "4" together and hold until "- -" shows on display.

You are now ready to enter the security code, pausing no more than 15 seconds between steps.

1. Press "MIN" and "000" appears on display.
2. Press "MIN" again and hold until last two digits of code appears. Release button.
3. Press and hold "HRS" until first one or two digits of the code appear.
4. Press "AM-FM," "rEP" will appear on the display.
5. Repeat steps 5 through 7.
6. Press "AM-FM," "SEC" will appear on the display. This meaning audio system is secured.

The indicator light will also flash when the ignition is off. If the display shows "—," the verification steps were not successful and the entire sequence must be done over.

UNLOCKING SECURED RADIO

If the audio system is secured ("SEC" shows on the display) and you wish to disable it, enter the security code as follow. (Do not pause more than 15 seconds between steps).

1. Turn ignition to "RUN" position. Make sure audio system is off. The time will show on the display.
2. Press pushbuttons "1" and "4" together until "SEC" shows on the display.
3. Press "MIN" and "000" will appears on the display.
4. Press "MIN" again and hold until the last two digits of the code appears. Release the button.
5. Press "HR" until the first one or two digits appear.
6. Press "AM-FM". If "—" shows, you have shut off the theft-deterrent feature. If "SEC" shows, the audio system is still secured.

DETERMINING FACTORY BACKUP UNLOCKING CODE FOR SECURED RADIO

If the security is activated and the radio is disconnected from battery power, the radio will display "LOC". The radio will not turn on until the correct unlocking code is entered. If the customer code is lost or unavailable, Refer to Dealer Communication System bulletin regarding the unlocking procedures or call technical assistance.

DIAGNOSIS

RADIO FIXED ANTENNA DIAGNOSIS

Unplug antenna lead-in at back of radio and plug a test antenna into radio. Make sure test antenna base is grounded to the vehicle chassis and keep hands off of antenna. Check radio reception in an area away from electrical interference. These include tall buildings, metal structures, power lines, fluorescent lighting and power tools. Tune to high and low ends of the dial on both AM and FM, checking weak and strong station reception. If reception is OK, problem exists with antenna and/or its lead-in cable. If reception is still poor, refer to Section 8A-150.

RADIO POWER ANTENNA MOUNTING AND CONNECTIONS

Poor grounding of the radio power antenna, either at the antenna mounting or at any other connection in the antenna/lead-in system, can result in seriously reduced radio performance. A poor ground can cause excess ignition noise in AM reception and erratic audio.

To check for a poor ground of the radio power antenna mast, perform the following:

1. Fully lower antenna.
2. Disconnect power antenna motor connector, (Buick) is in the rear compartment area (Chevrolet) is under hood right side.
3. Remove escutcheon from fender.
4. Attach alligator clips to upper end of mast to act as antenna. Leave other end of clip unattached.
5. Tune radio for weak AM station or signal which is dependent on clip, i.e., clip attached, station is present; clip removed, no station.
6. Remove clip.
7. Ground upper end of mast to body.
8. If radio station is not received, then antenna grounds are good. If station is still present or stronger, a poor ground or no ground connection is present in system.

Possible ground loss points are:

- Antenna upper mounting (bolts/screws loose, paint overspray).
- Coaxial connector at antenna (if applicable) loose or corroded. Remove to inspect inside connector for corrosion.
- Coaxial connector at extension cable (if applicable) loose.
- Coaxial connector at radio loose or corroded.
- Antenna harness connector corroded.

RADIO POWER ANTENNA LEAD-IN CABLE CHECK

Figures 8, 9, and 10

Usually, symptoms of a broken center conductor of the lead-in cable will result in no AM and weak FM. In case of continued reception or noise complaints, always check the lead-in with a multimeter. The chart and diagram in Figure 11 show accurate readings. When checking resistance, cautiously wiggle the lead-in tip and cable. If the readings shown in Figure 10 are not obtained, some portion of the lead-in is intermittent and the lead-in should be replaced.

Barbless antenna connectors are used to connect the antenna with the radio. This system consists of a barbless socket in the radio that should only be used with a barbless lead-in. In the event of installing a different radio, care should be taken not to mix the barbed and barbless connectors. Radio damage may occur. Adapter cables are available to allow any radio swapping that is necessary.

RADIO POWER ANTENNA CHECK

Figure 11

Improperly grounded antennas are usually the cause of poor reception or noise complaints. To assure a good ground, a braided ground strap should be connected from the housing case to chassis ground.

After checking and repairing the antenna, always make sure lead-in connector(s) are dirt and corrosion free, and are tightly fastened.

The antenna can be checked by using a multimeter. With the probes fastened to each point as shown in Figure 12, wiggle the separate antenna sections and antenna housing case. With a properly grounded antenna, the readings shown should always be obtained. If not, replace the antenna. Refer to "Radio Power Antenna" under "On-Vehicle Service" in this section.

MOISTURE IN RADIO POWER ANTENNA TUBE

Weak reception or fading may be caused by moisture in the support tube, due to condensation or leakage through the insulation bushings. If trouble has been traced to moisture in the tube, the antenna must be removed, disassembled, and thoroughly cleaned. All moisture can be removed by blowing out with compressed air, then pushing a clean dry cloth through the support tube as far as possible. Before assembling antenna, check drain holes in motor housing to be sure they are not obstructed.

SPEAKER DIAGNOSIS (CASSETTE ONLY)

Tools required

J 39916 Speaker Diagnostic Test Tape Kit



Important

- Always compare the front speakers to front, and rear speakers to rear. Do not compare front speaker to rear speaker because they could be different speakers or their mounting environment could cause them to sound different.

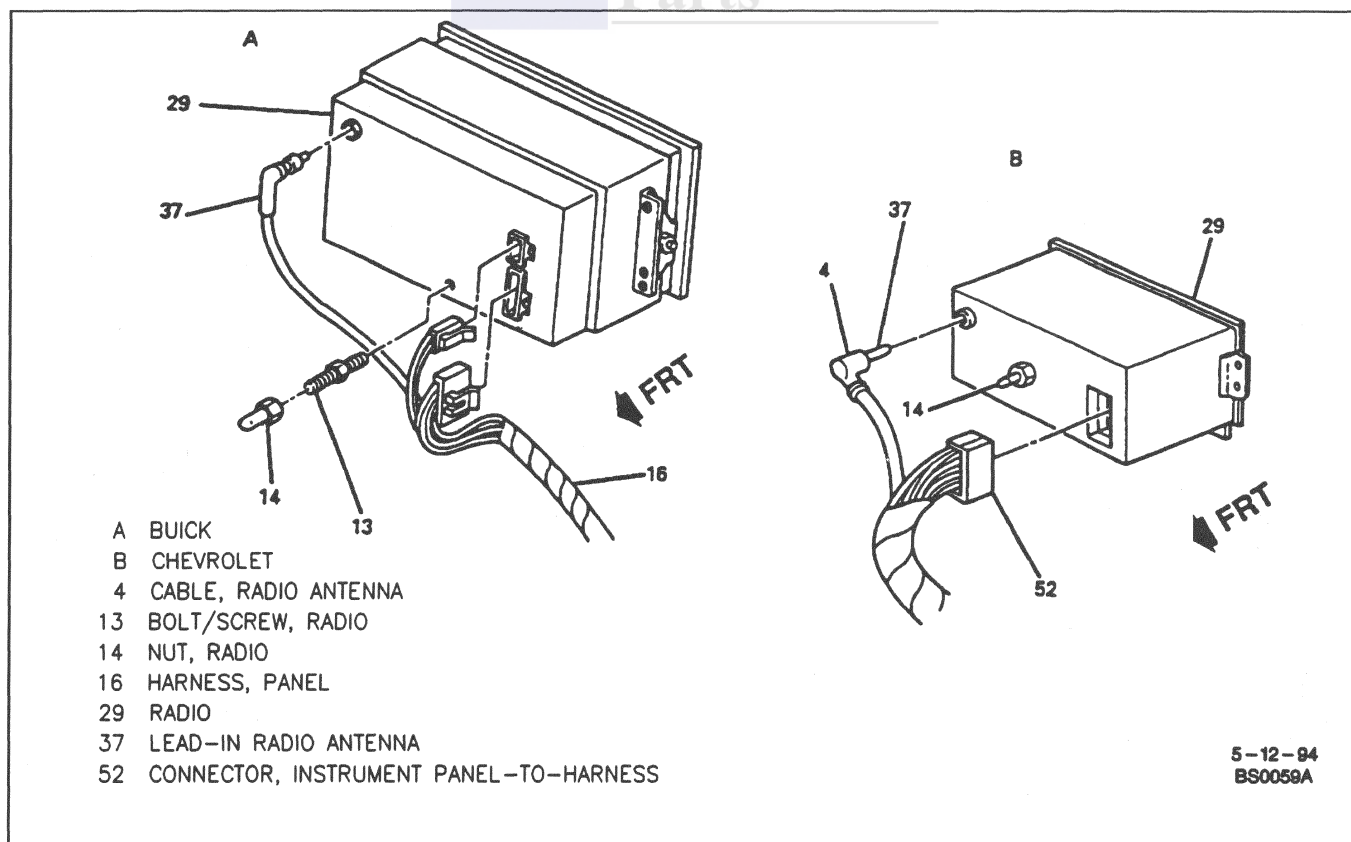


Figure 8 - Antenna Lead-In Radio

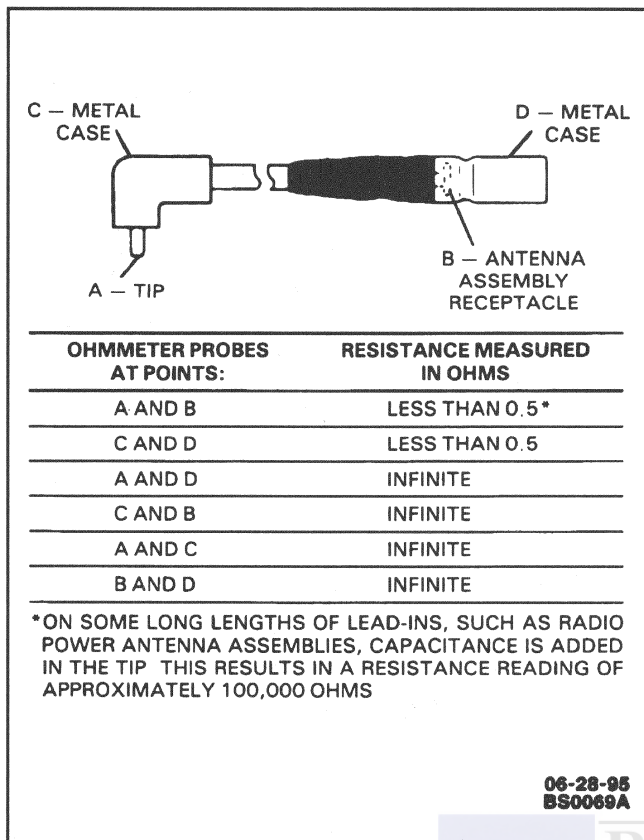


Figure 9 - Lead-In Cable Diagnosis

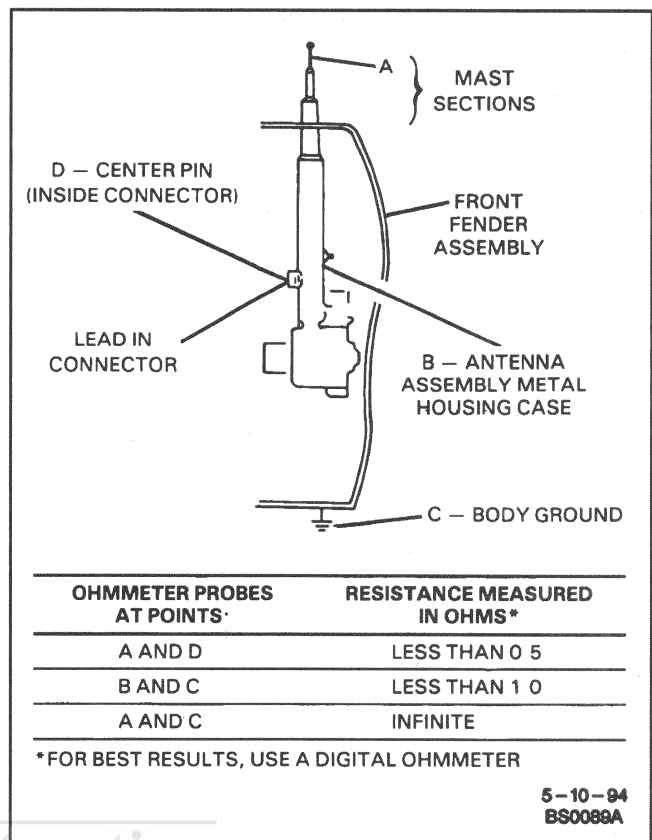


Figure 11 - Antenna Diagnosis (Typical)

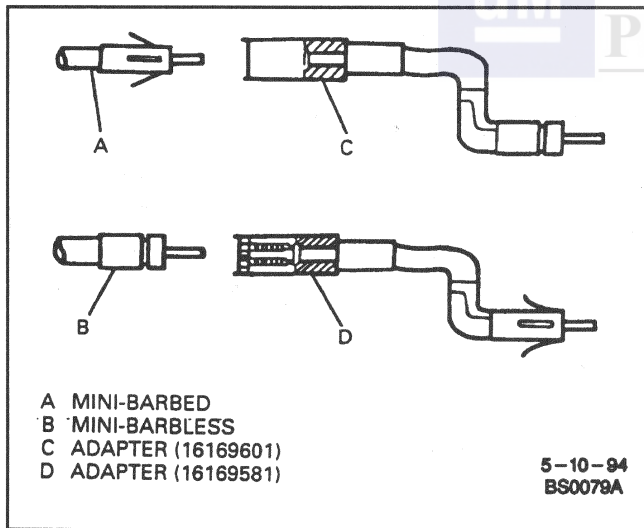


Figure 10 - Barbless Extension Cables Dealer Replace and Upgrade Ratios

Tones are used to test and evaluate coaxial speakers or other complex speaker systems. There are three basic tones used, 50 Hz tone, 500 Hz warble tone, and 9k Hz spectral tone. The combination tone is a blend of the above three tones.

BASS/SUB-WOOFER TEST (50Hz SINE TONE)

The 50 Hz tone is used to evaluate the bass response of an audio system. This tone is also helpful in evaluating audio systems which have separate subwoofer amplifiers and speakers.

MIDRANGE SPEAKER TEST (500 Hz WARBLE TONE)

The 500 Hz warble tone is used for the evaluation of midrange speaker response. This tone is qualified as a warble tone because it has different audio characteristics than a sine tone. This tone produces a warble sound. At these tone midrange frequencies, it is better to use a warble tone than a sine wave because the location of a warble tone source, such as a speaker, is easier to identify. A normal sine tone can set up a standing wave within a vehicle which can make it difficult to determine its source location.

TWEETER TEST (9k Hz SPECTRAL TONE)

The 9 Hz spectral tone is used for tweeter or high frequency evaluation. This tone is a section of frequencies of equal amplitudes ranging from 8.5k Hz - 9.5k Hz. This sounds like a group of crickets chirping. This type of tone is used for two reasons. One, much like the warble tone, it is easy to locate its source, and two, this type of tone is easier to identify for those people with high end hearing loss problems.

ALL SPEAKER TEST

The combination tone can be used for numerous audio problems such as distorted or no sound from speaker(s). When using the combination tone, comparative AC voltage measurements can be made on the speaker terminals, provided the fade and balance controls are in the detent position. With these voltage measurements, a determination can be made in the diagnosis of speaker or amplifier.

9A-12 AUDIO SYSTEMS

SPEAKER/GRILL RATTLE TEST (50 Hz to 8k Hz SWEPT SINE)

The next portion of the tape can be used to diagnose speaker and grill rattles. The first test is two tones played back to back. The second test is a variable frequency tone, but frequency change is at a much slower rate. Both tests can be used to repair a speaker rattle or buzz. If the problem has already been isolated, the fade and balance controls can be set to the proper location and the test tones can be played in the specific problem area.

MOTOR SPEED TEST

There is a two minute time period marked in this section of tape for the purpose of checking the cassette tape motor speed. This portion of the diagnostic tape can be used to verify complaints of abnormal sound from the cassette tape player. In some cases, improper tape motor speed can cause audio abnormalities. If the time taken for this is between one minute and fifty-six seconds to two minutes and one second, the tape motor speed is within tolerance.

TAPE CLEANING PROCEDURES

The recommended time for cleaning is every fifteen hours for best performance and every fifty hours to prevent damage to the tape head. The preferred tape cleaner is available as a part of the Audio System Kit P/N J39916.

NOISE DIAGNOSIS (DEAD SPACE)

This portion can be used for noise diagnosis such as alternator whine, switch pops, etc. which can be more easily detected during dead space (blank space in between songs). This portion of the diagnostic tape may be used in conjunction with noise diagnosis in Section 8A.

ON-VEHICLE SERVICE

TAPE PLAYER AND CASSETTE CARE

Tape Head and Capstan Cleaning

Figure 12

Two parts should be cleaned on the tape player, the head and the capstan. Since they can be reached through the tape door, leave the tape player in the vehicle. The head and capstan should be cleaned every 100 hours of cassette operation.

To clean the head and capstan, use a cotton swab dipped in rubbing alcohol.

A cassette cleaning kit may also be used to clean the head and capstan. Follow instructions on the kit to clean the cassette tape player.

Do not contact tape head with magnetized tools. If the head becomes magnetized, it will degrade every cassette played in the player.

No service is performed on the cassettes. The cassette manufacturer handles warranties of cassettes. The test cassette used by the dealer should be stored in its container to keep the tape clean. Store cassette away from extreme heat and direct sunlight.

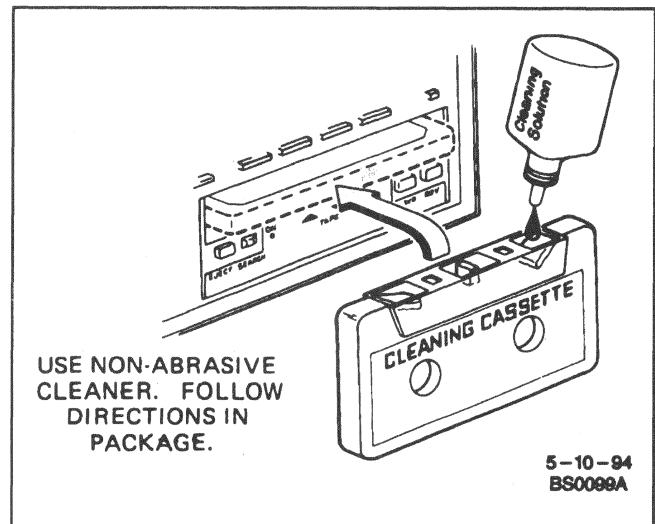


Figure 12 - Cassette Cleaning Kit

RADIO POWER ANTENNA CARE

Periodic cleaning may be necessary to assure proper radio power antenna operation.

CLEANING THE RADIO POWER ANTENNA:

1. Actuate antenna to full extension.
2. Dampen clean cloth with mineral spirits.
3. Wipe cloth over antenna sections, removing any dirt.
4. Actuate antenna through one complete cycle (retract and extend).
5. Repeat steps 1 through 4 at least two more times.

COMPACT DISC CARE

Handle discs carefully. Store in protective case away from sun, heat, and dust. If surface is soiled, dampen a clean soft cloth in a solution of mild neutral detergent and wipe clean. Mini discs called "singles" (about 3 inches in diameter) will not eject and should not be used.

RADIO

Refer to SECTION 8C for removal and installation procedures.

SPEAKERS

For removal and installation of radio front side door speakers, refer to SECTION 10-6. For removal and installation of rear speakers on sedans, refer to SECTION 10-8. For removal and installation of rear speakers on wagons, refer to SECTION 10-7.



Important

- All Delco® sound systems have ungrounded speakers. Installing add-on tape players, CBs or other units which use the vehicle speakers may damage your Delco® sound system, and is not recommended.

RADIO FIXED ANTENNA

(Buick Sedan)

Figure 13

Tool Required:
J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Move rear compartment mat to access antenna.
2. Lead-in cable (24) by turning counterclockwise and pulling at cable (4).
3. Bolt/screw (7).
4. Nut (2) and bezel (3), using J 38536.
5. Mast (1) and bracket (10).

Install or Connect

NOTICE: Refer to "Notice" on page 9A-1 of this section.

1. Mast (1) and bracket (10).
 - Align mast (1) and bracket (10) to right panel (8) and secure with bolt/screw (7).

Tighten

- Bolt/screw (7) to 6 N.m (53 lb. in.).
2. Nut (2) and bezel (3), using J 38536.

Tighten

- Nut (2) to 4 N.m (35 lb. in.).
3. Lead-in cable (24).
4. Return rear compartment mat to original position.

(Except Buick Sedan)

Figure 14

Tool Required:
J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Mast (33) from cable (36).
2. Mask front edge of right front side door with masking tape.
3. Loosen nut (34), using J 38536.
4. Bolt/screw (38).
5. Antenna lead-in (37).
6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Front wheelhouse panel bolts/screws from fender (39).
8. Pull out lower edge of front wheelhouse panel and block with wood to access cable (36).
9. Nut (34), using J 38536, and bezel (35).
10. Cable (36).

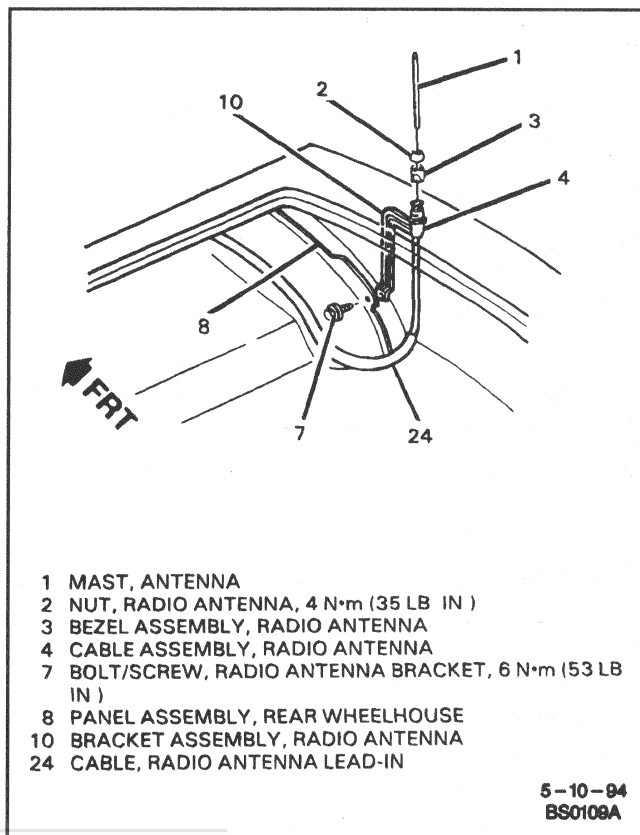


Figure 13 - Radio Fixed Antenna Mounting -(Buick Sedan)

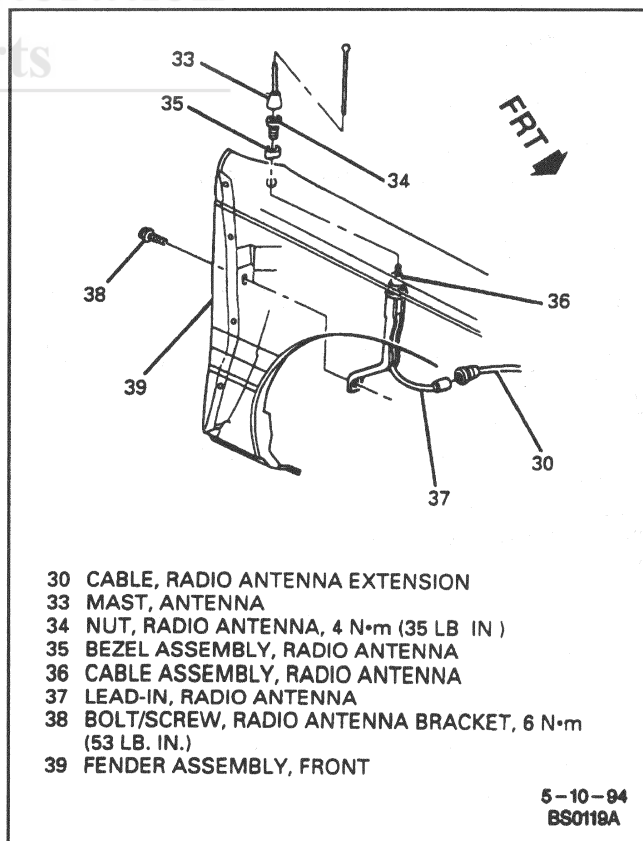


Figure 14 - Radio Fixed Antenna Mounting -(Except Buick Sedan)

9A-14 AUDIO SYSTEMS

Install or Connect

NOTICE: Refer to "Notice" on page 9A-1 of this section.

1. Cable (36), nut (34) and bezel (35), loosely.
2. Align cable (36) to right fender (39) and secure with bolt/screw (38).

Tighten

- A. Bolt/screw (38) to 6 N·m (53 lb. in.).
 - B. Nut (34) to 4 N·m (35 lb. in.), using J 38536.
3. Unblock rear wheelhouse panel.
 4. Front wheelhouse panel bolts/screws.

Tighten

- A. Bolts/screws (third, sixth and seventh from front of wheelhouse panel) to 25 N·m (18 lb. ft.).
 - B. Bolts/screws (all remaining) to 10 N·m (89 lb. in.).
5. Lower vehicle.
 6. Antenna lead-in (37).
 7. Mast (33) in cable (36).
 8. Remove tape from door edge.

RADIO POWER ANTENNA

(Buick Sedan)

Figure 15

Tool Required:
J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Move rear compartment mat to access antenna (25).
2. Cable (24) and electrical connectors (15 and 26).
3. Bolt/screw (9).
4. Bracket (12).
5. Nut (5) and bezel (6), using J 38536.
6. Antenna (25).

Install or Connect

NOTICE: Refer to "Notice" on page 9A-1 of this section.

1. Antenna (25).
2. Nut (5) and bezel (6), using J 38536.

Tighten

- Nut (5) to 4 N·m (35 lb. in.).
3. Bracket (12) to right panel (8) and secure with bolt/screw (9).

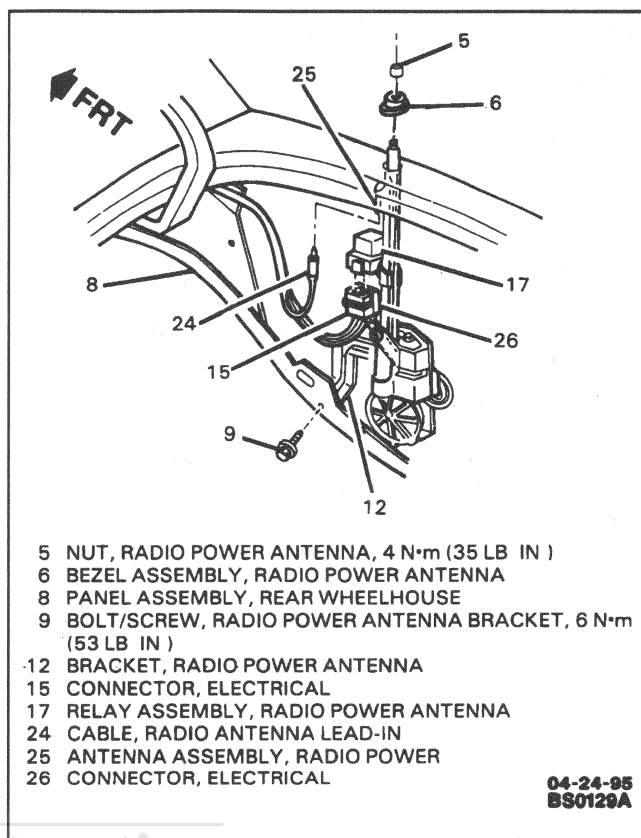


Figure 15 - Radio Power Antenna Mounting - (Buick Sedan)

Tighten

- Bolt/screw (9) to 6 N·m (53 lb. in.).
4. Electrical connectors (15 and 26) and cable (24).
 5. Return rear compartment mat to original position.

(Except Buick Sedan)

Figure 16

Tool Required:
J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Antenna lead-in connector (47) from radio lead-in connector (49).
2. Antenna wiring connector (48) from wiring harness connector.
3. Mask front edge of right front side door with tape.
4. Bolt/screw (9).
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Front wheelhouse panel bolts/screws.
7. Pull out lower edge of front wheelhouse panel and block with wood to access antenna (40).
8. Nut (5), using J 38536, and bezel (11).
9. Antenna (40).

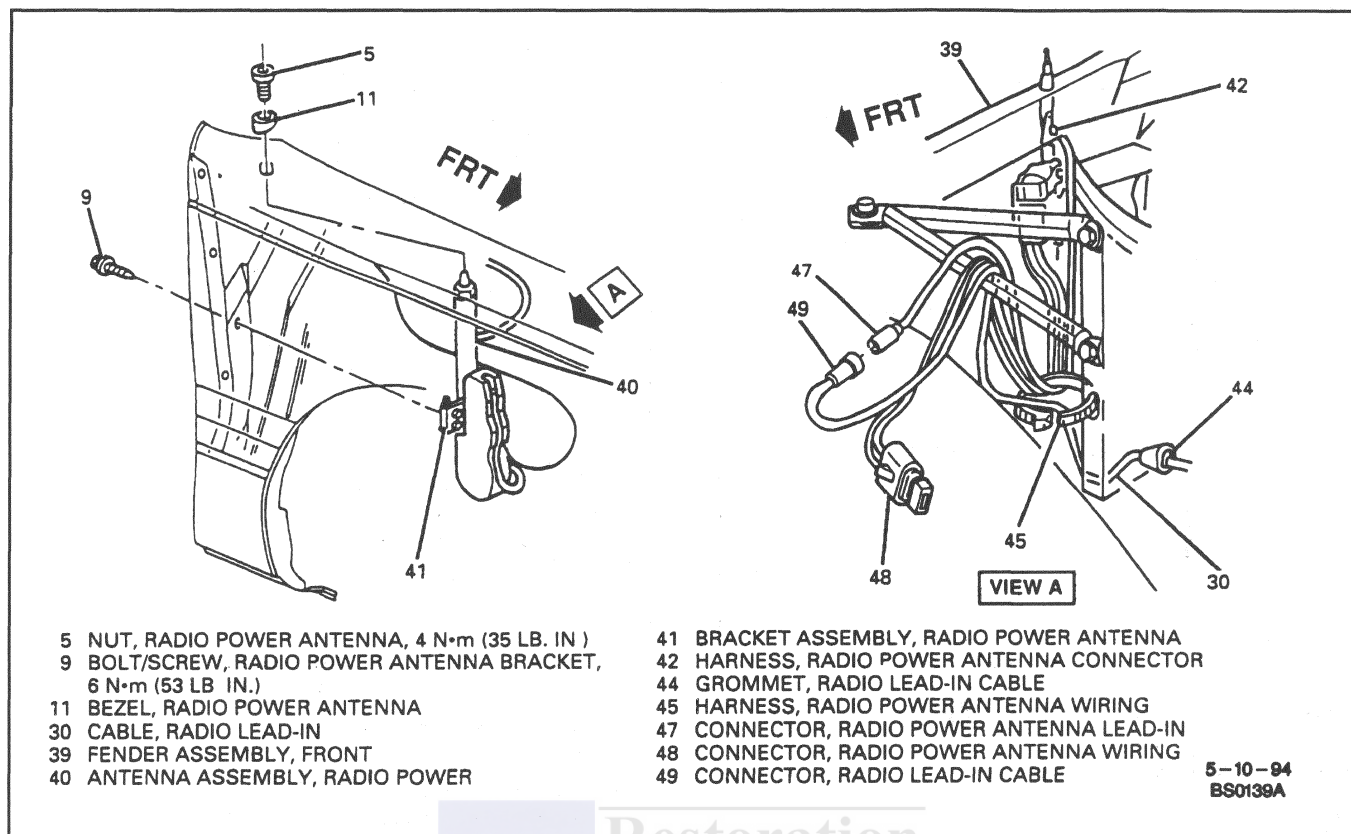


Figure 16 - Radio Power Antenna Mounting -(Except Buick Sedan)

Install or Connect

NOTICE: Refer to "Notice" on page 9A-1 of this section.

1. Antenna (40).
 - Position antenna (40) in fender (39).
2. Bezel (11) and nut (5), loosely.
3. Bracket (41) to fender (39) and secure with bolt/screw (9).

Tighten

- A. Bolt/screw (9) to 6 N·m (53 lb. in.).
- B. Nut (5) to 4 N·m (35 lb. in.), using J 38536.
4. Unblock front wheelhouse panel.
5. Front wheelhouse panel bolts/screws.

Tighten

- A. Front wheelhouse panel bolts/screws (third, sixth and seventh from front of panel) to 25 N·m (18 lb. ft.).
- B. Front wheelhouse panel bolts/screws (all remaining) to 10 N·m (89 lb. ft.).
6. Lower vehicle.
7. Remove tape from door edge.
8. Antenna wiring connector (48) to wiring harness connector.
9. Antenna lead-in connector (47) to radio lead-in connector (49).

Radio Power Antenna Mast Section

Figures 17 and 18

The power antenna mast is non-repairable and is not to be disassembled. Replace complete unit.

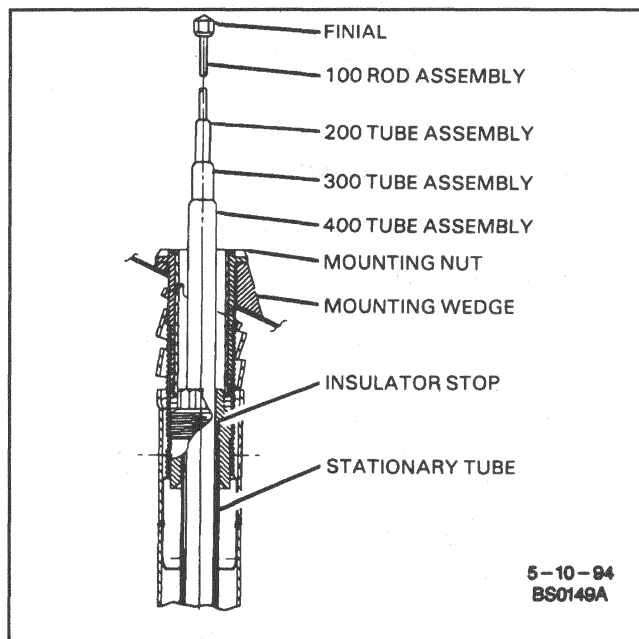


Figure 17 - Radio Power Antenna Mast Sections (Typical)

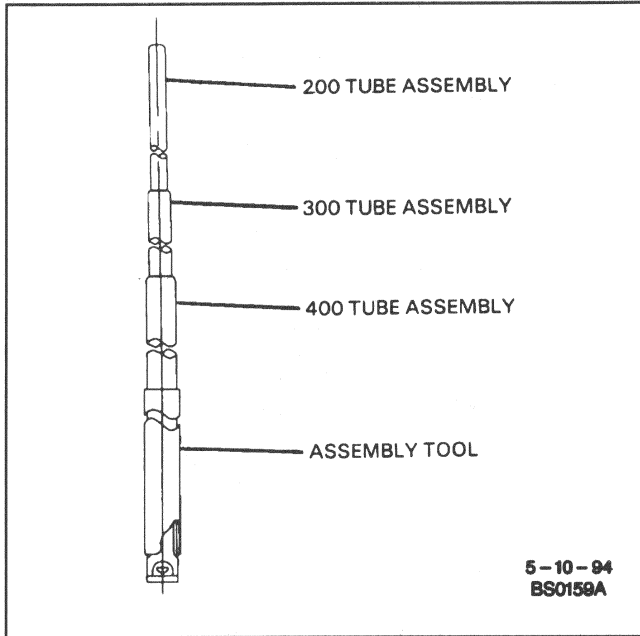


Figure 18 - Tube Installed (Typical)

Radio Power Antenna Relay

(Except Buick Sedan)

Figure 19

The radio power antenna relay is located in the convenience center under the instrument panel, left of the steering column.

(Buick Sedan)

Figure 15

The radio power antenna relay is located in the right rear compartment, behind the rear wheelhouse trim and attached to the antenna mast.

Radio Antenna Lead-In Cables

(Buick Sedan)

Figures 13 through 16 and 20

REAR RADIO ANTENNA LEAD-IN CABLE



Remove or Disconnect

- Lead-in cable (24) from cable (4) or antenna (25).
 - If removing lead-in cable (24) from cable (4), turn and pull lead-in cable connector.
- Rear seatback. Refer to SECTION 10-10.
- Floor carpet retainer. Refer to SECTION 10-5.
- Rear side door lock pillar garnish molding. Refer to SECTION 10-7.
- Right body hinge pillar trim finish panel. Refer to SECTION 10-5.
- Pull floor carpet assembly back far enough to access antenna lead-in cable (24).

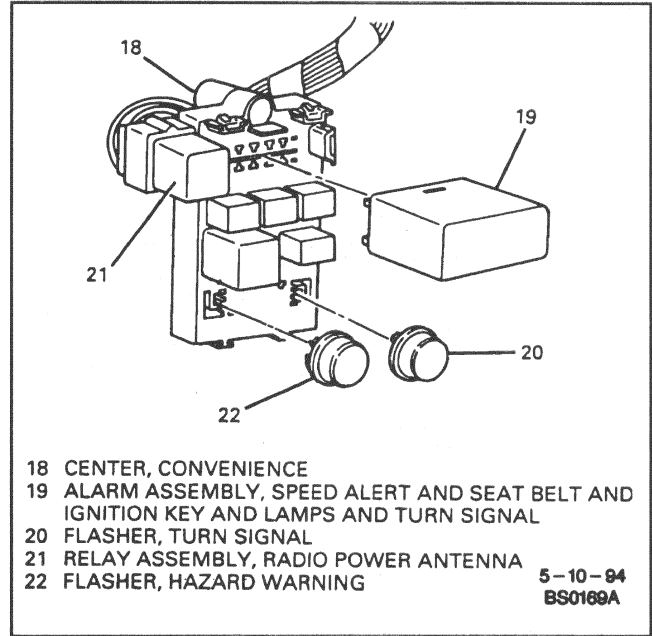


Figure 19 - Radio Power Antenna Relay -(Except Buick Sedan)

- Antenna lead-in cable (24) from antenna extension (30).
- Antenna lead-in cable (24) from rear compartment and from clips (31) along right side of frame.



Install or Connect

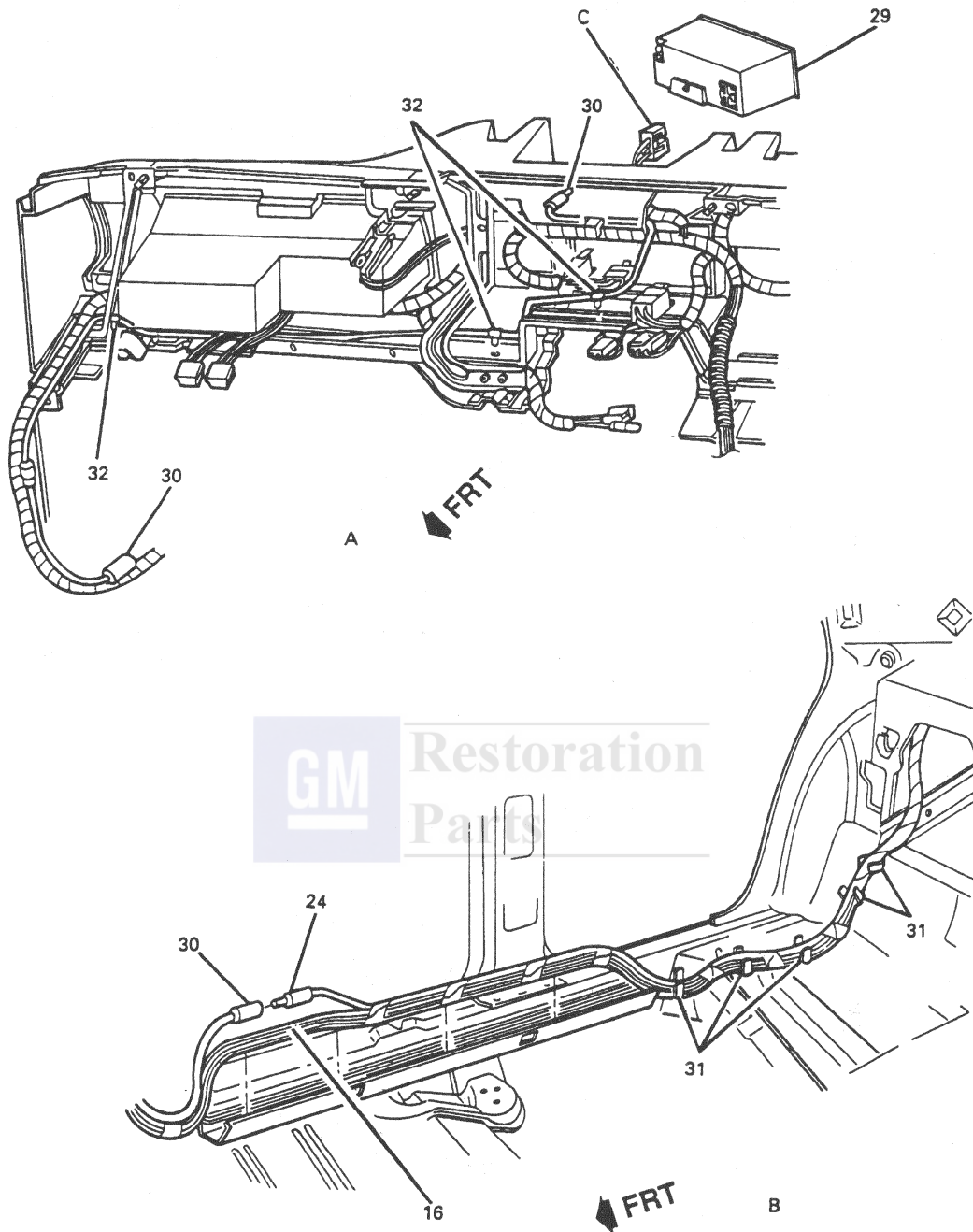
- Route antenna lead-in cable (24) through clips (31) along right side of frame and into rear compartment.
- Antenna lead-in cable (24) into antenna extension (30).
- Return floor carpet to its original position.
- Right body hinge pillar trim finish panel. Refer to SECTION 10-5.
- Rear side door lock pillar garnish molding. Refer to SECTION 10-7.
- Floor carpet retainer. Refer to SECTION 10-5.
- Rear seatback. Refer to SECTION 10-10.
- Antenna lead-in cable (24) into cable (4) or antenna (25).

FRONT RADIO ANTENNA LEAD-IN CABLE



Remove or Disconnect

- Right body hinge pillar trim panel. Refer to SECTION 10-5.
- Pull right front edge of carpeting back to access radio lead-in cable (30).
- Radio extension cable (30) from antenna lead-in cable (24), if Buick sedan (Figure 22).
- Instrument panel sound insulator.
- Radio. Refer to SECTION 8C.
- Radio extension cable (30) from radio antenna lead-in (37) for fixed antenna or lead-in connector (47) for power antenna, except Buick sedan.



- A CABLE ROUTING, COWL
- B CABLE ROUTING, RIGHT SIDE
- C CONNECTOR, ELECTRICAL
- 16 HARNESS ASSEMBLY, INSTRUMENT PANEL
- 24 CABLE, RADIO ANTENNA LEAD-IN
- 29 RADIO ASSEMBLY
- 30 CABLE, RADIO ANTENNA EXTENSION
- 31 CLIP, BODY WIRING HARNESS
- 32 CLIP, INSTRUMENT PANEL WIRING

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Figure 20 - Radio Antenna Lead-In Cable -(Buick Sedan)

9A-18 AUDIO SYSTEMS

7. Radio extension cable (30).
 - Pull radio lead-in cable (30) and grommet into passenger compartment. Tape back or cut both ends just before cable (30) enters instrument panel harness.

Install or Connect

1. Radio extension cable (30).
 - Route cable (30) from radio opening in instrument panel along instrument panel harness, down along instrument panel brace (just before instrument panel compartment) and behind front edge of carpeting. Feed lead-in cable through passenger compartment opening into engine compartment, fully seating grommet.

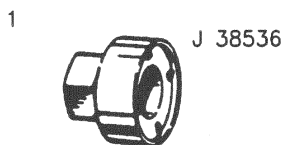
2. Radio extension cable (30) to radio antenna lead-in (37) for fixed antenna or lead-in connector (47) for power antenna, except Buick sedan.
3. Radio. Refer to SECTION 8C.
4. Instrument panel sound insulator.
5. Radio extension cable (30) to antenna lead-in cable (24), if Buick sedan (Figure 22).
6. Push right front edge of carpeting back into position.
7. Right body hinge pillar trim panel. Refer to SECTION 10-5.

SPECIFICATIONS

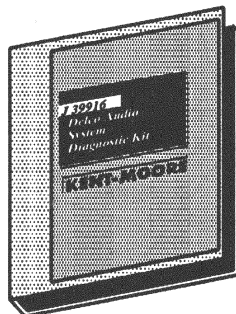
FASTENER TIGHTENING SPECIFICATIONS

Front Wheelhouse Panel Bolt/Screw (Third, Sixth and Seventh from Front).....	25 N.m (18 lb. ft.)
Front Wheelhouse Panel Bolt/Screw (All Remaining)	10 N.m (89 lb. in.)
Radio Antenna Bracket Bolt/Screw	6 N.m (53 lb. in.)
Radio Antenna Nut.....	4 N.m (35 lb. in.)
Radio Power Antenna Bracket Bolt/Screw.....	6 N.m (53 lb. in.)
Radio Power Antenna Nut	4 N.m (35 lb. in.)

SPECIAL TOOLS



2



J 39916

- 1 ANTENNA BEZEL SOCKET
- 2 SPEAKER DIAGNOSTIC TEST TAPE KIT

04-13-95
BT0019A

SECTION 9B

CRUISE CONTROL

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, and "tap-up" and "tap-down."

The main parts of the cruise control system are the functional control switches, cruise control module, speed sensor and cruise control release switch and stoplamp switches.

The cruise control system uses a cruise control module to obtain the desired vehicle cruise operation. Two important components in the module help to do this. One is an electronic controller and the second is an electric stepper motor. The controller monitors vehicle speed and operates the electric stepper motor. The motor moves a band and throttle linkage, in response to the controller, to maintain the desired cruise speed. The cruise control module contains a low speed limit which will prevent system engagement below a minimum speed of 40 km/h (25 mph). The operation of the controller is controlled by functional control switches located on the turn signal and headlamp dimmer switch and cruise control actuator and windshield wiper and windshield washer lever.

Cruise control release switch and stoplamp switches are provided to disengage the cruise system. The switches are mounted on the brake pedal bracket. When the brake pedal is depressed, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

CRUISE CONTROL MODULE

The cruise control module is mounted on the left wheelhouse panel near the brake master cylinder. The module has an electronic controller and an electric stepper motor to vary the throttle with each different cruise control mode. The module is not serviceable.

CRUISE CONTROL RELEASE SWITCH AND STOPLAMP SWITCH

The cruise control release switch and stoplamp switches are used to disengage the cruise control system. A release switch and a stoplamp switch mounted on the brake pedal bracket disengage the system electrically when the brake pedal is depressed. This is done by activating the brake cut-out input to the cruise control module. The speed of the vehicle at brake actuation will be stored in the memory of the system. The stoplamp switch has a three-wire brake lights connector and a two-wire cruise control disable connector. The cruise control release switch has two two-wire connectors: the larger cross-shaped Torque Converter Clutch (TCC) disable connector and the small cruise control disable connector.

9B-2 CRUISE CONTROL

VEHICLE SPEED SENSOR (VSS)

The Vehicle Speed Sensor (VSS) is mounted to the automatic transmission and produces an AC signal. The frequency of this signal is proportional to the speed at which the automatic transmission output shaft rotates, which in turn, is proportional to the speed of the vehicle.

The AC signal produced by the VSS is amplified and converted by the PCM. The signal is supplied to the cruise control module, speedometer, and power steering control module.

The signal to the PCM, cruise control module, and speedometer is at a rate of 4000 pulses per mile. The PCM, cruise control module, and speedometer internally convert the number of pulses per mile per second to determine vehicle speed.

For removal procedure, refer to SECTION 7A or to SECTION 8A for diagnostic information.

FUNCTIONAL CONTROLS

Off-On-Resume/Accelerate Switch

Figure 1

CAUTION: To keep the vehicle under control, and to prevent possible personal injury and vehicle damage, the cruise control should not be used on slippery or winding roads or in traffic of heavy or varying volume. When traveling down a steeply graded hill, the cruise control should be disengaged by depressing the brake pedal lightly. The automatic transmission can then be shifted into a lower gear range to help control vehicle speed.

The "OFF-ON-R/A" switch (14) has three positions. This switch turns the cruise control system "ON" and "OFF" and also returns cruise control operation to the last speed setting when momentarily moved toward the "R/A" (RESUME/ACCELERATE) position after braking. The "R/A" switch will work only after an initial speed has been set using the "SET/COAST" button. Do not hold the "OFF-ON-R/A" switch (14) in the "R/A" position. Release it immediately. If the "OFF-ON-R/A" switch (14) is held in the "R/A" position for more than one second, the system goes into the acceleration mode. To accelerate the vehicle, move the "OFF-ON-R/A" switch (14) to the "R/A" position and hold it there until the vehicle reaches the desired speed. When the "OFF-ON-R/A" switch (14) is released, the system will maintain the new cruise speed. In order to use the acceleration mode, the "OFF-ON-R/A" switch (14) must be in the "ON" position and the vehicle must be above the low-speed limit of 40 km/h (25 mph). Cruise control memory will be erased when the vehicle is put into "PARK."

The "OFF-ON-R/A" switch (14) can also be used to "tap-up" vehicle speed. In order to do this the cruise control system must be engaged and operating. "Tapping-up" is done by quickly pressing the

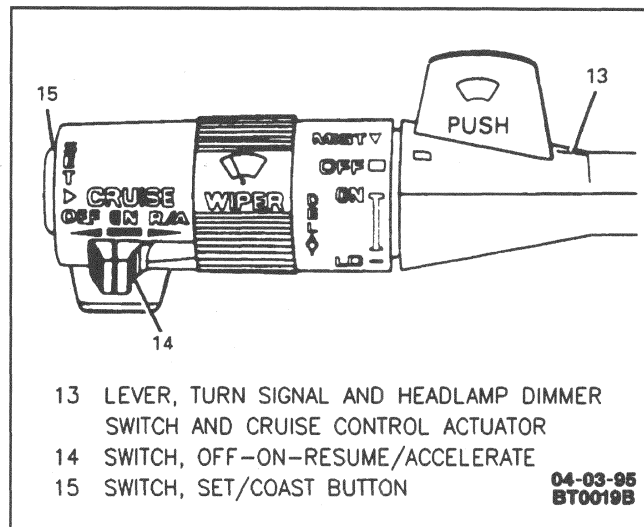


Figure 1 - Cruise Control Actuator Lever

"OFF-ON-R/A" switch (14) toward the "R/A" position and quickly releasing it, or "tapping" the "OFF-ON-R/A" switch (14). Do not hold the "OFF-ON-R/A" switch (14) in the "R/A" position, or the system will go into the acceleration mode. "Tap-up" is a function in which cruise speed can be increased by 1.6 km/h (1 mph) increments (one tap = 1.6 km/h (1 mph) increase).

Set/Coast Button Switch

Figure 1

The cruise control "SET/COAST" button switch (15) (located in the end of the turn signal and headlamp dimmer switch and cruise control actuator and windshield wiper and windshield washer lever) has three positions.

- **The Set Position** - With the "SET/COAST" button switch pressed and then released (vehicle speed must exceed the low speed limit point, and the "OFF-ON-R/A" switch (14) must be in the "ON" position), the cruise speed will be set at the speed the vehicle was going when the "SET/COAST" button switch (15) was released. Vehicle cruise speed will be within 1.6 km/h (1 mph) of the actual speed at engaged speed. The system will cruise until either the "OFF-ON-R/A" switch (14) is moved to "OFF," the ignition switch is turned "OFF," and/or the "SET/COAST" button switch (15) is pushed in fully and held. Pushing the brake pedal releases the "SET/COAST" button switch (15) but not the resume capability.
- **The Coast Position** - With the "SET/COAST" button switch (15) fully depressed, the driver can raise or lower vehicle speed. To increase speed, the driver can accelerate to a new speed, by fully depressing the "SET/COAST" button switch (15) and releasing the button. The cruise control module "forgets" the previously set speed. An increased control speed can be more easily set with the "OFF-ON-R/A" switch (14) as previously described. To decrease cruise speed,

the "SET/COAST" button switch (15) is held in, disengaging the cruise system, which allows the throttle to return to the idle position. When the vehicle has slowed to the desired cruise speed, releasing the "SET/COAST" button switch (15) will engage the system at the new selected speed. Cruise control memory will be erased when the vehicle is put into "PARK."

- **The "Tap Down" Position** - To "tap down," the cruise must be engaged and operating. "Tapping-down" is done by quickly pressing and releasing the "SET/COAST" button switch (15), or "tapping" the "SET/COAST" button switch (15). Do not hold the "SET/COAST" button switch (15) in or the system will go into the coast mode. "Tap-down" is a function in which cruise speed can be decreased by 1.6 km/h (1 mph) increments (one tap = 1.6 km/h (1 mph) decrease). The accelerator pedal may be pressed at any time to override the cruise system. Release of the accelerator pedal will return the vehicle to the previously set cruise speed.

DIAGNOSIS

IMPROPER CRUISE CONTROL OPERATION

In resolving any cruise system malfunction, first make a visual inspection. Check the system to ensure that there are no bare, broken or disconnected wires. If the high-mounted stoplamp bulbs are burned out, the cruise control system will be inoperable. If preliminary inspection reveals no solution and the system is inoperative, use diagnostic information in SECTION 8A.

ON-VEHICLE SERVICE

CRUISE CONTROL RELEASE SWITCH AND STOPLAMP SWITCHES

Adjustment

Figure 2

The release switch (6) and the stoplamp switch (5) cannot be adjusted until after the brake booster pushrod is assembled to brake pedal (3).



Adjust

1. Press brake pedal (3) and insert release switch (6) and stoplamp switch (5) into retainers (7 and 4) until fully seated.

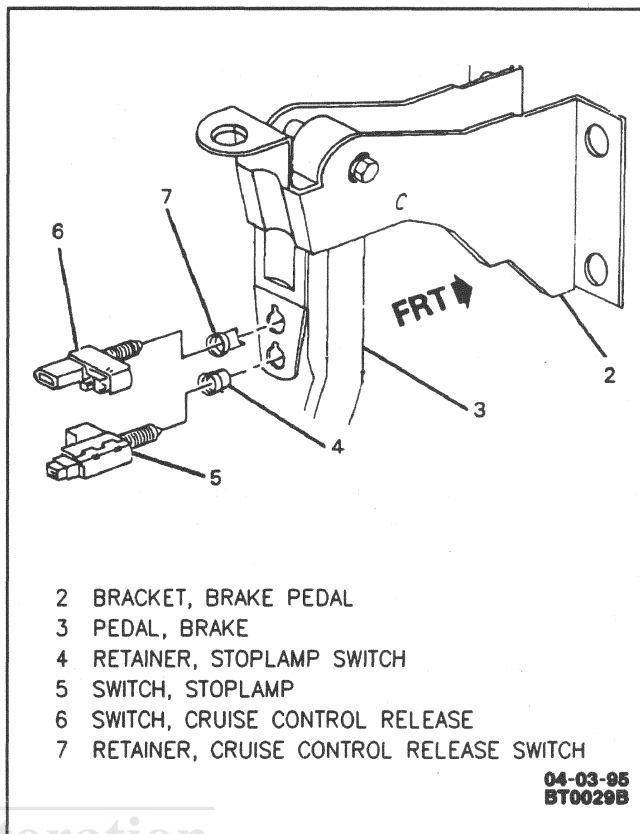


Figure 2 - Cruise Control Release Switch and Stoplamp Switch

2. Pull back on brake pedal (3) to its fully retracted position. Release switch (6) and stoplamp switch (5) will move within retainers (7 and 4) to their "adjusted" position.



Measure

- The following brake pedal travel distances can be used to check for properly adjusted release switch (6) and stoplamp switch (5).
- Release switch and stoplamp switch contacts must be open at 3.5 to 12.5 mm (1/8 to 1/2 inch) brake pedal travel, measured at the centerline of the brake pedal pad. Nominal actuation of the stoplamp switch contacts is about 4.5 mm (3/16 inch) after cruise control switch contacts close.

Replacement



Remove or Disconnect

1. Two electrical connectors.
2. Release switch (6) and stoplamp switch (5) from retainers (7 and 4).
3. Retainers (4 and 7) to bracket (2).

9B-4 CRUISE CONTROL

Install or Connect

1. Retainers (4 and 7) to bracket (2).
2. Release switch (6) and stoplamp switch (5) to retainers (7 and 4).
3. Two electrical connectors.

Adjust

- Release switch (6) and stoplamp switch (5) as outlined above.

ENGAGEMENT SWITCH

Figure 3

The engagement switch cannot be serviced. The complete turn signal, headlamp dimmer switch, cruise control actuator, windshield wiper, windshield washer lever must be replaced as an assembly.

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Steering column cover.
3. Electrical connector.
 - Make sure windshield wiper switch is in the "OFF" position.

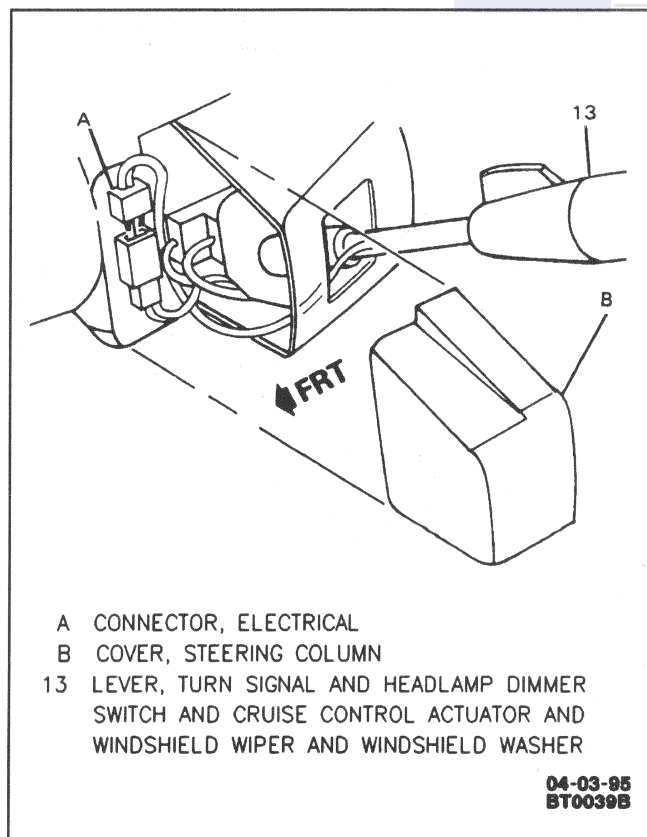


Figure 3 - Engagement Switch

4. Lever (13) by pulling it straight out.

Install or Connect

1. Lever (13) by pushing it in.
2. Electrical connector.
3. Steering column cover.
4. Battery negative cable.

CRUISE CONTROL MODULE

Figure 4

The cruise control module (1) is shock mounted to the left wheelhouse panel using three cruise control module bolts/screws (19) and three front wheelhouse panel hole plugs (20).

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Electrical connector from module (1).
3. Cruise control cable from module. Refer to "Cable Replacement" under "Cruise Control Cable" in this section.
4. Bolts/screws (19).
5. Module (1) and plugs (20).
6. Plugs (20) from module (1) if a new module (1) is being installed.

Install or Connect

NOTICE: Refer to "Notice" on page 9B-1 of this section.

1. Plugs (20) to module (1), if removed.
 - Align holes in accelerator and cruise control adjuster bracket to holes in wheelhouse panel and position module (1) on wheelhouse panel.
2. Bolts/screws (19).

Tighten

- Bolts/screws (19) to 8 N.m (71 lb. in.).
3. Cable to module (1). Refer to "Cable Replacement" under "Cruise Control Cable" in this section.
 4. Electrical connector to module (1).
 5. Battery negative cable.

Adjust

- Cable, if necessary. Refer to "Cable Adjustment" under "Cruise Control Cable" in this section.

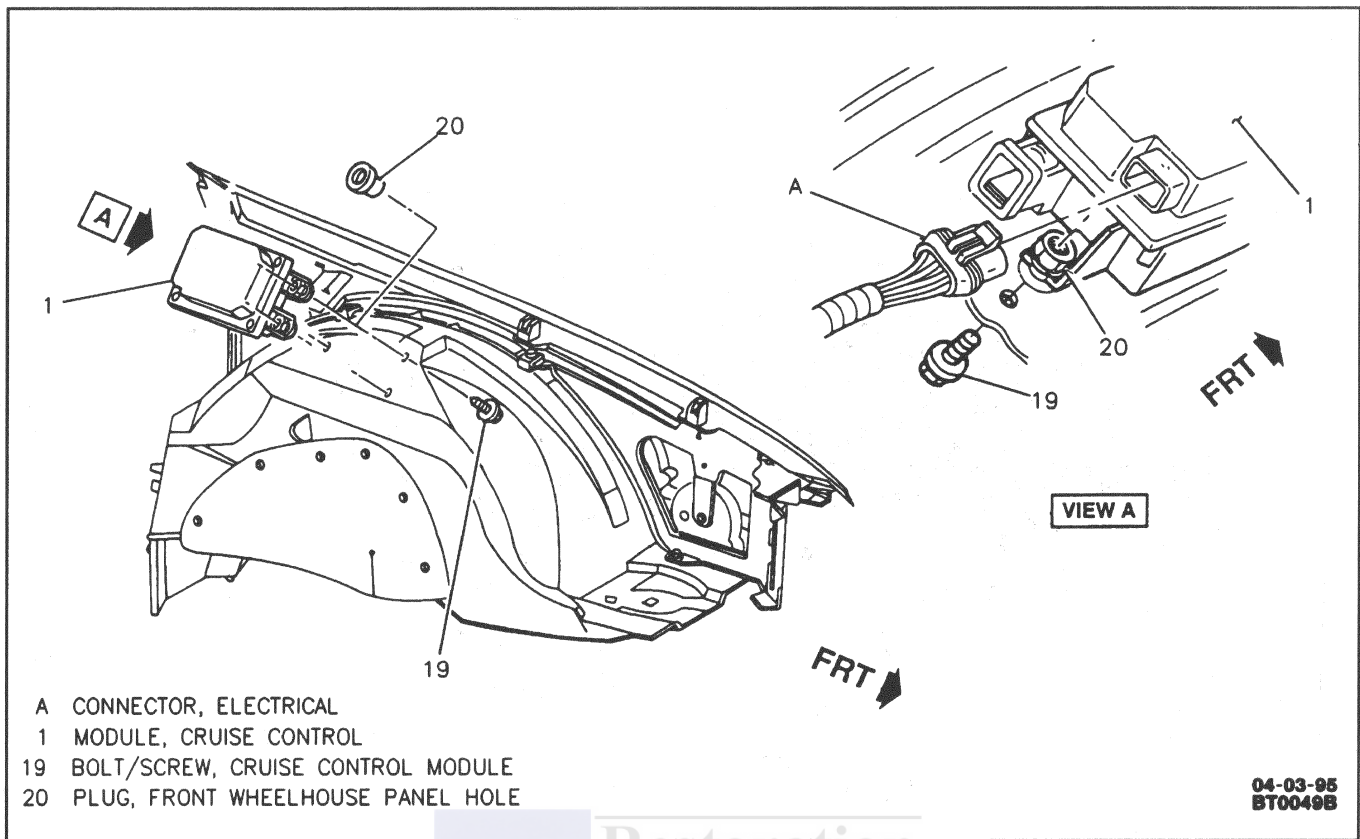


Figure 4 - Cruise Control Module

CRUISE CONTROL CABLE

Figures 5 through 7

The cable (21) is connected between the module (1) and the throttle body fuel injection (TBI) throttle lever.

Cable Replacement

↔ Remove or Disconnect

1. Air cleaner and resonator. Refer to SECTION 6C.
2. Cruise control screw adjuster from TBI throttle lever.
 - Snaps off with flat tipped tool.
3. Cable (21) from accelerator bracket.
4. Cable (21) from module (1).
 - A. Compress conduit tangs and pull out of cruise control module housing.
 - B. Disconnect cable bead from cruise motor band end fitting on module (1).
 - C. Note routing and remove cable (21) from vehicle.

→ Install or Connect

1. Cable (21) to module (1).
 - A. Attach cable bead to cruise motor band end fitting on module (1).
 - B. Pull engine end of cable (21) until it is taut.

- C. Install cable to module with alignment arrow positioned as shown (Figure 6).
- D. Slide cable conduit over band until tangs on conduit engage holes in module housing.

! Important

- Band must not be twisted.
2. Cable (21) to support bracket.
 - Use routing noted during removal.
 - Locking tab must be fully seated to bracket. Verify secure installation by pulling back fitting in opposite direction of installation.
 3. Cable screw adjuster to TBI throttle body lever.

🔑 Adjust

- Cable. Refer to "Cable Adjustment" in the following procedure.
4. Air cleaner and resonator. Refer to SECTION 6C.

Cable Adjustment

1. Remove air cleaner and resonator. Refer to SECTION 6C.
2. With throttle closed, adjust a gap of 0-2 mm between cable slug and face of adjustment screw.
 - Turn screw adjuster clockwise to slacken cable.
 - Turn screw adjuster counter-clockwise to tighten cable.

9B-6 CRUISE CONTROL

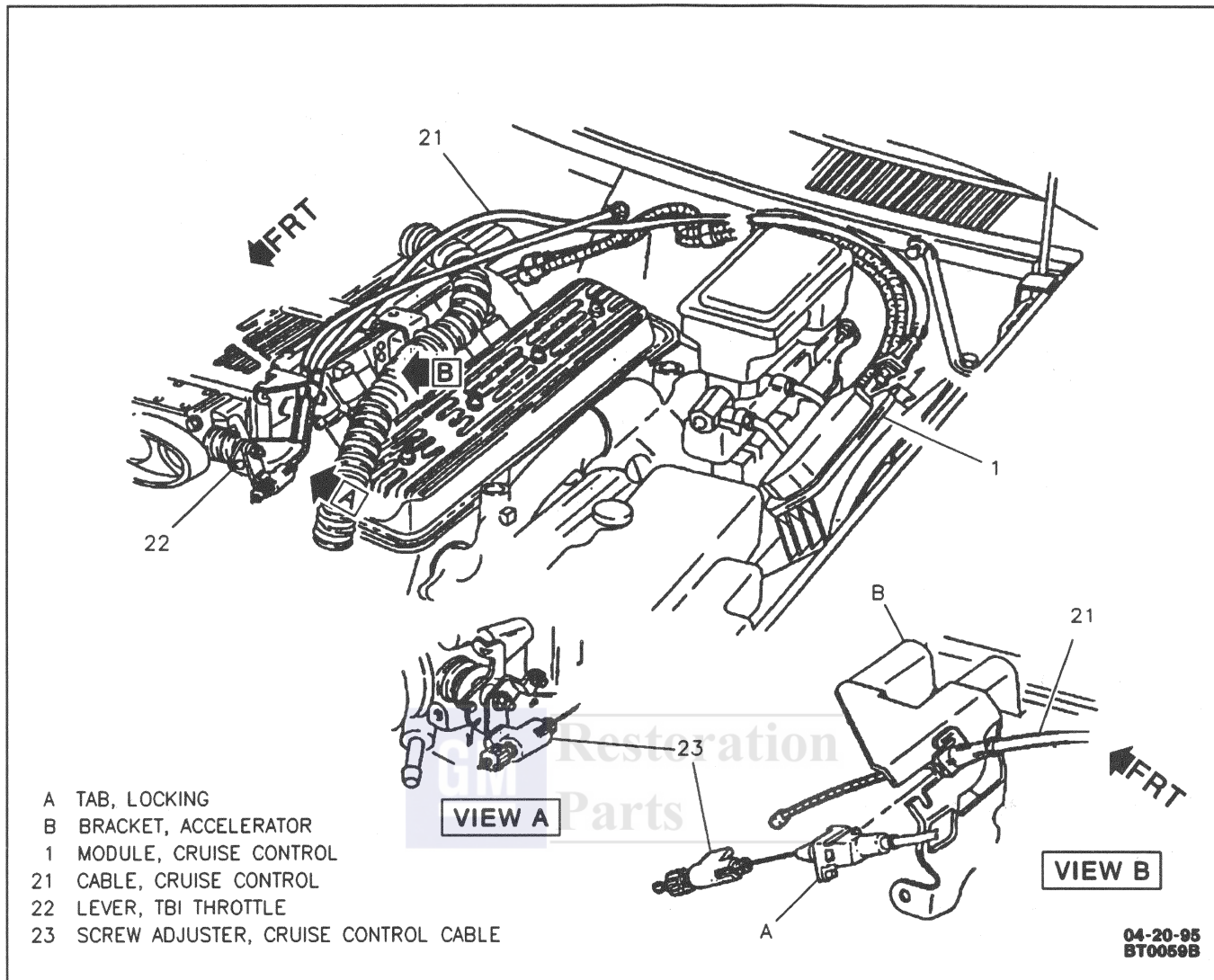


Figure 5 - Cruise Control Cable-to-Throttle Body Injector

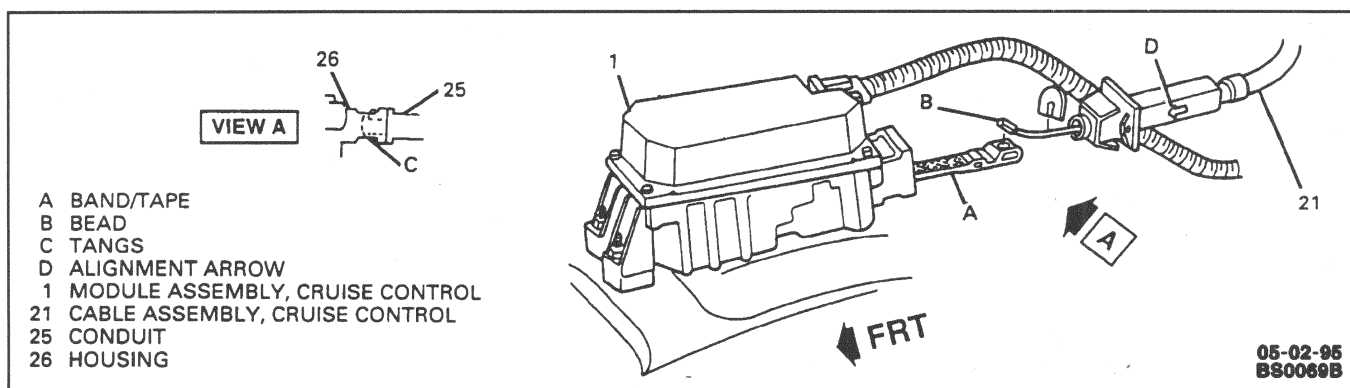


Figure 6 - Cruise Control Cable from Cruise Control Module



Important

- Excess slack in cable can cause hesitation or surging of cruise performance.
- Excess tightness will cause unstable engine idle.

3. Install air cleaner and resonator. Refer to SECTION 6C.

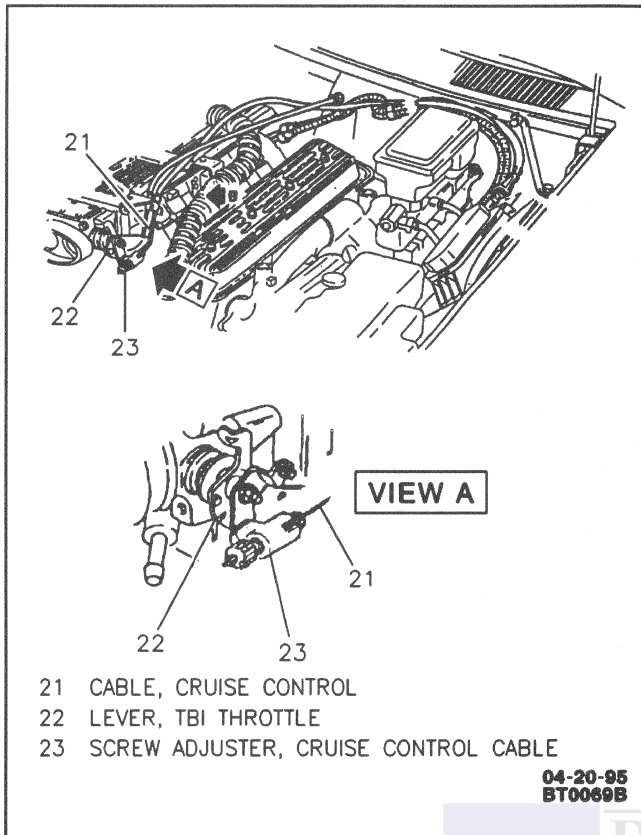


Figure 7 - Cable Adjustment

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Cruise Control Module Bolt/Screw.....8 N·m (71 lb. in.)



SECTION 9C

TWILIGHT SENTINEL

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in SECTION 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Daytime Running Lamp (DRL) Ambient		Headlamp and Instrument Panel Lamp	
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GENERAL DESCRIPTION

The twilight sentinel option provides automatic on-off control of the head lamp capsules. It will also keep the exterior lamps turned on for a preselected period of time after the ignition switch is turned "OFF".

The system consists of a headlamp automatic control ambient light sensor (photocell), the headlamp automatic control ambient light sensor module, and a time delay control with an on-off switch. Connections to the vehicle lamps parallel the regular lamp switch connections. The headlamp switch must be turned "OFF" for automatic control.

The light sensor is mounted in the windshield defroster nozzle grille to obtain an unobstructed view of skylight through the windshield. The module is mounted to the right hinge pillar behind the trim panel (kick panel).

The time delay control and on-off switch is part of the headlamp and instrument panel lamp dimmer switch.

TWILIGHT SENTINEL

Automatic Lamp Operation

The twilight sentinel operates automatically when the ignition switch is "ON," the headlamp switch is "OFF" and the control rheostat is in an "ON" position.

When the headlamp switch is in "PARK" or "ON," or the ambient light sensor module is powering the exterior lamps and instrument panel lamps, the "Lights-On" warning will function under either condition.

As the intensity of light reaching the light sensor decreases, the resistance of the light sensor increases. When the module senses a high resistance in the light sensor, the module allows battery voltage to be applied to the headlamp capsules.

With the dimmer switch in "LO," the low-beam headlamps are "ON". With the dimmer switch in "HI," the high-beam headlamps and indicator are "ON". The module also applies battery voltage to the headlamps, parking lamps, turn signal lamps and taillamps.

9C-2 TWILIGHT SENTINEL

As the intensity of the light reaching the light sensor increases, the resistance of the light sensor decreases. When the module senses a low resistance in the light sensor, the module turns the headlamps "OFF" and also turns the parking lamps, turn signal lamps and taillamps "OFF".

A time delay circuit in the module reduces the chance of switching the lamps on or off while passing under viaducts, trees, bright lights or any other condition where lamp control is not wanted. The time delay is 30 seconds. The length of the time delay is set in production and cannot be altered.

The variable time delay rheostat adjusts only the time delay during which the lamps stay on after the ignition switch is turned off. This time delay can be adjusted from a few seconds to a maximum of 3 minutes.

Manual Lamp Operation

The system can be turned off by setting the time delay rheostat to the "OFF" position. This allows non-automatic control of the exterior lamps by use of the regular headlamp switch.

If exterior lamps are desired during daylight, either of two methods can be used:

1. Exterior lamps can be operated with the regular headlamp switch. The switch is wired in parallel with the twilight sentinel and can bypass the system whether the rheostat is "ON" or "OFF". If the headlamp switch is turned "ON," all lamps will remain on after the ignition switch is turned "OFF" however, when a vehicle is equipped with a tone alarm package, a warning tone sounds as a reminder.
2. The light sensor can be covered to block out light. This causes the lamps to turn on and still enables the system to turn lamps off automatically when the ignition switch is turned off. (If the light sensor has been exposed to light, the time delay must elapse before the lamps will turn on.)

DAYTIME RUNNING LAMPS (DRL) (CANADIAN ONLY)

All Canadian vehicles are equipped with daytime running lamps. The daytime running lamp system includes a daytime running lamp control module, a relay, an ambient light sensor and a diode. When the ignition switch is in the "RUN" position, the system lights the "LO" beam headlamps at a reduced intensity during daylight, and at full intensity during low light conditions (night).

Daytime Running Lamp (DRL) Ambient Light Sensor (Canadian Only)

The headlamp automatic control ambient light (daylight) sensor is located underneath the windshield defroster nozzle grille in the center of the instrument panel upper trim pad.

As the intensity of light reaching the sensor increases, the electrical resistance of the sensor decreases. When the DRL control module senses a low resistance in the sensor, the module allows voltage to be applied to the DRL diode and then to the "LO"

beam headlamps. Due to the voltage drop across the diode, the "LO" beam headlamps are on at a reduced intensity.

As the intensity of light reaching the sensor decreases, the electrical resistance of the sensor increases. When the DRL module senses a high resistance in the sensor, the module closes an internal relay and allows the "LO" beam headlamps to come to full intensity.

DIAGNOSIS

For complete diagnostic information on Daytime Running Lamps (DRL) or twilight sentinel, refer to SECTION 8A-101 or 8A-102.

ON-VEHICLE SERVICE

HEADLAMP AUTOMATIC CONTROL AMBIENT LIGHT SENSOR (PHOTOCELL)

Figure 1

 Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Grille (2) from instrument panel upper trim pad (3).
 - Gently unsnap.
3. Light sensor (1) and harness connector (4) from grille (2).
 - Twist counterclockwise.
4. Light sensor (1) from harness connector (4).

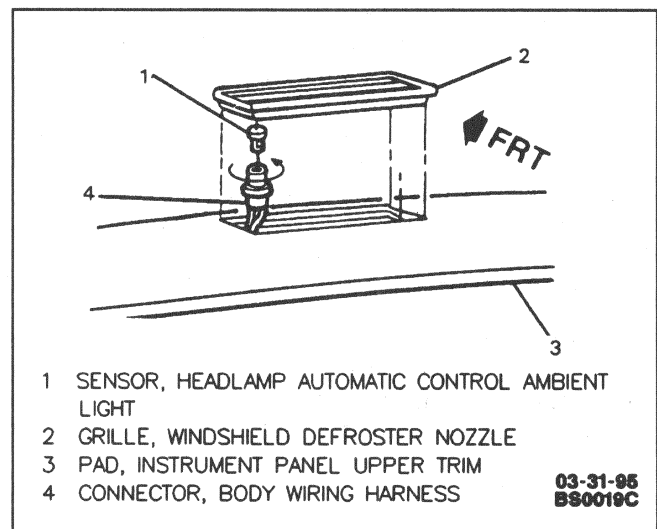


Figure 1- Headlamp Automatic Control Ambient Light Sensor (Photocell)



Install or Connect

1. Light sensor (1) to harness connector (4).
2. Harness connector (4) and light sensor (1) to grille (2).
 - Twist clockwise.
3. Grille (2).
 - Snap into place.
4. Battery negative cable.

HEADLAMP AUTOMATIC CONTROL MODULE OR DAYTIME RUNNING LAMP CONTROL MODULE

Figure 2



Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Right body hinge pillar trim panel (kick panel). Refer to SECTION 10-5.
3. Harness connectors (5) from module (6 or 7).
4. Module (6 or 7) by sliding forward to unlock tabs.
5. Bolts/screws (9) attaching instrument panel wiring harness bracket (15) to right hand hinge pillar.



Install or Connect

NOTICE: Refer to “Notice” on page 9C-1 of this section.

1. Bolts/screws (9) attaching instrument panel wiring harness bracket (15) to right hand hinge pillar.



Tighten

- Bolts/screws (9) to 1.9 N.m (17 lb. in.).
2. Align tabs on module (6 or 7) and slide back to lock in place.
 3. Harness connectors (5) to module (6 or 7).
 4. Right body hinge pillar trim panel. Refer to SECTION 10-5
 5. Battery negative cable.

Daytime Running Lamp Diode

Figure 2



Remove or Disconnect

1. Bolt/screw (10) attaching diode (8) to brake pedal bracket (14).
2. Connector from diode (8).
3. Diode (8).



Install or Connect

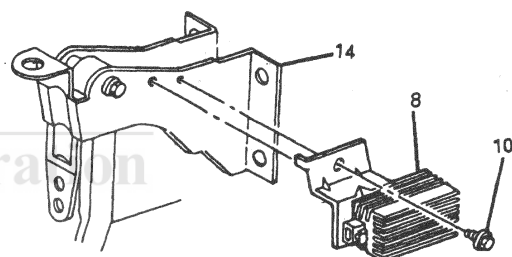
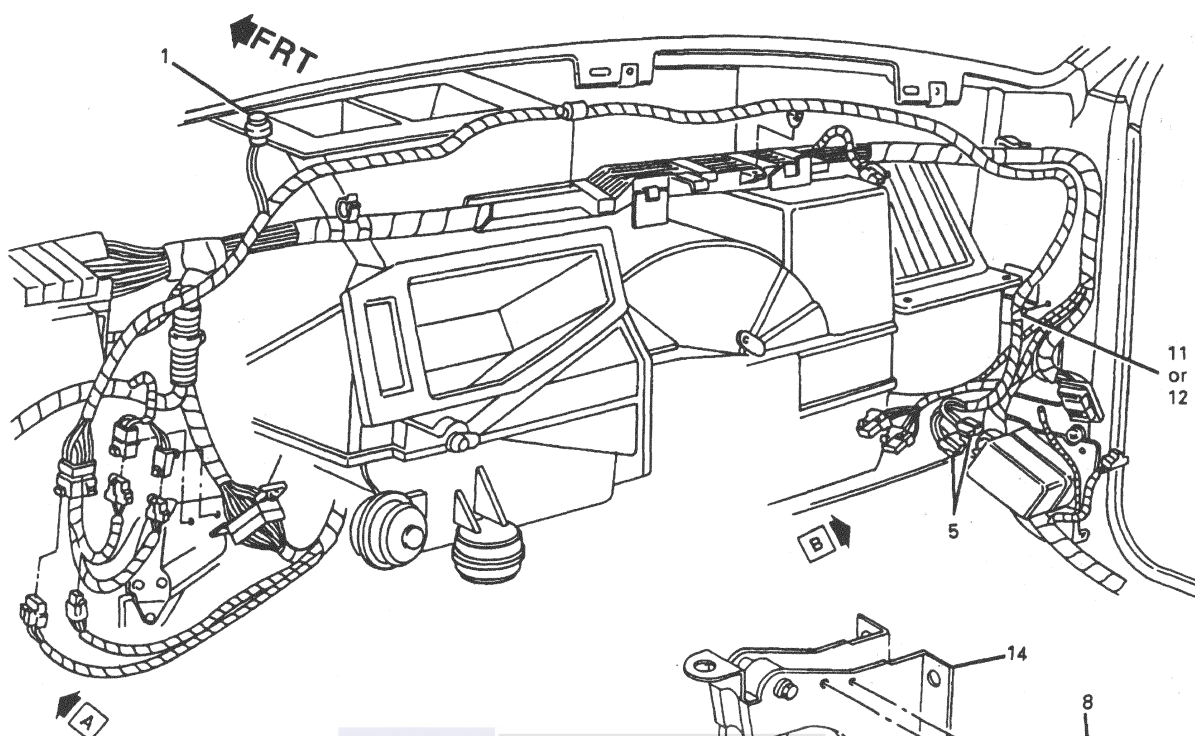
NOTICE: Refer to “Notice” on page 9C-1 of this section.

1. Diode (8).
2. Connector to diode (8).
3. Bolt/screw (10) attaching diode (8) to brake pedal bracket (14).



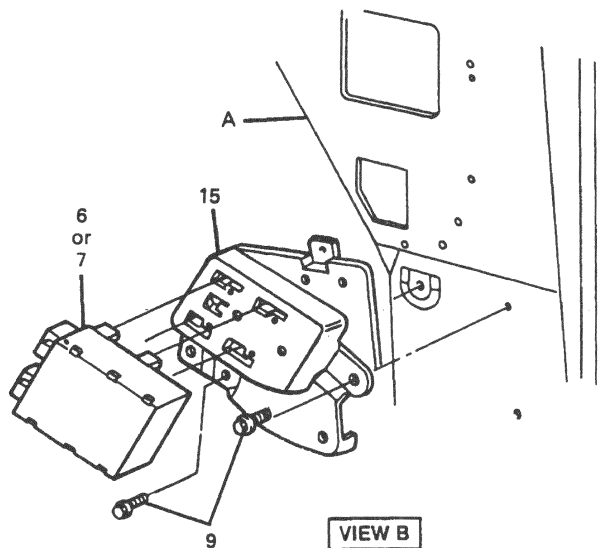
Tighten

- Bolt/screw (10) to 1.9 N.m (17 lb. in.).



VIEW A

- A SHEAR WALL, RIGHT HAND
- 1 SENSOR, HEADLAMP AUTOMATIC CONTROL AMBIENT LIGHT
- 5 CONNECTOR, INSTRUMENT PANEL HARNESS
- 6 MODULE, HEADLAMP AUTOMATIC CONTROL
- 7 MODULE, DAYTIME RUNNING LAMP CONTROL
- 8 DIODE, DAYTIME RUNNING LAMP (WITH BRACKET)
- 9 BOLT/SCREW, INSTRUMENT PANEL WIRING HARNESS BRACKET
- 10 BOLT/SCREW, DAYTIME RUNNING LAMP RESISTOR
- 11 HARNESS, HEADLAMP AUTOMATIC BEAM CONTROL WIRING
- 12 HARNESS, DAYTIME RUNNING LAMP WIRING
- 14 BRACKET, BRAKE PEDAL
- 15 BRACKET, INSTRUMENT PANEL WIRING



VIEW B

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Figure 2 - Headlamp Automatic Control Module, Daytime Running Lamp Control Module and Lamp Diode

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Daytime Running Lamp Resistor Diode Bolt/Screw	1.9 N.m (17 lb. in.)
Instrument Panel Wiring Harness Bracket Bolt/Screw	1.9 N.m (17 lb. in.)





SECTION 9D

THEFT DETERRENT SYSTEMS

CAUTION: This vehicle is equipped with the Supplemental Inflatable Restraint (SIR). Refer to **CAUTIONS** in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow **CAUTIONS** could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

PASS-Key II® SYSTEM

The personal automotive security system (PASS-Key II®) is standard equipment on this vehicle. The system is designed to prevent vehicle theft by disabling the engine unless an ignition key with a specific electrical resistance is used in the ignition cylinder. The components of the system are the ignition key, the ignition cylinder, the theft deterrent module, the theft deterrent relay, and the Powertrain Control Module (PCM).

SYSTEM OPERATION

The PASS-Key II® system is designed to prevent the engine from starting if the proper resistance is not sensed from the ignition key. Of the 15 key codes (resistance values) available, only one will work with each theft deterrent module.

The PASS-Key II® system prevents the engine from starting by controlling the theft deterrent relay and the PCM fuel enable input. If the PCM does not sense the proper Pulse Width Modulated (PWM) signal on the fuel enable input, it will not provide fuel to the engine.

If the wrong resistance value is sensed when the ignition switch is in the "RUN" position, the theft deterrent module will not ground the theft deterrent relay and will not output the fuel enable PWM signal for approximately three minutes. This prevents the engine from starting and discourages the thief from trying key codes (resistance values) at random.

If the correct resistance value is sensed when the ignition switch is in the "RUN" position, the theft deterrent module will ground the theft deterrent relay assembly and output the fuel enable PWM signal. This will allow the engine to start normally.

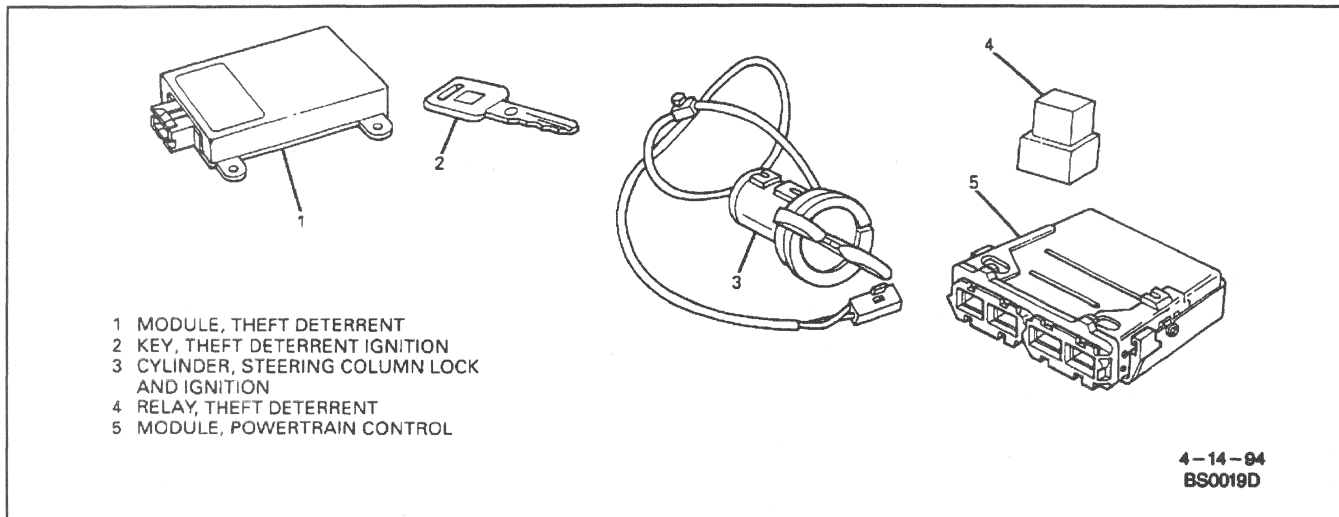


Figure 1 - PASS-Key II® System Components (Typical)

SYSTEM COMPONENTS

Ignition Key

Figure 1

The ignition key for vehicles equipped with the PASS-Key II® system is an assembly of a typical square ignition key blank and resistor. The ignition key blank and resistor are not serviceable separately. There are 15 different ignition keys, each with a different resistance value. The ignition key also has mechanical cuts similar to non-PASS-Key II® ignition keys.

! Important

- When servicing the PASS-Key II® system, obtain all ignition keys, if possible, and verify proper values with tool J 35628-A, VATS/PASS Interrogator. Refer to "Copying Ignition Key Assemblies" in this section.

Steering Column Lock and Ignition Cylinder

Figure 2

The ignition cylinder in the system contains a set of electrical contacts used to measure the resistor in the ignition key. When servicing the ignition cylinder, be certain to maintain proper wire routing. A two pin connector at the base of the steering column connects the contacts to the vehicle wiring. The connector is also used for diagnostic purposes. The ignition cylinder also performs all functions of ignition cylinders on non-PASS-Key II® vehicles. When replacing an ignition cylinder, it will be necessary to make new ignition keys which match the PASS-Key II® key code of the theft deterrent module and the mechanical cut of the new ignition cylinder.

! Important

- The wire routing for the contacts inside the steering column is critical.

Theft Deterrent Module

The theft deterrent module contains the logic of the PASS-Key II® system. The theft deterrent module has inputs from the ignition circuit and the resistor. The theft deterrent module has outputs to the starter enable circuit, the fuel enable circuit, and the security lamp circuit.

Theft Deterrent Relay

The relay is used to stop the engine from cranking if the correct resistance is not sensed at the ignition key. It prevents the engine from cranking by opening the circuit to the starter solenoid switch.

Powertrain Control Module (PCM)

The PCM reads the fuel enable circuit to determine if fuel injection should be allowed. If the fuel enable PWM signal is not present, the PCM will not allow fuel injection. If the PWM signal is present, the PCM will allow fuel injection and normal engine operation.

The PCM has some diagnostic features associated with the fuel enable input, including diagnostic trouble codes. For details, refer to SECTION 6E.

Ignition Input

The ignition input is used to turn the theft deterrent module on. When the theft deterrent module is turned on, it will read the resistor and control the outputs accordingly. When the theft deterrent module is turned off the resistor is not read, and the theft deterrent relay and fuel enable output will not allow the engine to start. When the ignition switch is in the "OFF" position, the battery input to the theft deterrent module will draw about 1 milli-amp.

Key Resistor Inputs

The key resistor inputs are used to determine if the correct ignition key is being used to start the vehicle. The key resistor inputs are read only when the theft deterrent module is first turned on. If the key code (resistance value) of the ignition key matches the value stored in the theft deterrent module, the theft deterrent relay and fuel enable output will allow the

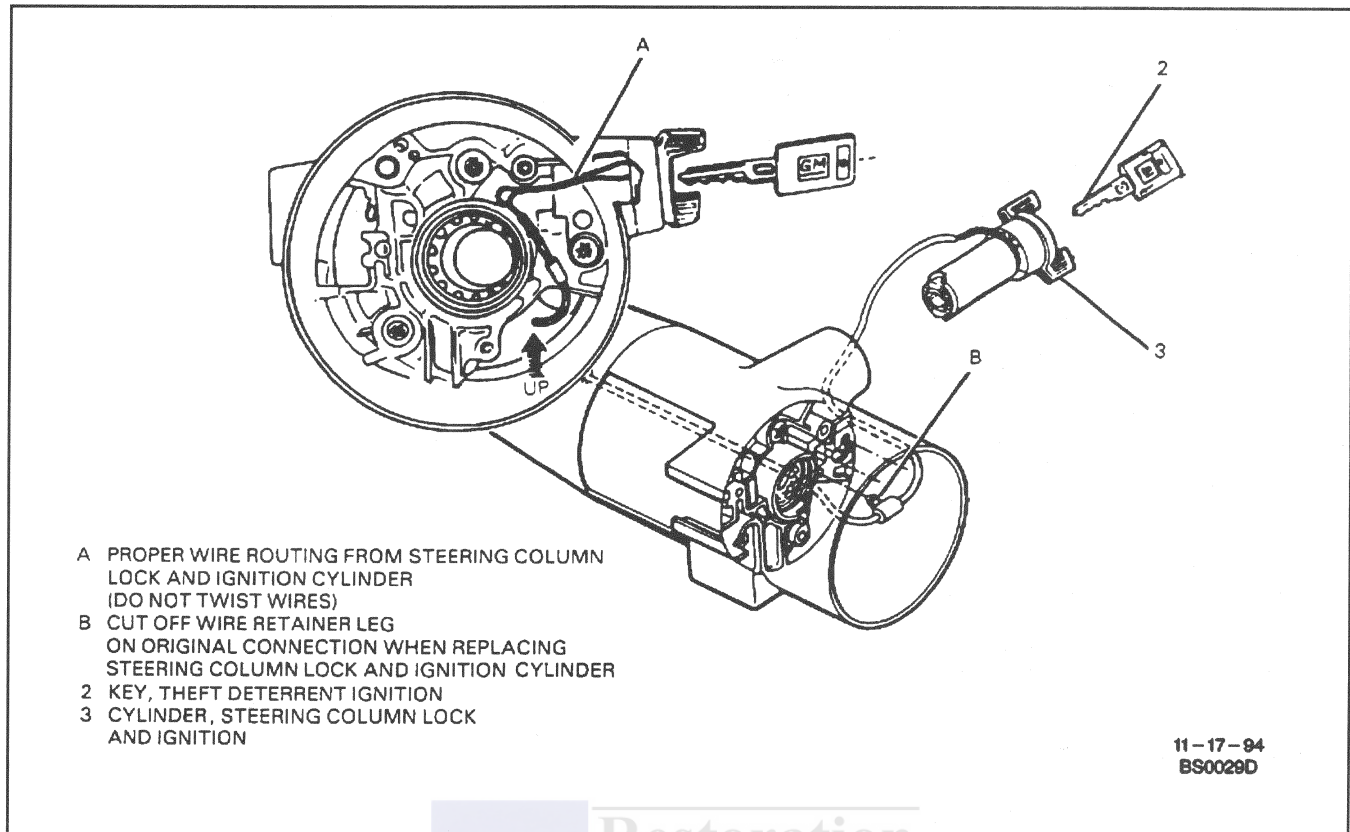


Figure 2 - Ignition Cylinder Wire Routing

vehicle to start. If the resistance value of the ignition key does not match the value stored in the theft deterrent module, the relay and fuel enable output will not allow the vehicle to start.

Starter Enable Output

The starter enable circuit controls the theft deterrent relay. When the theft deterrent module sees the proper resistance at the ignition key, it grounds the theft deterrent relay which closes the starter enable circuit. This process allows the engine to be cranked. If the theft deterrent module does not see the proper resistance at the ignition key, it will not ground the theft deterrent relay.

Fuel Enable Output

The fuel enable circuit is an output from the theft deterrent module and an input to the PCM. When the theft deterrent module sees the proper resistance at the ignition key, it will output a Pulse Width Modulated (PWM) signal to the PCM. If the theft deterrent module does not see the proper resistance at the ignition key, it will not output the PWM signal to the PCM.

Security Indicator Lamp Output

The security lamp for Chevrolet reads "PASS KEY FAULT," for Buick "PASS KEY". Lamp output will be grounded any of the following conditions:

- During five second bulb test.

- Key in "START" or "RUN" position when module is preventing the vehicle from starting.
- Key in "START" or "RUN" position and module not properly programmed.

DIAGNOSIS

For diagnosis of theft deterrent system, refer to SECTION 8A.

ON-VEHICLE SERVICE

IGNITION KEY

Copying Ignition Keys

Tool Required:

J 35628-A VATS/PASS Interrogator

To copy an ignition key, it is necessary to first determine which PASS-Key II® key code (resistance value) is needed. The ignition key being copied must be tested to determine the key code. The ignition key may be tested using J 35628-A. To use J 35628-A, turn the tool on, make sure the tool wiring connectors are disconnected and insert the ignition key into the tool lock cylinder. The "Key Code Reader" will display the key code of the ignition key. Obtain an ignition key blank matching this key code and cut it to match the original ignition key.

9D-4 THEFT DETERRENT SYSTEMS

PELLET CODE	KEY RESISTANCE IN OHMS		
	Nominal	Low	High
1	402	386	438
2	523	502	564
3	681	654	728
4	887	852	942
5	1130	1085	1195
6	1470	1411	1549
7	1870	1795	1965
8	2370	2275	2485
9	3010	2890	3150
10	3740	3590	3910
11	4750	4560	4960
12	6040	5798	6302
13	7500	7200	7820
14	9530	9149	9931
15	11800	11328	12292

T5639

Replacing Lost Ignition Keys

Tool Required:

J 35628-A VATS/PASS Interrogator

To replace lost ignition keys it is necessary to determine the mechanical cut and the electrical key code.

The mechanical and electrical key codes are recorded on the vehicle invoice. If these codes are available, use them to create a new ignition key. If they are not, follow the procedure below.

The mechanical cut must be determined first. The mechanical cut can be determined from the key code on the ignition cylinder or from the original key "knock outs". If the mechanical cut cannot be determined, the ignition cylinder should be replaced. Make an ignition key blank with the correct mechanical cut to use while determining the proper electrical key code.

To determine the proper electrical key code, use J 35628-A and the following procedure:



Important

- Do not disconnect yellow two-way SIR connector.

1. Connect J 35628-A wiring to PASS-Key II® dash connector at base of steering column. Do not connect to steering column wiring.
2. Turn J 35628-A on and place key code switch to "1" and attempt to start engine with proper mechanically cut key. If engine starts, key code is "1".
3. If engine does not start, turn ignition off and press 4-minute timer on J 35628-A.
4. When timer light goes out, place key code switch to "2" and attempt to start engine. If engine starts, key code is "2".

5. Continue trying different key codes until proper key code is found.
6. Make new ignition key with proper key code and mechanical cut.

THEFT DETERRENT MODULE AND THEFT DETERRENT RELAY

Figures 3 and 4



Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Instrument panel sound insulator, if Buick. Refer to SECTION 8C.
3. Electrical connector from power steering control module, if equipped.
4. Bolt/screw (6) from theft deterrent module bracket to ABS module bracket.
5. Slowly lower module bracket and pull it forward to allow rear bracket tab to clear slot at rear of ABS module bracket.
6. Electrical connector from module (1).
7. Slide relay (8) off end of module bracket (7).
8. Electrical connector from relay (8).
9. Bolt/screw (9) from module bracket nut.



Install or Connect

NOTICE: Refer to "Notice" on page 9D-1 of this section.

1. Slide tab on theft deterrent module (1) under metal tab on module bracket (7).
2. Bolt/screw (9) through tab on module (1) to module bracket nut.
3. Electrical connector to relay (8).
4. Electrical connector to module (1).
5. Slide relay on slotted tab on module bracket (7).
6. Insert rear tab on module bracket (7) into slot at rear of ABS module bracket.
7. Insert front end of theft deterrent module bracket inside ABS module bracket.
8. Bolt/screw (6) through ABS module bracket to theft deterrent module bracket (7).
9. Electrical connector to power steering control module, if equipped.
10. Instrument panel sound insulator, if Buick. Refer to SECTION 8C.
11. Battery negative cable.

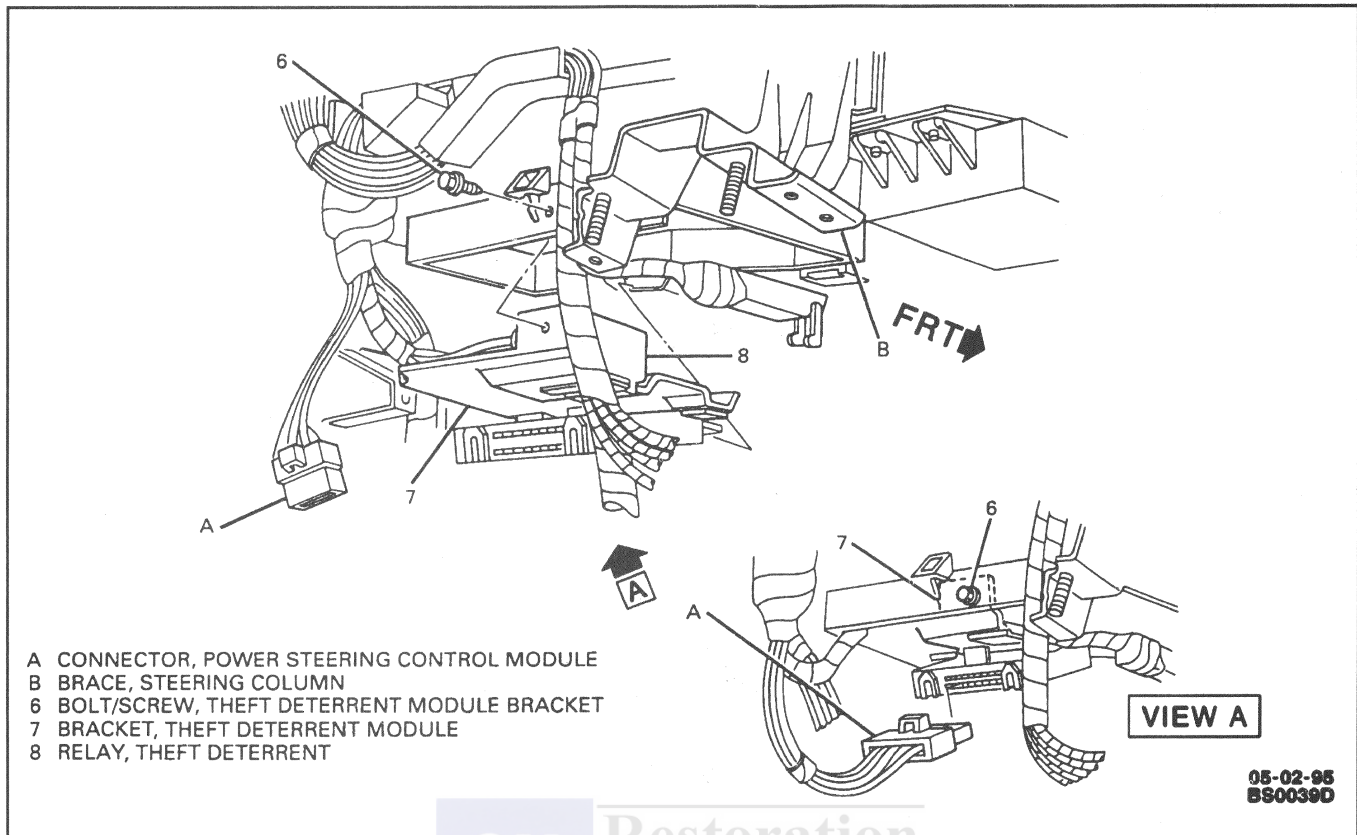


Figure 3-Theft Deterrent Module Bracket

PROGRAMMING A NEW THEFT DETERRENT MODULE

! Important

- Any new PASS-KEY II® Theft Deterrent Module will automatically program to the resistance of the key (or Interrogator setting) being used at the first ignition "ON" cycle. This can only be done once for the life of the module.

New modules are unprogrammed. Before the system will function properly after a new module has been installed, it must be programmed to the code that matches the customer's keys. Programming a new module is very simple:

1. Install the new, unprogrammed module.
2. Insert one of the customer's keys in the ignition lock cylinder and turn it to the "RUN" position. It's a good idea to start the engine at this time to verify system operation.
3. Observe the indicator lamp:
 - The indicator lamp should light for about five seconds and then go out. If the wiring or contacts to the key resistance pellet or the key is defective or intermittent and a new module is installed, the engine will start but the indicator will flash at a rate of one flash per second until the ignition switch is turned off. This indicates that the module did not program and that the system components, wiring and contacts should be checked for a fault.

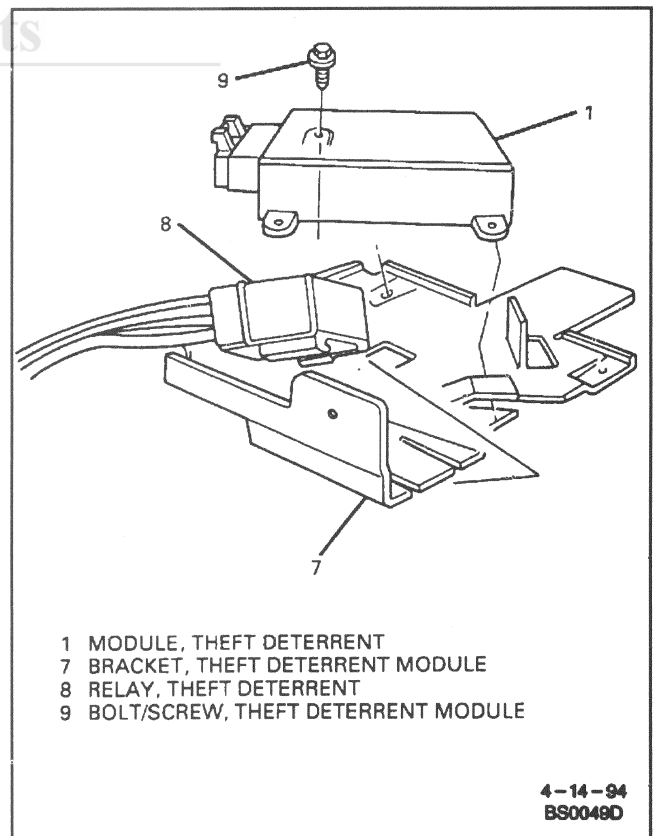


Figure 4 - Theft Deterrent Module and Relays

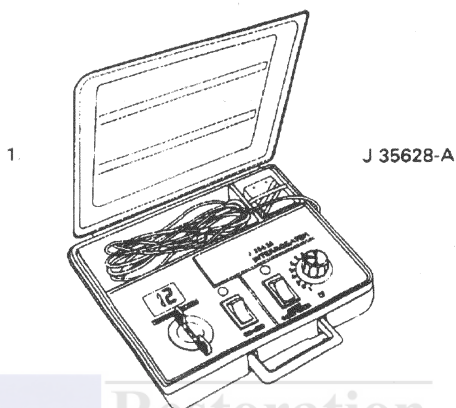
9D-6 THEFT DETERRENT SYSTEMS



Important

- Before connecting the Interrogator to the ignition lock cylinder circuit, always verify vehicle key code and set the code into the Interrogator using the "key code" knob. This will prevent programming an unprogrammed module with an undesired key code.

SPECIAL TOOLS



1. VATS/PASS INTERROGATOR

4-14-94
BS0059D

GM

Restoration
Parts

SECTION 9E

ENGINE COOLANT HEATER

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The engine coolant heater is installed into the engine block at a water jacket plug location. An engine coolant heater cord runs from the engine coolant heater along the front wheelhouse panel, to the left front fender inner panel just forward of the windshield washer solvent container. The heater is rated at 600 watts and uses a 110-volt AC power supply.

ON-VEHICLE SERVICE

ENGINE COOLANT HEATER REPLACEMENT

Figure 1

Remove or Disconnect

CAUTION: Perform this operation when the engine is cool or personal injury may result.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain engine coolant from engine block into an approved container. Refer to SECTION 6B.
3. Cord from heater (1).
4. Loosen bolt/screw (2).

NOTICE: When removing the engine coolant heater from the engine block, be careful not to score the machined surface of the plug hole.

5. Engine coolant heater (1) carefully from plug hole.
 - If removing heater (1) permanently, install water jacket plug into plug hole and replace engine coolant. For engine coolant replacement procedures, refer to SECTION 6B.



Clean

- Plug hole.
 - Remove burrs, sealer, paint and other rough spots.



Install or Connect

NOTICE: The element must not touch the engine block inner wall in the installed position or damage to the engine block and heater could result.

NOTICE: Refer to “Notice” on page 9E-1 of this section.

1. Apply coat of engine coolant heater lubricant, GM P/N 9985164 or equivalent, to O-ring and walls of plug holes.
2. Engine coolant heater (1) into plug hole.
 - A. Insert heating element end of heater (1) into plug hole.
 - B. Line up heater (1) with plug hole and push it straight into place.
 - C. Rotate heater (1) so that center electrical contact and bolt/screw (2) are in line horizontally, parallel to crankshaft centerline.
 - D. Turn bolt/screw (2) so that yoke presses against engine block inner wall.



Tighten

- Bolt/screw (2) to 1.9 N·m (17 lb. in.).

CAUTION: Engine coolant heater cord must not touch the engine, hot pipes, manifold or any moving parts or damage to the vehicle and possible personal injury may result.

9E-2 ENGINE COOLANT HEATER

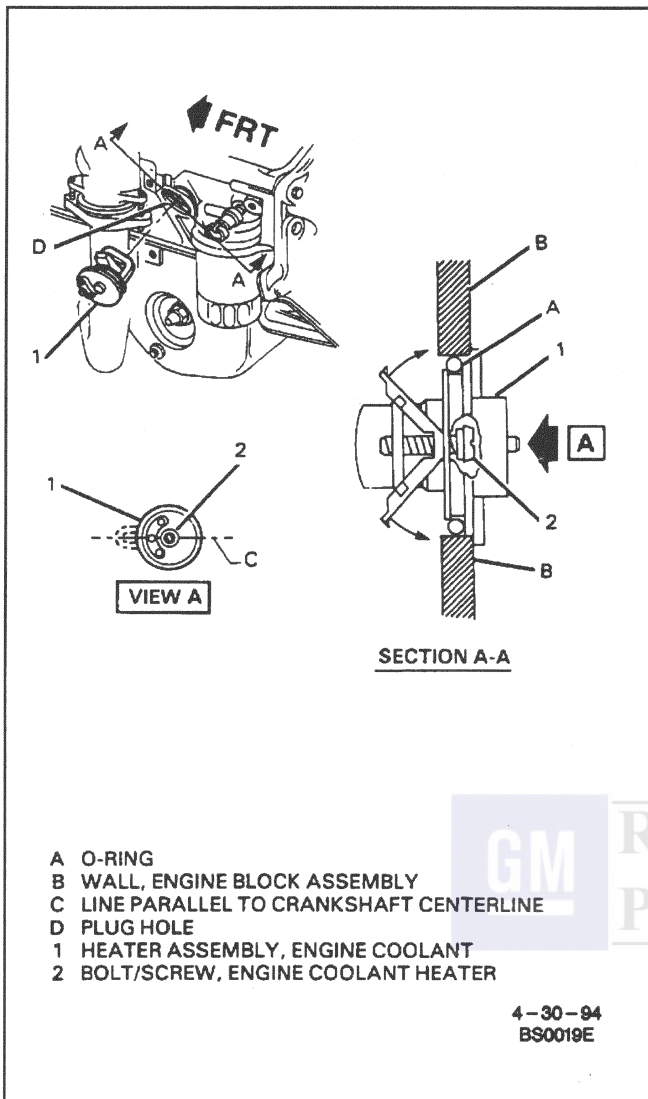


Figure 1 - Engine Coolant Heater

3. Cord to heater (1).
4. Lower vehicle.
5. Replace engine coolant. Refer to SECTION 6B.

ENGINE COOLANT HEATER CORD REPLACEMENT

Figure 2

Remove or Disconnect

1. Note position and routing of cord (4) for proper placement during installation.
2. Cord (4) from heater (1).
3. Transmission bolt/screw (5) from clip (3).
4. Cord (4) from vehicle routing.
5. Cord (4) from fender brace (9).

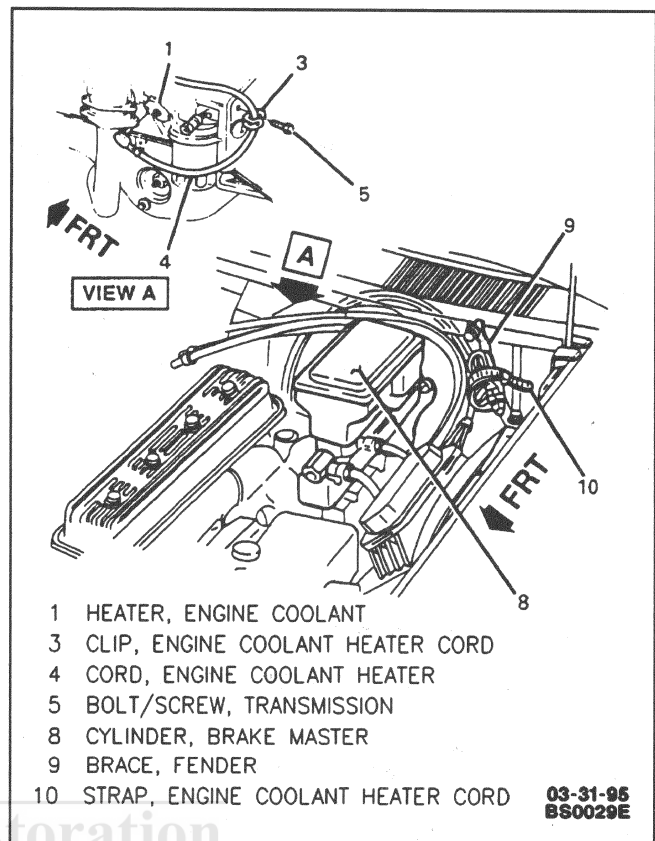


Figure 2 - Engine Coolant Heater Cord

Install or Connect

CAUTION: Engine coolant heater cord must not touch the engine, hot pipes, manifold or any moving parts, or damage to the vehicle and possible personal injury may result.

NOTICE: Refer to "Notice" on page 9E-1 of this section.

1. Cord (4) to vehicle routing as noted during removal.
2. Cord (4) to fender brace (9) using strap (10).
3. Transmission bolt/screw (5) to clip (3).

Tighten

- Transmission bolt/screw (5) to 47 N.m (35 lb. ft.).
- 4. Cord (4) to heater (1).

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Engine Coolant Heater Bolt/Screw	1.9 N·m (17 lb. in.)
Transmission Bolt/Screw	47 N·m (35 lb. ft.)





SECTION 9J

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to **CAUTIONS** in this section under “ON-VEHICLE SERVICE” and the SIR Component and Wiring Location view in this section before performing service on or around SIR components or wiring. Failure to follow **CAUTIONS** could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

RESTRAINT DEVICES

Figures 1 and 2

The Supplemental Inflatable Restraint (SIR) system helps supplement the protection offered by the driver and front passenger seat belts by deploying an air bag from the center of the steering wheel and from the top of the right side of the instrument panel (Figure 1).

The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle (Figure 2). To further absorb the crash energy there is a knee bolster located beneath the instrument panel for both the driver and passenger and the steering column is collapsible.

SYSTEM DESCRIPTION

Figure 3

The SIR system consists of the Sensing and Diagnostic Module (SDM), the forward discriminating sensor, the driver inflator module, the SIR coil

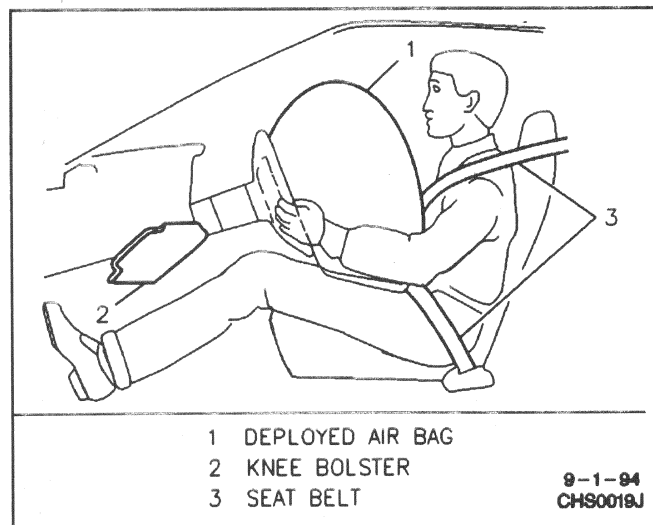


Figure 1 - Restraint Devices

assembly, the passenger inflator module and the "AIR BAG" warning lamp in the instrument cluster. The SDM, SIR coil assembly (driver side only), driver inflator module, passenger inflator module and connector wires make up the deployment loops. The function of the deployment loops is to supply current through the inflator modules, which will cause deployment of the air bags in the event of a frontal crash of sufficient force, up to 30 degrees off the centerline of the vehicle. The inflator modules are only supplied enough current to deploy when the SDM or the SDM and the forward discriminating sensor detect vehicle velocity changes severe enough to warrant deployment.

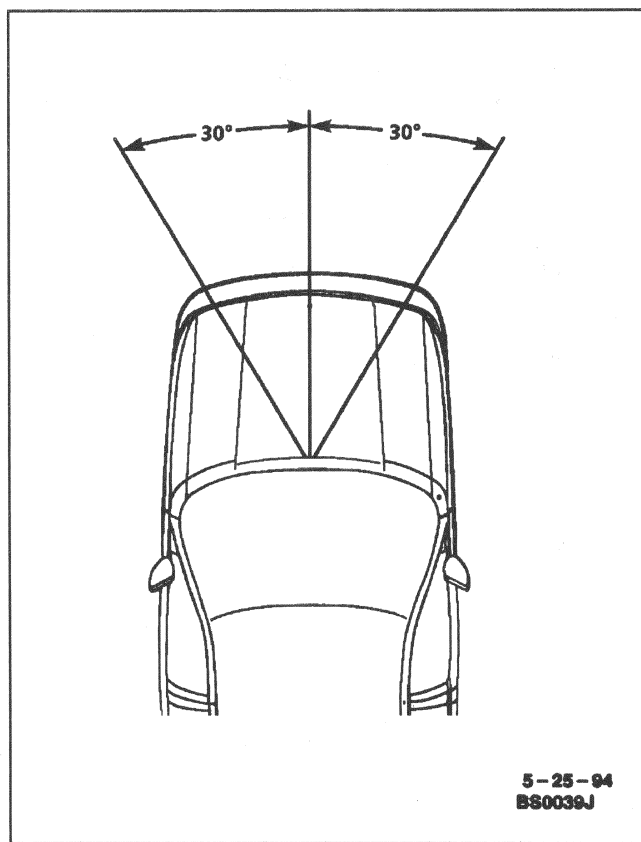


Figure 2 - SIR System "Deployment Window"

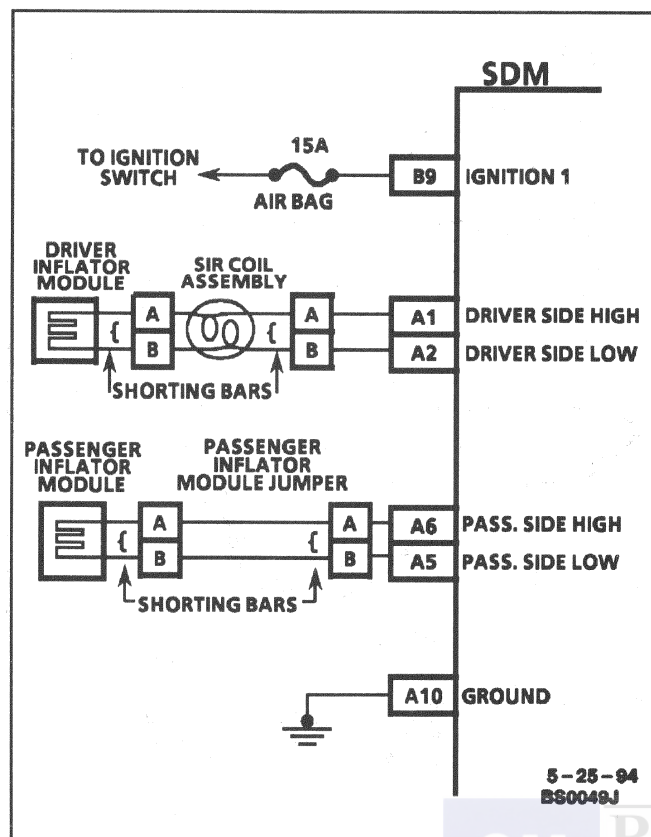


Figure 3 - Deployment Loops

The SDM contains a sensing device which converts vehicle velocity changes to an electrical signal. The electrical signal generated is processed by the SDM and then compared to a value stored in memory. When the generated signal exceeds the stored value, additional signal processing is performed and the generated signals are compared to signals stored in memory. When two of the generated signals exceed the stored values or when one of the generated signals exceeds the stored value and the forward discriminating sensor closes, the SDM will cause current to flow through the inflator modules deploying the air bags.

COMPONENT DESCRIPTION

Figure 4

SDM

CAUTION: During service procedures, be very careful when handling a Sensing and Diagnostic Module (SDM). Never strike or jar the SDM. Never power up the SIR system when the SDM is not rigidly attached to the vehicle. All SDM and mounting bracket fasteners must be carefully torqued and the arrow must be pointed toward the front of the vehicle to ensure proper operation of the SIR system. The SDM could be activated when powered while not rigidly attached to the vehicle which could cause deployment and result in personal injury.

The Sensing and Diagnostic Module (SDM) is designed to perform the following functions in the SIR system:

1. **Energy Reserve** - The SDM maintains a 36 Volt Loop Reserve (36 VLR) energy supply to provide deployment energy when ignition voltage is lost in a frontal crash.
2. **Frontal Crash Detection** - The SDM monitors vehicle velocity changes to detect frontal crashes which are severe enough to warrant deployment.
3. **Air Bag Deployment** - When a frontal crash of sufficient force is detected, the SDM will cause enough current to flow through the inflator modules to deploy the air bags.
4. **Frontal Crash Recording** - The SDM records information regarding the SIR system status during a frontal crash.
5. **Malfunction Detection** - The SDM performs diagnostic monitoring of the SIR system electrical components and sets a diagnostic trouble code when a malfunction is detected.
6. **Malfunction Diagnosis** - The SDM displays SIR diagnostic trouble codes and system status information through the use of a scan tool.
7. **Driver Notification** - The SDM warns the vehicle driver of SIR system malfunctions by controlling the "AIR BAG" warning lamp.

The SDM is connected to the SIR wiring harness by a 20-way connector. This harness connector uses a shorting bar across certain terminals in the contact area. This shorting bar connects the "AIR BAG" warning lamp to ground when the SDM harness connector is disconnected.

This will cause the "AIR BAG" warning lamp to come "ON" steady whenever the ignition switch is at the RUN, BULB TEST or START positions with the SDM disconnected.

"AIR BAG" Warning Lamp

Ignition voltage is applied to the "AIR BAG" warning lamp when the ignition switch is at the RUN, BULB TEST or START position. The SDM controls the lamp by providing ground with a lamp driver. The "AIR BAG" warning lamp is used in the SIR system to do the following:

1. Verify lamp and SDM operation by flashing seven times when the ignition switch is first turned "ON."
2. Warn the vehicle driver of SIR electrical system malfunctions which could potentially affect the operation of the SIR system. These malfunctions could result in non-deployment in case of a frontal crash or deployment for conditions less severe than intended.

The "AIR BAG" warning lamp is the key to driver notification of SIR system malfunctions. For proper lamp operation, refer to the "SIR Diagnostic System Check" in this section.

Forward Discriminating Sensor

The forward discriminating sensor is used by the SDM to determine whether or not certain frontal crashes require deployment of the air bags. The sensor

**CHEVROLET SHOWN
BUICK SIMILAR**

**CHEVROLET SHOWN
BUICK SIMILAR**

VIEW A

VIEW A

1 MODULE, PASSENGER INFLATOR 2 PIGTAIL, PASSENGER INFLATOR MODULE 3 INSTRUMENT PANEL 4 LATCH, HOOD 5 SENSOR, FORWARD DISCRIMINATING 6 CONNECTOR, FORWARD DISCRIMINATING SENSOR HARNESS	7 COIL, SIR 8 MODULE, DRIVER INFLATOR 9 CONNECTOR, DRIVER INFLATOR MODULE HARNESS 10 SDM 11 BRACKET, STEERING COLUMN SUPPORT 12 HARNESS, SIR WIRING
---	--

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Figure 4 - SIR Component and Wiring Location Views

consists of a sensing element, normally open switch contacts and a diagnostic resistor. The sensing element closes the switch contacts when the vehicle velocity changes are severe enough to warrant deployment. The diagnostic resistor is connected in parallel with the switch contacts inside the sensor. The diagnostic resistor, in conjunction with resistors in the SDM, causes a voltage drop which allows the SDM to monitor the integrity of the forward discriminating sensor and associated circuitry.

SIR Coil Assembly

Figure 5

The SIR coil assembly consists of two current-carrying coils. They are attached to the steering column and allow rotation of the steering wheel while maintaining continuous contact of the driver deployment loop to the driver inflator module.

There is a shorting bar on the yellow 2-way connector near the base of the steering column which connects the SIR coil to the SIR wiring harness. The shorting bar shorts the circuits to the SIR coil and driver inflator module when the yellow 2-way connector is disconnected. The circuit to the driver inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the steering column or other SIR system components.

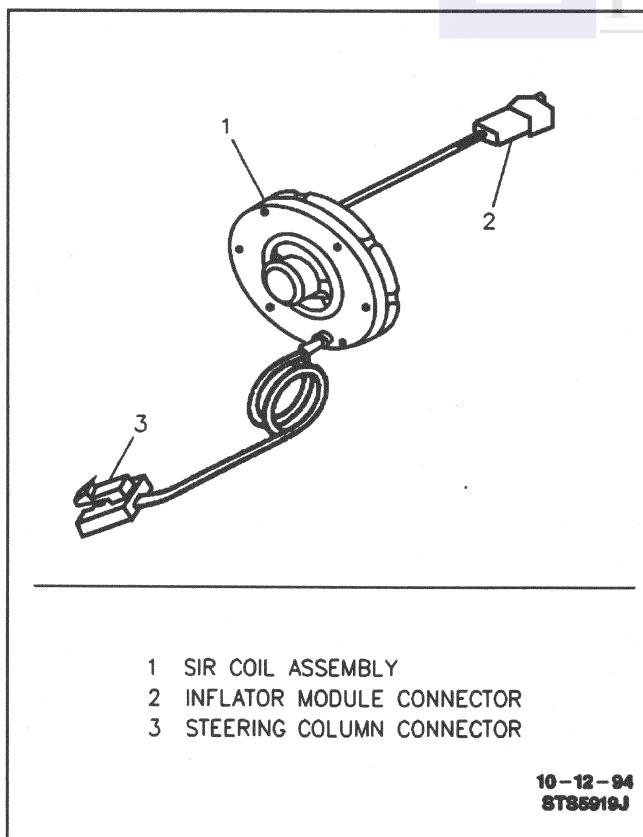


Figure 5 - SIR Coil Assembly

Inflator Modules

Figures 6 and 7

The inflator modules consist of an inflatable bag and an inflator (a canister of gas-generating material and an initiating device). When the vehicle is in a frontal crash of sufficient force, the SDM causes current to flow through the deployment loops. Current passing through the initiator ignites the material in the inflator module. The gas produced from this reaction rapidly inflates the air bag.

There is a shorting bar on the driver inflator module side of the upper steering column connector which connects the SIR coil assembly to the driver inflator module. The shorting bar shorts across the driver inflator module circuits when the upper steering column connector is disconnected. The circuit to the driver inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the driver inflator module, the steering column or other SIR system components.

There is a shorting bar on the passenger inflator module connector which connects to the SIR wiring harness. The shorting bar shorts across the passenger inflator module circuits when the passenger inflator module connector is disconnected.

The circuit to the passenger inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the passenger inflator module, the instrument panel or other SIR system components.

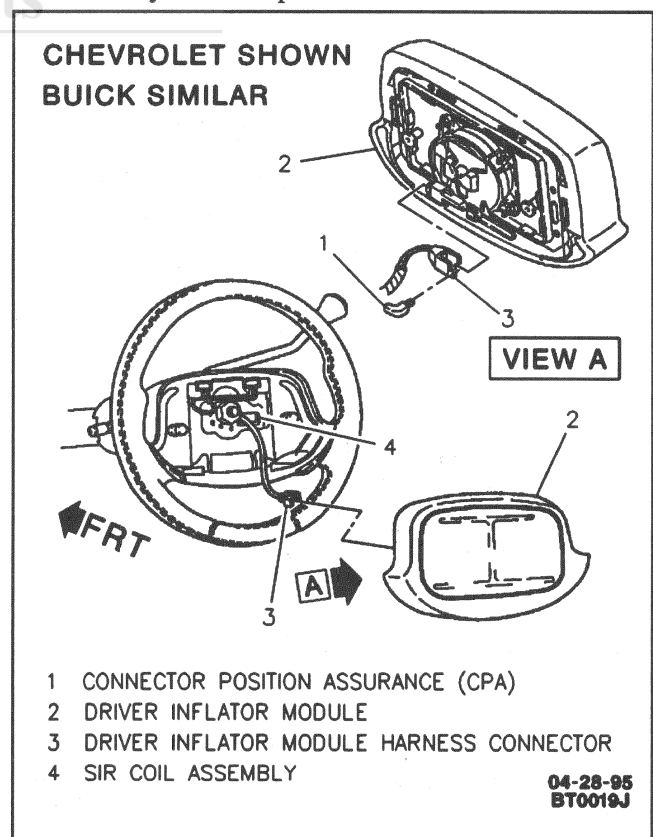


Figure 6 - Driver Inflator Module

9J-6 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

Steering Column

The steering column is energy absorbing and is designed to compress in a frontal crash to decrease the chance of injury to the driver. A steering column reinforcement is also used for additional support.

Knee Bolsters

The knee bolsters are used to absorb energy and control the forward movement of the vehicle's front seat occupants during a frontal crash, by limiting leg movement.

DEFINITIONS:

AIR BAG - An inflatable cloth cushion designed to deploy in certain frontal crashes. It supplements the protection offered by the seat belts by distributing the impact load more evenly over the vehicle occupant's head and torso.

ASYNCHRONOUS - Performed in a non-periodic fashion, i.e. no defined time or interval.

B+ - Battery voltage, the voltage available at the battery at the time of the indicated measurement. With the key "ON" and the engine not running, the system voltage will likely be between 12 and 12.5 volts. At idle the voltage may be 14 to 16 volts. The voltage could be as low as 10 volts during engine cranking.

BULB TEST - The SDM will cause the "AIR BAG" warning lamp to flash seven times and then go "OFF" whenever the ignition switch transitions to the RUN position from any other ignition switch position and no malfunctions are detected.

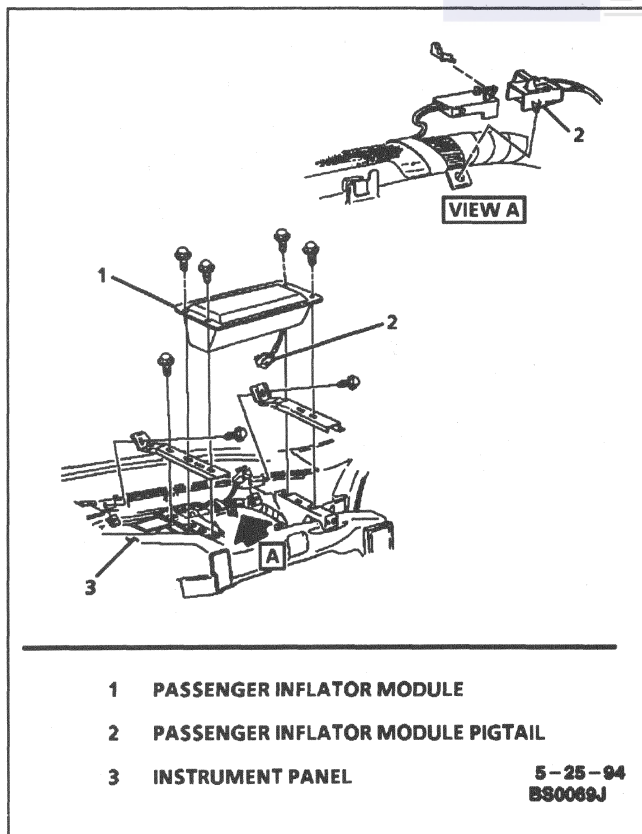


Figure 7a - Passenger Inflator Module (Chevrolet)

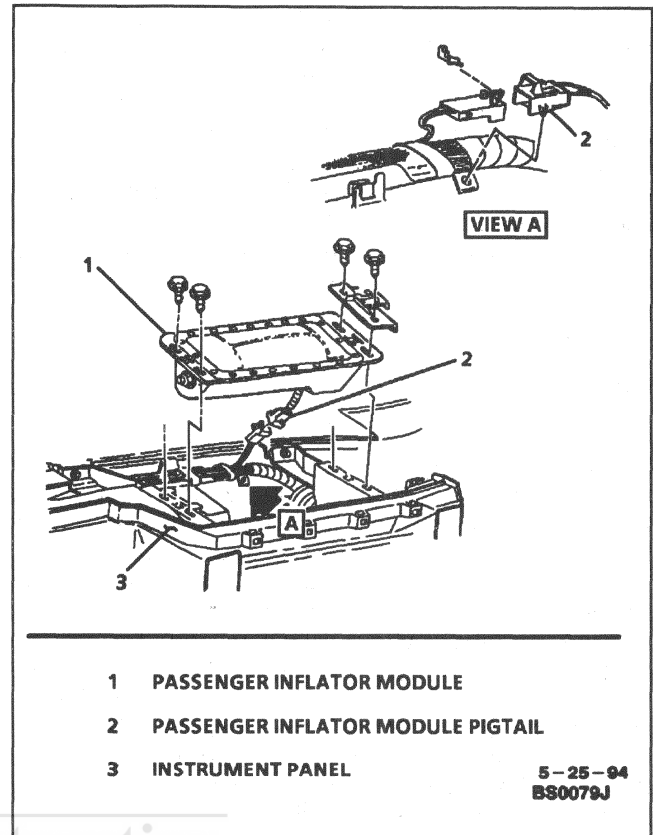


Figure 7b - Passenger Inflator Module (Buick)

"CONTINUOUS MONITORING" - Tests performed by the SDM on the SIR system every 100 milliseconds while "Ignition 1" voltage is in the normal operating voltage range at the SDM.

"CURRENT SOURCE DIAGNOSTICS" - Tests performed by the SDM after ignition, 36 VLR, and deployment loop voltages are all measured within their respective normal voltage ranges. This test checks for proper resistance of the deployment loops and for proper operation of the driver and passenger current sources. If an open is detected this test is aborted before resistance's are calculated, however, should the open clear the test will be completed meaning resistance's will be checked.

DATA LINK CONNECTOR (DLC) - Formerly "ALDL," a connector which is connected by wires to multiple on-board computers allowing communication with an off-board computer, such as a scan tool.

DATUM LINE - A base line parallel to the plane of the underbody or frame from which all vertical measurements originate.

DEPLOY - To inflate the air bag.

DEPLOYMENT LOOPS - The circuits which supply current to the inflator modules to deploy the air bags.

DIAGNOSTIC TROUBLE CODE (DTC) - Formerly "Code," a numerical designator used by the SDM to indicate specific SIR system malfunctions.

DRIVER CURRENT SOURCE - An output of the SDM which injects current into the driver inflator module circuits.

DRIVER INFLATOR MODULE - An assembly located in the steering wheel hub consisting of an inflatable bag, an inflator and an initiator.

EEPROM - Electrically Erasable Programmable Read Only Memory. Memory which retains its contents when power is removed from the SDM.

FORWARD DISCRIMINATING SENSOR - A sensor which is calibrated to supply a signal to the SDM when the vehicle changes are severe enough to warrant deployment.

HIGHER PRIORITY FAULT - Each diagnostic trouble code is assigned a priority based on the detectability with other DTCs present. The priority corresponds to the detectability of the malfunction ONLY, and does NOT relate to the criticality of the malfunction with respect to deployment or non-deployment under any given condition.

IGNITION CYCLE - The voltage at the SDM "Ignition 1" input, with ignition switch "ON," greater than 6.4 volts for at least 10 seconds before turning ignition switch "OFF."

IGNITION 1 - A battery voltage (B+) circuit which is only powered with the ignition switch in the RUN, BULB TEST, or START positions.

INITIATOR - The electrical component inside the inflator module which, when sufficient current flows, sets off the chemical reaction that inflates the air bag.

NORMAL OPERATING VOLTAGE RANGE - The voltage measured between the SDM "Ignition 1" terminal and "Ground" terminal is between 6.4, and 16 volts.

PASSENGER CURRENT SOURCE - An output of the SDM which injects current into the passenger inflator module circuit.

PASSENGER INFLATOR MODULE - An assembly located in the right side of the I/P consisting of an inflatable bag, an inflator and an initiator.

SCAN TOOL - An off-board computer used to read diagnostic information from on-board computers via the data link connector.

SDM - Sensing and Diagnostic Module which provides reserve energy to the deployment loops, deploys the air bags when required and performs diagnostic monitoring of all SIR system components.

SERIAL DATA - Information representing the status of the SIR system.

SIR - Supplemental inflatable restraint.

SIR COIL ASSEMBLY - An assembly of two current-carrying coils in the driver deployment loop that allows the rotation of the steering wheel while maintaining the continuous contact of the driver deployment loop to the driver inflator module.

SIR WIRING HARNESS - The wires and connectors that electrically connect the components in the SIR system.

"TURN-ON" - Test which the SDM performs on the SIR system once during each ignition cycle immediately after "Ignition 1" voltage is applied to the SDM and before "Continuous Monitoring."

36 VLR - The 36 volt loop reserve energy supply from the SDM which provides deployment power when vehicle voltage is lost in a frontal crash.

DIAGNOSIS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

DIAGNOSTIC TROUBLE CODES

The "SIR Diagnostic System Check" must always be the starting point of any SIR system diagnosis. The "SIR Diagnostic System Check" checks for proper "AIR BAG" warning lamp operation and checks for SIR diagnostic trouble codes using the scan tool.

1. Current diagnostic trouble codes - Malfunctions that are presently being detected. Current diagnostic trouble codes are stored in RAM (Random Access Memory).
2. History diagnostic trouble codes - All malfunctions detected since the last time the history memory was cleared. History diagnostic trouble codes are stored in EEPROM.

Scan Tool Diagnostics

A scan tool is used to read current and history diagnostic trouble codes and to clear all diagnostic trouble codes after a repair is completed. The scan tool must be updated to communicate with the SIR system through a replaceable cartridge before it can be used for SIR diagnostics. To use the scan tool, connect it to the data link connector and turn the ignition switch "ON." The scan tool reads serial data from the SDM "Serial Data" output terminal "B3" to the data link connector terminal "M."

USE OF SPECIAL TOOLS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

You should be familiar with the tools listed in this section under the heading "SIR SPECIAL TOOLS." You should be able to measure voltage and resistance. You should be familiar with proper use of a scan tool such as the Tech 1 Diagnostic Computer TK-0, SIR Driver/Passenger Load Tool J 38715, Connector Test Adapter Kit J 35616-A, and the DVM (Digital Multimeter) J 39200.

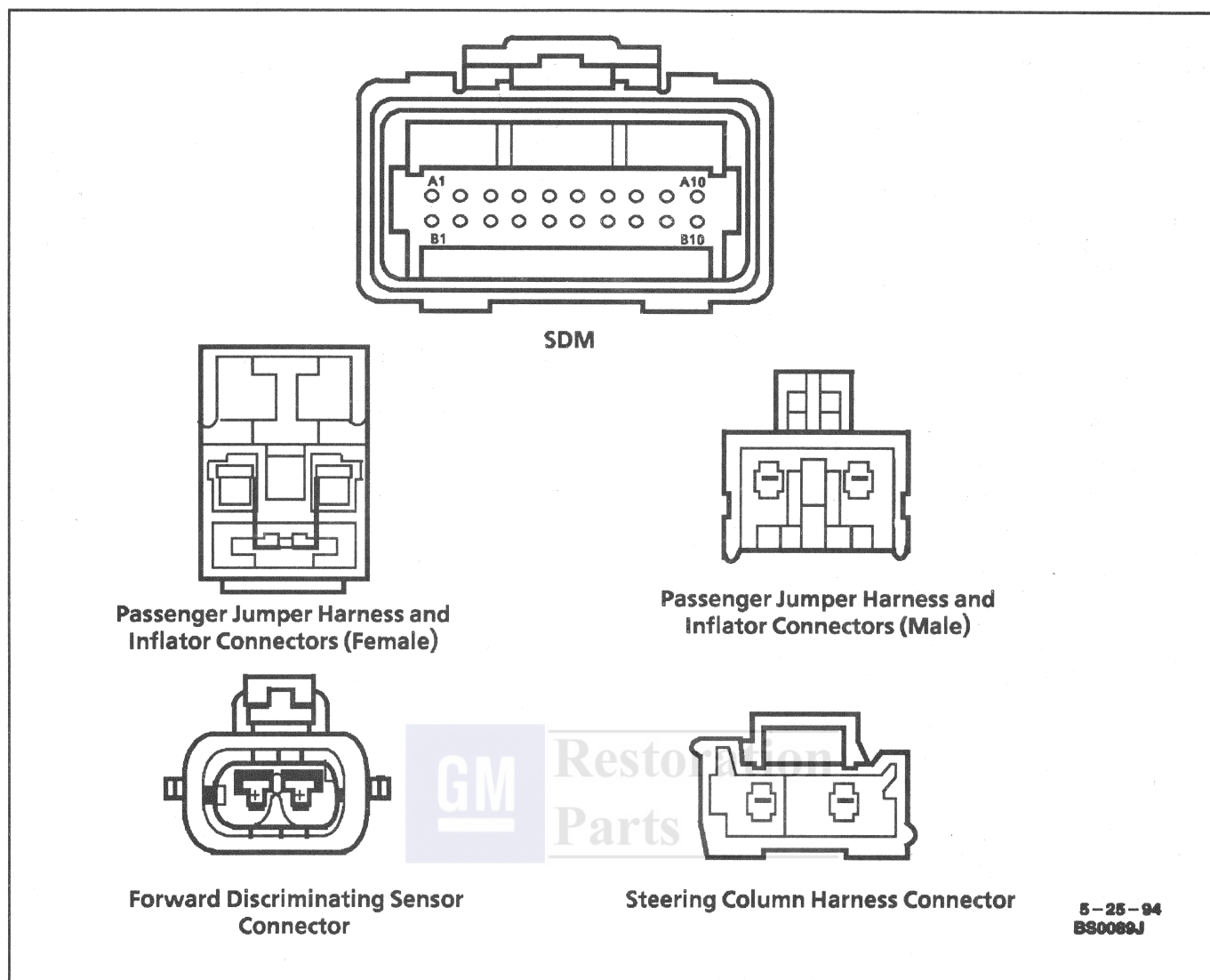


Figure 8 - SIR Connector Body Face Views

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

NOTICE: If the vehicle interior has been exposed to extensive water intrusion, such as water leaks, window left open, driving through high water and so forth, the Sensing and Diagnostic Module (SDM) may need to be replaced. With the ignition "OFF," inspect the area under the front seat and the area around the SDM, including the carpet. If any significant soaking or evidence of significant soaking is detected, the water must be removed, water damage repaired and the SDM must be replaced. Before attempting any of these repairs, the SIR system must be disabled. See section 9J under "ON-VEHICLE SERVICE" for instructions on how to disable the SIR system and replace the SDM.

SIR DIAGNOSTIC SYSTEM CHECK

The diagnostic procedures used in this section are designed to find and repair SIR system malfunctions. To get the best results, it is important to use the diagnostic charts and follow the sequence listed below.

- A. PERFORM THE "SIR DIAGNOSTIC SYSTEM CHECK." The "SIR Diagnostic System Check" must be the starting point of any SIR diagnostics. The "SIR Diagnostic System Check" checks for proper "AIR BAG" warning lamp operation, the ability of the SDM to communicate through the "Serial Data" line and whether SIR diagnostic trouble codes exist.
- B. REFER TO THE PROPER DIAGNOSTIC CHART AS DIRECTED BY THE "SIR DIAGNOSTIC SYSTEM CHECK." The "SIR Diagnostic System Check" will lead you to the correct chart to diagnose any SIR system malfunctions. **Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.**
- C. REPEAT THE "SIR DIAGNOSTIC SYSTEM CHECK" AFTER ANY REPAIR OR DIAGNOSTIC PROCEDURES HAVE BEEN PERFORMED. Performing the "SIR Diagnostic System Check" after all repair or diagnostic procedures will ensure that the repair has been made correctly and that no other malfunctions exist.

CIRCUIT DESCRIPTION

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "AIR BAG" fuse to the SDM at the "Ignition 1" input, terminal "B9" and from the "I/P INDC" fuse to the SDM at the "Redundant Indicator Ignition 1" input, terminal "A4." The SDM responds by flashing the "AIR BAG" warning lamp seven times while performing tests on the SIR system.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the SDM at the "Crank" input, terminal "B1." The SDM

responds by grounding the "SIR Indicator" output terminal "A9" until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" steady during cranking.

After cranking the SDM will flash the "AIR BAG" warning lamp six times and perform tests on the SIR system.

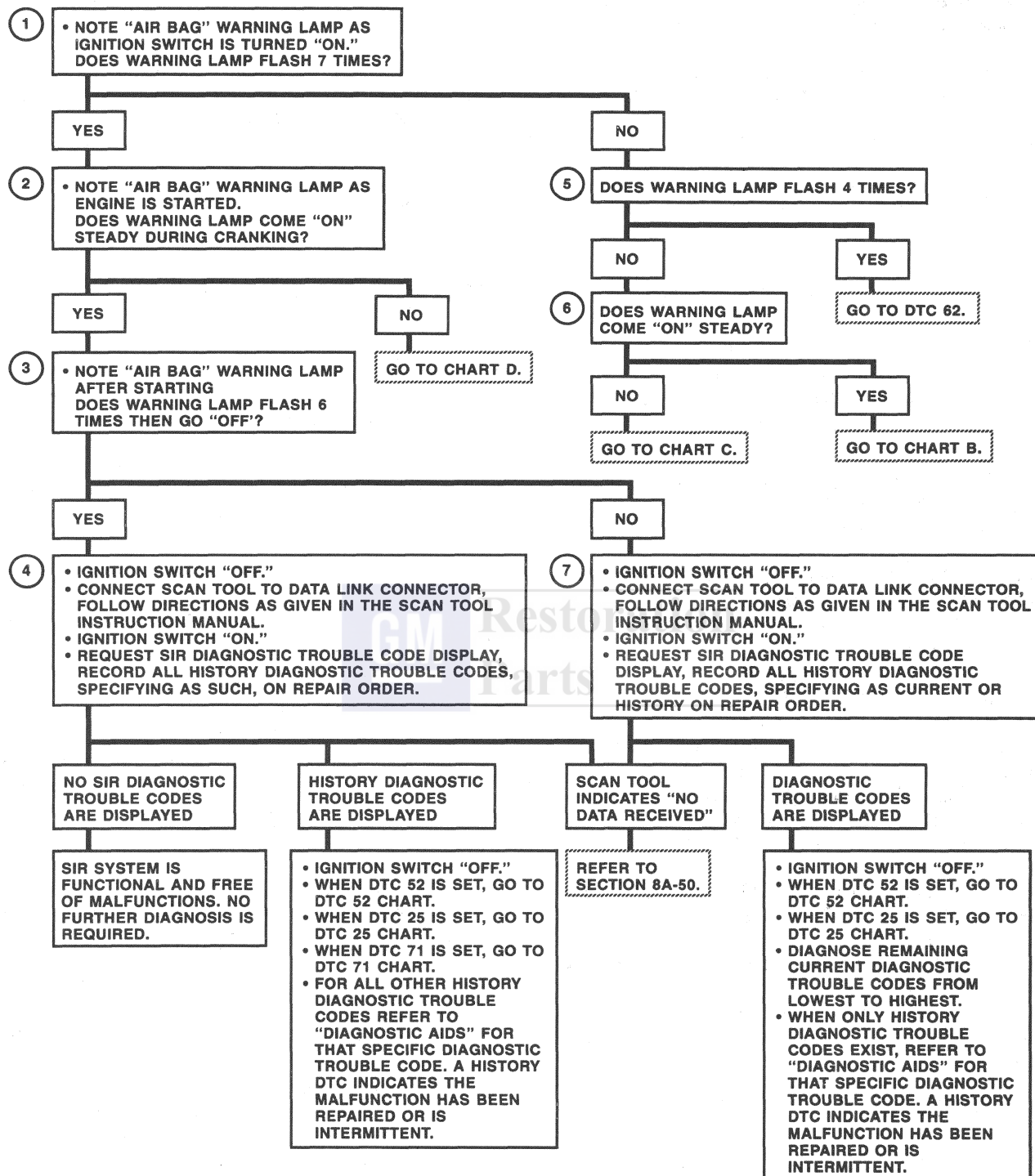
NOTES ON SYSTEM CHECK CHART:

1. The "AIR BAG" warning lamp should flash seven times after ignition is first turned "ON."
2. The "AIR BAG" warning lamp should remain "ON" steady during cranking.
3. After cranking, the "AIR BAG" warning lamp should flash six times then go "OFF."
4. This test checks for the proper operation of the "Serial Data" line. This test will also determine whether history diagnostic trouble codes are stored and, if so, identify them.
5. When the "AIR BAG" warning lamp flashes four times during BULB TEST this indicates a malfunction in the redundant lamp driver circuitry. These malfunctions are diagnosed by DTC 62 chart.
6. Improper operation of the "AIR BAG" warning lamp is indicated. This test differentiates a warning lamp stays "ON" condition from a warning lamp does not come "ON" condition.
7. This test checks for proper operation of the "Serial Data" line. This test will also identify the stored diagnostic trouble codes and whether they are current or history.

DIAGNOSTIC AIDS:

The order in which diagnostic trouble codes are diagnosed is very important. Failure to diagnose the diagnostic trouble codes in the order specified may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.

SIR DIAGNOSTIC SYSTEM CHECK





9J-12 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

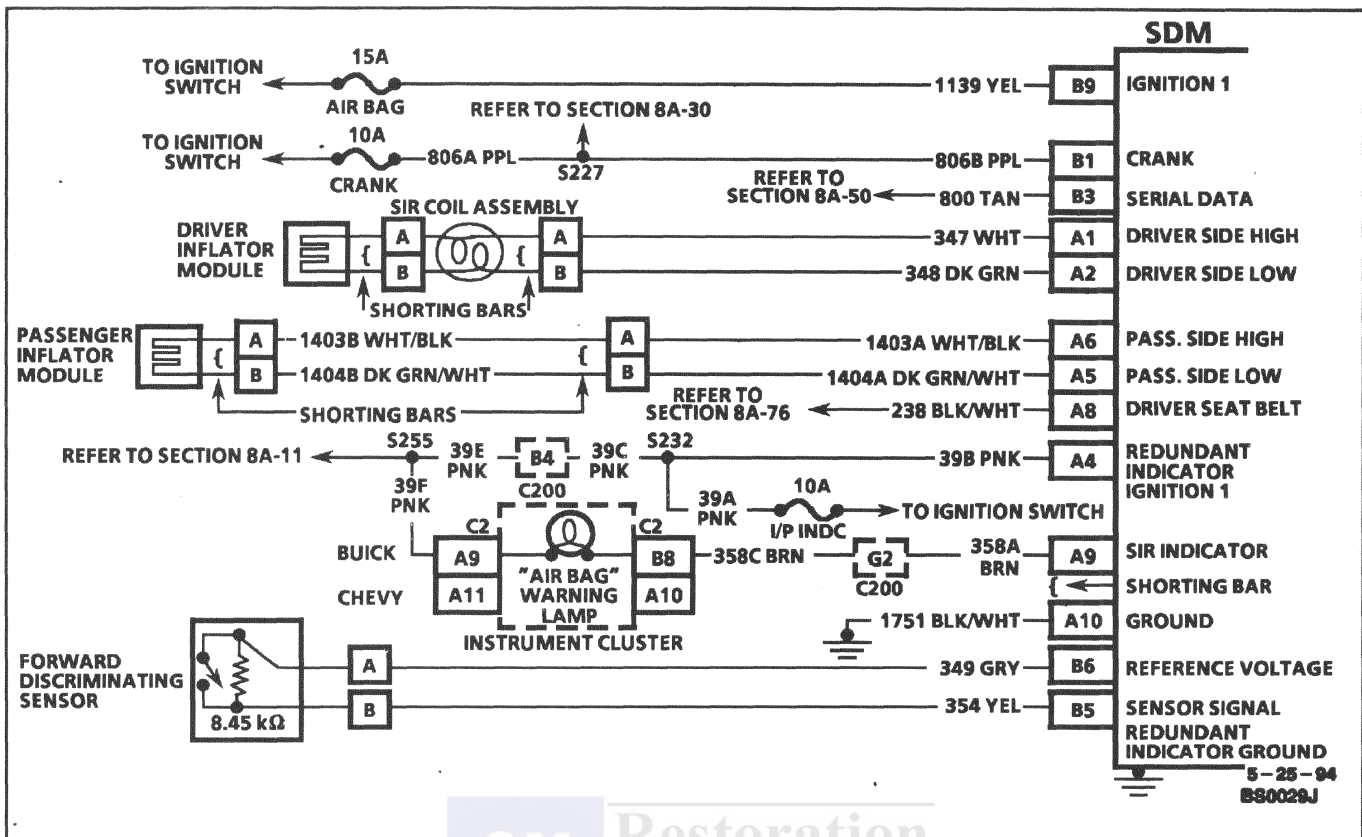


CHART A SDM INTEGRITY CHECK

Circuit Description:

When the SDM recognizes "Ignition 1" voltage, applied to terminal "B9," is greater than 6.4 volts, the "AIR BAG" warning lamp is flashed seven times to verify operation. At this time the SDM performs "Turn-ON" tests followed by "Current Source Diagnostics" and "Continuous Monitoring" tests. When a malfunction is detected the SDM sets a current diagnostic trouble code and illuminates the "AIR BAG" warning lamp. The SDM will clear current diagnostic trouble codes and move them to a history file when the malfunction is no longer detected and/or the ignition switch is cycled, except for DTCs 51, 52 and 71. DTC 51 can only be cleared using a scan tool "Clear Codes" command. DTCs 52 and 71 may not clear after a "Clear Codes" command is issued.

Chart Test Description:

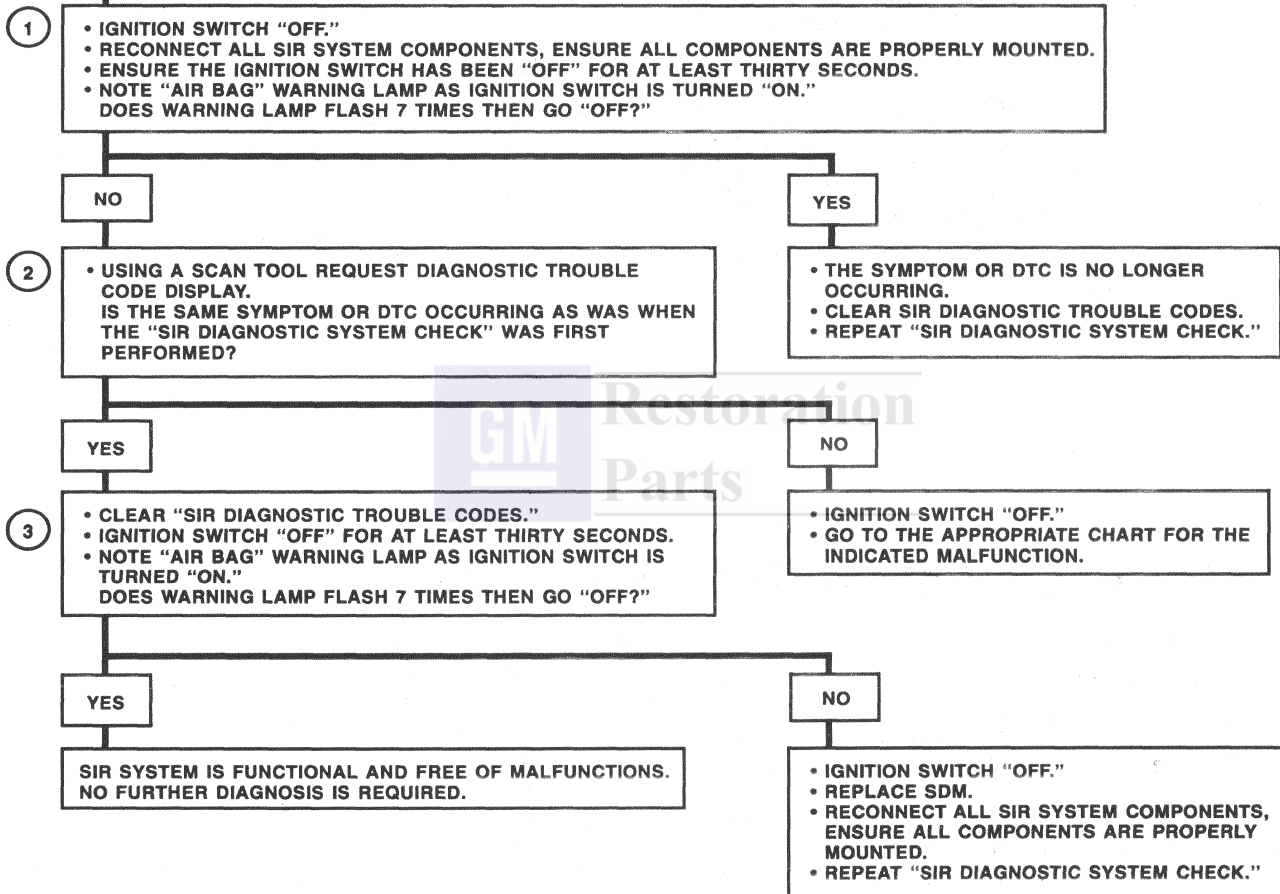
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test confirms a current malfunction. If no current malfunction is occurring (History DTC set) the "Diagnostic Aids" for the appropriate diagnostic trouble code should be referenced. The SDM should not be replaced for a History DTC.
2. This test checks for a malfunction introduced into the SIR system during the diagnostic process. It is extremely unlikely that a malfunctioning SDM would cause a new malfunction to occur during the diagnostic process.
3. When all circuitry outside the SDM has been found to operate properly, as indicated by the appropriate diagnostic chart, then and only then should the SDM be replaced.

CHART A SDM INTEGRITY CHECK

CAUTION: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING A SENSING AND DIAGNOSTIC MODULE (SDM). NEVER STRIKE OR JAR THE SDM. NEVER POWER UP THE SIR SYSTEM WHEN THE SDM IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SDM AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SIR SYSTEM. THE SDM COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.

THIS CHART ASSUMES THAT THE "SIR DIAGNOSTIC SYSTEM CHECK" AND EITHER A SYMPTOM CHART OR A DIAGNOSTIC TROUBLE CODE CHART DIAGNOSIS HAVE BEEN PERFORMED. WHEN ALL CIRCUITRY OUTSIDE THE SDM HAS BEEN FOUND TO OPERATE PROPERLY, AS INDICATED BY THE APPROPRIATE DIAGNOSTIC CHART, AND THE SYMPTOM OR DTC REMAINS CURRENT, THE FOLLOWING DIAGNOSTIC PROCEDURES MUST BE PERFORMED TO VERIFY THE NEED FOR SDM REPLACEMENT.



9J-14 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

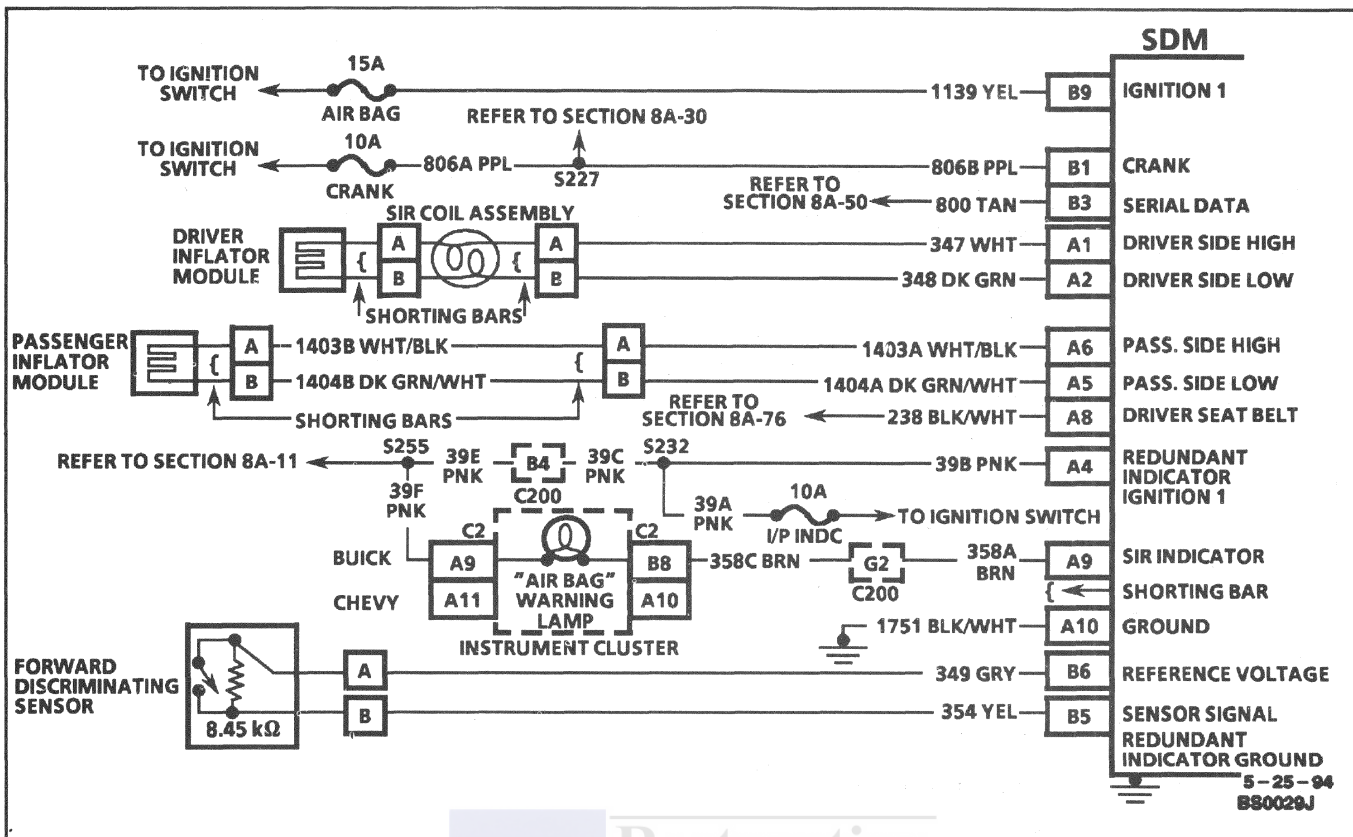


CHART B

"AIR BAG" WARNING LAMP COMES "ON" STEADY

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "I/P INDC" fuse to "Redundant Indicator Ignition 1" terminal "A4," and to the "AIR BAG" warning lamp which is connected to "SIR Indicator" terminal "A9." The "AIR BAG" fuse applies system voltage to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times. If "Ignition 1" is outside of the normal operating voltage range, the "AIR BAG" warning lamp will come "ON" solid with no DTCs set.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the SDM at the "Crank" input. The SDM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking. After cranking, the SDM will flash the "AIR BAG" warning lamp six times.

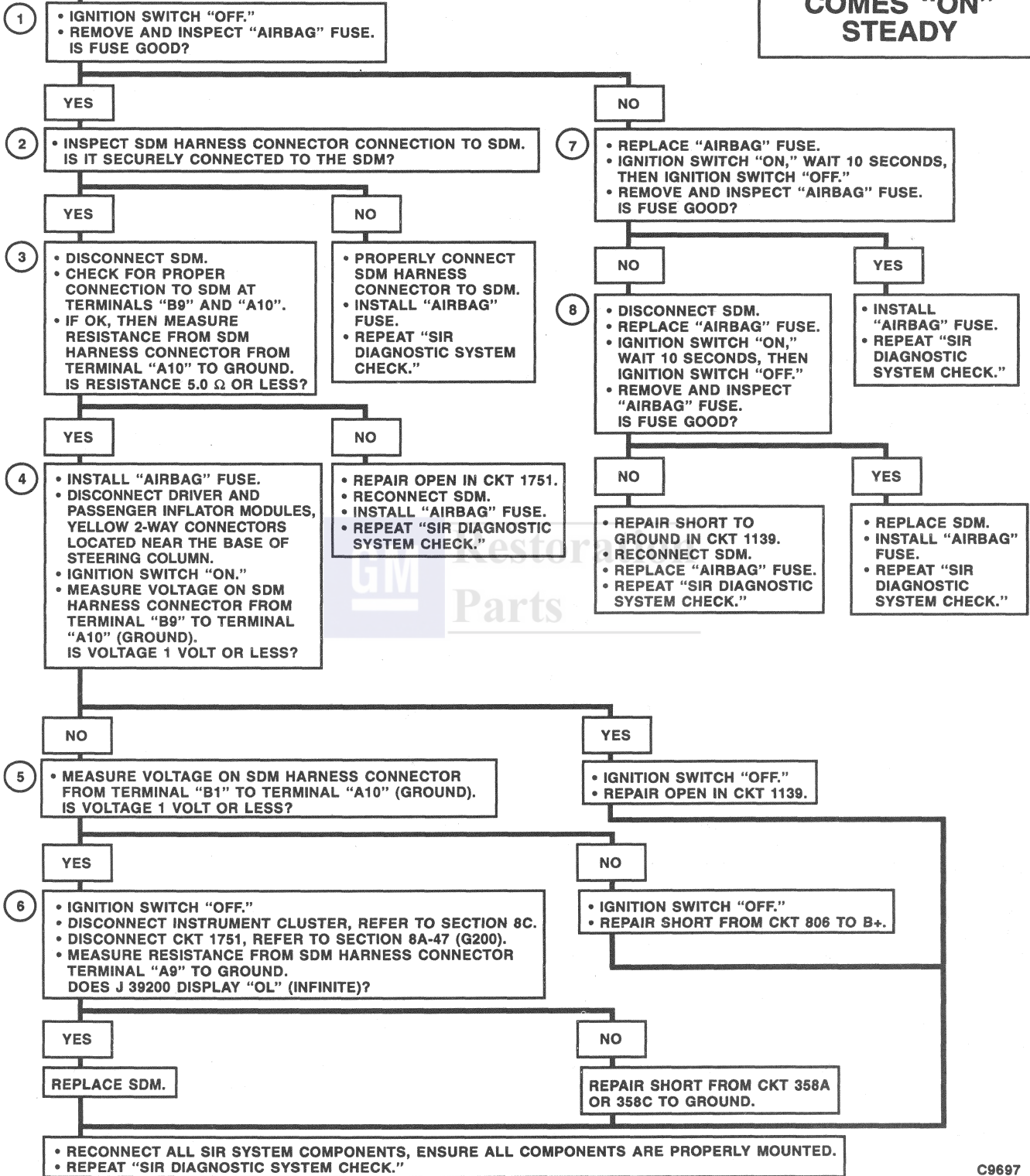
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. An open "AIR BAG" fuse would cause the "AIR BAG" warning lamp to come "ON" steady.
2. A disconnected SDM harness connector will cause the warning lamp to come "ON" steady via the shorting bar from terminal "A9" to terminal "A10" (ground).
3. This test checks for an open in the ground circuit to the SDM.
4. This test checks for an open in the "Ignition 1" circuit to the SDM.
5. This test checks for a short from the "Crank" input circuit to B+.
6. This test checks for a short from the "SIR Indicator" circuit to ground.
7. This test checks whether a short to ground caused the "AIR BAG" fuse to open.
8. This test determines whether the short to ground is due to a short in the wiring.

CHART B
“AIR BAG”
WARNING LAMP
COMES “ON”
STEADY

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.



9J-16 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

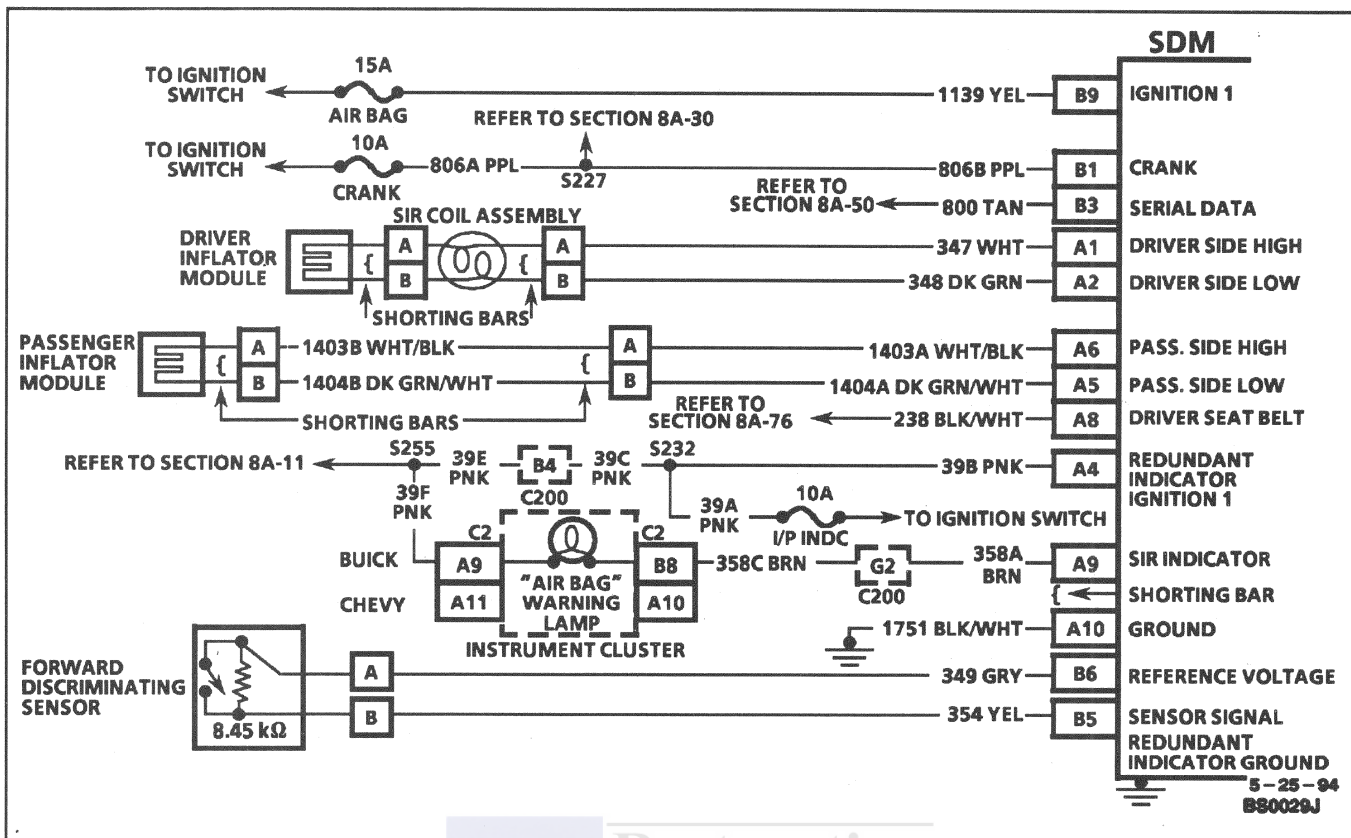


CHART C

(Page 1 of 2)

"AIR BAG" WARNING LAMP DOES NOT COME "ON"

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "I/P INDC" fuse to "Redundant Indicator Ignition 1" terminal "A4," and to the "AIR BAG" warning lamp which is connected to "SIR Indicator" terminal "A9." The "AIR BAG" fuse applies system voltage to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times. If "Ignition 1" is outside of the normal operating voltage range, the "AIR BAG" warning lamp will come "ON" solid with no DTCs set.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the SDM at the "Crank" input. The SDM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the SDM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

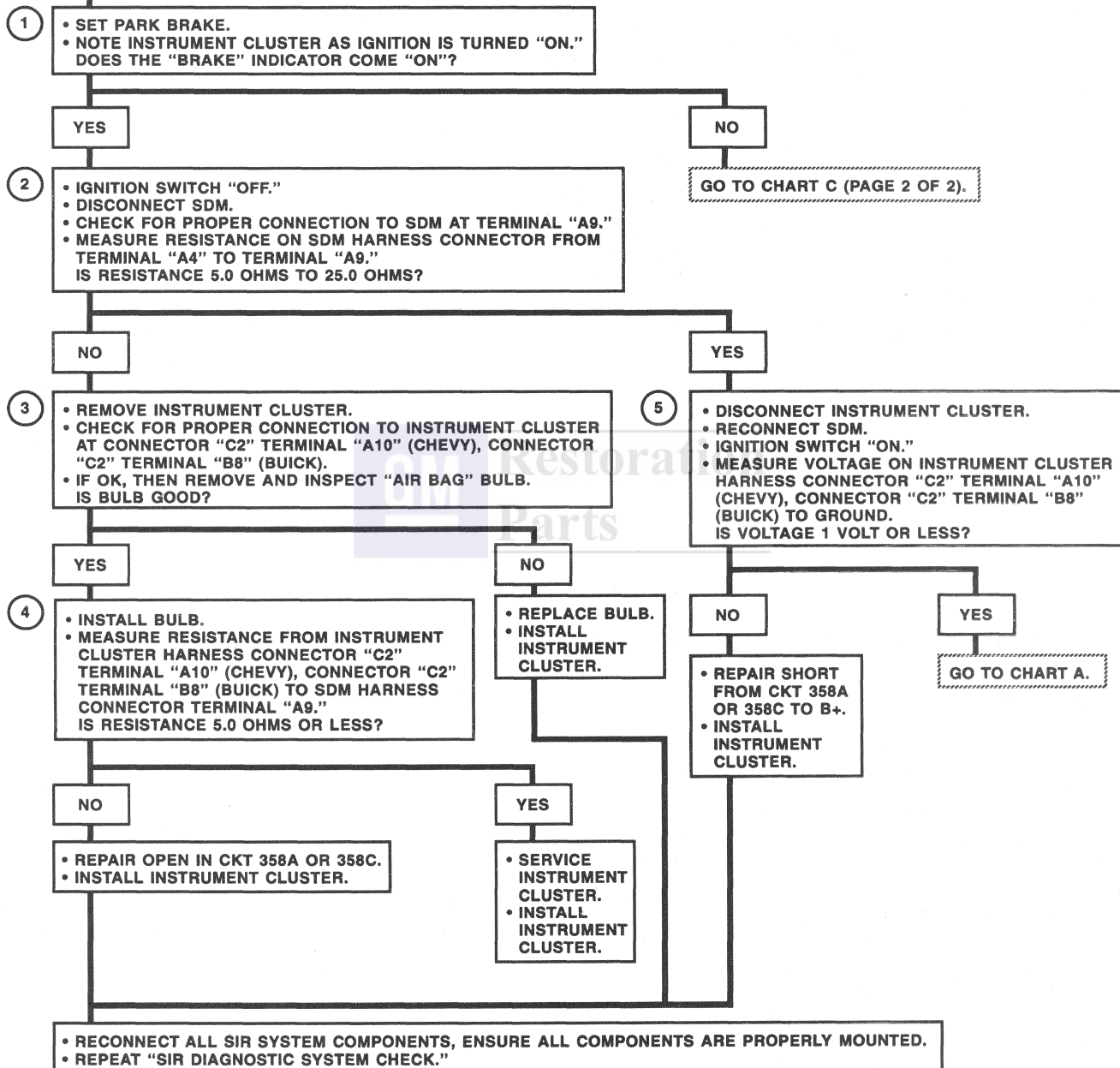
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the "AIR BAG" warning lamp circuitry or in the instrument cluster power feed circuitry.
2. This test checks for an open in the "SIR Indicator" circuit, instrument cluster circuitry, and "AIR BAG" warning lamp bulb.
3. This test checks whether the open is due to a bad bulb.
4. This test determines whether the malfunction is an open in the "SIR Indicator" circuit or an open in the instrument cluster.
5. This test determines whether the malfunction is due to a short from the "SIR Indicator" circuit to B+.

CHART C

(Page 1 of 2)
**"AIR BAG" WARNING LAMP
 DOES NOT COME "ON"**

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.



9J-18 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

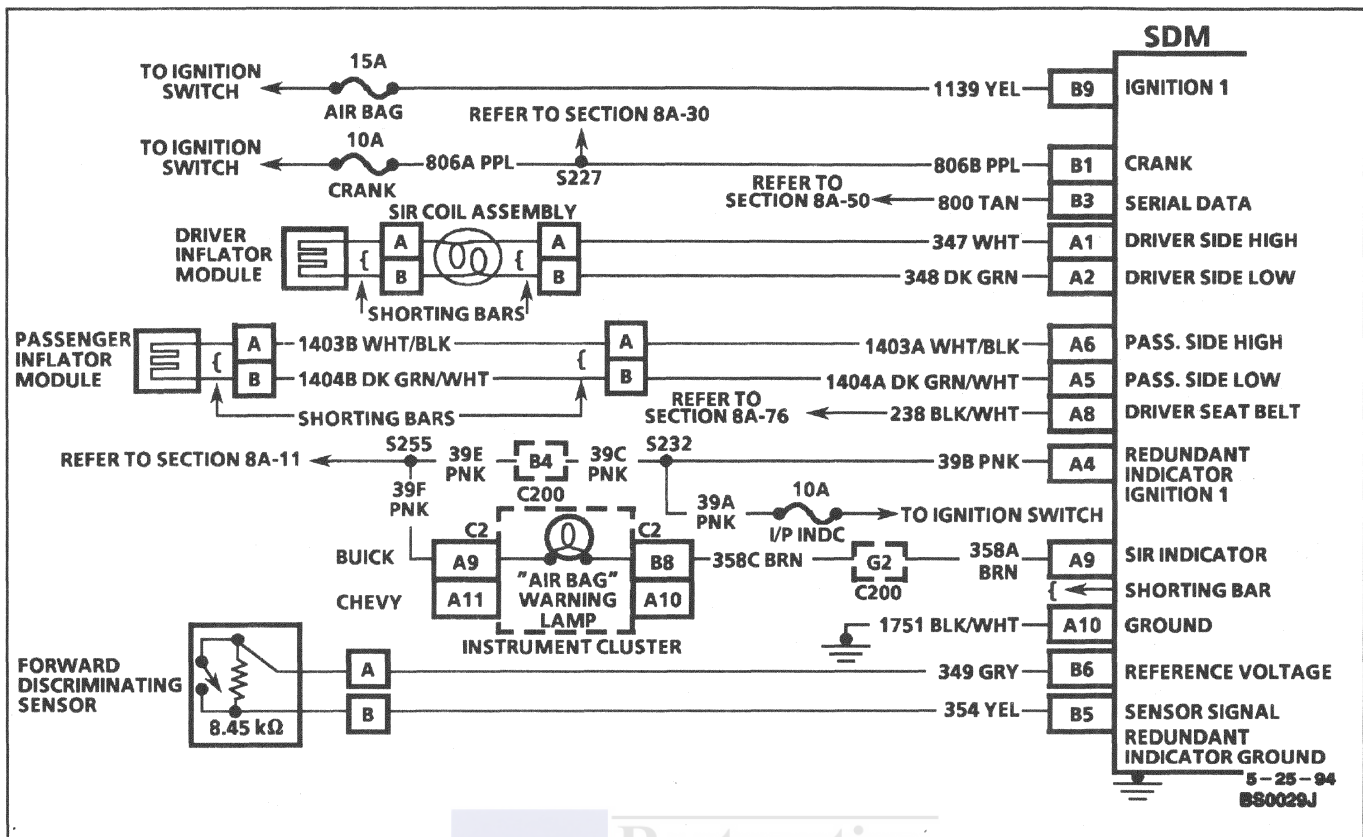


CHART C

(Page 2 of 2)

"AIR BAG" WARNING LAMP DOES NOT COME "ON"

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "I/P INDC" fuse to "Redundant Indicator Ignition 1" terminal "A4," and to the "AIR BAG" warning lamp which is connected to "SIR Indicator" terminal "A9." The "AIR BAG" fuse applies system voltage to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times. If "Ignition 1" is outside of the normal operating voltage range, the "AIR BAG" warning lamp will come "ON" solid with no DTCs set.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the SDM at the "Crank" input. The SDM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the SDM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

- This test checks whether power is available to the instrument cluster power feed circuit.
- This test checks for a short from the instrument cluster power feed circuit to ground.
- This test determines whether the short to ground is due to a short in the wiring.
- This test checks whether the malfunction is due to an open power feed circuit from the "I/P INDC" fuse to connector "C200" terminal "B4."
- This test determines whether the malfunction is due to an open power feed circuit from connector "C200" terminal "B4" to the instrument cluster or an open in the power feed to the "I/P INDC" fuse.

CHART C

(Page 2 of 2)
**"AIR BAG" WARNING LAMP
 DOES NOT COME "ON"**

WERE YOU SENT HERE FROM CHART C (PAGE 1 OF 2)?

YES

NO

GO TO CHART C (PAGE 1 OF 2).

6

- IGNITION SWITCH "OFF."
- REMOVE AND INSPECT "I/P INDC" FUSE. IS FUSE GOOD?

NO

YES

7

- REPLACE "I/P INDC FUSE.
- IGNITION SWITCH "ON", WAIT 10 SECONDS, THEN IGNITION SWITCH "OFF."
- REMOVE AND INSPECT "I/P INDC" FUSE. IS FUSE GOOD?

9

- DISCONNECT INSTRUMENT CLUSTER.
- CHECK FOR PROPER CONNECTION AT INSTRUMENT CLUSTER HARNESS CONNECTOR "C2" TERMINAL "A11" (CHEVY), CONNECTOR "C2" TERMINAL "A9" (BUICK).
- IF OK THEN DISCONNECT CONNECTOR "C200."
- MEASURE RESISTANCE FROM CONNECTOR "C200" TERMINAL "B4" TO EACH TERMINAL OF THE "I/P INDC" FUSE HOLDER. IS EITHER MEASUREMENT 5.0 OHMS OR LESS?

NO

YES

8

- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- DISCONNECT SDM.
- REPLACE "I/P INDC" FUSE.
- IGNITION SWITCH "ON", WAIT 10 SECONDS.
- IGNITION SWITCH "OFF."
- REMOVE AND INSPECT "I/P INDC" FUSE. IS FUSE GOOD?

- INSTALL "I/P INDC" FUSE.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

10

- MEASURE RESISTANCE FROM CONNECTOR "C200" TERMINAL "B4" TO INSTRUMENT CLUSTER HARNESS CONNECTOR "C2" TERMINAL "A11" (CHEVY), CONNECTOR "C2" TERMINAL "A9" (BUICK). IS RESISTANCE 5.0 OHMS OR LESS?

- REPAIR OPEN IN CKT 39A OR CKT 39C.
- INSTALL "I/P INDC" FUSE.

NO

YES

- REPAIR SHORT TO GROUND IN CKT 39.
- REPLACE "I/P INDC" FUSE.

- INSTALL "I/P INDC" FUSE.
- GO TO CHART A.

- REPAIR OPEN IN POWER FEED TO "I/P INDC" FUSE, REFER TO SECTION 8A-10.
- INSTALL "I/P INDC" FUSE.

- REPAIR OPEN IN CKT 39E OR CKT 39F.
- INSTALL "I/P INDC" FUSE.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-20 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

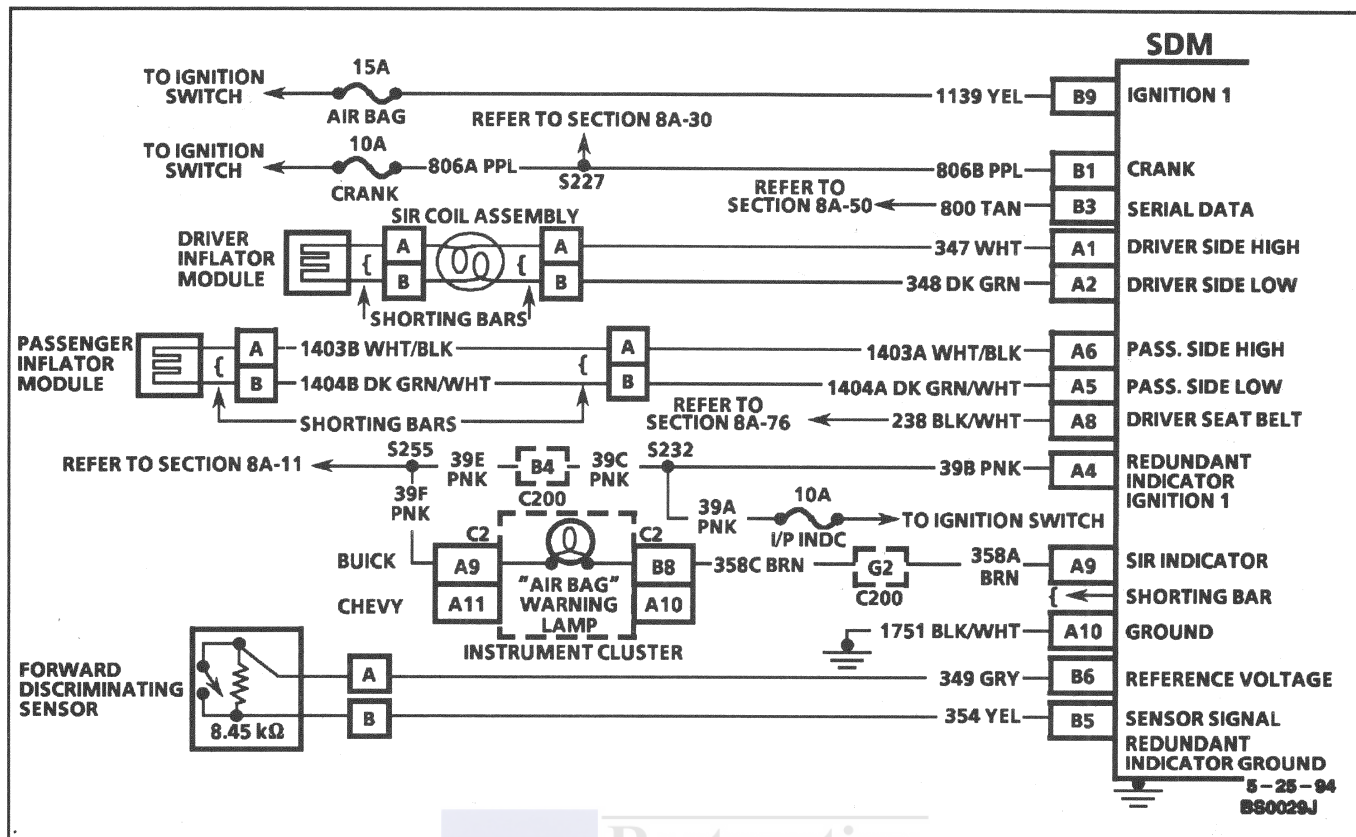


CHART D

"AIR BAG" WARNING LAMP DOES NOT COME "ON" STEADY DURING CRANK

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "I/P INDC" fuse to "Redundant Indicator Ignition 1" terminal "A4," and to the "AIR BAG" warning lamp which is connected to "SIR Indicator" terminal "A9." The "AIR BAG" fuse applies system voltage to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times. If "Ignition 1" is outside of the normal operating voltage range, the "AIR BAG" warning lamp will come "ON" solid with no DTCs set.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the SDM at the "Crank" input. The SDM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the SDM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

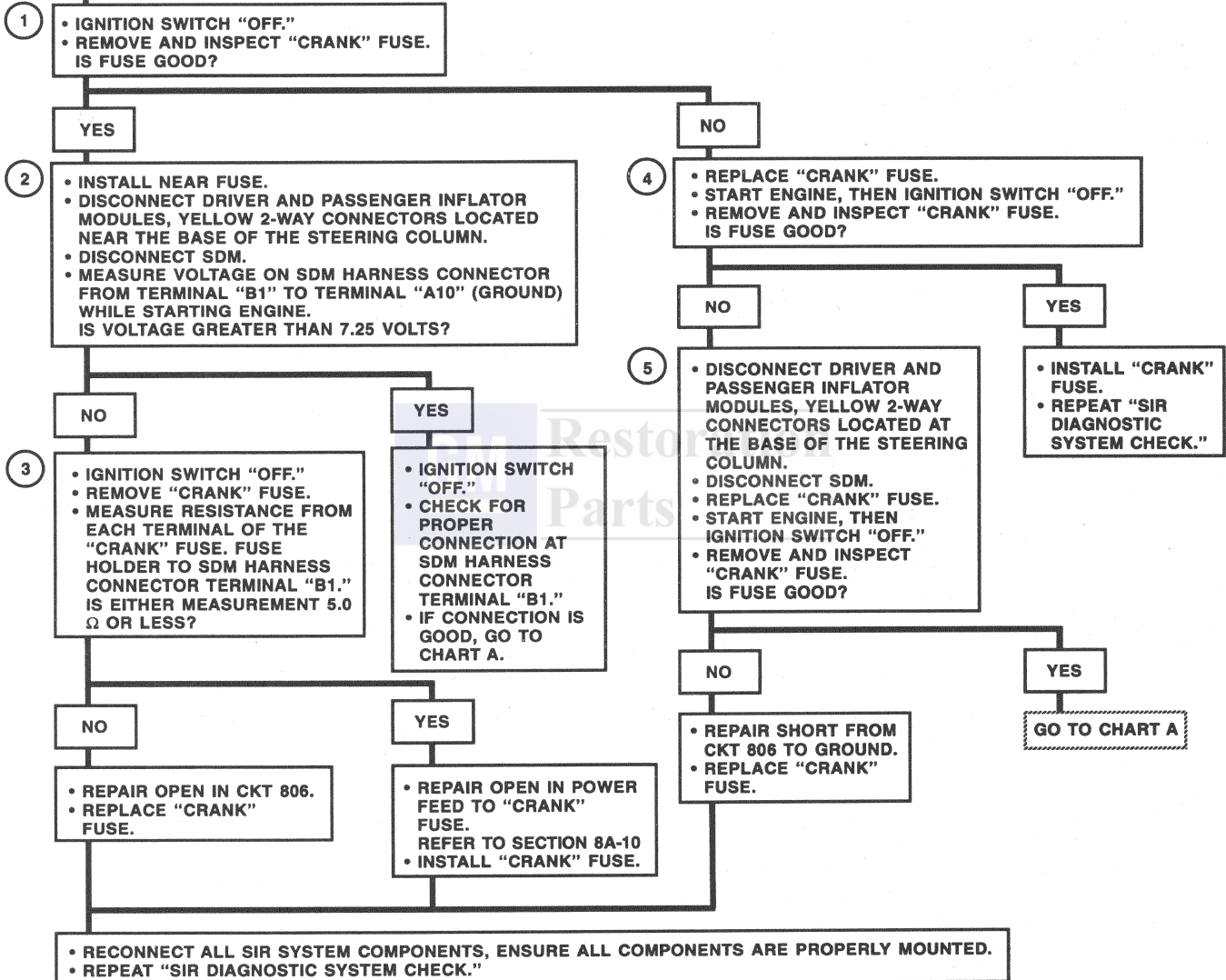
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the malfunction is due to an open "CRANK" fuse.
2. This test checks for a proper signal to the "Crank" input during cranking.
3. This test determines whether the lack of a proper crank signal is due to an open "Crank" input circuit or an open power feed to the "CRANK" fuse.
4. This test checks whether the "CRANK" fuse is open due to a short to ground in the "Crank" input circuit.
5. This test determines whether the short to ground is in the wiring harness.

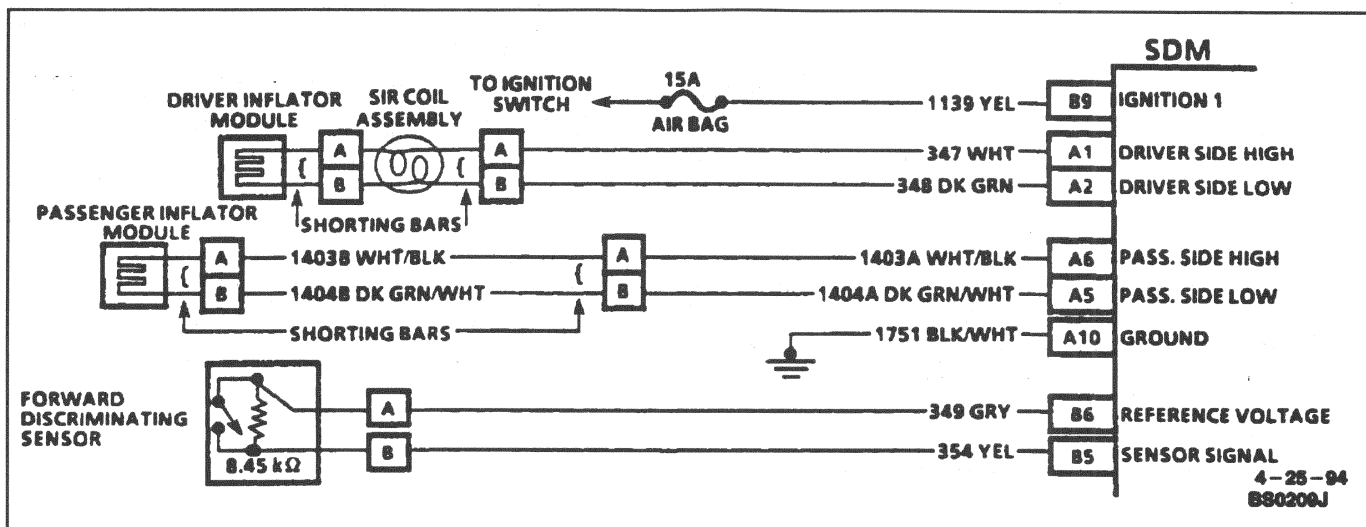
CHART D

“AIR BAG” WARNING LAMP DOES NOT COME “ON” STEADY DURING CRANK

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO “INTERMITTENTS AND POOR CONNECTION” IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO “WIRING REPAIR” IN THIS SECTION.



9J-22 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 15

PASSENGER INITIATOR CIRCUIT RESISTANCE HIGH

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Passenger Side Low" terminal "A5" is grounded through a resistor and the passenger current source connected to "Passenger Side High" terminal "A6" allows a known amount of current to flow. By monitoring the voltage difference between "Passenger Side High" and "Passenger Side Low" the SDM calculates the combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 1404, and connector terminal contact.

DTC Will Set When:

The combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 1404, and connector terminal contact is above a specified value. This test is run once each ignition cycle during the "Current Source Diagnostics" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring," 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the passenger inflator module circuitry or in the SDM wiring harness circuitry.
2. This test checks whether the malfunction is due to high resistance in CKT 1403.
3. This test checks whether the malfunction is due to high resistance in CKT 1404.
4. This test determines whether the malfunction is due to the passenger inflator module or the passenger inflator module jumper.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at the passenger inflator module harness connector terminals "A" and "B," SDM terminals "A5" and "A6," or a poor wire to terminal connection in CKT 1403 or CKT 1404. This test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check, unless DTC 17 or DTC 26 is detected. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 15 PASSENGER INITIATOR CIRCUIT RESISTANCE HIGH

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1

- IGNITION SWITCH "OFF."
 - DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF STEERING COLUMN.
 - CHECK FOR PROPER CONNECTION TO PASSENGER INFLATOR MODULE AT TERMINALS "A" AND "B."
 - IF OK, THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO DRIVER AND PASSENGER INFLATOR MODULE HARNESS CONNECTORS, LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 15 CURRENT?

YES

NO

2

- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
 - DISCONNECT SDM.
 - CHECK FOR PROPER CONNECTION TO SDM AT TERMINALS "A5" AND "A6."
 - IF OK, THEN MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A6" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "A."
- IS RESISTANCE 2.0 Ω OR LESS?

4

- IGNITION SWITCH "OFF."
 - REMOVE UPPER TRIM PAD, REFER TO SECTION 8C.
 - DISCONNECT PASSENGER INFLATOR MODULE JUMPER (IF EQUIPPED, OTHERWISE REPLACE PASSENGER INFLATOR MODULE).
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM PASSENGER INFLATOR MODULE HARNESS CONNECTOR AND CONNECT TO THE JUMPER NEAR THE PASSENGER INFLATOR MODULE, LEAVE CONNECTED TO DRIVER SIDE.
 - RECONNECT CONNECTOR NEAR BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 15 CURRENT?

YES

NO

3

- MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A5" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B."
- IS RESISTANCE 2.0 Ω OR LESS?

REPAIR HIGH RESISTANCE OR OPEN IN CKT 1403.

YES

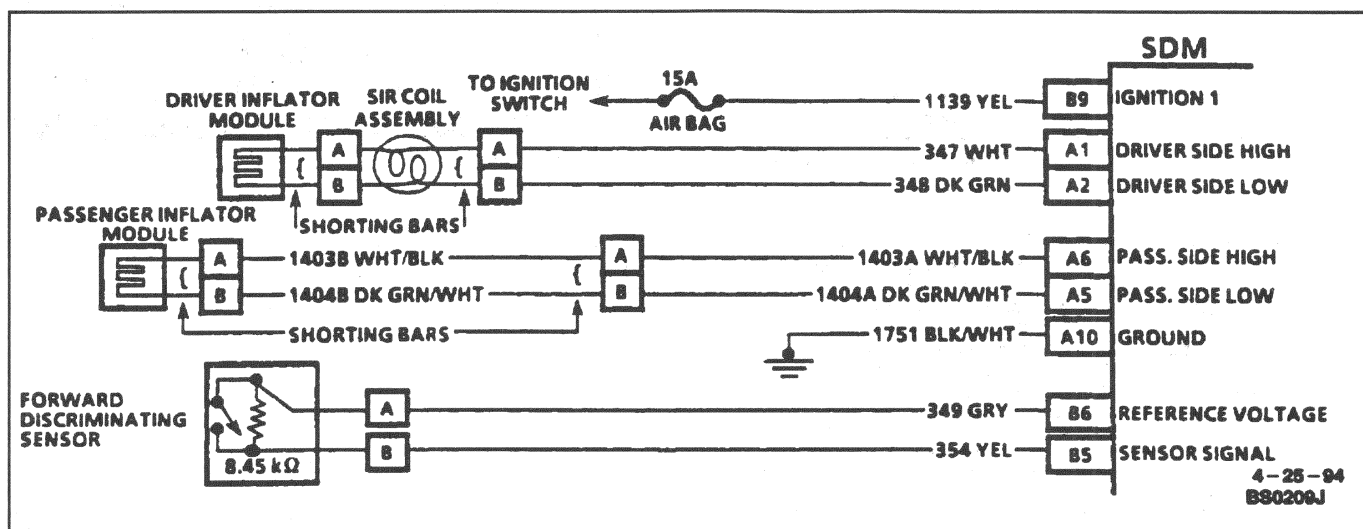
NO

GO TO CHART A.

REPAIR HIGH RESISTANCE OR OPEN IN CKT 1404.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-24 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 16

PASSENGER INITIATOR CIRCUIT RESISTANCE LOW

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Passenger Side Low" terminal "A5" is grounded through a resistor and the passenger current source connected to "Passenger Side High" terminal "A6" allows a known amount of current to flow. By monitoring the voltage difference between "Passenger Side High" and "Passenger Side Low" the SDM calculates the combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 1404, and connector terminal contact.

DTC Will Set When:

The combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 1404, and connector terminal contact is below a specified value. This test is run once each ignition cycle during the "Current Source Diagnostics" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring," 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 16 and 22 will set simultaneously when the "Driver Side High" circuit is shorted to the "Passenger Side High" circuit due to parallel current paths.
2. This test determines whether the malfunction is in the passenger inflator module circuitry or in the SDM wiring harness circuitry.
3. This test checks for a short from the "Passenger Side High" circuit to the "Passenger Side Low" circuit.
4. This test checks for a short from the "Passenger Side High" circuit to the "Driver Side Low" circuit.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 1403 and CKT 347, CKT 348 or CKT 1404, or a malfunctioning shorting bar on the passenger inflator module which would require replacement of the module. The test for this diagnostic trouble code is only run while "AIR BAG" warning lamp is performing the bulb check, unless DTC 17 or DTC 26 is detected. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 16 PASSENGER INITIATOR CIRCUIT RESISTANCE LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1 IS DTC 22 ALSO CURRENT?

NO

YES

- 2
- IGNITION SWITCH "OFF."
 - DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO DRIVER AND PASSENGER INFLATOR MODULE HARNESS CONNECTORS, LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 16 CURRENT?

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- REPAIR SHORT FROM CKT 347 TO CKT 1403.

YES

NO

- 3
- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
 - DISCONNECT SDM.
 - MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR FROM TERMINAL "A5" TO TERMINAL "A6."
- DOES J 39200 DISPLAY "OL" (INFINITE)?

- IGNITION SWITCH "OFF."
- REPLACE PASSENGER INFLATOR MODULE.

YES

NO

- 4
- MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM TERMINAL "A2" TO TERMINAL "A6."
- DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR SHORT FROM CKT 1403 TO CKT 1404.

YES

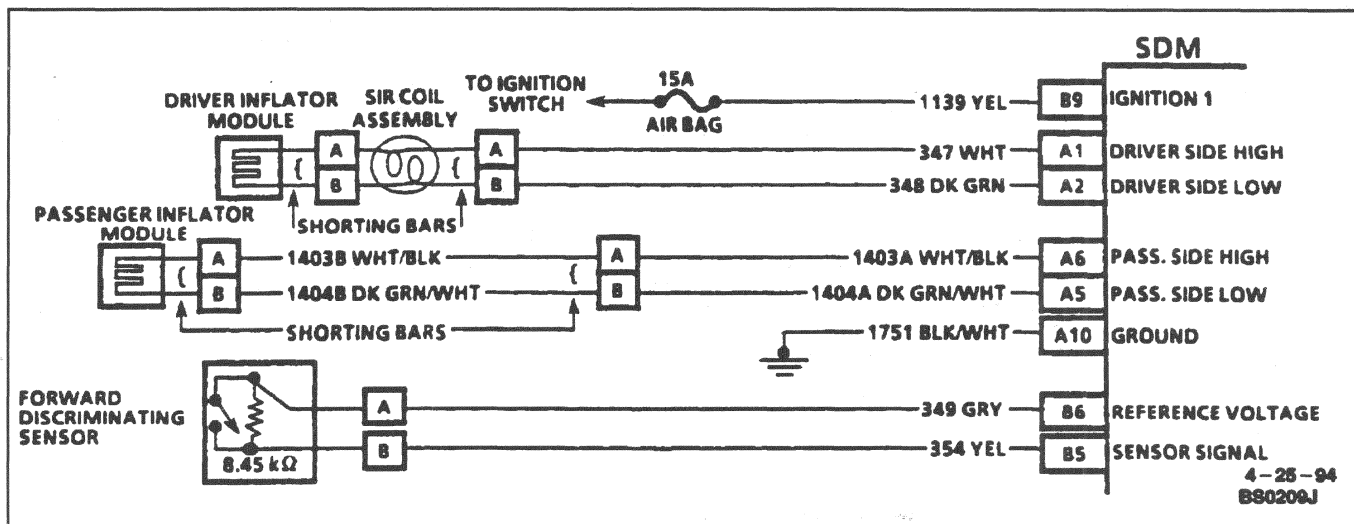
NO

GO TO CHART A.

REPAIR SHORT FROM CKT 1403 TO CKT 348.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-26 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 17 PASSENGER INITIATOR CIRCUIT OPEN

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Passenger Side Low" terminal "A5" is grounded through a resistor and the passenger current source connected to "Passenger Side High" terminal "A6" allows a known amount of current to flow. After "Current Source Diagnostics" are completed the SDM removes the low resistance ground from "Passenger Side Low" and switches the passenger current source at "Passenger Side High." The SDM then measures the voltage at "Passenger Side High" and "Passenger Side Low" during "Continuous Monitoring." By monitoring the voltage difference between "Passenger Side High" and "Passenger Side Low" the SDM calculates the combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 1404, and connector terminal contact.

DTC Will Set When:

The voltage difference between "Passenger Side High" terminal "A6" and "Passenger Side Low" terminal "A5" is above or equal to a specified value for 500 milliseconds during "Current Source Diagnostics" or "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage difference between "Passenger Side High" terminal "A6" and "Passenger Side Low" terminal "A5" is below a specified value for 500 milliseconds during "Continuous Monitoring."

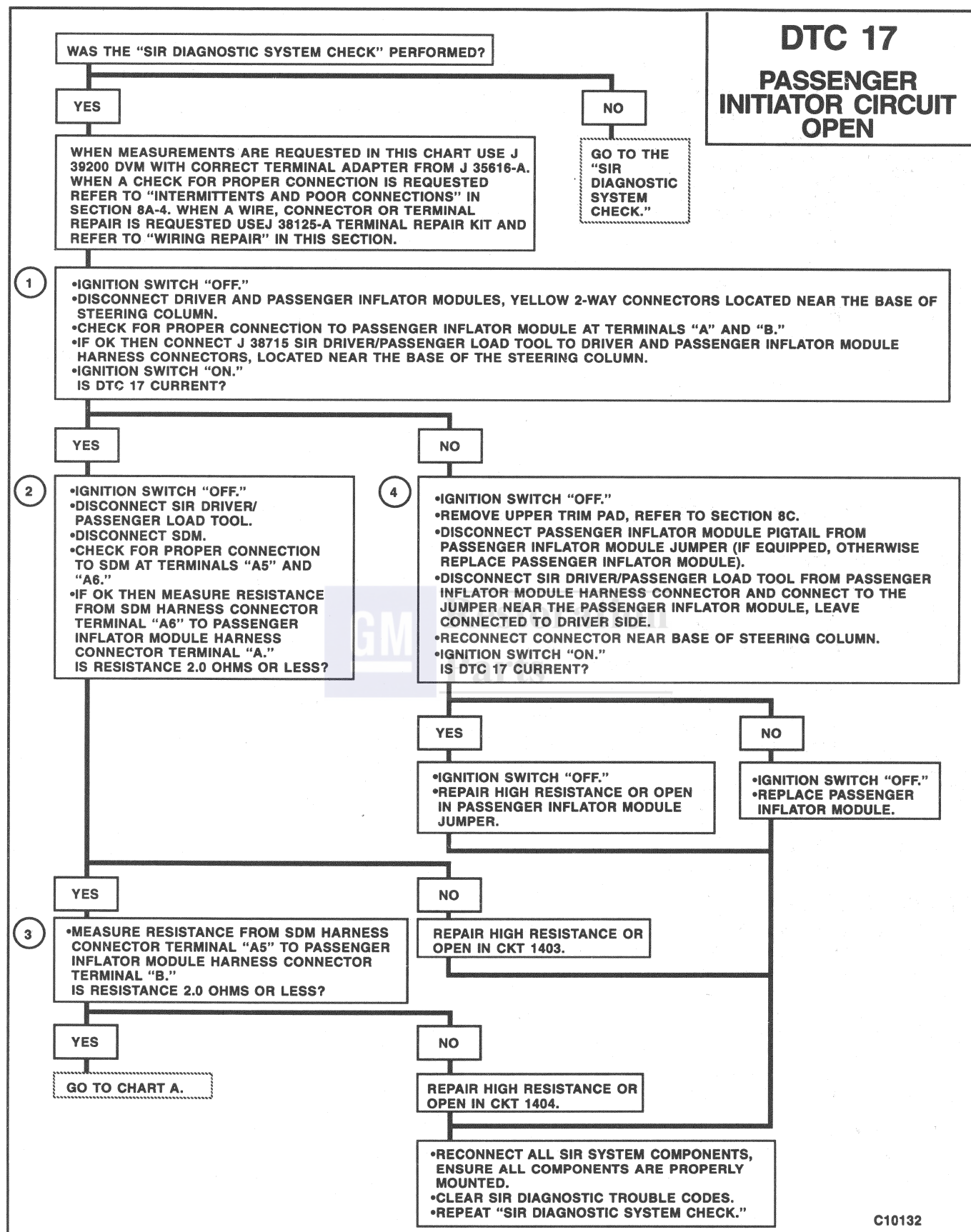
DTC Chart Test Description:

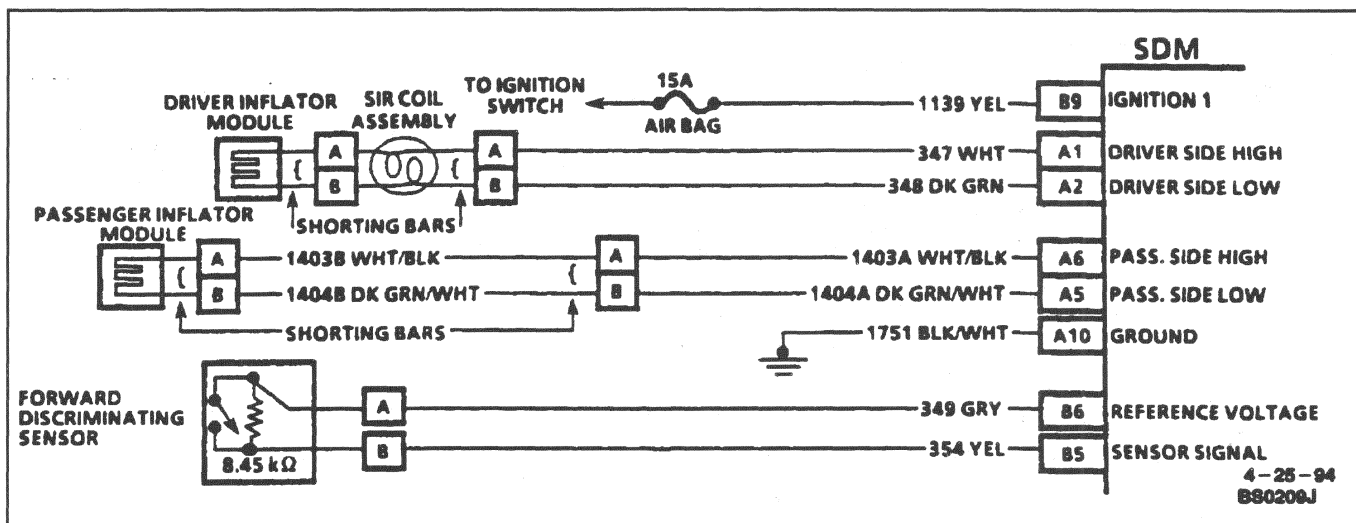
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the passenger inflator module circuitry or in the SDM wiring harness circuitry.
2. This test checks whether the malfunction is due to high resistance in CKT 1403.
3. This test checks whether the malfunction is due to high resistance in CKT 1404.
4. This test determines whether the malfunction is due to the passenger inflator module or the passenger inflator module jumper.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at the passenger inflator module harness connector terminals "A" and "B," SDM terminals "A5" and "A6," or an open in CKT 1403 or CKT 1404.





DTC 21

DRIVER INITIATOR CIRCUIT RESISTANCE HIGH

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Driver Side Low" terminal "A2" is grounded through a resistor and the driver current source connected to "Driver Side High" terminal "A1" allows a known amount of current to flow. By monitoring the voltage difference between "Driver Side High" and "Driver Side Low" the SDM calculates the combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347 and 348, and connector terminal contact.

DTC Will Set When:

The combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347 and 348, and connector terminal contact is above a specified value. This test is run during the "Current Source Diagnostics" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring," 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the driver inflator module circuitry or in the SDM wiring harness circuitry.
2. This test checks whether the malfunction is due to a high resistance in CKT 347.
3. This test checks whether the malfunction is due to a high resistance in CKT 348.
4. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at terminals "A" and "B" of the SIR coil connector at the base of the steering column, terminals "A" and "B" of the driver inflator module connector at the top of the steering column, SDM terminals "A1" and "A2" or a poor wire to terminal connection in CKT 347 or CKT 348. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check, unless DTC 17 or DTC 26 is detected. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 21 DRIVER INITIATOR CIRCUIT RESISTANCE HIGH

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1

- IGNITION SWITCH "OFF."
 - DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - CHECK FOR PROPER CONNECTION TO SIR COIL ASSEMBLY CONNECTOR AT TERMINALS "A" AND "B."
 - IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO DRIVER AND PASSENGER INFLATOR MODULE HARNESS CONNECTORS, LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 21 CURRENT?

YES

NO

2

- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
 - DISCONNECT SDM.
 - CHECK FOR PROPER CONNECTION TO SDM AT TERMINALS "A1" AND "A2."
 - IF OK THEN MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A1" TO DRIVER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "A."
- IS RESISTANCE 2.0Ω OR LESS?

4

- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM DRIVER INFLATOR MODULE HARNESS CONNECTOR.
 - REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
 - CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
 - RECONNECT DRIVER INFLATOR MODULE HARNESS CONNECTOR AT THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 21 CURRENT?

YES

NO

3

- MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A2" TO DRIVER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B."
- IS RESISTANCE 2.0Ω OR LESS?

REPAIR HIGH RESISTANCE OR OPEN IN CKT 347.

YES

NO

- IGNITION SWITCH "OFF."
- REPLACE SIR COIL ASSEMBLY, REFER TO SECTION 3F5.

- IGNITION SWITCH "OFF."
- REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.

YES

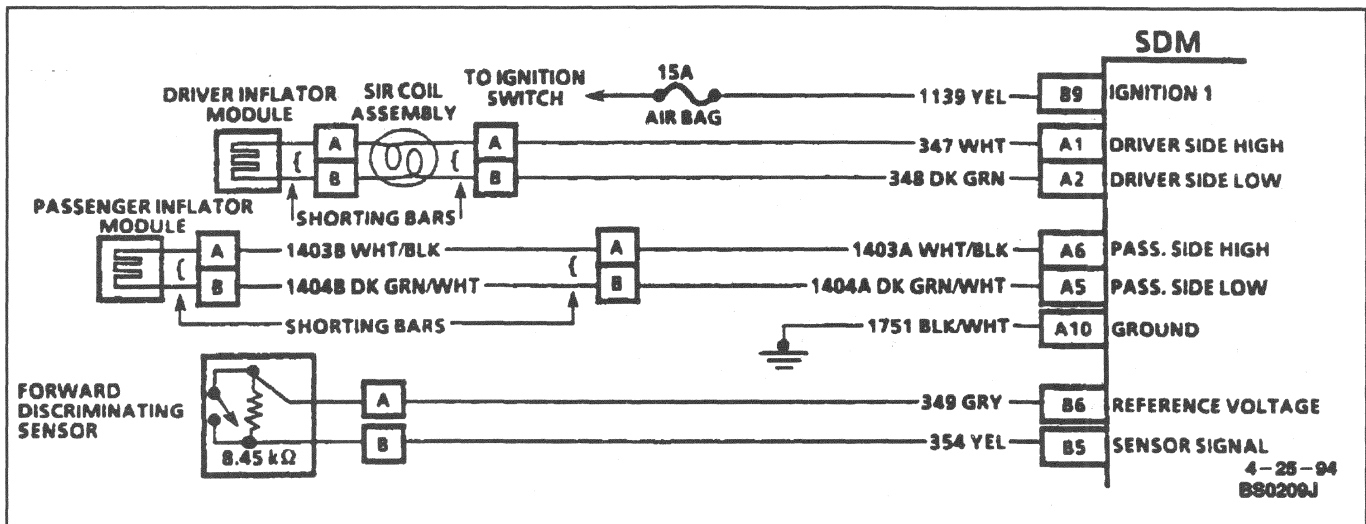
NO

GO TO CHART A.

REPAIR HIGH RESISTANCE OR OPEN IN CKT 348.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-30 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 22 DRIVER INITIATOR CIRCUIT RESISTANCE LOW

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Driver Side Low" terminal "A2" is grounded through a resistor and the driver current source connected to "Driver Side High" terminal "A1" allows a known amount of current to flow. By monitoring the voltage difference between "Driver Side High" and "Driver Side Low" the SDM calculates the combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347 and 348, and connector terminal contact.

DTC Will Set When:

The combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347 and 348, and connector terminal contact is below a specified value. This test is run during the "Current Source Diagnostics" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring," 3) No "crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 16 and 22 will set simultaneously when the "Driver Side High" circuit is shorted to the "Passenger Side High" circuit due to parallel current paths.
2. This test determines whether the malfunction is in the driver inflator module circuitry or in the SDM wiring harness circuitry.
3. This test checks for a short from the "Driver Side High" circuit to the "Driver Side Low" circuit.
4. This test checks for a short from the "Driver Side High" circuit to the "Passenger Side Low" circuit.
5. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 347 and CKT 348, CKT 1403 or CKT 1404, or a malfunctioning shorting bar on the driver inflator module or SIR coil assembly which would require replacement of the component. The test for this diagnostic trouble code is only run while "AIR BAG" warning lamp is performing the bulb check, unless DTC 17 or DTC 26 is detected. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 22 DRIVER INITIATOR CIRCUIT RESISTANCE LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1 IS DTC 16 ALSO CURRENT?

NO

YES

- 2
- IGNITION SWITCH "OFF."
 - DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO DRIVER AND PASSENGER INFLATOR MODULE HARNESS CONNECTORS, LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 22 CURRENT?

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- REPAIR SHORT FROM CKT 347 TO CKT 1403.

YES

NO

- 3
- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
 - DISCONNECT SDM.
 - MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM TERMINAL "A1" TO TERMINAL "A2."
- DOES J 39200 DISPLAY "OL" (INFINITE)?

- 5
- IGNITION SWITCH "OFF."
 - DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM DRIVER INFLATOR MODULE HARNESS CONNECTOR.
 - REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
 - CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
 - RECONNECT DRIVER INFLATOR MODULE HARNESS CONNECTOR AT THE BASE OF THE STEERING COLUMN.
 - IGNITION SWITCH "ON."
- IS DTC 22 CURRENT?

YES

NO

- 4
- MEASURE RESISTANCE ON SDM HARNESS CONNECTOR TERMINAL "A1" TO TERMINAL "A5."
- DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR SHORT FROM CKT 347 TO CKT 348.

YES

NO

GO TO CHART A.

REPAIR SHORT FROM CKT 347 TO CKT 1404.

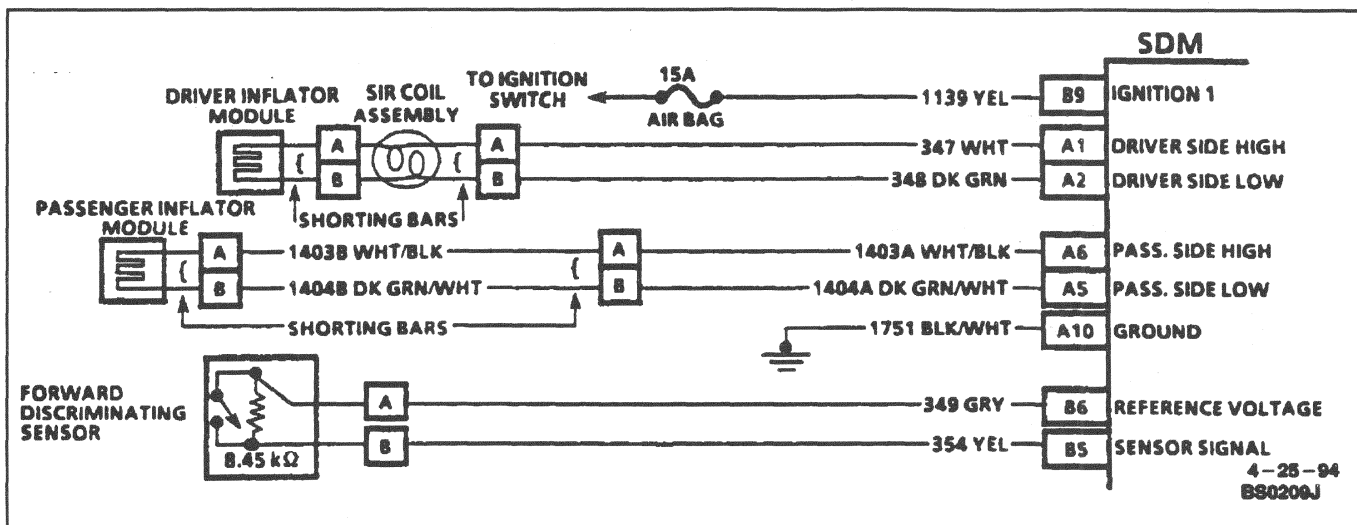
YES

NO

- IGNITION SWITCH "OFF."
- REPLACE SIR COIL ASSEMBLY, REFER TO SECTION 3F5.

- IGNITION SWITCH "OFF."
- REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."



DTC 24

(Page 1 of 2)

INITIATOR CIRCUIT VOLTAGE LOW

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM monitors the voltages at "Driver Side Low" terminal "A2" and "Passenger Side Low" terminal "A5" to detect shorts to ground in the inflator module circuits.

DTC Will Set When:

The 36 VLR power supply in the SDM is in its normal operating voltage range and at least one of the two inflator modules is not open. Then the voltage measured at "Driver Side Low" and "Passenger Side Low" is below a specified value for 500 milliseconds. This test is run during "Turn-ON" tests and every 100 milliseconds during "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" and the voltage measured at "Passenger Side Low" are above a specified value for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is occurring in the driver inflator module circuitry.
2. This test determines whether the malfunction is occurring in the passenger inflator module circuitry.

Diagnostic Aids:

Refer to DTC 24 (Page 2 of 2).

DTC 24
(Page 1 of 2)
INITIATOR CIRCUIT VOLTAGE LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1

- IGNITION SWITCH "OFF."
 - DISCONNECT DRIVER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR LOCATED AT THE BASE OF THE STEERING COLUMN, LEAVE PASSENGER INFLATOR MODULE CONNECTED.
 - CONNECT SIR DRIVER/PASSENGER LOAD TOOL J 38715 TO DRIVER INFLATOR MODULE HARNESS CONNECTOR.
 - IGNITION SWITCH "ON."
- IS DTC 24 CURRENT?

YES

NO

2

- IGNITION SWITCH "OFF."
 - DISCONNECT PASSENGER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR LOCATED NEAR THE BASE OF THE STEERING COLUMN.
 - CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR, LEAVE DRIVER INFLATOR MODULE HARNESS CONNECTOR CONNECTED TO LOAD TOOL.
 - IGNITION SWITCH "ON."
- IS DTC 24 CURRENT?

- IGNITION SWITCH "OFF."
- REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
- REMOVE AND INSPECT SIR COIL AND CONNECTING WIRES FOR DAMAGE. DETERMINE AND REPAIR THE CAUSE OF DAMAGE AND REPLACE SIR COIL, REFER TO SECTION 3F5.

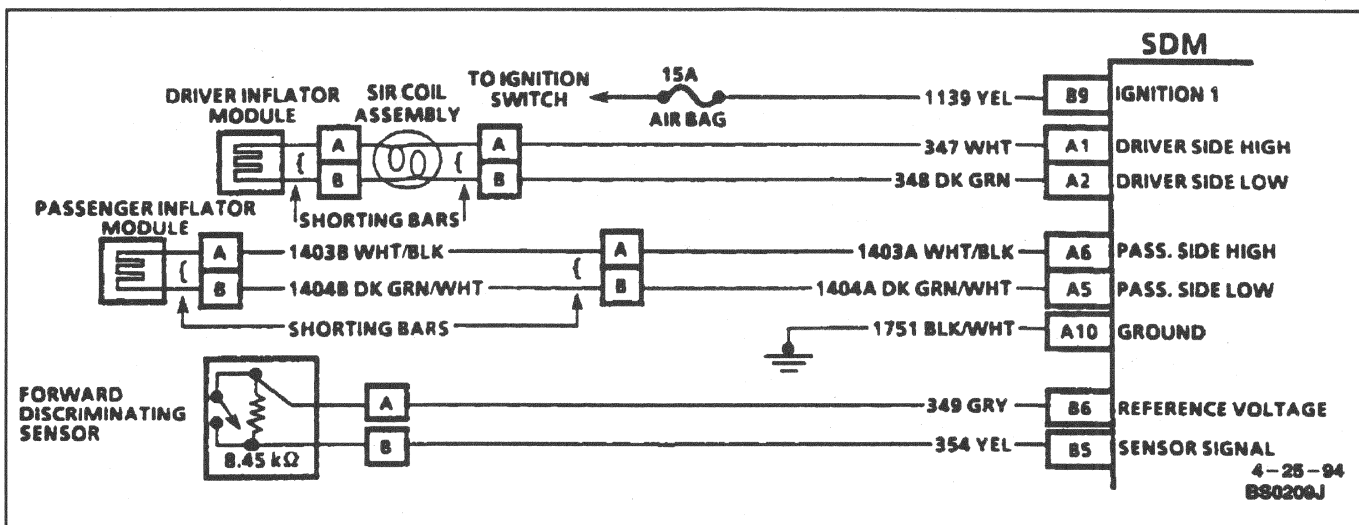
YES

NO

CONTINUE WITH DIAGNOSIS ON NEXT PAGE.

- IGNITION SWITCH "OFF."
- REPLACE PASSENGER INFLATOR MODULE.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."



DTC 24

(Page 2 of 2)

INITIATOR CIRCUIT VOLTAGE LOW

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM monitors the voltages at "Driver Side Low" terminal "A2" and "Passenger Side Low" terminal "A5" to detect shorts to ground in the inflator module circuits.

DTC Will Set When:

The 36 VLR power supply in the SDM is in its normal operating voltage range and at least one of the two inflator modules is not open. Then the voltage measured at "Driver Side Low" and "Passenger Side Low" is below a specified value for 500 milliseconds. This test is run during "Turn-ON" tests and every 100 milliseconds during "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" and the voltage measured at "Passenger Side Low" are above a specified value for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

3. This test checks for a short from "Driver Side High" to ground.
4. This test checks for a short from "Driver Side Low" to ground.
5. This test checks for a short from "Passenger Side Low" to ground.
6. This test checks for a short from "Passenger Side High" to ground.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short to ground in the inflator module circuits. Inspect CKTs 347, 348, 1403 and 1404 carefully for cutting or chafing. If the wiring pigtail of the SIR coil assembly, driver inflator module or passenger inflator module is damaged the component must be replaced.

DTC 24

(Page 2 of 2)

INITIATOR CIRCUIT VOLTAGE LOW

WERE YOU SENT HERE FROM DTC 24 (PAGE 1 OF 2)?

YES

NO

GO TO DTC 24 (PAGE 1 OF 2).

3

•IGNITION SWITCH "OFF."
•DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
•DISCONNECT SDM.
•MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM
TERMINAL "A1" TO TERMINAL "A10" (GROUND).
DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 347 TO GROUND.

4

•MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM
TERMINAL "A2" TO TERMINAL "A10" (GROUND).
DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 348 TO GROUND.

5

•MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM
TERMINAL "A5" TO TERMINAL "A10" (GROUND).
DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 1404 TO GROUND.

6

•MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM
TERMINAL "A6" TO TERMINAL "A10" (GROUND).
DOES J 39200 DISPLAY "OL" (INFINITE)?

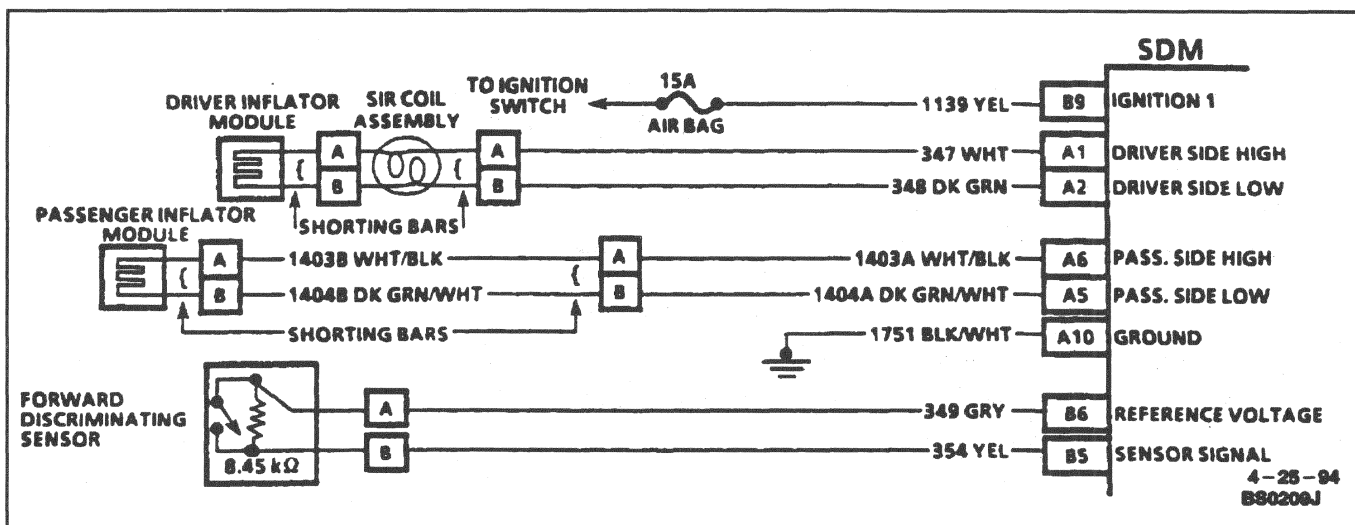
YES

NO

REPAIR SHORT FROM CKT 1403 TO GROUND.

GO TO CHART A.

•RECONNECT ALL SIR SYSTEM COMPONENTS.
ENSURE ALL COMPONENTS ARE PROPERLY
MOUNTED.
•CLEAR SIR DIAGNOSTIC TROUBLE CODES.
•REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."



DTC 25

(Page 1 of 2)

INITIATOR CIRCUIT SHORT TO IGNITION

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM monitors the voltages at "Driver Side Low" terminal "A2" and "Passenger Side Low" terminal "A5" to detect shorts to B+ in the inflator module circuits.

DTC Will Set When:

The 36 VLR power supply in the SDM is in its normal operating voltage range and neither of the two inflator modules is open. Then the voltage measured at "Driver Side Low" and "Passenger Side Low" is within a specified range. Once these conditions are met the SDM will ground "Driver Side Low" and "Passenger Side Low" through a resistor and check that "Ignition 1" is in the normal operating voltage range. When all previous conditions are met and the

voltage measured at "Driver Side Low" and at "Passenger Side Low" is above a specified value, DTC 25 will set.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp, sets DTC 25 and also DTC 71.

DTC Will Clear When:

The malfunction is no longer occurring and the ignition switch is turned "OFF," however, DTC 71 will remain current.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

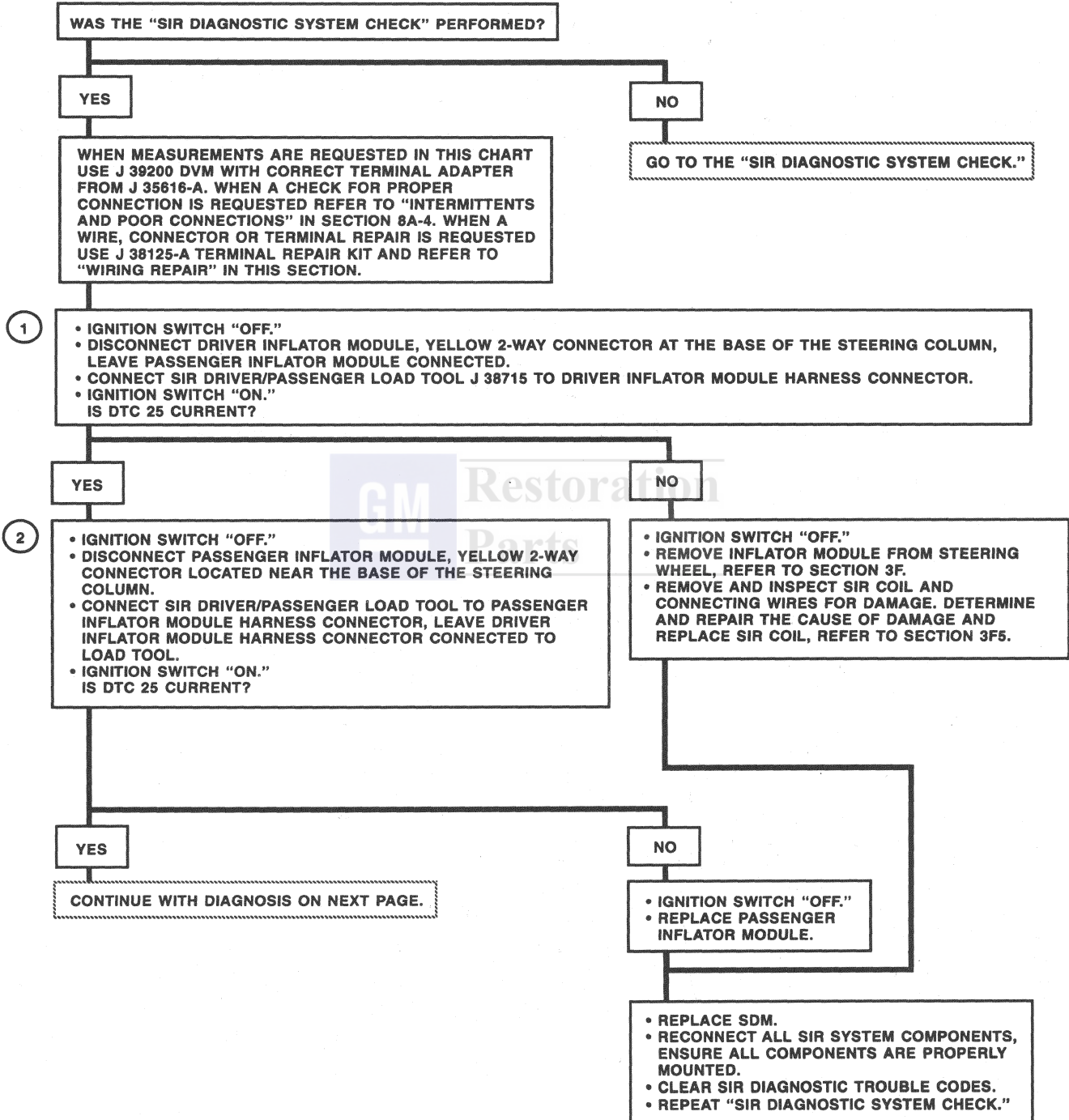
1. This test determines whether the malfunction is occurring in the driver inflator module circuitry.
2. This test determines whether the malfunction is occurring in the passenger inflator module circuitry.

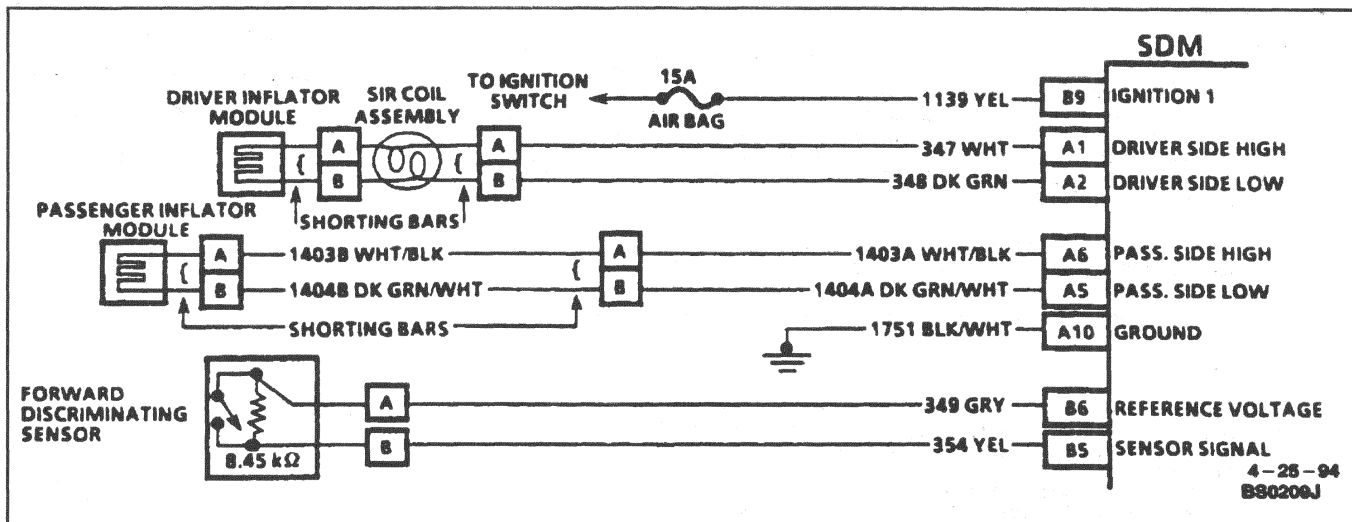
Diagnostic Aids:

Refer to DTC 25 (Page 2 of 2).

NOTICE: WHEN DTC 25 HAS BEEN SET IT IS NECESSARY TO REPLACE THE SDM. SETTING DTC 25 WILL ALSO CAUSE DTC 71 TO SET. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND THE MALFUNCTION IS STILL PRESENT, DTCs 25 AND 71 WILL REMAIN CURRENT. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND MALFUNCTION IS NO LONGER PRESENT, DTC 25 WILL CLEAR BUT DTC 71 WILL REMAIN CURRENT. ENSURE THAT THE SHORT TO B+ CONDITION IS REPAIRED PRIOR TO INSTALLING A REPLACEMENT SDM TO AVOID DAMAGING THE SDM.

DTC 25 (Page 1 of 2) INITIATOR CIRCUIT SHORT TO IGNITION





DTC 25

(Page 2 of 2)

INITIATOR CIRCUIT SHORT TO IGNITION

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM monitors the voltages at "Driver Side Low" terminal "A2" and "Passenger Side Low" terminal "A5" to detect shorts to B+ in the inflator module circuits.

DTC Will Set When:

The 36 VLR power supply in the SDM is in its normal operating voltage range and neither of the two inflator modules is open. Then the voltage measured at "Driver Side Low" and "Passenger Side Low" is within a specified range. Once these conditions are met the SDM will ground "Driver Side Low" and "Passenger Side Low" through a resistor and check that "Ignition 1" is in the normal operating voltage range. When all previous conditions are met and the voltage measured at "Driver Side Low" and at "Passenger Side Low" is above a specified value, DTC 25 will set.

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp, sets DTC 25 and also DTC 71.

DTC Will Clear When:

The malfunction is no longer occurring and the ignition switch is turned "OFF," however, DTC 71 will remain current.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

3. This test checks for a short from "Driver Side High" to B+.
4. This test checks for a short from "Driver Side Low" to B+.
5. This test checks for a short from "Passenger Side High" to B+.
6. This test checks for a short from "Passenger Side Low" to B+.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short to B+ in the inflator module circuits. A DTC 25 history would be accompanied by DTC 71 current. A careful inspection of the circuits and components indicated on DTC 25 charts is essential to ensure that the replacement SDM will not be damaged.

DTC 25 (Page 2 of 2) INITIATOR CIRCUIT SHORT TO IGNITION

NOTICE: WHEN DTC 25 HAS BEEN SET IT IS NECESSARY TO REPLACE THE SDM. SETTING DTC 25 WILL ALSO CAUSE DTC 71 TO SET. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND THE MALFUNCTION IS STILL PRESENT, DTCs 25 AND 71 WILL REMAIN CURRENT. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND MALFUNCTION IS NO LONGER PRESENT, DTC 25 WILL CLEAR BUT DTC 71 WILL REMAIN CURRENT. ENSURE THAT THE SHORT TO B+ CONDITION IS REPAIRED PRIOR TO INSTALLING A REPLACEMENT SDM TO AVOID DAMAGING THE SDM.

WERE YOU SENT HERE FROM DTC 25 (PAGE 1 OF 2)?

YES

NO

GO TO DTC 25 (PAGE 1 OF 2).

3

•IGNITION SWITCH "OFF."
•CONNECT SIR DRIVER/PASSENGER LOAD TOOL.
•DISCONNECT SDM.
•IGNITION SWITCH "ON."
•MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "A1" TO TERMINAL "A10" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?

YES

NO

4

•MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "A2" TO TERMINAL "A10" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?

•IGNITION SWITCH "OFF."
•REPAIR SHORT FROM CKT 347 TO B+.

YES

NO

5

•MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "A6" TO TERMINAL "A10" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?

•IGNITION SWITCH "OFF."
•REPAIR SHORT FROM CKT 348 TO B+.

YES

NO

6

•MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "A5" TO TERMINAL "A10" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?

•IGNITION SWITCH "OFF."
•REPAIR SHORT FROM CKT 1403 TO B+.

YES

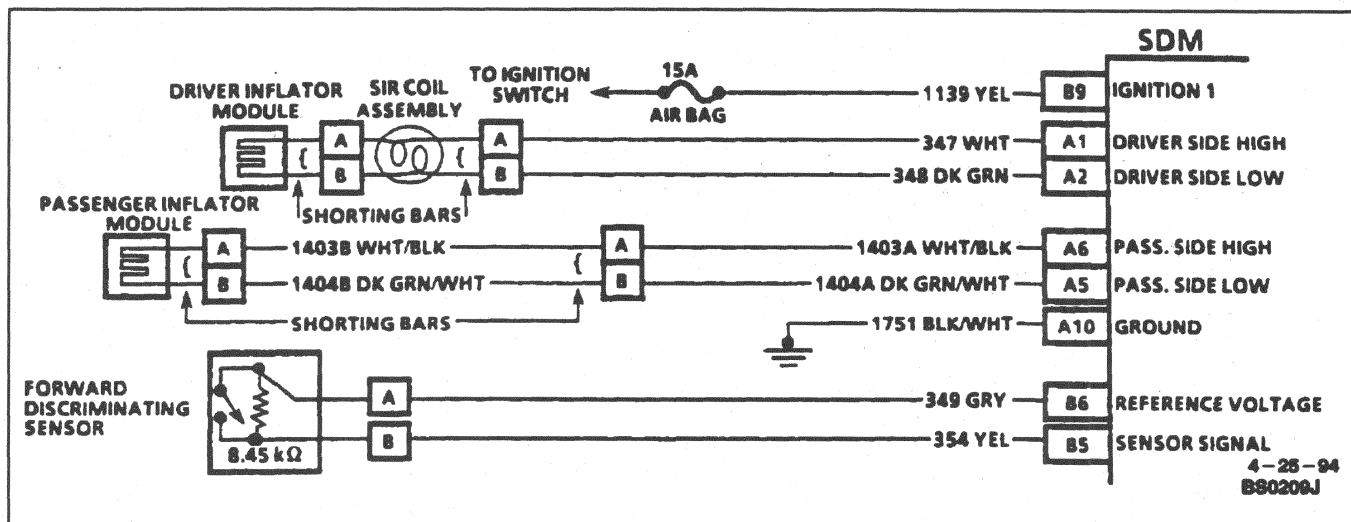
NO

GO TO CHART A.

•IGNITION SWITCH "OFF."
•REPAIR SHORT FROM CKT 1404 TO B+.

•REPLACE SDM.
•RECONNECT ALL SIR SYSTEM COMPONENTS,
ENSURE ALL COMPONENTS ARE PROPERLY
MOUNTED.
•CLEAR SIR DIAGNOSTIC TROUBLE CODES.
•REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-40 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 26 DRIVER INITIATOR CIRCUIT OPEN

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics." "Driver Side Low" terminal "A2" is grounded through a resistor and the driver current source connected to "Driver Side High" terminal "A1" allows a known amount of current to flow. After "Current Source Diagnostics" are completed the SDM removes the low resistance ground from "Driver Side Low" and switches the driver current source at "Driver Side High." The SDM then measures the voltage at "Driver Side High" and "Driver Side Low" during "Continuous Monitoring." By monitoring the voltage difference between "Driver Side High" and "Driver Side Low" the SDM calculates the combined resistance of the SIR coil assembly, driver inflator module, harness wiring CKTs 347 and 348, and connector terminal contact.

DTC Will Set When:

The voltage difference between "Driver Side High" terminal "A1" and "Driver Side Low" terminal "A2" is above or equal to a specified value for 500 milliseconds during "Current Source Diagnostics" or "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage difference between "Driver Side High" terminal "A1" and "Driver Side Low" terminal "A2" is below a specified value for 500 milliseconds during "Continuous Monitoring."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the driver inflator module circuitry or in the SDM wiring harness circuitry.
2. This test checks whether the malfunction is due to high resistance in CKT 347.
3. This test checks whether the malfunction is due to high resistance in CKT 348.
4. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at the driver inflator module terminals "A" and "B," SIR coil assembly terminals "A" and "B," SDM terminals "A1" and "A2," or an open in CKT 347 or CKT 348.

DTC 26 **DRIVER INITIATOR CIRCUIT OPEN**

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- CHECK FOR PROPER CONNECTION TO SIR COIL ASSEMBLY CONNECTOR AT TERMINALS "A" AND "B."
- IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO DRIVER AND PASSENGER INFLATOR MODULE HARNESS CONNECTORS, LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- IGNITION SWITCH "ON."
- IS DTC 26 CURRENT?

YES

NO

2

- IGNITION SWITCH "OFF."
- DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
- DISCONNECT SDM.
- CHECK FOR PROPER CONNECTION TO SDM AT TERMINALS "A1" AND "A2."
- IF OK THEN MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A1" TO DRIVER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "A."
- IS RESISTANCE 2.0Ω OR LESS?

4

- IGNITION SWITCH "OFF."
- DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM DRIVER INFLATOR MODULE HARNESS CONNECTOR.
- REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
- CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
- RECONNECT DRIVER INFLATOR MODULE HARNESS CONNECTOR AT THE BASE OF THE STEERING COLUMN.
- IGNITION SWITCH "ON."
- IS DTC 26 CURRENT?

YES

NO

3

- MEASURE RESISTANCE FROM SDM HARNESS CONNECTOR TERMINAL "A2" TO DRIVER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B."
- IS RESISTANCE 2.0Ω OR LESS?

REPAIR HIGH RESISTANCE OR OPEN IN CKT 347.

YES

NO

- IGNITION SWITCH "OFF."
- REPLACE SIR COIL ASSEMBLY, REFER TO SECTION 3F5.

- IGNITION SWITCH "OFF."
- REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.

YES

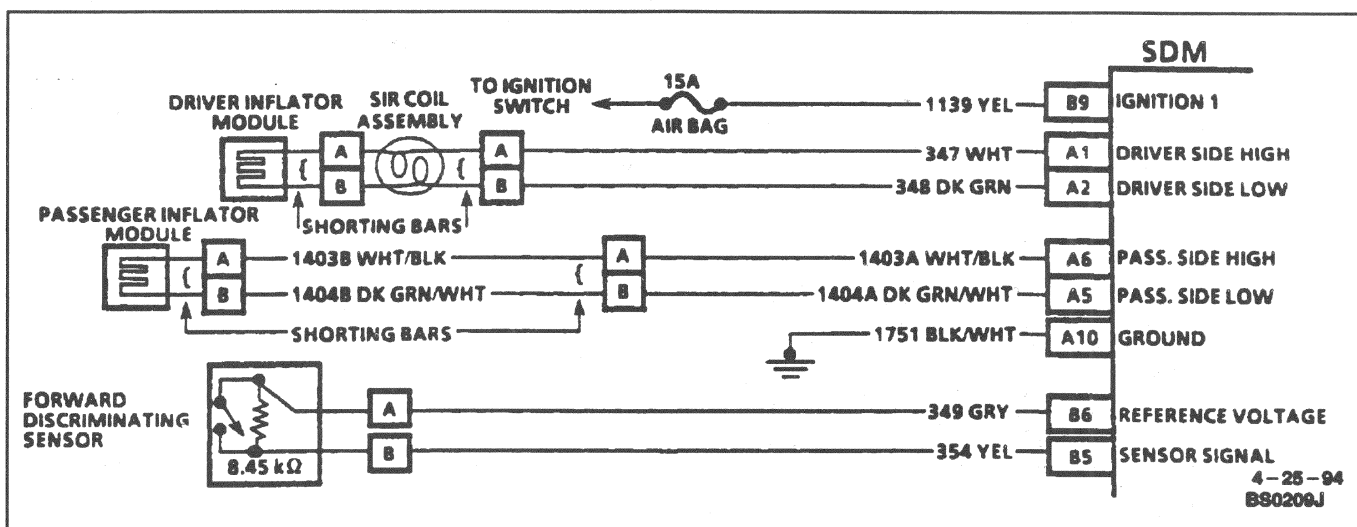
NO

GO TO CHART A.

REPAIR HIGH RESISTANCE OR OPEN IN CKT 348.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

9J-42 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 35

DISCRIMINATING SENSOR OPEN OR SHORT TO GROUND

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics" followed by "Continuous Monitoring." The SDM supplies "Reference Voltage" at terminal "B6" and measures the voltage at "Sensor Signal" terminal "B5." During normal operation the voltage measured at "Sensor Signal" will be about one half the "Reference Voltage."

DTC Will Set When:

The voltage measured at "Sensor Signal" terminal "B5" is below a specified value for 500 milliseconds during "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Sensor Signal" terminal "B5" is in its normal range for 500 milliseconds during "Continuous Monitoring."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks proper resistance of the forward discriminating sensor.
2. This test checks for an open in the "Reference Voltage" circuit.
3. This test checks for an open in the "Sensor Signal" circuit.
4. This test checks for a short from "Reference Voltage" to ground.
5. This test checks for a short from "Sensor Signal" to ground.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the forward discriminating sensor at terminals "A" or "B," poor connection to the SDM at terminals "B5" or "B6," a short to ground in CKT 349 or CKT 354, or an open in CKT 349 or CKT 354.

DTC 35**DISCRIMINATING SENSOR OPEN
OR SHORT TO GROUND**

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BELOW THE I/P COMPARTMENT.
- DISCONNECT SDM.
- CHECK FOR PROPER CONNECTION TO SDM AT TERMINALS "B5" AND "B6."
- IF OK THEN DISCONNECT FORWARD DISCRIMINATING SENSOR.
- CHECK FOR PROPER CONNECTION TO FORWARD DISCRIMINATING SENSOR AT TERMINALS "A" AND "B."
- IF OK THEN MEASURE RESISTANCE OF FORWARD DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "B." IS RESISTANCE 8.54K OHMS OR LESS?

YES

NO

2

- MEASURE RESISTANCE FROM FORWARD DISCRIMINATING SENSOR HARNESS CONNECTOR TERMINAL "A" TO SDM HARNESS CONNECTOR TERMINAL "B6." IS RESISTANCE 5.0 OHMS OR LESS?

REPLACE FORWARD DISCRIMINATING SENSOR.

YES

NO

3

- MEASURE RESISTANCE FROM FORWARD DISCRIMINATING SENSOR HARNESS CONNECTOR TERMINAL "B" TO SDM HARNESS CONNECTOR TERMINAL "B5." IS RESISTANCE 5.0 OHMS OR LESS?

REPAIR OPEN CKT 349.

YES

NO

4

- MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM TERMINAL "B6" TO TERMINAL "A10" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR OPEN CKT 354.

YES

NO

5

- MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM TERMINAL "B5" TO TERMINAL "A10" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR SHORT FROM CKT 349 TO GROUND.

YES

NO

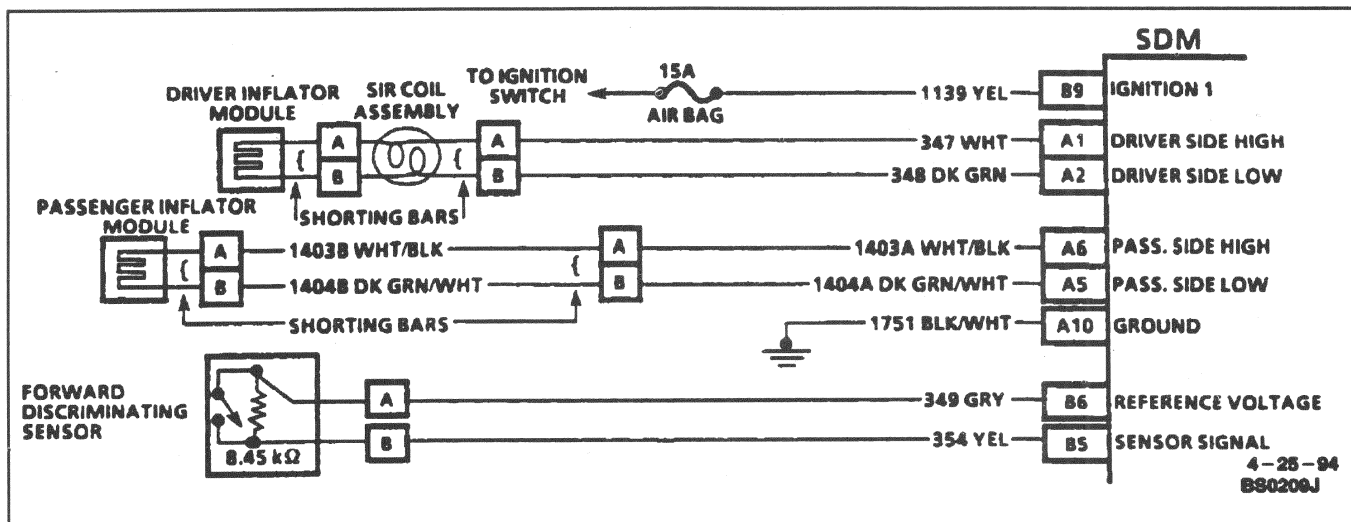
GO TO CHART A.

REPAIR SHORT FROM CKT 354 TO GROUND.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

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9J-44 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 36

DISCRIMINATING SENSOR CLOSED OR SHORT TO IGNITION

Circuit Description:

When the ignition switch is turned "ON," the SDM will perform tests to diagnose critical malfunctions within itself. Upon passing these tests "Ignition 1," 36 VLR, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SDM then proceeds with the "Current Source Diagnostics" followed by "Continuous Monitoring." The SDM supplies "Reference Voltage" at terminal "B6" and measures the voltage at "Sensor Signal" terminal "B5." During normal operation the voltage measured at "Sensor Signal" will be about one half the "Reference Voltage."

DTC Will Set When:

The voltage measured at "Sensor Signal" terminal "B5" is above a specified value for 500 milliseconds during "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Sensor Signal" terminal "B5" is in its normal range for 500 milliseconds during "Continuous Monitoring."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks proper resistance of the forward discriminating sensor.
2. This test checks for a short from the "Reference Voltage" circuit to the "Sensor Signal" circuit.
3. This test checks for a short from "Reference Voltage" to B+.
4. This test checks for a short from "Sensor Signal" to B+.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short from CKT 349 to CKT 354, a short from CKT 349 to B+, or a short from CKT 354 to B+.

DTC 36

DISCRIMINATING SENSOR CLOSED OR SHORT TO IGNITION

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN.
- DISCONNECT FORWARD DISCRIMINATING SENSOR AND SDM.
- MEASURE RESISTANCE OF FORWARD DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "B". IS RESISTANCE 8.36K OHMS OR MORE?

YES

NO

2

- MEASURE RESISTANCE ON SDM HARNESS CONNECTOR FROM TERMINAL "B5" TO TERMINAL "B6". DOES J 39200 DISPLAY "OL" (INFINITE)?

REPLACE FORWARD DISCRIMINATING SENSOR.

YES

NO

3

- IGNITION SWITCH "ON."
- MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "B6" TO TERMINAL "A10" (GROUND). IS VOLTAGE 1 VOLT OR LESS?

REPAIR SHORT FROM CKT 349 TO CKT 354.

YES

NO

4

- MEASURE VOLTAGE ON SDM HARNESS CONNECTOR FROM TERMINAL "B5" TO TERMINAL "A10" GROUND. IS VOLTAGE 1 VOLT OR LESS?

- IGNITION SWITCH "OFF."
- REPAIR SHORT FROM CKT 349 TO B+.

YES

NO

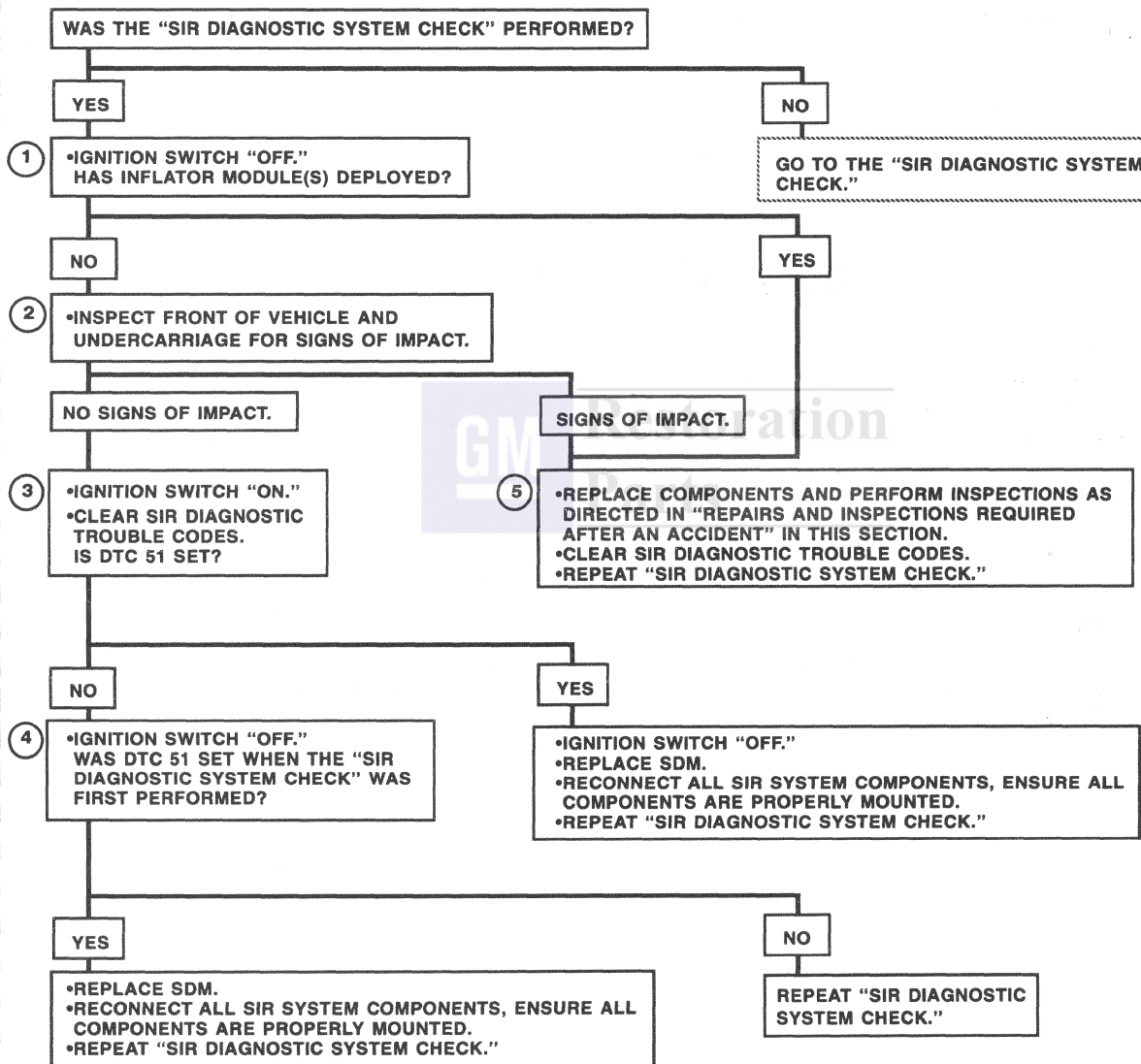
- IGNITION SWITCH "OFF."
- GO TO CHART A.

- IGNITION SWITCH "OFF."
- REPAIR SHORT FROM CKT 354 TO B+.

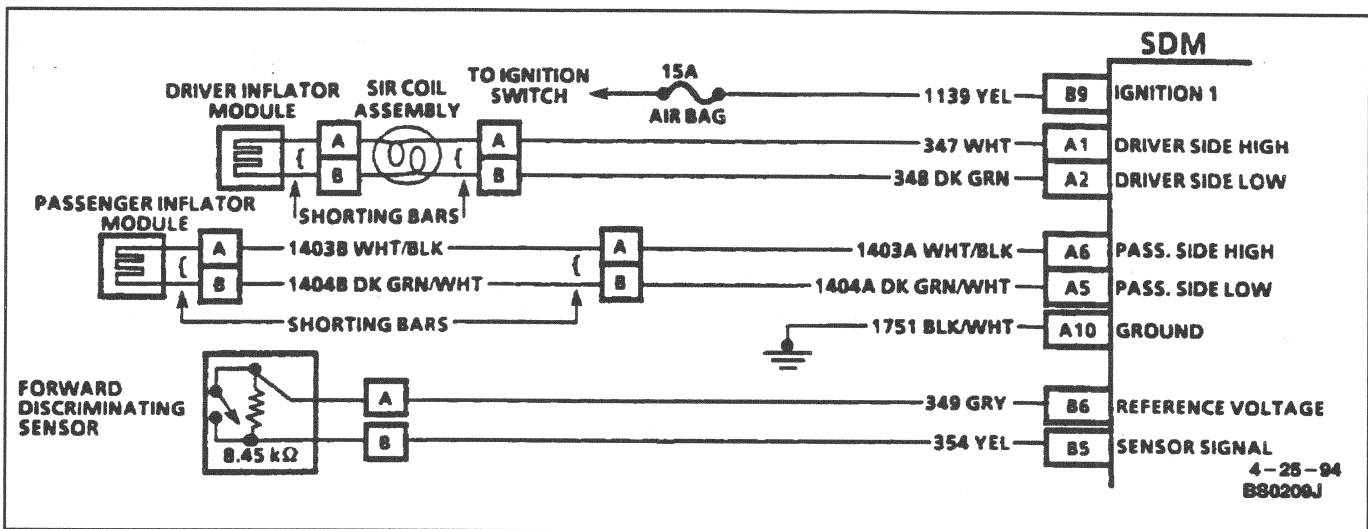
- RECONNECT ALL SIR SYSTEM COMPONENTS. ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

DTC 51 FRONTAL CRASH DETECTED

CAUTION: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING A SENSING AND DIAGNOSTIC MODULE (SDM). NEVER STRIKE OR JAR THE SDM. NEVER POWER UP THE SIR SYSTEM WHEN THE SDM IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SDM AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SIR SYSTEM. THE SDM COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.



9J-48 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 52
DATA AREA FULL

Circuit Description:

When there is a frontal crash of sufficient force, up to 30 degrees off the centerline of the vehicle, the SDM will cause enough current to flow to deploy the air bags and will set DTC 51. At this time the SDM will record information regarding SIR system status and vehicle status in EEPROM. DTC 52 will set when the SDM has stored information regarding two frontal crash events.

DTC Will Set When:

The SDM attempts to store frontal crash information and finds the EEPROM data area full. This test is run each time the SDM stores or attempts

to store information regarding a frontal crash event and also during the "Turn-ON" tests.

Action Taken:

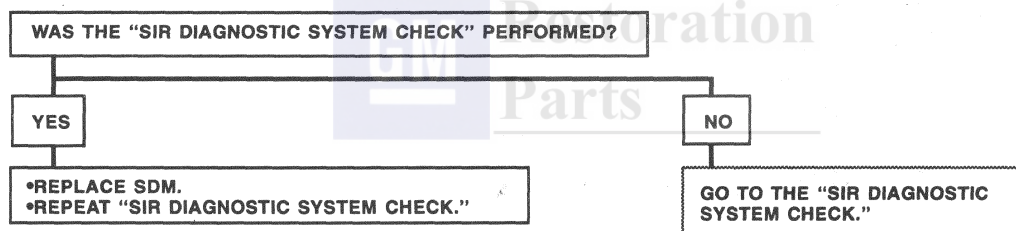
SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

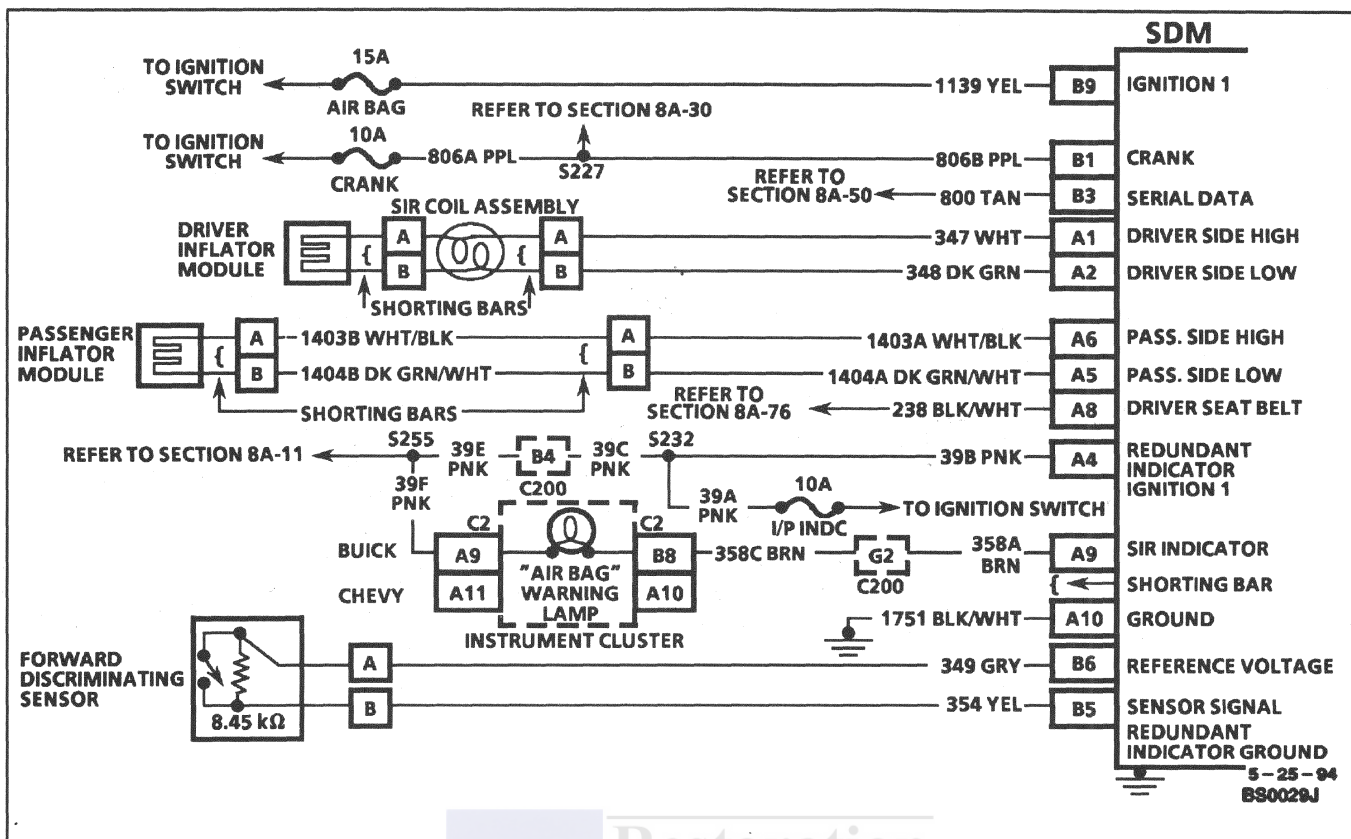
A scan tool "Clear Codes" command is received by the SDM. If, at the next ignition "ON" after receiving a "Clear Codes" command, the SDM detects the data area is full, a history diagnostic trouble code is set. This allows the "AIR BAG" warning lamp to illuminate should any additional malfunctions be detected.

DTC 52
DATA AREA FULL

CAUTION: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING A SENSING AND DIAGNOSTIC MODULE (SDM). NEVER STRIKE OR JAR THE SDM. NEVER POWER UP THE SIR SYSTEM WHEN THE SDM IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SDM AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SIR SYSTEM. THE SDM COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.



9J-50 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 61

SIR INDICATOR CIRCUIT FAILURE

Circuit Description:

When the ignition switch is first turned "ON" battery voltage is applied to the "AIR BAG" warning lamp and to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times alternating between the primary and redundant lamp drivers. The SDM monitors the primary lamp driver output by comparing the output state at "SIR Indicator" terminal "A9" to the microprocessor commanded state. When "Ignition 1" is above a specified value and the output state does not match the commanded state of the primary lamp driver for 400 milliseconds DTC 61 is set.

DTC Will Set When:

"Ignition 1" voltage is above a specified value and the output state at the "SIR Indicator" terminal "A9" does not match the commanded state of the primary lamp driver for 400 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

SDM attempts to turn "ON" the "AIR BAG" warning lamp using the redundant lamp driver and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

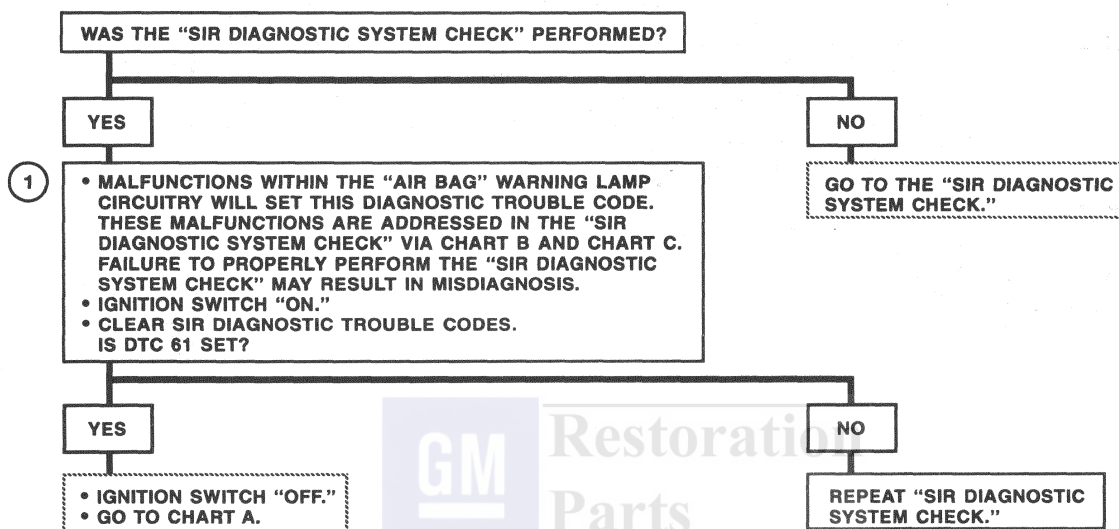
DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

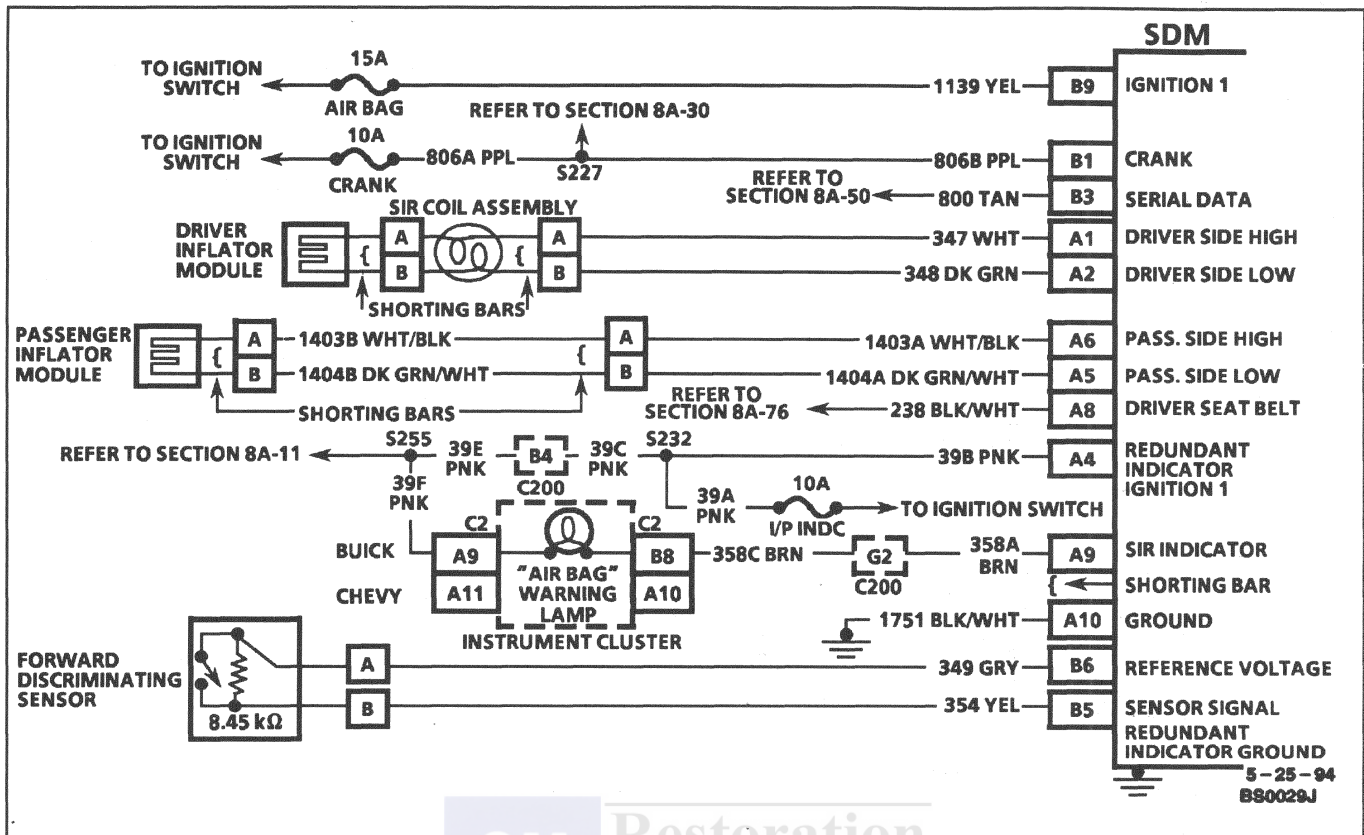
- When the SDM is configured for a serial data controlled warning lamp (smart cluster) DTC 61 will set. Clearing SIR diagnostic trouble codes will reset the SDM allowing the SDM to control the "AIR BAG" warning lamp.

Diagnostic Aids: Refer to CHARTS B and C to diagnose warning lamp circuit malfunctions.

DTC 61 SIR INDICATOR CIRCUIT FAILURE



9J-52 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 62

REDUNDANT SIR INDICATOR CIRCUIT FAILURE

Circuit Description:

When the ignition switch is first turned "ON" battery voltage is applied to the "AIR BAG" warning lamp and to the "Ignition 1" input, terminal "B9." The SDM responds by flashing the "AIR BAG" warning lamp seven times alternating between the primary and redundant lamp drivers. The SDM monitors the redundant lamp driver output by comparing the output state at "SIR Indicator" terminal "A9" to the microprocessor commanded state. When "Ignition 1" is above a specified value and the output state does not match the commanded state of the redundant lamp driver for 400 milliseconds DTC 62 is set.

DTC Will Set When:

"Ignition 1" voltage is above a specified value and the output state at the "SIR Indicator" terminal "A9" does not match the commanded state of the redundant lamp driver for 400 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

SDM attempts to turn "ON" the "AIR BAG" warning lamp using the primary lamp driver and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

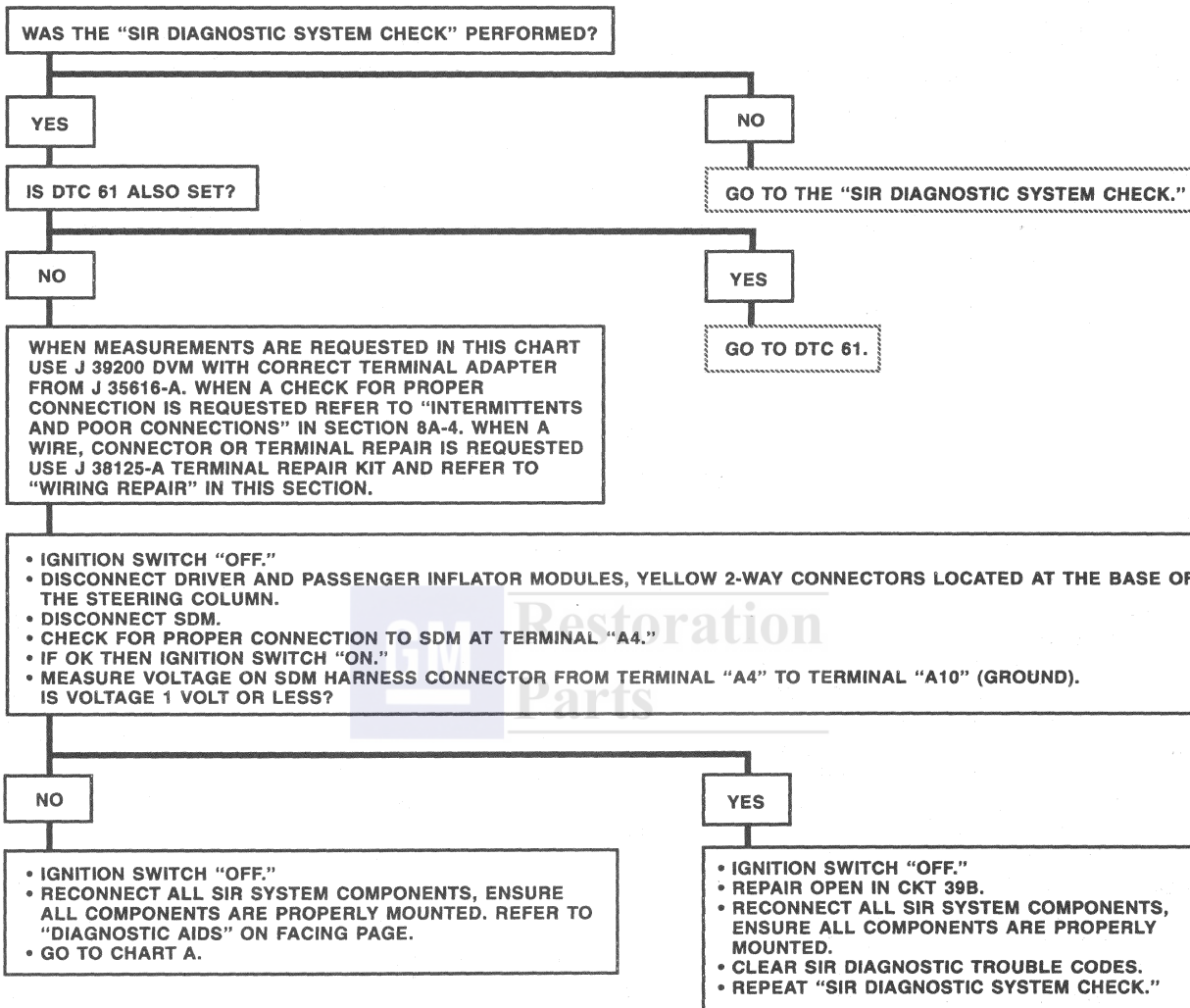
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is due to an open in the "Redundant Indicator Ignition 1" circuit.

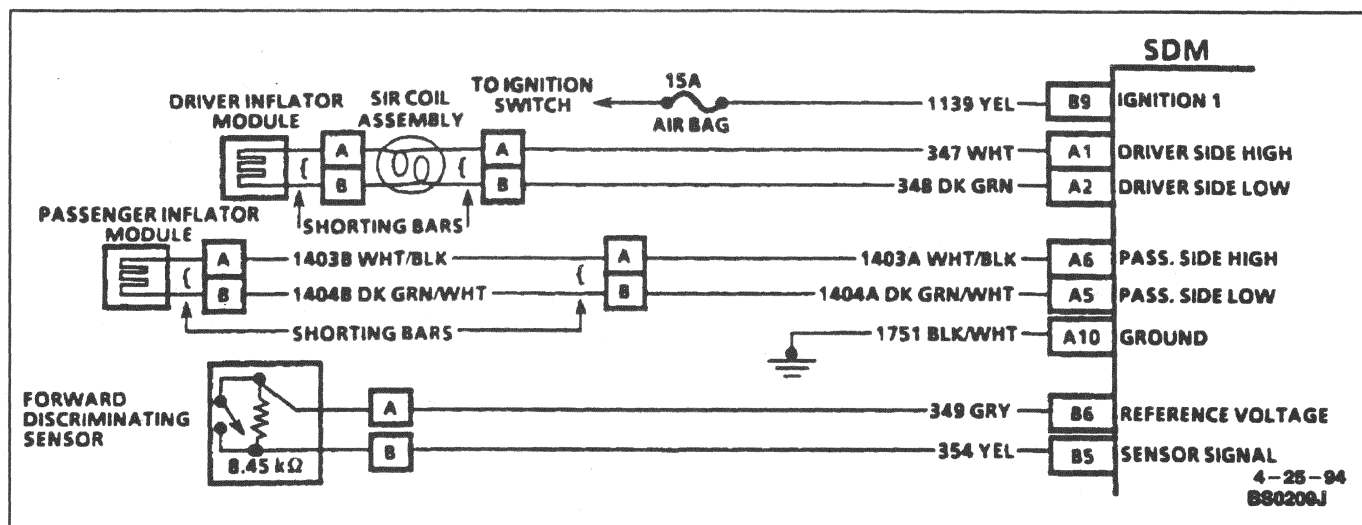
Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the SDM at terminal "A4" or an open in CKT 39B. A poor "Redundant Indicator Ground" connection to the SDM would set DTC 62. It is important that the SDM mounting surface is free of any dirt or foreign material and that the fasteners are properly torqued to ensure a good "Redundant Indicator Ground."

DTC 62 REDUNDANT SIR INDICATOR CIRCUIT FAILURE



9J-54 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM



DTC 71 INTERNAL SDM FAULT

Circuit Description:

DTC 71 is an indication of a potential internal SDM malfunction and will set if any of the following conditions are detected: 1) 36 VLR voltage out of normal operating range, 2) Crash data recording reserve voltage discharge time failure for three consecutive ignition cycles, 3) The calculated checksum for internal memory does not match the stored value, 4) The voltage measured at "Driver Side Low" and/or "Passenger Side Low" is too high, 5) The sensing device inside the SDM which converts vehicle velocity changes to an electrical signal is malfunctioning, 6) The driver current source and/or passenger current source is malfunctioning, 7) The temporary memory storage area is malfunctioning, 8) SDM is unable to read from or write to EEPROM, 9) The arming sensor inside the SDM is not closed during a deployment event, 10) DTC 25 has been set.

DTC Will Set When:

Any of the above indicated malfunctions are detected by the SDM. The malfunctions described above are tested at different times: 1) "Turn-ON" and "Continuous Monitoring," 2) "Turn-ON," 3) "Turn-ON," 4) "Continuous Monitoring," 5) "Turn-ON" and "Continuous Monitoring," 6) "Current Source Diagnostics," 7) "Turn-ON," 8) "Turn-ON," 9) Asynchronously, 10) "Turn-ON" and "Continuous Monitoring."

Action Taken:

SDM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

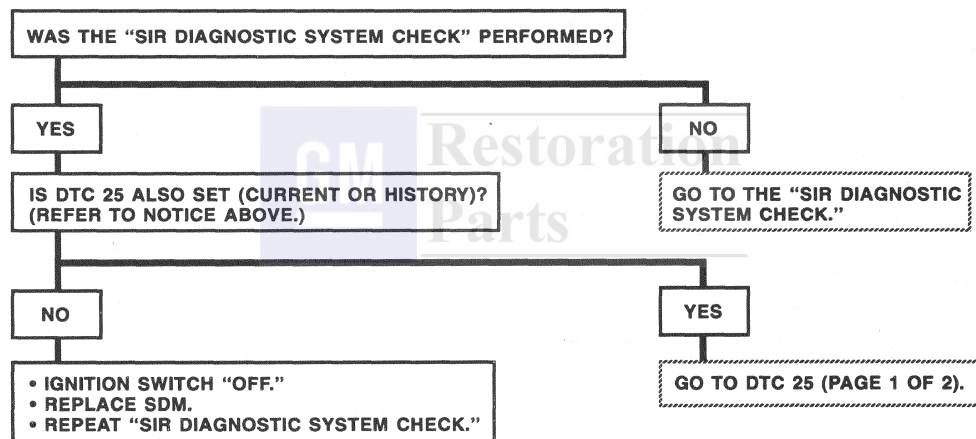
DTC Will Clear When:

A scan tool "Clear Codes" command is received by the SDM. Some of the indicated malfunctions will only allow the "AIR BAG" warning lamp to go out briefly then come back "ON."

DTC 71 INTERNAL SDM FAULT

CAUTION: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING A SENSING AND DIAGNOSTIC MODULE (SDM). NEVER STRIKE OR JAR SDM. NEVER POWER UP THE SIR SYSTEM WHEN THE SDM IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SDM AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SIR SYSTEM. THE SDM COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.

NOTICE: WHEN DTC 25 HAS BEEN SET IT IS NECESSARY TO REPLACE THE SDM. SETTING DTC 25 WILL ALSO CAUSE DTC 71 TO SET. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND THE MALFUNCTION IS STILL PRESENT, DTCs 25 AND 71 WILL REMAIN CURRENT. WHEN A SCAN TOOL "CLEAR CODES" COMMAND IS ISSUED AND MALFUNCTION IS NO LONGER PRESENT, DTC 25 WILL CLEAR BUT DTC 71 WILL REMAIN CURRENT. ENSURE THAT THE SHORT TO B+ CONDITION IS REPAIRED PRIOR TO INSTALLING A REPLACEMENT SDM TO AVOID DAMAGING THE SDM.



ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The SDM can maintain sufficient voltage to cause a deployment for up to 10 seconds after the ignition switch is turned "OFF," the battery is disconnected or the fuse powering the SDM is removed. Many of the service procedures require removal of the "AIR BAG" fuse and disconnection of the deployment loops to avoid an accidental deployment.

Disabling the SIR System

Figure 9

 Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
- Turn the ignition switch to "LOCK" and remove key.
- 1. "AIR BAG" fuse from I/P fuse block.
- 2. Connector Position Assurance (CPA) and yellow 2-way connector for both connectors located near the base of the steering column.

 Important

- With the "AIR BAG" fuse removed and ignition switch "ON," the "AIR BAG" warning lamp will be "ON." This is normal operation and does not indicate a SIR system malfunction.

Enabling the SIR System

Figure 9

 Install or Connect

- Turn ignition switch to "LOCK" and remove key.
- 1. Both yellow 2-way connectors located near the base of the steering column and the corresponding CPA.
- 2. "AIR BAG" fuse to I/P fuse block.
- Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes seven times and then turns "OFF." If it does not operate as described, perform the "SIR Diagnostic System Check" in this section.

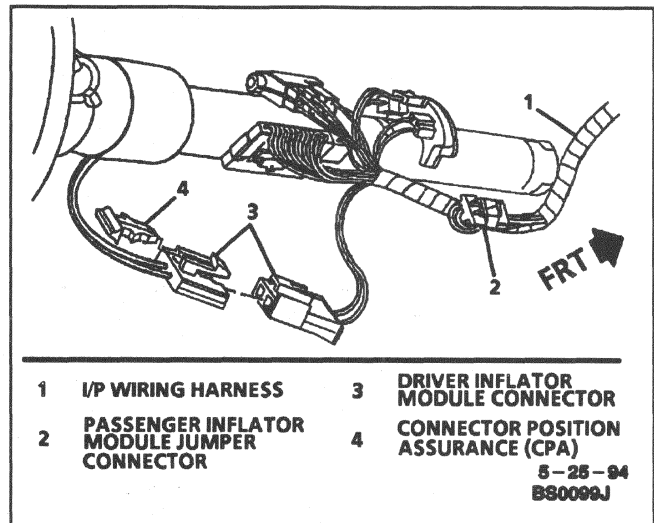


Figure 9 - Yellow 2-Way SIR Connectors (Driver and Passenger)

Handling/Installation/Diagnosis

1. Inflator modules should not be subjected to temperatures above 65°C (150°F).
2. Discriminating sensors, inflator modules, or SDMs should not be used if they have been dropped from a height of 91.4 centimeters (3 feet) or greater.
3. When a discriminating sensor or SDM is replaced, it MUST be oriented with the arrow on the sensor pointing toward the front of the vehicle. It is very important for the discriminating sensor and the SDM to be located flat on the mounting surface, parallel to the vehicle datum line. It is important that the mounting surface is free of any dirt or other foreign material.
4. Do not apply power to the SIR system unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.
5. The "SIR Diagnostic System Check" must be the starting point of any SIR diagnostics. The "SIR Diagnostic System Check" will verify proper "AIR BAG" warning lamp operation and will lead you to the correct chart to diagnose any SIR malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacements.

REPAIRS AND INSPECTIONS REQUIRED AFTER AN ACCIDENT

 Important

- If any SIR system components are damaged, they must be replaced. If SIR component mounting points are damaged, they must be repaired or replaced.
- Never use SIR parts from another vehicle. This does not include remanufactured parts purchased from an authorized GM dealer; they may be used for SIR repairs.

- Do not attempt to service discriminating sensors, the SDM, the SIR coil assembly, or the inflator modules. Service of these items is by replacement only.
- Verify the part number of replacement inflator modules. Some GM inflator modules look identical but contain different internal components.

CAUTION: Proper operation of the sensors and Supplemental Inflatable Restraint (SIR) system requires that any repairs to the vehicle structure return it to the original production configuration. Deployment requires, at a minimum, replacement of the sensors, the inflator modules, and dimensional inspection of the steering column. Any visible damage to the SDM mounting bracket(s) requires replacement, sensors in the area of accident damage must be replaced, and the steering column must be dimensionally inspected, whether deployment occurred or not.

Accident With Deployment - Component Replacement and Inspections

Certain SIR components must be replaced or inspected for damage after a frontal crash involving air bag deployment. Those components are:

- Inflator modules.
- All SIR system sensors.

! Important

- Refer to "Sensor Replacement Guidelines" below for important information on sensor replacement in both deployment and non-deployment crashes.

Inspect and replace, if necessary, the following SIR components:

- SIR coil assembly - Inspect wiring and connector for any signs of scorching, melting, or damage due to excessive heat. Replace if damaged. Refer to SECTION 3F5.

Accident With or Without Deployment - Component Inspections

Certain SIR and restraint system components must be inspected after any crash, whether the air bag deployed or not. These components are:

- Steering column - Dimensionally inspect per "Checking Steering Column for Accident Damage" in SECTION 3F5.
- Sensors, if in the area of accident damage.

! Important

- Refer to "Sensor Replacement Guidelines" below for important information on sensor replacement in both deployment and non-deployment crashes.

- Knee bolsters and mounting points - Inspect for any distortion, bending, cracking, or other damage.
- I/P steering column reinforcement plate - Inspect for any distortion, bending, cracking, or other damage.
- I/P braces - Inspect for any distortion, bending, cracking, or other damage.
- Seat belts and mounting points - Refer to "Seat Belts" in SECTION 10-11.

Sensor Replacement Guidelines

SIR sensor replacement policy requires replacement of the sensors in the area of accident damage only.

The "area of accident damage" is defined as that area of the vehicle which is crushed, bent, or damaged in other ways. An example might be a significant front-end collision in which the forward portions of the vehicle have contacted another vehicle, tree, guardrail, etc. In this example, a sensor on the front of the vehicle, such as the radiator tie bar, would require replacement, since that portion of the vehicle was damaged in the accident. A sensor in the passenger compartment, such as the SDM would not require mandatory replacement. Of course, if the SDM sets a diagnostic trouble code and the diagnostic chart leads to a malfunctioning sensor that was not in the area of accident damage, that sensor should also be replaced.

Sensors in the area of accident damage should be replaced even if those sensors do not appear to be damaged. Do not attempt to determine whether a sensor is OK - ALWAYS replace it if it is in the area of accident damage.

Also, if a sensor is in an area of accident damage, but the SIR system has NOT been deployed, replace the sensor. The sensor bracket may be slightly bent, wiring may be damaged, etc., and the sensor might not work properly in another collision. Again, do not attempt to determine whether a sensor is OK - ALWAYS replace it if it is in the area of accident damage.

SENSING AND DIAGNOSTIC MODULE (SDM)

Figure 10

CAUTION: During service procedures, be very careful when handling a Sensing and Diagnostic Module (SDM). Never strike or jar the SDM. Never power up the SIR system when the SDM is not rigidly attached to the vehicle. All SDM and mounting bracket fasteners must be carefully torqued and the arrow must be pointing toward the front of the vehicle to ensure proper operation of the SIR system. The SDM could be activated when powered while not rigidly attached to the vehicle which could cause deployment and result in personal injury.

9J-58 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

NOTICE: If the vehicle interior has been exposed to extensive water intrusion, such as water leaks, window left open, driving through high water and so forth, the Sensing and Diagnostic Module (SDM) may need to be replaced. With the ignition "OFF," inspect the area under the front seat and the area around the SDM, including the carpet. If any significant soaking or evidence of significant soaking is detected, the water must be removed, water damage repaired and the SDM must be replaced. Before attempting any of these repairs, the SIR system must be disabled. See section 9J under "ON-VEHICLE SERVICE" for instructions on how to disable the SIR system and replace the SDM.

↔ Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.
- 1. Accelerator pedal assembly, refer to SECTION 6C.
- 2. Connector Position Assurance (CPA) and electrical connector.
- 3. Fasteners from SDM.
- 4. SDM from vehicle.

CAUTION: Proper operation of the Sensing and Diagnostic Module (SDM) requires the SDM to be rigidly attached to the vehicle structure and that the arrow on the sensor be pointing toward the front of the vehicle.

→← Install or Connect

- 1. SDM to vehicle, ensure arrow is pointing toward the front of the vehicle.
- 2. SDM Fasteners.

Tighten

- Fasteners to 8.5 N·m (75 lb. in.).
- 3. Electrical connector and CPA.
- 4. Accelerator pedal assembly, refer to SECTION 6C.
- Enable the SIR system, refer to "Enabling the SIR System" in this section.

FORWARD DISCRIMINATING SENSOR

Figure 11

CAUTION: During service procedures, be very careful when handling a sensor. Never strike or jar a sensor. Under some circumstances, it could cause improper operation of the Supplemental Inflatable Restraint (SIR) system. All sensors and mounting bracket bolts must be carefully torqued to assure proper operation.

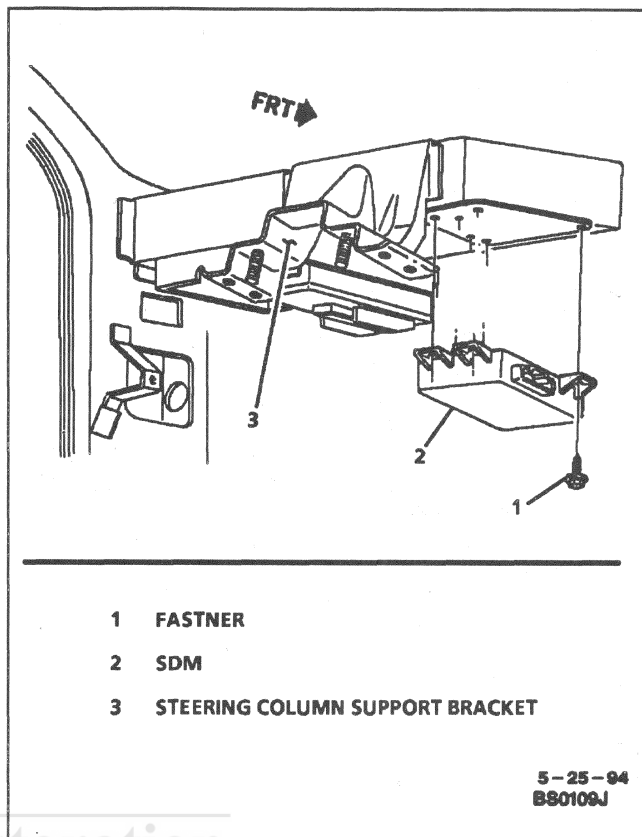


Figure 10 - Sensing and Diagnostic Module

↔ Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section
- 1. Connector Position Assurance (CPA) and electrical connector.
- 2. Sensor fasteners.
- 3. Sensor from vehicle.

CAUTION: Proper operation of the forward discriminating sensor requires the sensor to be rigidly attached to the vehicle structure and that the arrow on the sensor be pointing toward the front of the vehicle.

→← Install or Connect

- 1. Sensor in vehicle, ensure arrow is pointing toward the front of the vehicle.
- 2. Sensor fasteners.

Tighten

- Fasteners to 2.8 N·m (25 lb.in.).
- 3. Electrical connector and CPA.
- Enable the SIR system, refer to "Enabling the SIR System" in this section.

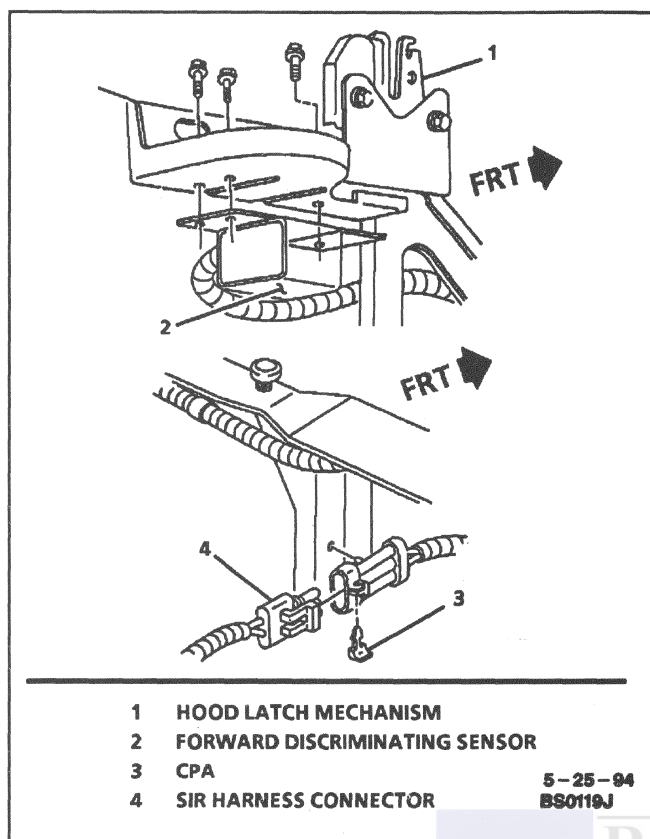


Figure 11 - Forward Discriminating Sensor

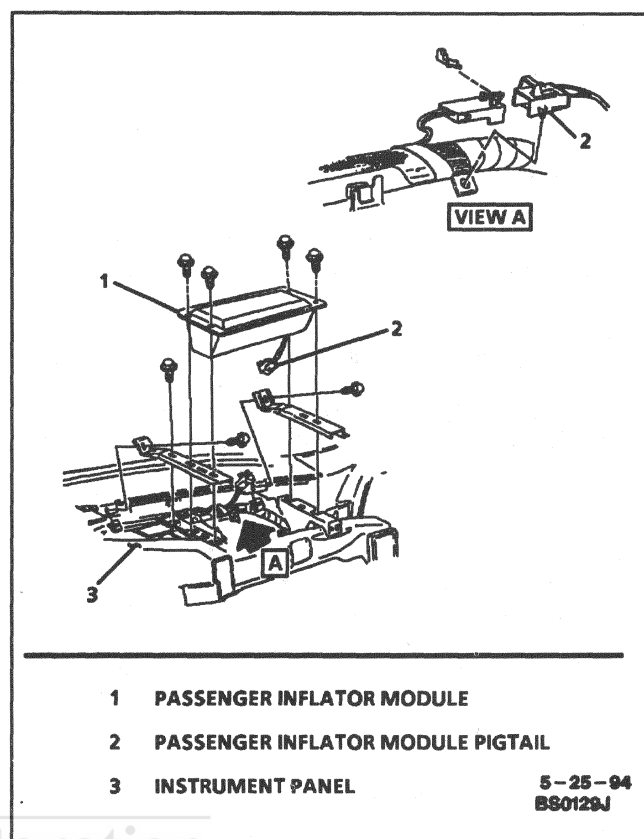


Figure 12a - Passenger Inflator Module (Chevrolet)

PASSENGER INFLATOR MODULE

Figure 12

CAUTION: The following procedures must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) system and prevent false diagnostic trouble codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

Live (Undeployed) Inflator Module

Refer to "Inflator Module Handling/Shipping/Scrapping" in this section.

Deployed Inflator Module

After the inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda).

Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with many service procedures, you should wear gloves and safety glasses.

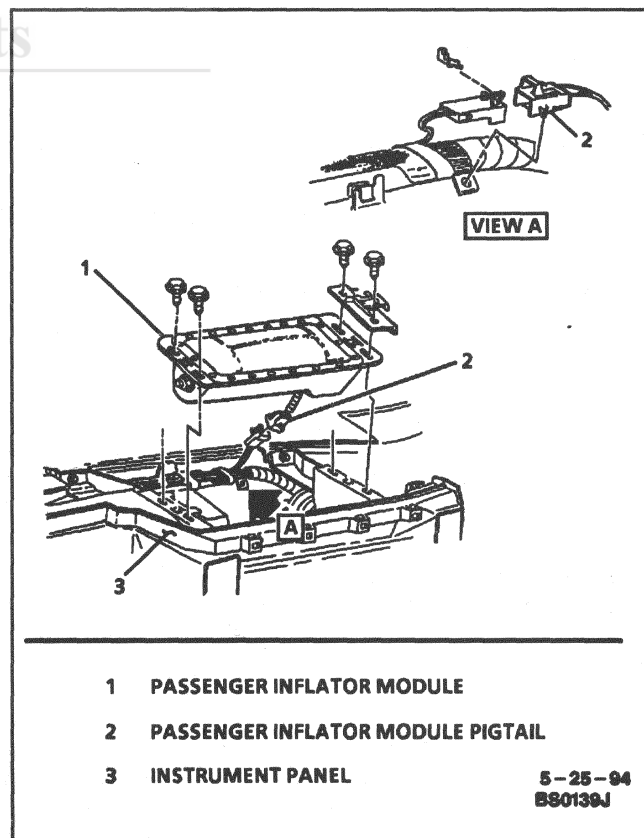


Figure 12b - Passenger Inflator Module (Buick)

9J-60 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

Remove or Disconnect

- Disable the SIR system, refer to “Disabling the SIR System” in this section.
- 1. Upper trim pad, refer to SECTION 8C.
- 2. Connector Position Assurance (CPA) and electrical connector.
- 3. Fasteners from passenger inflator module.
- 4. Passenger inflator module from vehicle.

CAUTION: When carrying a live inflator module, make sure the bag opening is pointed away from you. Never carry the inflator module by the wires or connector on the side of the module. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflator module on a bench or other surface, always face the bag up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Otherwise personal injury may result.

Install or Connect

1. Passenger inflator module to vehicle.
2. Fasteners to passenger inflator module.

Tighten

- Fasteners to 10 N.m (89 lb.in.).
- 3. Electrical connector and CPA.
- 4. Upper trim pad, refer to SECTION 8C.
- Enable SIR system, refer to “Enabling the SIR System” in this section.

“AIR BAG” WARNING LAMP

Refer to SECTION 8C.

DRIVER INFLATOR MODULE

Refer to SECTION 3F.

SIR COIL ASSEMBLY

Refer to SECTION 3F5.

INFLATOR MODULE HANDLING/SHIPPING/SCRAPPING

Figure 13

Live (Undeployed) Inflator Module

Special care is necessary when handling and storing a live (undeployed) inflator module. The rapid gas generation produced during deployment of the air bag could cause the inflator module, or an object in front of the inflator module, to be thrown through the air in the unlikely event of an accidental deployment.



Figure 13 - Proper Live Inflator Module Handling

CAUTION: When carrying a live inflator module, make sure the bag opening is pointed away from you. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. Never carry the inflator module by the wires or connector on the underside of the module. When placing a live inflator module on a bench or other surface, always face the bag and trim cover up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Never rest a steering column assembly on the steering wheel with the inflator module face down and column vertical. Otherwise, personal injury may result.

Shipping Procedures For Live (Undeployed) Inflator Modules

Service personnel should refer to the latest Service Bulletins for proper SIR inflator module shipping procedures.

Inflator Module Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) inflator module. This information covers proper procedures for disposing of a live inflator module.

Before a live inflator module can be disposed of, it must be deployed. Live inflator modules must not be disposed of through normal refuse channels.

CAUTION: Failure to follow proper Supplemental Inflatable Restraint (SIR) inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state, and/or local laws.

If a vehicle is the subject of a Product Liability Report related to the SIR system and is subject to a Preliminary Investigation (GM-1241), DO NOT DEPLOY the inflator module and DO NOT ALTER the SIR system in any manner. Refer to the applicable service bulletin on SIR shipping procedures for details on handling SIR systems involved with GM-1241. If a vehicle is the subject of a campaign affecting inflator modules, DO NOT DEPLOY the inflator module. Follow instructions in the Campaign Service Bulletin for proper disposition of the inflator module.

If an inflator module is replaced under warranty, DO NOT DEPLOY the air bag. The inflator module may need to be returned, undeployed, to Inland Fisher Guide. Refer to procedures shown in the appropriate service bulletin regarding SIR shipping procedures.

In situations which require deployment of a live inflator module, deployment may be accomplished inside or outside the vehicle. The method employed depends upon the final disposition of the particular vehicle, as noted in "Deployment Outside Vehicle" and "Deployment Inside Vehicle" in this section.

Deployment Outside Vehicle (Driver Inflator Module)

Figures 14 through 21

Deployment outside the vehicle is proper when the vehicle is to be returned to service. This includes, for example, situations in which the vehicle will be returned to useful service after a functionally or

cosmetically deficient inflator module is replaced. Deployment and disposal of a malfunctioning inflator module is, of course, subject to any required retention period.

For deployment of a live (undeployed) inflator module outside the vehicle, the deployment procedure must be followed exactly. Always wear safety glasses during this deployment procedure until a deployed inflator module is scrapped or until an undeployed inflator module is shipped. Before performing the procedures you should be familiar with servicing the SIR system and with proper handling of the inflator module. Procedures should be read fully before they are performed.

The following procedure requires use of J 38826 SIR deployment harness with appropriate pigtail adapter. Do not attempt procedure without J 38826 adapter.

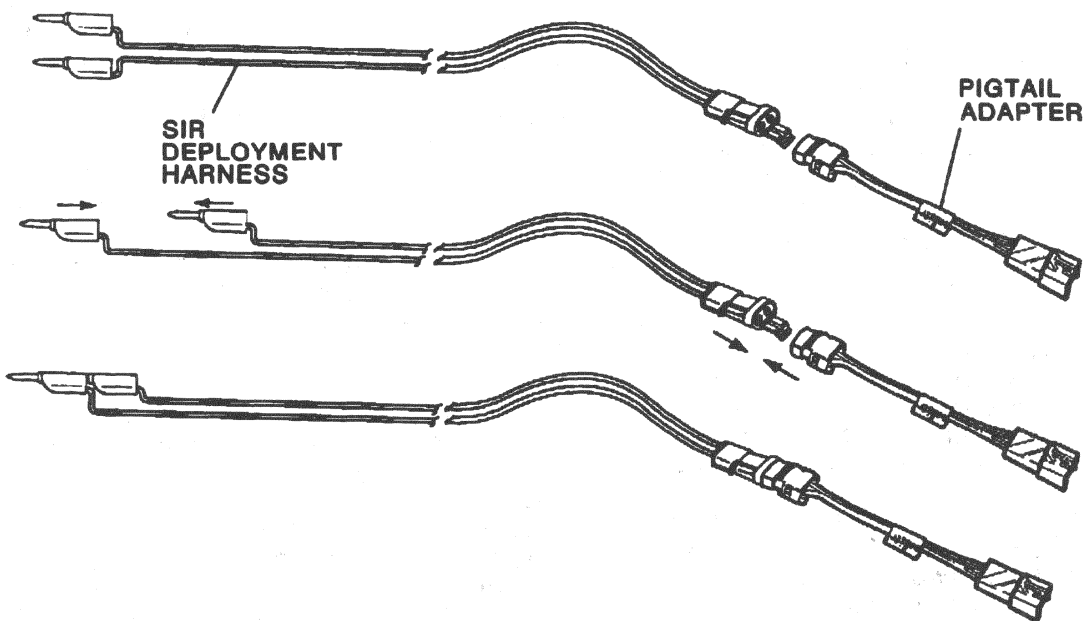
CAUTION: Failure to follow procedures in the order listed may result in personal injury. Never connect deployment harness to any power source before connecting deployment harness to the driver inflator module. Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

! Important

- This information applies only to driver inflator modules. Refer to "Deployment Outside Vehicle (Passenger Inflator Module)" in this section for information on passenger inflator module scrapping.
- 1. Turn ignition switch to "LOCK," remove key and put on safety glasses.
- 2. Inspect J 38826 SIR Deployment Harness and appropriate pigtail adapter for damage. If harness or pigtail adapter is damaged, discard and obtain a replacement.
- 3. Short the two SIR deployment harness leads together by fully seating one banana plug into the other. SIR deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed (Figure 14).
- 4. Connect the appropriate pigtail adapter to the SIR deployment harness (Figure 14).
- 5. Remove driver inflator module from vehicle. Refer to SECTION 3F.
- 6. Remove horn lead from the back of the driver inflator module.
- 7. Remove all horn buttons and steering wheel control buttons from driver inflator module, if applicable.

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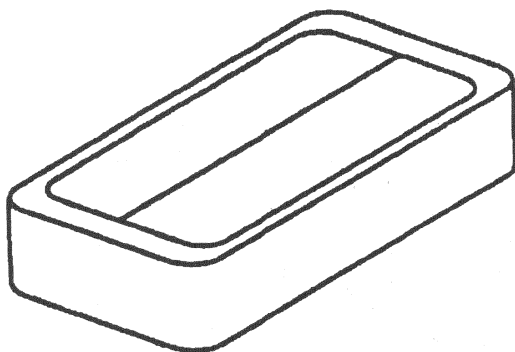
CAUTION: SIR DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED.



5-23-04
STS6019J

Figure 14 - Shorting the SIR Deployment Harness Wires

VINYL TRIM COVER MUST FACE UP



5-23-04
STS6029J

Figure 15 - Proper Storage of Inflator Module

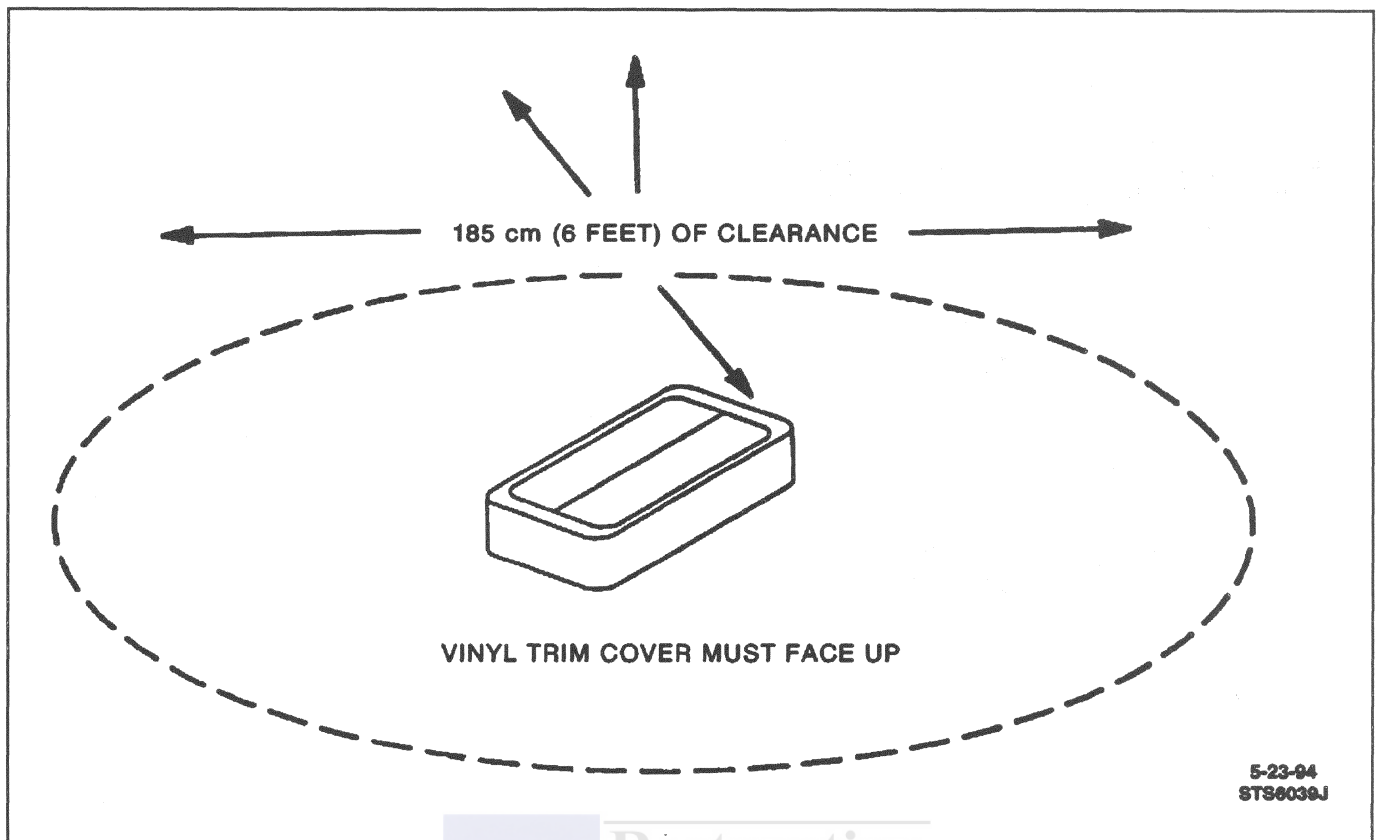


Figure 16 - Provide Adequate Clearance for the Air Bag to Deploy

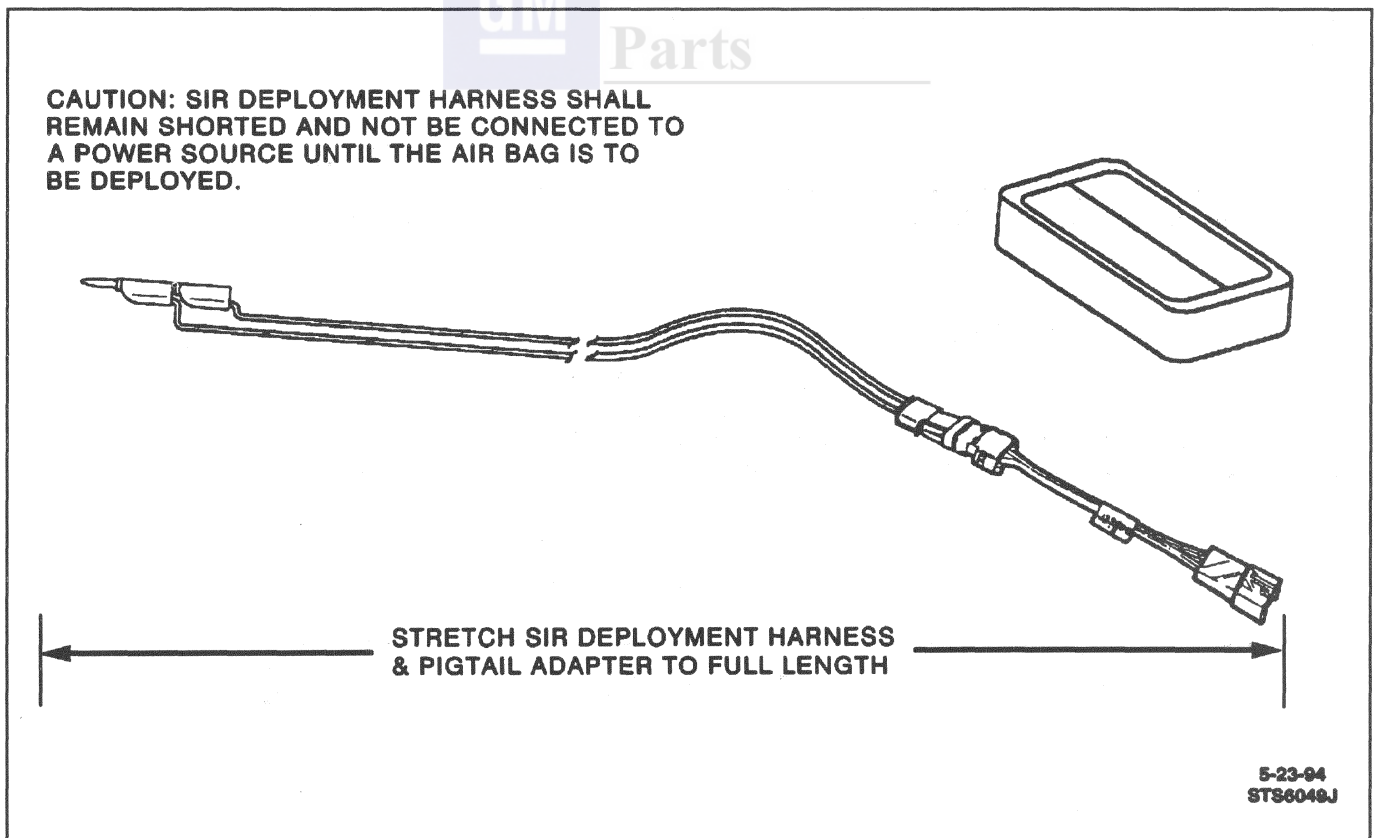
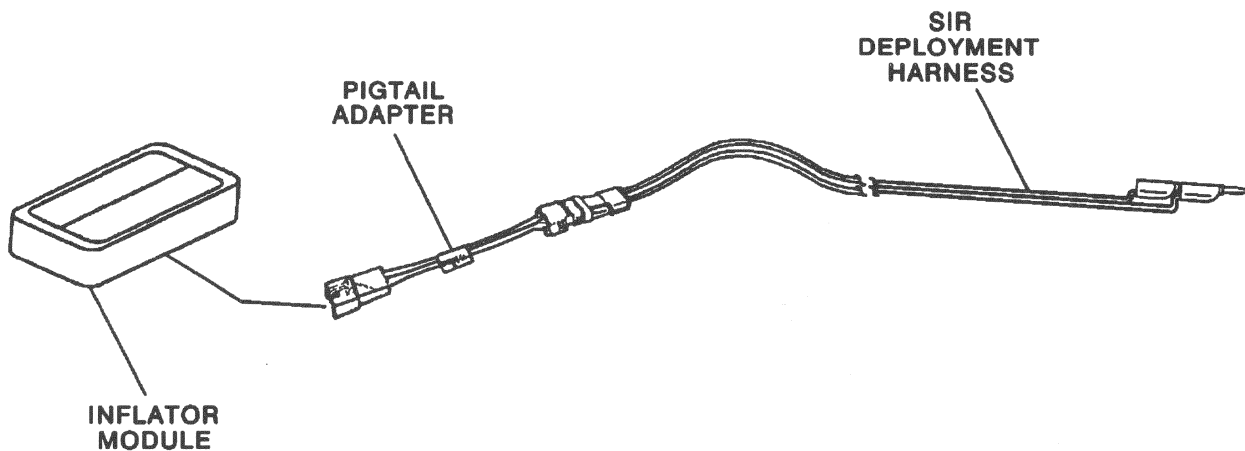


Figure 17 - Stretching the SIR Deployment Harness and Pigtail Adapter

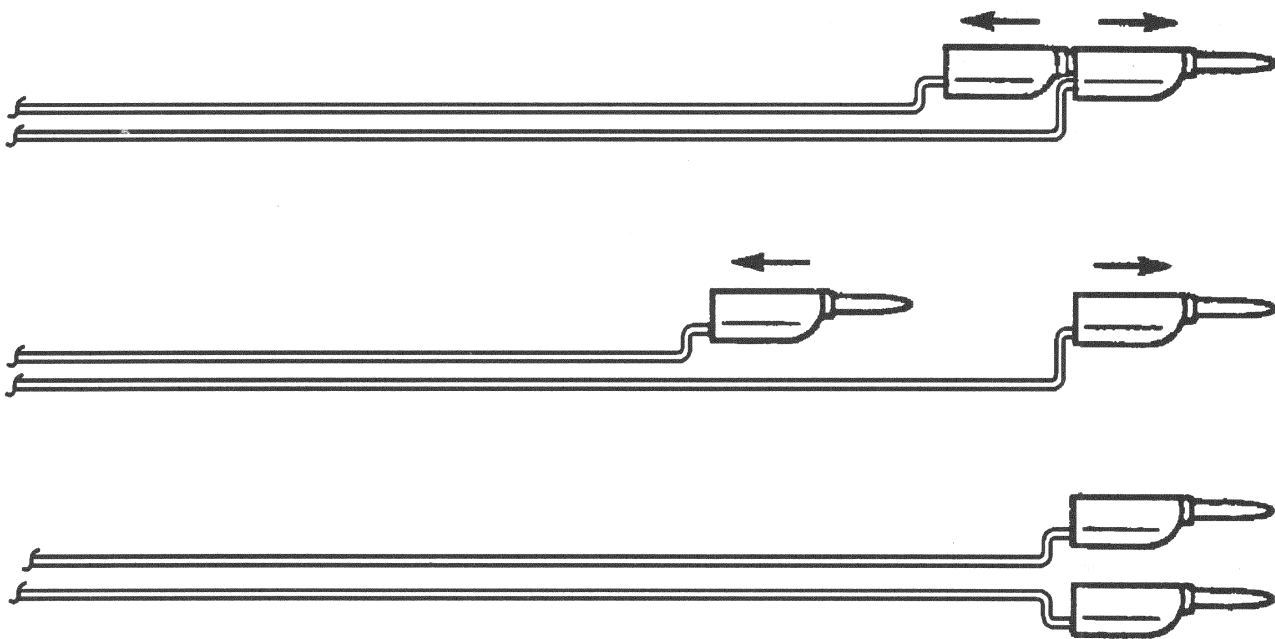
9J-64 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

CAUTION: SIR DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED.



5-23-94
STS6069J

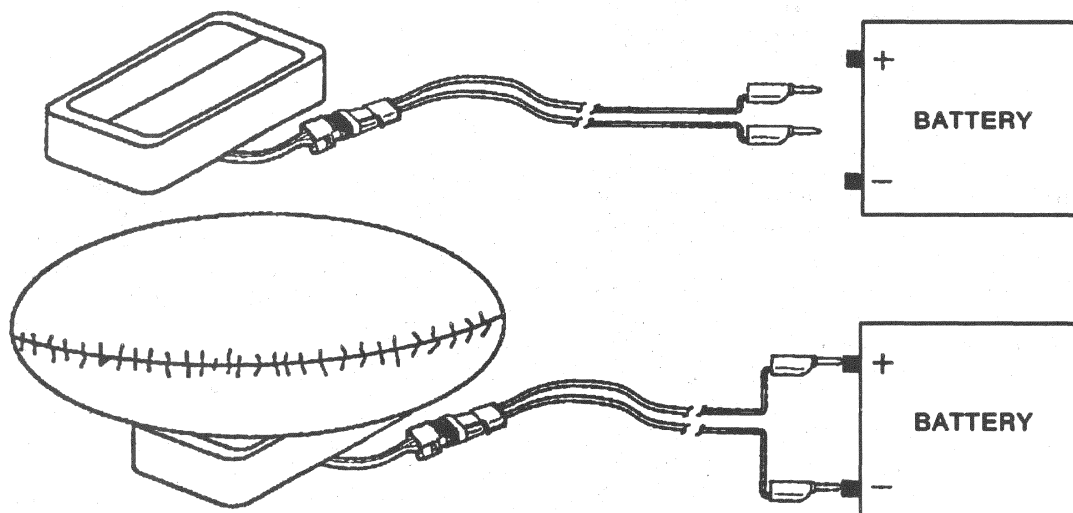
Figure 18 - Connecting the SIR Deployment Harness to the Inflator Module



9-30-94
STS6069J

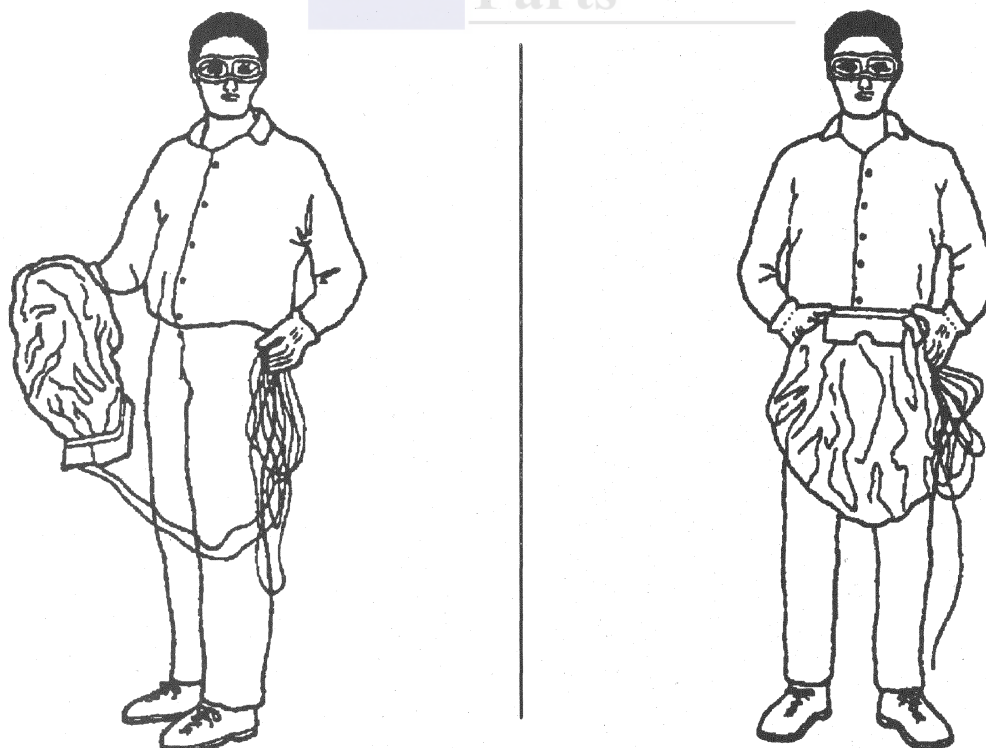
Figure 19 - Separating the Two Shorted Banana Plugs

CAUTION: THE INFLATOR MODULE WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT.



5-23-04
ST86079J

Figure 20 - Connecting to a Power Source



5-23-04
ST86089J

Figure 21 - Handling a Hot, Deployed Inflator Module

9J-66 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag and trim cover up and away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures may result in personal injury.

8. Place the driver inflator module on a work bench or other surface away from all loose or flammable objects with its vinyl trim cover facing up, away from the surface (Figure 15).
9. Clear a space on the ground about 185 cm (six feet) in diameter where the driver inflator module is to be deployed. A paved, outdoor location where there is no activity is preferred. If an outdoor location is not available, a space on the shop floor where there is no activity and sufficient ventilation is recommended. Ensure no loose or flammable objects are within the deployment area (Figure 16).
10. Place the driver inflator module, with its vinyl trim cover facing up, on the ground in the space just cleared (Figure 16).
11. Stretch the SIR deployment harness and pigtail adapter from the driver inflator module to its full length (Figure 17).
12. Place a power source near the shorted end of the SIR deployment harness. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
13. Connect the driver inflator module to the pigtail adapter on the SIR deployment harness. Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The driver inflator module will immediately deploy the air bag when a power source is connected to it (Figure 18).

Important

- Ensure that the pigtail adapter is firmly seated into the driver inflator module connector. Failure to fully seat the connectors may leave the shorting bar located in the driver inflator module connector functioning (shorted) and may result in non-deployment of the driver inflator module.
14. Verify that the area around the driver inflator module is clear of all people and loose or flammable objects.
 15. Verify that the driver inflator module is resting with its vinyl trim cover facing up.
 16. Notify all people in the immediate area that you intend to deploy the driver inflator module. The deployment will be accompanied by a substantial report which may startle the uninformed.
 17. Separate the two banana plugs on the SIR deployment harness (Figure 19).

NOTICE: When the air bag deploys, the driver inflator module may jump about 30 cm (one foot) vertically. This is a normal reaction of the driver inflator module to the force of the rapid gas expansion inside the air bag.

NOTICE: When the air bag deploys, the rapid gas expansion will create a substantial report. Notify all people in the immediate area that you intend to deploy the driver inflator module.

CAUTION: Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The driver inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment harness to the power source should always be the last step prior to deployment in the inflator module deployment procedure. Failure to follow procedures in the order listed may result in personal injury.

18. Connect the SIR deployment harness wires to the power source to immediately deploy the driver inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 20).
19. Disconnect the SIR deployment harness from the power source.
20. Short the two SIR deployment harness leads together by fully seating one banana plug into the other (Figure 14).
21. In the unlikely event that the driver inflator module did not deploy after following these procedures, proceed immediately with Steps 26 through 29. If the driver inflator module did deploy, proceed with Steps 22 through 25.
22. Put on a pair of shop gloves to protect your hands from possible irritation and heat when handling the deployed driver inflator module.

After the driver inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with the atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As a precaution, however, gloves and safety glasses are recommended to prevent any possible irritation of the skin or eyes.

CAUTION: Safety precautions must be observed when handling a deployed inflator module. After deployment, the metal surfaces of the inflator module will be very hot. Allow the inflator module to cool before handling any metal portion of it. Do not place the deployed inflator module near any flammable objects. Failure to follow procedures may result in fire or personal injury.

After a driver inflator module has been deployed, the metal canister and surrounding areas of the driver inflator module will be very hot. Do not touch the metal areas of the driver inflator module for about 10 minutes after deployment. If the deployed driver inflator module must be moved before it is cool, wear gloves and handle by the air bag or vinyl trim (Figure 21).

23. Disconnect the pigtail adapter from the driver inflator module as soon after deployment as possible. This will prevent damage to the pigtail adapter or SIR deployment harness due to possible contact with the hot driver inflator module canister. The pigtail adapter and SIR deployment harness are designed to be reused. They should, however, be inspected for damage after each deployment and replaced if necessary.
24. Dispose of the deployed driver inflator module through normal refuse channels after it has cooled for at least 10 minutes.
25. Wash your hands with mild soap and water afterward.

NOTICE: The remaining steps are to be followed in the unlikely event that the driver inflator module did not deploy after following these procedures.

26. Ensure that the SIR deployment harness has been disconnected from the power source and that its two banana plugs have been shorted together by fully seating one banana plug into the other (Figure 14).
27. Disconnect the pigtail adapter from the driver inflator module.

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag and trim cover up and away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures may result in personal injury.

28. Temporarily store the driver inflator module with its vinyl trim cover facing up, away from the surface upon which it rests.
29. Call the Technical Assistance group for further assistance.

Deployment Outside Vehicle (Passenger Inflator Module)

CAUTION: Failure to follow proper SIR inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

General Motors dealers should refer to the latest General Motors Service Bulletins for proper live (undeployed) passenger inflator module scrapping and disposal procedures. All others should contact a local General Motors dealership for proper live passenger inflator module scrapping and disposal procedures. Deployed passenger inflator modules may be disposed of through normal refuse channels.

Deployment Inside Vehicle (Vehicle Scrapping Procedure)

Figures 22 through 30

Deployment inside the vehicle is proper when the vehicle is to be destroyed or salvaged for component parts. This includes, but is not limited to, the following situations:

1. The vehicle has completed its useful life.
2. The vehicle has been damaged beyond repair in a non-deployment type accident.
3. The vehicle has been stripped or damaged beyond repair in a theft.
4. The vehicle will be salvaged for component parts to be used on a vehicle with a different Vehicle Identification Number (VIN) as opposed to being rebuilt as the same VIN. Never use SIR components from another vehicle.

This is done to ensure SIR system integrity since only new SIR system components, with the exception of remanufactured parts as noted below, may be used in servicing an SIR equipped vehicle. Remanufactured parts purchased from an authorized General Motors dealer may be used for SIR repairs.

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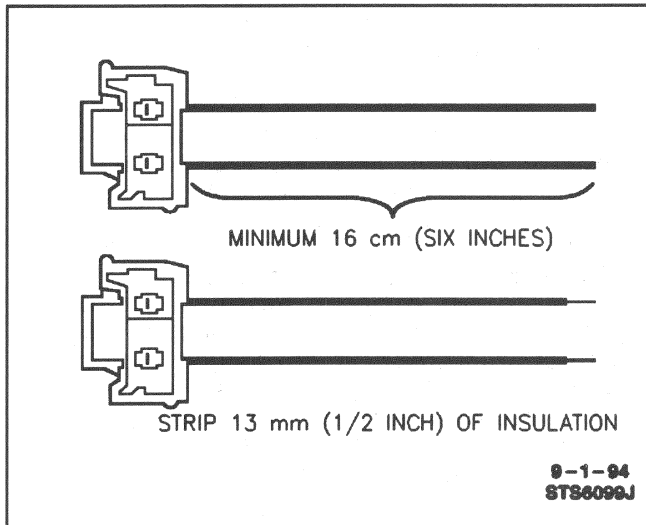


Figure 22 - Cutting the Harness Connector Wires

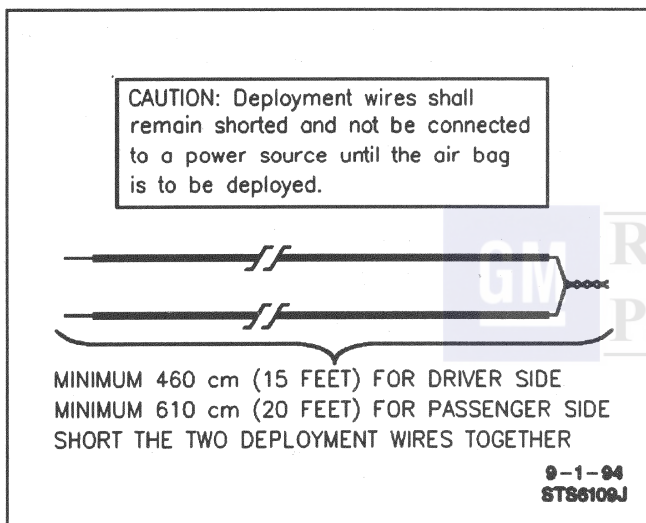


Figure 23 - Shorting the Deployment Wires

CAUTION: Failure to follow proper SIR inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

1. Turn ignition switch to "LOCK," remove key and put on safety glasses.
2. Remove all loose objects from front seats.
3. Disconnect driver inflator module, yellow 2-way connector located at the base of the steering column.

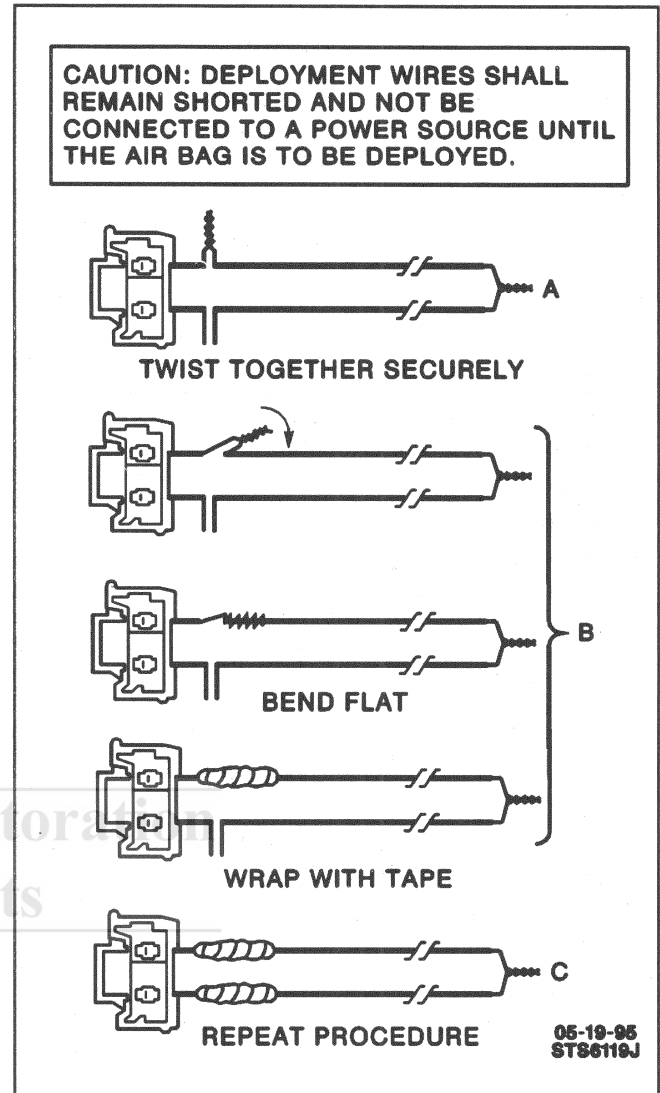


Figure 24 - Fabricating the Deployment Harness

4. Cut the driver inflator module yellow 2-way harness connector from the vehicle leaving at least 16 cm (six inches) of wire at the connector (Figure 22).
5. Strip 13 mm (1/2 inch) of insulation from each wire lead of the connector (Figure 22).
6. Cut two 460 cm (15 feet) deployment wires from 0.8 mm² (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the driver deployment harness.
7. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
8. Short the wires by twisting together one end from each (Figure 23). Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

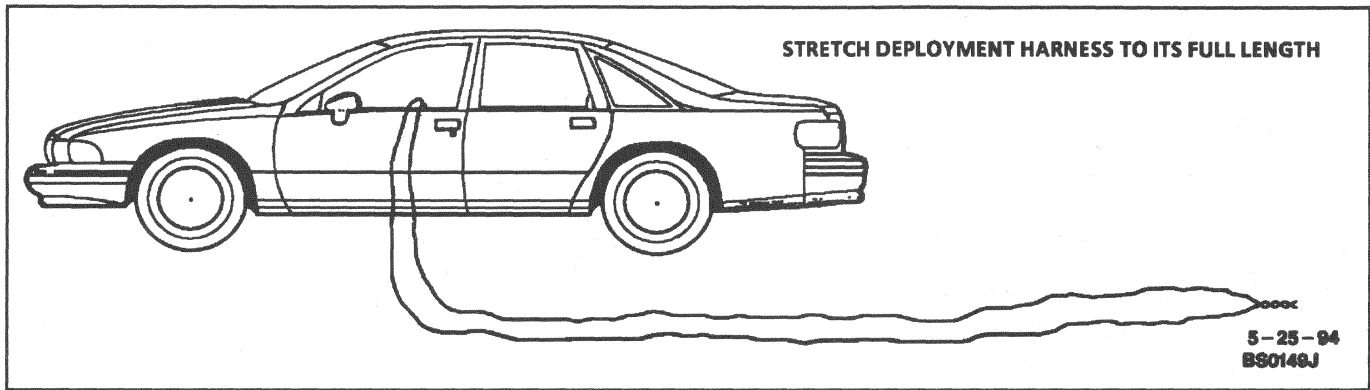


Figure 25 - Prepare Deployment Harness for In-Vehicle Deployment (Driver)

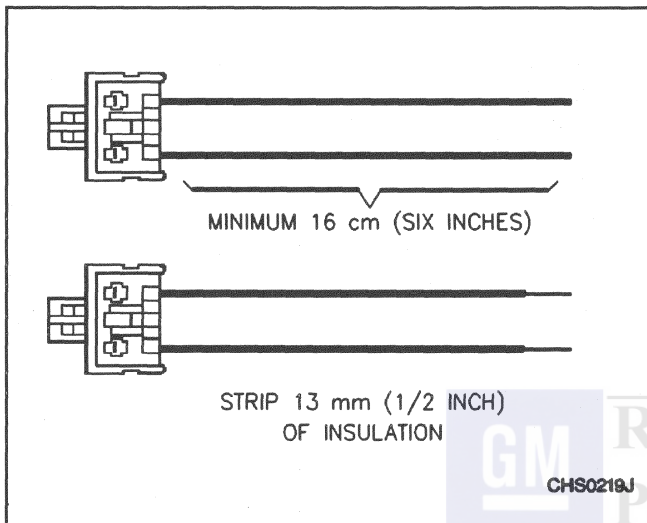


Figure 26 - Cutting the Harness Connector Wires

CAUTION: Failure to follow procedures in the order listed could result in personal injury. Never connect deployment wires to any power source before connecting deployment wires to the inflator module leads. Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

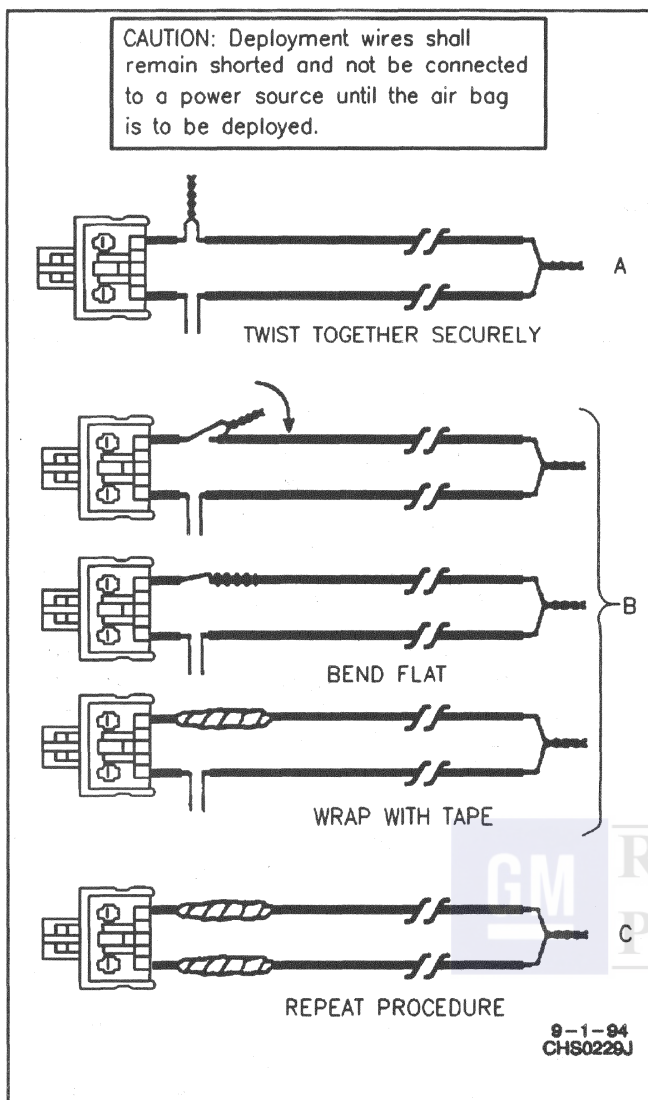
9. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure (Figure 24-A).
10. Bend twisted connection made in the previous step flat and wrap tightly with electrical tape to insulate and secure (Figure 24-B).
11. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire (Figure 24-C).
12. Connect the deployment harness to the driver inflator module, yellow 2-way connector at the base of the steering column. Route deployment harness out the driver side of the vehicle (Figure 25).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

13. Disconnect passenger inflator module, yellow 2-way connector located near the base of the steering column.
14. Cut the passenger inflator module harness connector from the vehicle leaving at least 16 cm (six inches) of wire at the connector (Figure 26).
15. Strip 13 mm (1/2 inch) of insulation from each wire lead of the connector (Figure 26).
16. Cut two 610 cm (20 feet) deployment wires from 0.8mm² (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the passenger deployment harness.
17. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
18. Short the wires by twisting together one end from each (Figure 23). Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

CAUTION: Failure to follow procedures in the order listed could result in personal injury. Never connect deployment wires to any power source before connecting deployment wires to the inflator module leads. Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

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19. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure (Figure 27-A).
20. Bend twisted connection made in the previous step flat and wrap tightly with electrical tape to insulate and secure (Figure 27-B).
21. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire (Figure 27-C).
22. Connect the deployment harness to the passenger inflator module jumper, yellow 2-way connector located near the base of the steering column. Route deployment harness out the passenger side of the vehicle (Figure 28).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

23. Verify that the inside of the vehicle and the area surrounding the vehicle are clear of all people and loose or flammable objects.
24. Stretch the driver and passenger deployment harnesses to their full length (Figures 25 and 28).
25. Completely cover windshield area and front door window openings with a drop cloth, blanket or similar item. This reduces the possibility of injury due to possible fragmentation of the vehicle's glass or interior.
26. Notify all people in the immediate area that you intend to deploy the air bags. The deployment will be accompanied by a substantial report which may startle the uninformed.
27. Separate the two ends of the driver deployment harness wires (Figure 29).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

NOTICE: When the air bag deploys, the rapid gas expansion will create a substantial report. Notify all people in the immediate area that you intend to deploy the air bags.

28. Connect the driver deployment harness wires to a power source to immediately deploy the driver inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 29).
29. Separate the two ends of the passenger deployment harness wires (Figure 30).

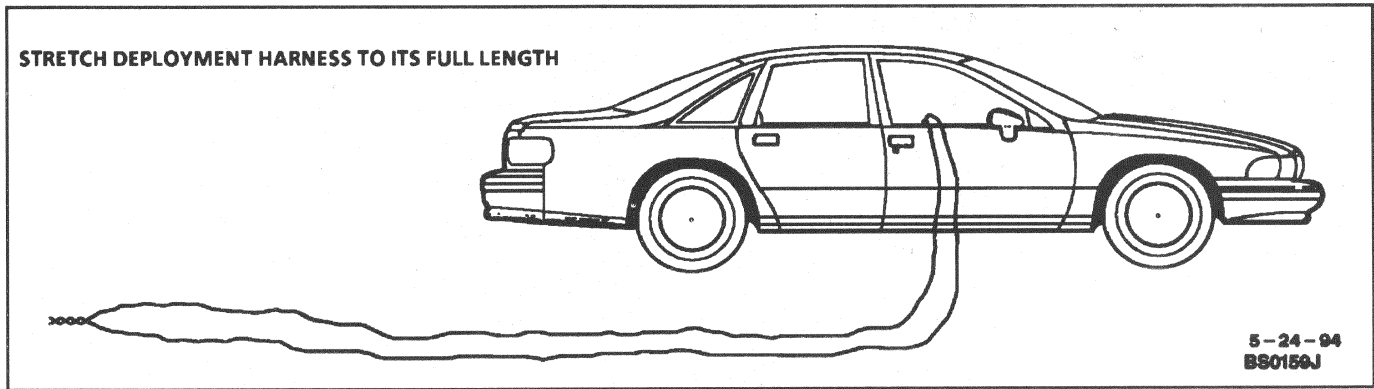


Figure 28 - Prepare Deployment Harness for In-Vehicle Deployment(Passenger)

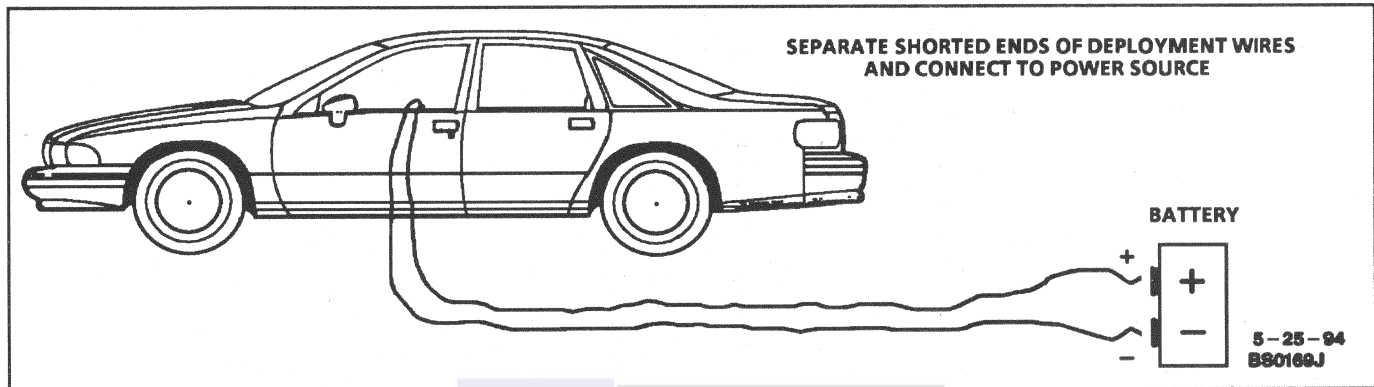


Figure 29 - Separate Shorted End of Deployment Harness and Connect to Power Source(Driver)

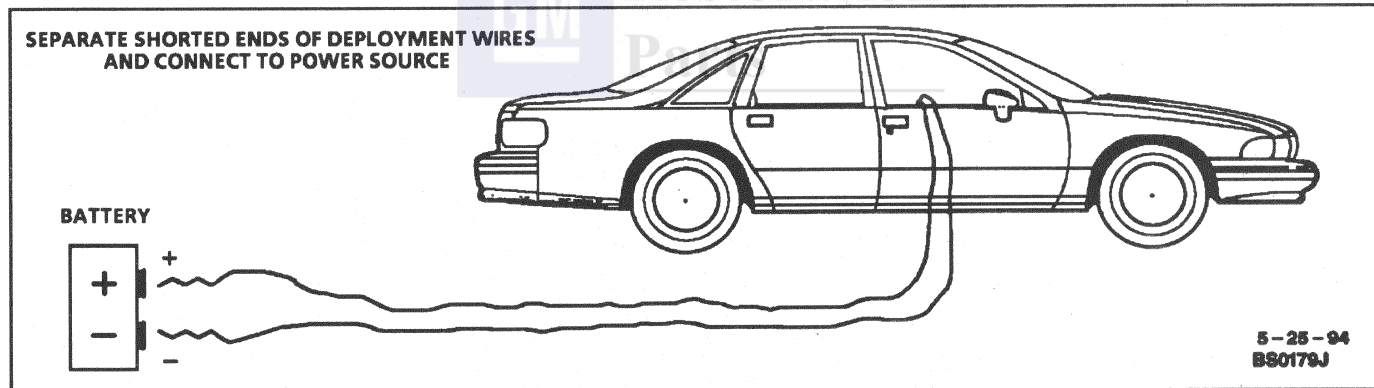


Figure 30 - Separate Shorted End of Deployment Harness and Connect to Power Source(Passenger)

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

30. Connect the passenger deployment harness wires to a power source to immediately deploy the passenger inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 30).

After an inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As a precaution, however, gloves and safety glasses are recommended to prevent any possible irritation of the skin or eyes.

CAUTION: Safety precautions must be observed when handling a deployed inflator module. After deployment, the metal surfaces of the inflator module will be very hot. Allow the inflator module to cool before handling any metal portion of it. Do not place the hot deployed inflator module near any flammable objects. Failure to follow procedures could result in fire or personal injury.

After an inflator module has been deployed, the metal canister and surrounding areas of the inflator module will be very hot. Do not touch the metal areas of the inflator module for about 10 minutes after deployment. If the deployed inflator module must be moved before it is cool, wear gloves and handle by the air bag or vinyl trim.

31. Short the driver deployment harness wires by twisting together one end from each. Repeat this procedure for the passenger deployment harness.
32. Carefully remove drop cloth from vehicle and clean off any fragments or discard drop cloth entirely.
33. Disconnect driver deployment harness and passenger deployment harness from vehicle and discard.
34. In the unlikely event that either or both of the inflator modules did not deploy after following these procedures, proceed immediately with Steps 36 through 38.
35. With both air bags deployed the vehicle may be scrapped in the same manner as a non-SIR equipped vehicle.
36. Remove the undeployed inflator module(s) from the vehicle. For driver inflator module refer to SECTION 3F, for passenger inflator module refer to "On-Vehicle Service" in this section.

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures could result in personal injury.

37. Temporarily store the inflator module with the air bag opening facing up, away from the surface upon which it rests.
38. Call the Technical Assistance group for further assistance.

Deployed Inflator Module Handling

After the inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then

quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with many service procedures, you should wear gloves and safety glasses.

WIRING REPAIR

Special wiring repair procedures have been developed for use on the Supplemental Inflatable Restraint (SIR) system due to the sensitive nature of the circuitry. These specific procedures and instructions must be followed when working with SIR system wiring, and wiring components (such as connectors and terminals).

Terminal Repair Kit J 38125-A

Essential tool kit J 38125-A contains special "sealed splices" for use in repairing SIR system wiring. A special crimping tool, heat torch, and instruction manual for these splices are also included.

Two critical features of the sealed splices are a special heat shrink sleeve with sealing adhesive to produce an environmentally sealed splice and a cross hatched (knurled) core crimp to provide necessary contact integrity for the sensitive, low energy circuits.

Terminal Repair Kit J 38125-A also serves as a generic terminal repair kit. The kit contains a large sampling of common GM electrical terminals and the correct tools to attach them to wires and remove them from connectors. **The terminals in the kit are not to be used to replace damaged SIR system terminals unless specifically indicated by the terminal package.** The SDM terminal repair assembly pack is included in J 38125-A for SIR use.

SIR Connector (Plastic Body and Terminal Metal Pin) Repair

If any connector or terminal in the SIR wire harness (except pigtailed) is damaged, it should be repaired using one of the connector repair assembly packs. These kits include an instruction sheet and the sealed splices which will be used to splice the new wires, connector, and terminals to the harness. The splice crimping tool, which is color keyed to match the splices from Terminal Repair Kit J 38125-A, must be used to apply these splices.

The terminals in the SIR system are made of a special metal to provide necessary contact integrity for the sensitive, low energy circuits. These terminals are only available in the connector repair assembly packs, do not substitute any other terminals for those in the assembly packs.

If individual terminals are damaged on the SDM connector, they should be repaired using the SDM terminal repair assembly pack. If individual terminals are damaged on any other SIR connection, the entire connection should be replaced using the appropriate connector repair assembly pack. It may be necessary to replace the entire SIR wiring harness.

SIR Wire Pigtail Repair

If the wiring pigtail (a wire or wires attached directly to the component, not by a connector) is damaged, the entire component (with pigtail) must be replaced. Examples of "pigtail" components are the passenger inflator module, the discriminating sensor and the SIR coil assembly. Absolutely no wire, connector, or terminal repairs are to be attempted on the discriminating sensor, the passenger inflator module, or the SIR coil assembly.

SIR Wire Repair

If any wire except the pigtail is damaged, the wire should be repaired by splicing in a new section of wire of the same gauge size (.5, .8, 1.0, etc.). The sealed splices and splice crimping tool from Terminal Repair Kit J 38125-A must be used for these repairs. The following wiring repair procedures must be used to ensure the integrity of the sealed splice application.

Step One: Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness. The crimp and sealed splice sleeves may be used on all types of insulation except tefzel and coaxial and may only be used to form a one-to-one splice.

Step Two: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40 mm (1.5 in.) away from other splices, harness branches, or connectors.

Step Three: Strip the Insulation

NOTICE: The following procedures must be followed in the order listed. If wire strands are damaged, the procedure must be repeated until a clean strip with all wire strands intact is obtained.

If it is necessary to add a length of wire to the existing harness, be certain to use the same size as the original wire. To find the correct wire size either find the wire on the schematic and convert the metric size to the equivalent AWG size or use an AWG wire gage.

If unsure about the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation. Strip approximately 7.5 mm (5/16 in.) of insulation from each wire to be spliced. Be careful to avoid nicking or cutting any of the strands. Check the stripped wire for nicks or cut strands. If the wire is damaged, repeat this procedure after removing the damaged section.

Step Four: Select and Position the Splice Sleeve

Select the proper sealed splice sleeve according to wire size. The splice sleeves and tool nests are color coded (see following chart).

Color Splice Sleeve	Crimp Tool Nest Color	Wire Gage AWG/(Metric)
Salmon (yellow-pink)	Red	20, 18/(0.5, 0.8)
Blue	Blue	16, 14/(1.0, 2.0)
Yellow	Yellow	12, 10/(3.0, 5.0)

Crimp and Seal Splice Chart

Using the J 38125-A Splice Crimp Tool (Figure 31), position the splice sleeve in the proper color nest of the hand crimp tool. Place the splice sleeve in the nest so that the crimp falls midway between the end of the barrel and the stop.

The sleeve has a stop in the middle of the barrel to prevent the wire from going further (Figure 32). Close the hand crimper handles slightly to hold the splice sleeve firmly in the proper nest.

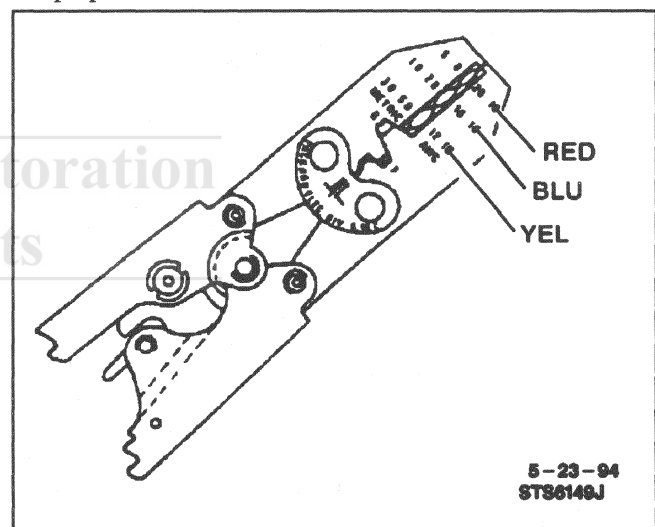


Figure 31 - Splice Crimp Tool J 38125-A

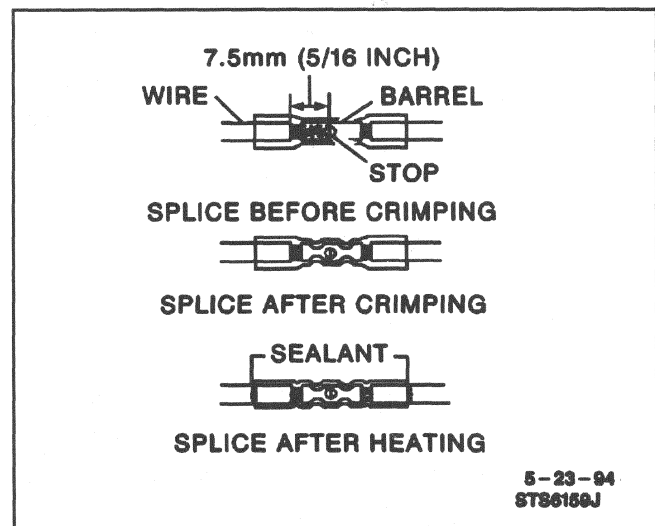


Figure 32 - Seal Splice Sequence

9J-74 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

Step Five: Insert Wires Into Splice Sleeve and Crimp

Insert the wire into the splice sleeve until it hits the barrel stop and close the handles of the crimp tool tightly until the crimper handles open when released (Figure 32). The crimper handles will not open until the proper amount of pressure is applied to the splice sleeve. Repeat Steps 4 and 5 for opposite end of the splice.

Step Six: Shrink the Insulation Around the Splice

Using the heat torch apply heat where the barrel is crimped. Gradually move the heat barrel to the open end of the tubing, shrinking the tubing completely as the heat is moved along the insulation. A small amount of sealant will come out of the end of the tubing when sufficient shrinking is achieved (Figure 32).

SIR System Wire Splice Repair

If any of the original equipment splices (three wires or more) in the SIR system wiring are damaged they should be repaired by applying a new splice (not sealed) from the Terminal Repair Kit J 38125-A.

Carefully follow the instructions included in the kit for proper splice clip application. Cloth duct tape may be substituted for splice tape if necessary.

Alternative Repair Methods

No alternative repair methods are available for the SIR system wiring and components.

Connector Position Assurance (CPA)

The Connector Position Assurance (CPA) is a small plastic insert that is inserted through the locking tabs of all of the SIR system connectors. The purpose of the CPA is to assure the connector halves are securely connected and they cannot vibrate apart. The CPA must be in place to ensure good contact between the SIR mating terminals.

Terminal Position Assurance (TPA)

The Terminal Position Assurance (TPA) insert is similar to the plastic "combs" used in ECM connectors. The function of the TPA is to keep the terminal securely seated in the connector body. The TPA is not to be removed from the connector body unless a terminal must be removed for replacement.

SPECIAL TOOLS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

SIR DRIVER/PASSENGER LOAD TOOL

The SIR Driver/Passenger Load Tool J 38715 is used only when called for in this section. It is used as a diagnostic aid and safety device to prevent inadvertent inflator module deployment.

The load tool has four yellow connectors attached to its case. The three small connectors are electrically functional and serve as resistive load substitutions. The large dummy connector does not serve as a load substitution and is not used.

No more than two connectors are used at any time. One of the small connectors is used to substitute the load of the driver inflator module when it is connected at the top of the column to the SIR coil assembly. Another small connector is used to substitute the load of the driver inflator module and the SIR coil assembly when it is connected at the base of the column to the SIR wiring harness. The third small connector is used to substitute for the load of the passenger inflator module when connected to the passenger inflator module harness connector. By substituting the resistance of the load tool when called for, a determination can be made as to whether an inflator circuit component is causing system malfunction and which component is causing the malfunction. The load tool should be used only when specifically called for in the diagnostic procedures.

J 39200 DVM

The J 39200 DVM is the preferred DVM for use in SIR diagnosis and repair. However, J 34029-A may be used if J 39200 is not available. No other DVMs are approved for SIR diagnosis and repair.

SCAN TOOL

The Tech 1 is used to read and clear SIR System Diagnostic Trouble Codes (DTCs). The Tech 1 will also provide SIR system circuit values using the "Data List" function. Refer to the Tech 1 Operator's Manual for specific information on how to use the Tech 1.

Scan tools from other manufacturers may be used. Refer to the Operator's Manual for the tool for specific instructions.

J 35616-A CONNECTOR TEST ADAPTER KIT

The J 35616-A Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the appropriate adapter will ensure that no damage to the terminal will occur from the DVM probe, such as spreading or bending. The adapter will also give an idea of whether contact tension is sufficient, helping to find an open or intermittent open due to poor terminal contact.

SPECIFICATIONS**FASTENER TIGHTENING SPECIFICATIONS**

Driver Inflator Module Fasteners 6.0 N.m (53 lb. in.)
Forward Discriminating Sensor Fasteners..... 2.8 N.m (25 lb. in.)
Passenger Inflator Module Fasteners..... 10 N.m (89 lb. in.)
Sensing and Diagnostic Module Fasteners 8.5 N.m (75 lb. in.)

SERVICE PARTS INFORMATION

PART NAME	SERVICE PARTS CATALOG REFERENCE NAME	SERVICE PARTS CATALOG GROUP
Driver Inflator Module	MODULE, INFL RST STRG WHL	14.865
Forward Discriminating Sensor	SENSOR, INFL RST F/END DISCRM	14.865
Passenger Inflator Module	MODULE, INFL RST I/P	14.865
SIR Coil Assembly	COIL KIT, INFL RST STRG WHL MDL	14.865
SDM	MODULE, INFL RST DIAGN ENGY RESV (W/SENSOR)	14.865
Warning Lamp "AIR BAG"		9.744



9J-76 SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

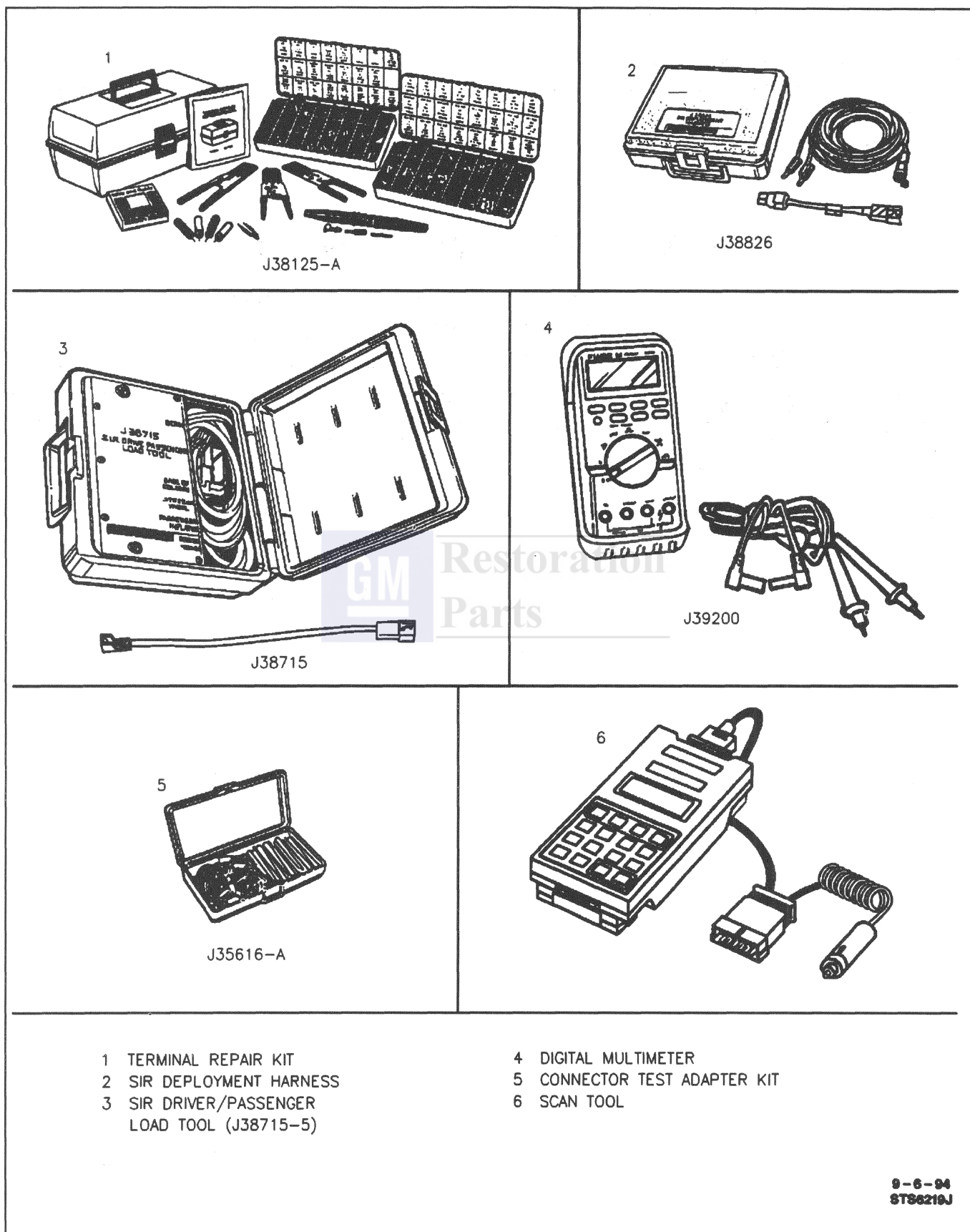


Figure 33 - SIR Special Tools

SECTION 9K

REMOTE KEYLESS ENTRY

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Important

The Remote Keyless Entry System is intended to be used as a supplementary vehicle entry device. It is not intended to replace, but rather should be used in conjunction with a door lock key. The system could be disabled due to radio frequency interference or low transmitter battery power level. It is therefore necessary to always maintain access to a door lock key.

CONTENTS

General Description.....	9K-1	Automatic Door Lock Feature	9K-2
Functional Operation.....	9K-1	Diagnosis	9K-2
Transmitter.....	9K-1	On-Vehicle Service.....	9K-26
Battery Replacement	9K-1	Receiver.....	9K-26
Receiver.....	9K-2	Programming the Receiver	9K-27

GENERAL DESCRIPTION

The remote keyless entry system (remote control door lock system) is used to lock and unlock front and rear side doors, turn on interior lamps, and release the rear compartment lid or end gate window of the vehicle. A small receiver is installed on the rear window panel sheet metal of the sedan, and on the left rear inner wheelhouse of the wagon. This remote lock control feature operates on a 315 MHz radio frequency at a low energy level. If the remote lock control feature fails to operate from a normal distance, check for two conditions: weak batteries in remote lock control transmitter (expected battery life is two years): or close proximity to a radio transmitter, such as a radio station tower, airport transmitter, and some mobile or CB radios.

The transmitter is a hand-held item that is attached to a keyring. It has three buttons that control the functions of the system. The transmitter complies with FCC rules Part 15. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and 2) This device must accept any interference that may be received, including interference that may cause undesired operation.

FUNCTIONAL OPERATION

Figure 1

Unlocking Front and Rear Side Doors

1. Press "UNLOCK" button once and release to unlock driver's front side door only.

2. Press "UNLOCK" button a second time (within 1 to 5 seconds of the first depression) to unlock the remaining front and rear side doors.

Releasing Rear Compartment Lid or End Gate Window Assembly

- Press bottom button marked with vehicle symbol on top cover to release rear compartment lid or end gate window assembly.

Locking Front and Rear Side Doors

- Press "DOOR" button marked with key symbol.

TRANSMITTER

The transmitter will transmit a radio signal to the receiver, which will control functions of the receiver. The range is approximately 10 m (33 feet).

Battery Replacement

Figure 1

Remove or Disconnect

1. Keyring from transmitter.
2. Top cover from bottom cover, using flat-bladed tool at eyelet end to unsnap, if necessary.
3. Batteries.

9K-2 REMOTE KEYLESS ENTRY

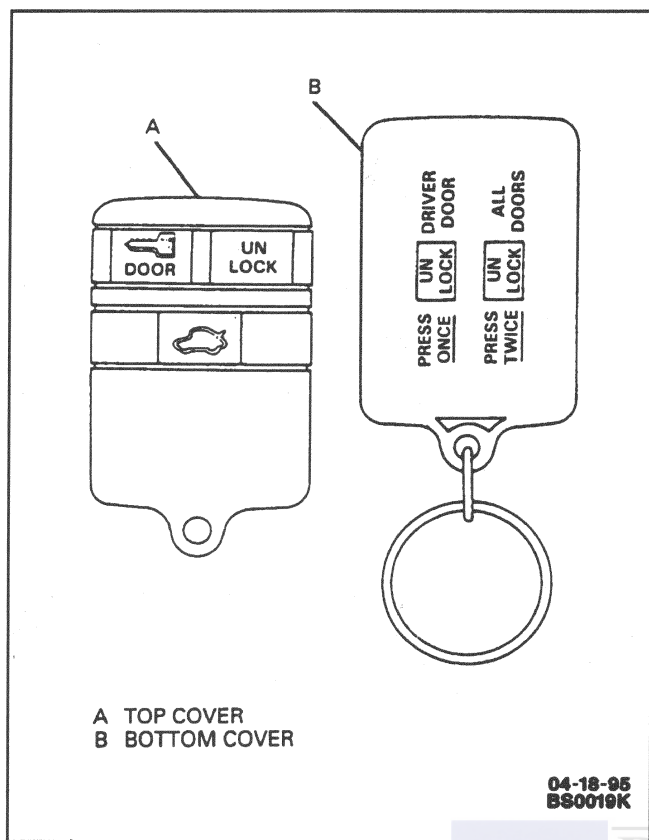


Figure 1 - Remote Control Door Lock Transmitter (Typical)

Install or Connect

NOTICE: Use of wrong type of battery will cause damage to the transmitter.

1. Batteries.
 - Use battery type DL2016, or equivalent.
2. Top cover by snapping into bottom cover.
3. Keyring to transmitter.

Inspect

- Transmitter operation.

RECEIVER

The transmitter signal (frequency) is stored in the receiver assembly's non-volatile memory. However, the memory will be erased if the programming connector is grounded.

The remote control door lock receiver is battery fed and is always monitoring the transmitter signal. When the correct transmitter signal is received to lock the front and rear side doors, a transistor driver will energize the correct lock control relay coil. The receiver will also control which lock control relays will be energized to unlock the front and rear side doors, or release the rear compartment lid or end gate window.

Automatic Door Lock Feature (Buick)

The automatic door lock feature is controlled through the receiver.

With the ignition switch in the "ON" position, moving the automatic transmission control lever out of the "PARK" position, engages the receiver causing the doors to lock.

To unlock the front and rear side doors, return the automatic transmission control lever to the "PARK" position.

If a door is opened after the front and rear side doors have locked, the door will relock once it is closed, only if the transmission control lever is out of "PARK," the ignition switch is "ON" and the brake pedal is pressed.

The automatic door unlock feature may be disabled if desired. In order to disable the feature, reprogram one or both transmitter. Repeat the following button sequence three times after the last transmitter has been programmed, but before the program connector is disconnected:

- A. door lock
- B. door unlock
- C. rear compartment lid unlock

The door locks and rear compartment lid motor will cycle three times indicating that the automatic door unlock feature has been disabled.

To reinstate the automatic door unlock feature, reprogram normally.

If the automatic door lock feature fails to operate, refer to "Diagnosis" in this section or to SECTION 8A-30.

DIAGNOSIS

Perform the following troubleshooting hints before beginning system diagnosis.

- Be certain power door locks function normally using the LH and RH front door lock switches. If power door locks do not function normally, refer to SECTION 8A-130 for diagnosis.
- Check that transmitter battery terminals are clean and make good contact with the battery.
- Try a second transmitter if available. If the second transmitter works, remove the battery and install the battery in the original transmitter. Try the original transmitter again. If the original transmitter still does not work, the original transmitter is defective.

Refer to the "Symptom Table" for diagnosis of the remote keyless entry system. For a point-to-point wiring schematic refer to SECTION 8A-132.

ABBREVIATIONS

A/T	Automatic Transmission
DTC	Diagnostic Trouble Code
RKE	Remote Keyless Entry/Theft Deterrent System
RCDLR	Remote Control Door Lock Receiver

SYMPTOM TABLE

SYMPTOM	CHART	PAGE
KEYLESS ENTRY SYSTEM INOPERATIVE	9K-1	9K-6
DRIVER'S DOOR LOCK OR UNLOCK FUNCTION INOPERATIVE, PASSENGER DOOR LOCK OPERATES NORMALLY	9K-2	9K-8
REAR GLASS RELEASE INOPERATIVE (BUICK)	9K-3	9K-10
REAR GLASS RELEASE AVAILABLE WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION OUT OF "PARK" (BUICK).	9K-4	9K-12
COURTESY LAMPS DO NOT TURN "ON" WHEN UNLOCK FUNCTION IS OPERATED (COURTESY LAMPS TURN "ON" WHEN ANY DOOR IS OPEN) UNLOCK FUNCTION OPERATES NORMALLY. (BUICK)	9K-5	9K-14
REAR COMPARTMENT LID RELEASE INOPERATIVE	9K-6	9K-16
REAR COMPARTMENT LID RELEASE AVAILABLE WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION OUT OF "PARK."	9K-7	9K-18
KEYLESS ENTRY RECEIVER/TRANSMITTER WILL NOT PROGRAM.	9K-8	9K-20
DOORS DO NOT UNLOCK WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION IS SHIFTED TO "PARK." (BUICK)	9K-9	9K-22
DOORS DO NOT AUTOMATICALLY LOCK WHEN ALL DOORS ARE CLOSED AND TRANSMISSION IS SHIFTED OUT OF "PARK" WITH IGNITION SWITCH IN "RUN." (BUICK)(SEE LAST BULLET IN "DIAGNOSIS" INFORMATION.)	9K-10	9K-24
UNLOCK FUNCTION INOPERATIVE, LOCK FUNCTION OPERATES NORMALLY (PASSENGER DOORS ONLY).	CHECK FOR OPEN IN CKT 194 FROM RCDLR OR POOR CONNECTION AT RCDLR "C1" CONNECTOR TERMINAL "D". IF OK, REPROGRAM USING A KNOWN GOOD TRANSMITTER, AND RE-TEST FUNCTIONS. IF UNLOCK FUNCTION REMAINS INOPERATIVE, REPLACE RCDLR.	
LOCK FUNCTION INOPERATIVE, LOCK FUNCTION OPERATES NORMALLY (ALL DOORS).	CHECK FOR OPEN IN CKT 195 FROM RCDLR OR POOR CONNECTION AT RCDLR "C1" CONNECTOR TERMINAL "E". IF OK, REPROGRAM USING A KNOWN GOOD TRANSMITTER, AND RE-TEST FUNCTIONS. IF LOCK FUNCTION REMAINS INOPERATIVE, REPLACE RCDLR.	
COURTESY LAMPS REMAIN "ON" WITH ALL DOORS CLOSED AND IGNITION SWITCH IN "RUN." (BUICK)	CHECK FOR SHORT TO GROUND IN CKT 1393 TO THE RCDLR. IF OK, REPLACE RCDLR.	
COURTESY LAMPS REMAIN "ON" FOR MAXIMUM OF APPROX. 40 SECONDS AFTER ALL DOORS ARE CLOSED AND IGNITION SWITCH IS IN "RUN." (BUICK)	CHECK FOR OPEN IN CKT 639 TO THE RCDLR OR POOR CONNECTION AT RCDLR "C1" CONNECTOR TERMINAL "B". IF OK, REPLACE RCDLR.	
LOCKS WON'T RE-LOCK AFTER ALL DOORS ARE SHUT AND BRAKE PEDAL IS DEPRESSED. (COURTESY LAMPS AND AUTOMATIC DOOR LOCKS WORK NORMAL.) (BUICK)	CHECK FOR OPEN IN CKT 17 TO RCDLR. IF OK, REPLACE RCDLR.	

9K-4 REMOTE KEYLESS ENTRY

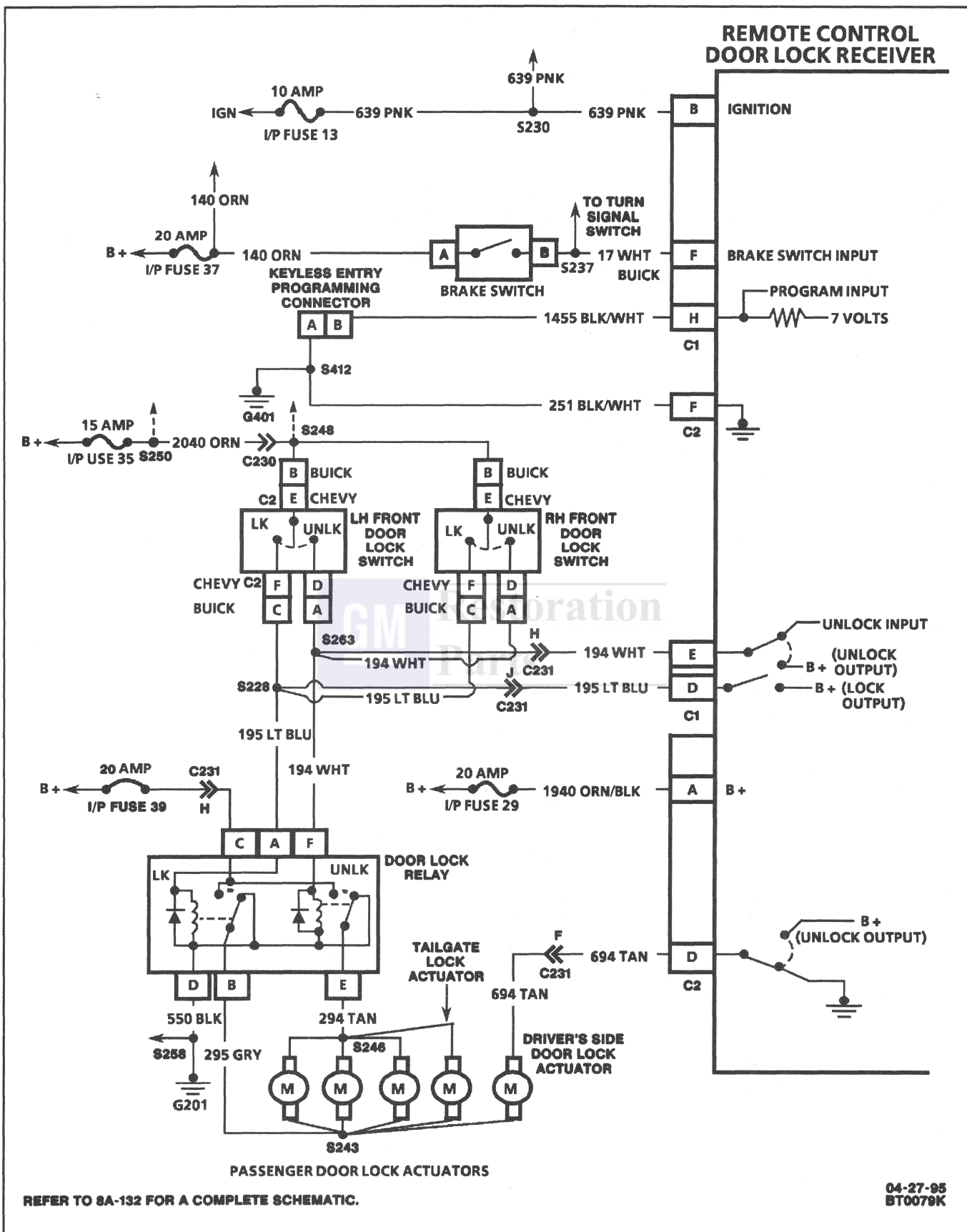
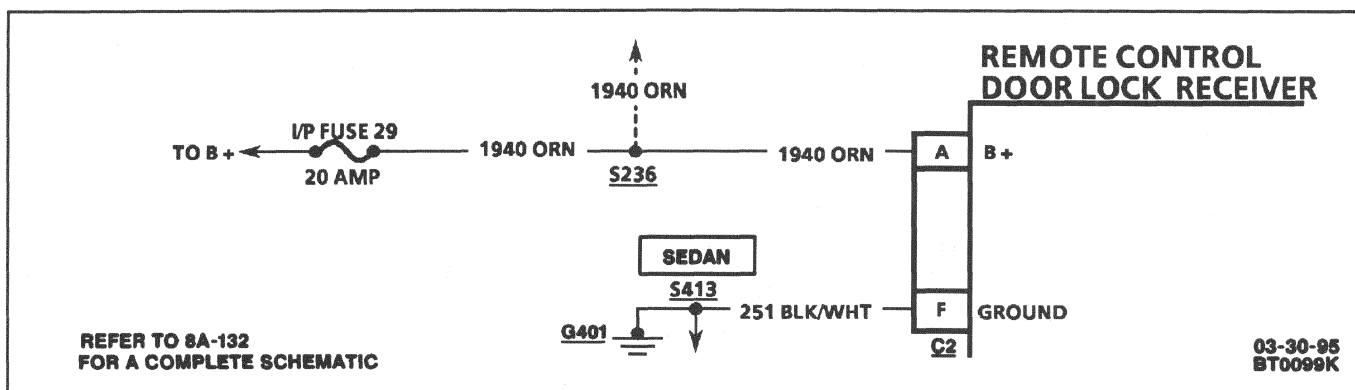


Figure 9K-4 - Remote Keyless Entry Wiring Diagram Sedan/Wagon (1 of 2)



9K-6 REMOTE KEYLESS ENTRY



9K-1

REMOTE KEYLESS ENTRY SYSTEM INOPERATIVE

Circuit Description:

Battery voltage is applied to the RCDLR at all times through I/P fuse 29. The RCDLR is grounded at all times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

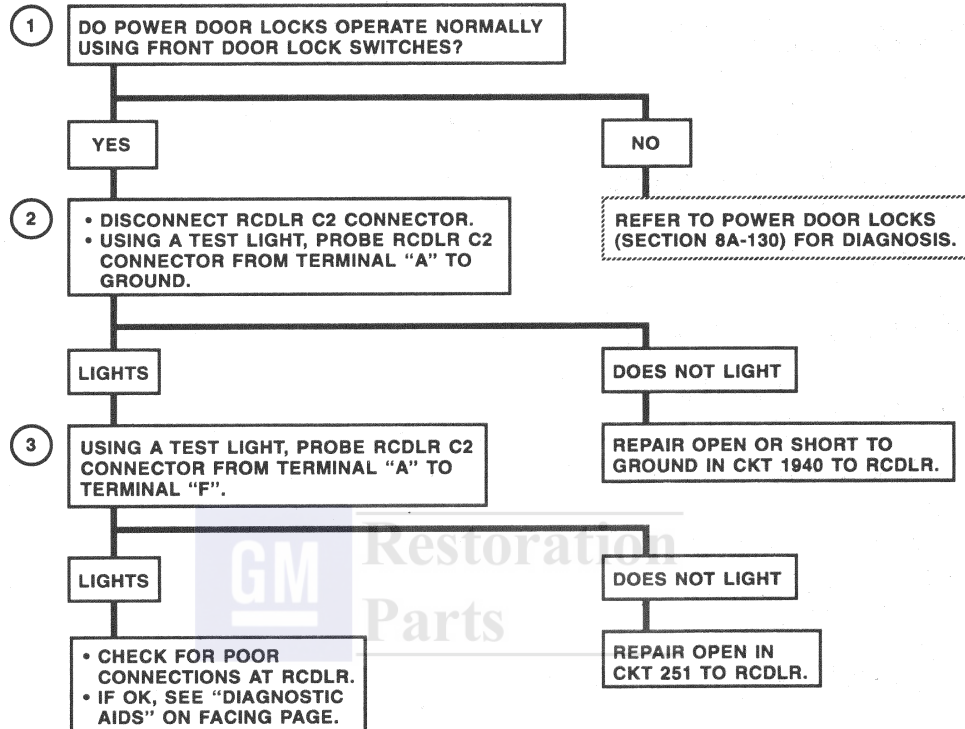
1. Isolate a power door lock system fault or a RKE system fault.

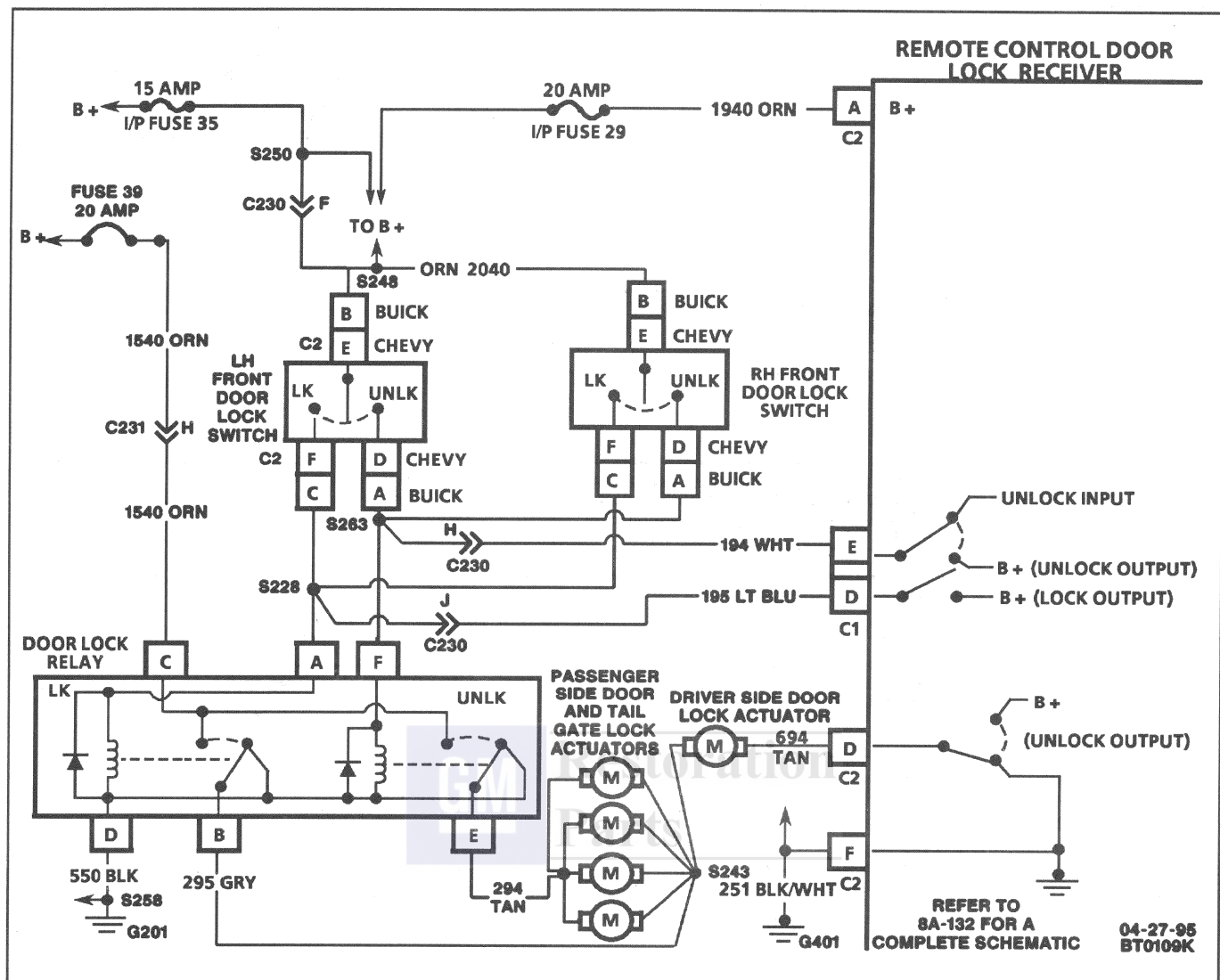
2. Check for battery voltage at the RCDLR connector.
3. Check for ground at the RCDLR connector.

Diagnostic Aids:

Program a known good transmitter (see procedure in this section), and test the RKE system. If the RKE system operates normally, the original transmitter was defective. If the RKE system is still inoperative, replace the RCDLR. If a known good transmitter will not program, refer to 9K-8, Page 9K-20 in this section.

9K-1 **KEYLESS ENTRY SYSTEM** **INOPERATIVE**





9K-2

DRIVER'S DOOR LOCK OR UNLOCK FUNCTION INOPERATIVE, PASSENGER DOOR LOCKS OPERATE NORMALLY

Circuit Description:

Lock function: Battery voltage is applied through the door lock relay and CKT 295 to the driver's door lock actuator. The driver's door lock actuator is grounded through CKT 694 and RCDLR. Unlock function: The RCDLR receiver applies voltage to the driver's door lock actuator through CKT 694. The driver's door lock actuator is grounded through CKT 295 and the door lock relay.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Operating the door lock switches will indicate if driver's door lock functions.
2. Check for unlock signal at the RCDLR.

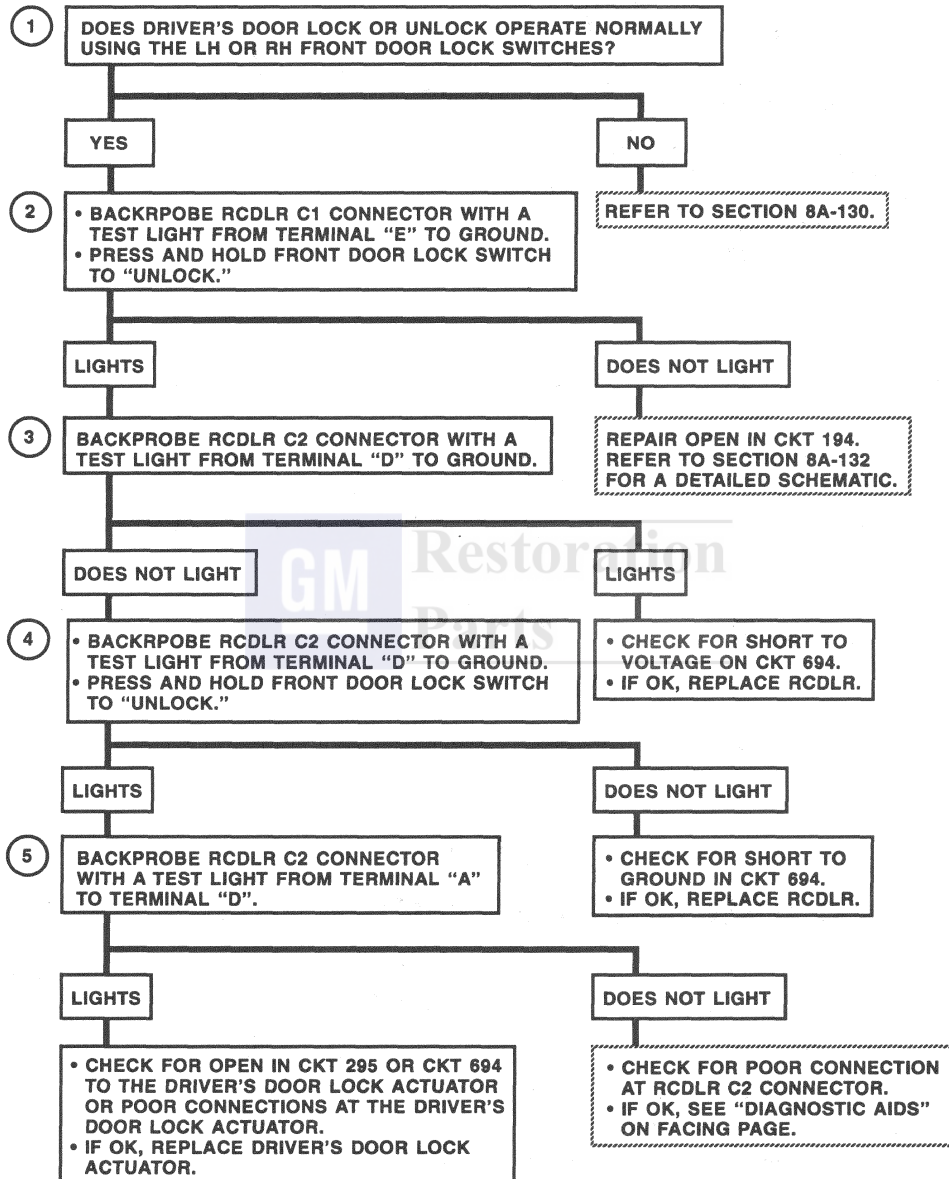
3. Check for voltage on CKT 694. Voltage on CKT 694 would prevent the driver's door lock actuator from locking.
4. Check that the RCDLR grounds CKT 694 to enable a lock request.
5. Check for open in CKT 295 or CKT 694 to driver's door lock actuator.

Diagnostic Aids:

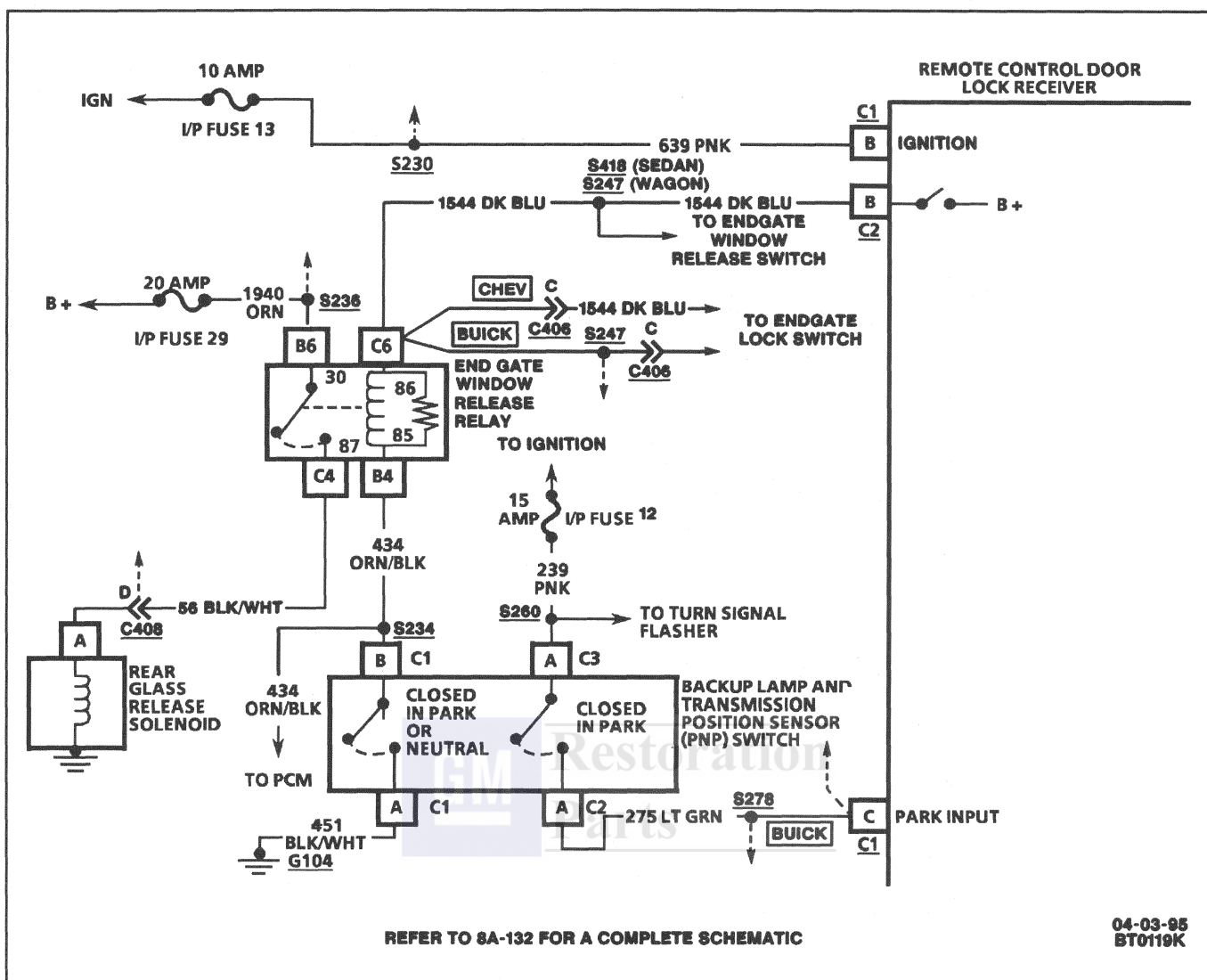
Program a known good transmitter (see procedure in this section) and test the driver's door lock and unlock functions. If the driver's door lock and unlock functions operate normally, the original transmitter was defective. If the driver's door lock and unlock functions are still inoperative replace the RCDLR. If a known good transmitter will not program, refer to 9K-8, Page 9K-20 in this section.

9K-2

DRIVER'S DOOR LOCK OR UNLOCK FUNCTION INOPERATIVE, PASSENGER DOOR LOCKS OPERATE NORMALLY



9K-10 REMOTE KEYLESS ENTRY



9K-3

REAR GLASS RELEASE INOPERATIVE (BUICK)

Circuit Description:

When the RCDLR senses no voltage on CKT 693 and CKT 275, the rear glass release function can be activated using the transmitter. When the RCDLR senses voltage on CKT 639 and CKT 275, (ignition switch in "RUN" and A/T in "PARK") the rear glass release function can also be activated using the transmitter. When the RCDLR senses voltage on CKT 639 (ignition switch in "RUN") and no voltage on CKT 275 (A/T not "PARK") the rear glass release function cannot be activated by the transmitter.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

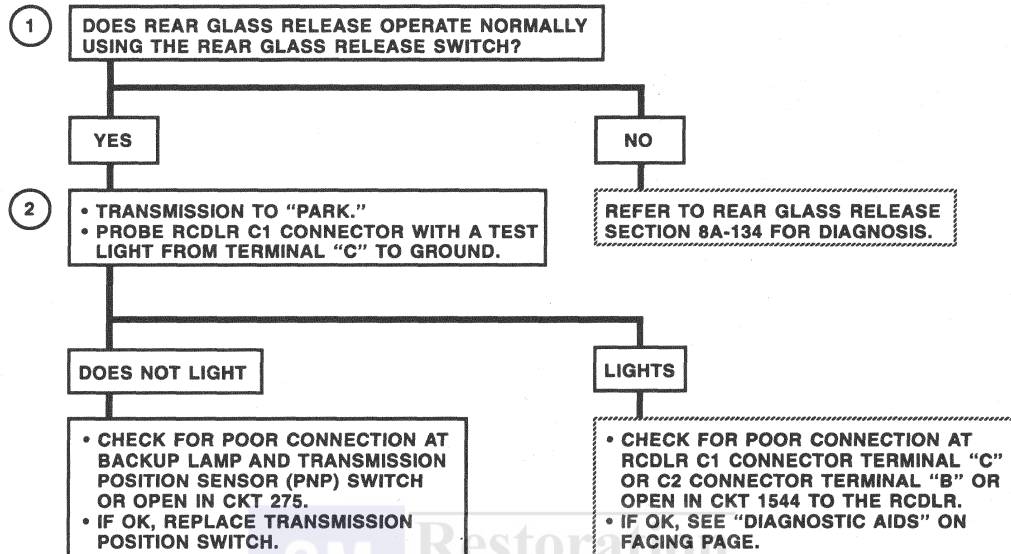
1. Determine an RKE system fault or rear glass release system fault.

2. Test the backup lamp and transmission position (PNP) switch. With the A/T in "PARK," the backup lamp and transmission position (PNP) switch should be closed, applying voltage to CKT 275.

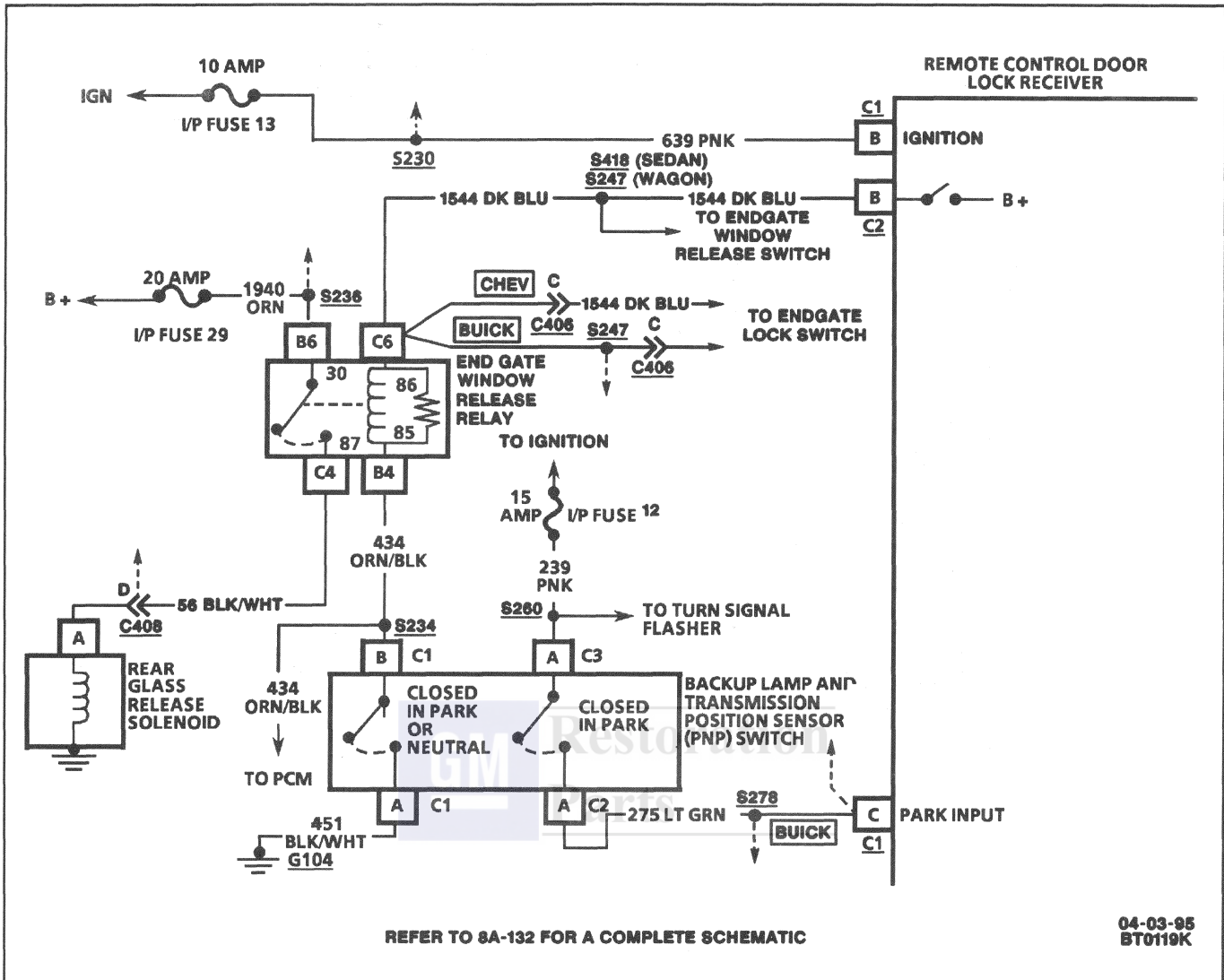
Diagnostic Aids:

Program a known good transmitter (see procedure in this section) and test the rear glass release function. If the rear glass release function operate normally, the original transmitter was defective. If the rear glass release functions are still inoperative replace the RCDLR. If a known good transmitter will not program, refer to 9K-8, Page 9K-20 in this section.

9K-3 REAR GLASS RELEASE INOPERATIVE (BUICK)



9K-12 REMOTE KEYLESS ENTRY



9K-4

REAR GLASS RELEASE AVAILABLE WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION OUT OF "PARK" (BUICK)

Circuit Description:

When the RCDLR senses no voltage on CKT 693 and CKT 275, the rear glass release function can be activated using the transmitter. When the RCDLR senses voltage on CKT 639 and CKT 275, (ignition switch in "RUN" and A/T in "PARK") the rear glass release function can also be activated using the transmitter. When the RCDLR senses voltage on CKT 639 (ignition switch in "RUN") and no voltage on CKT 275 (A/T not "PARK") the rear glass release function cannot be activated by the transmitter.

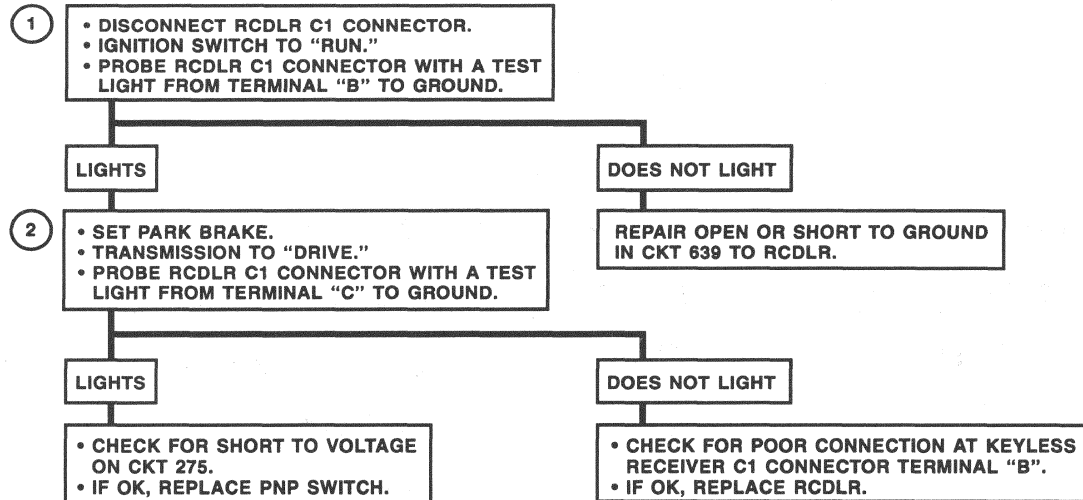
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

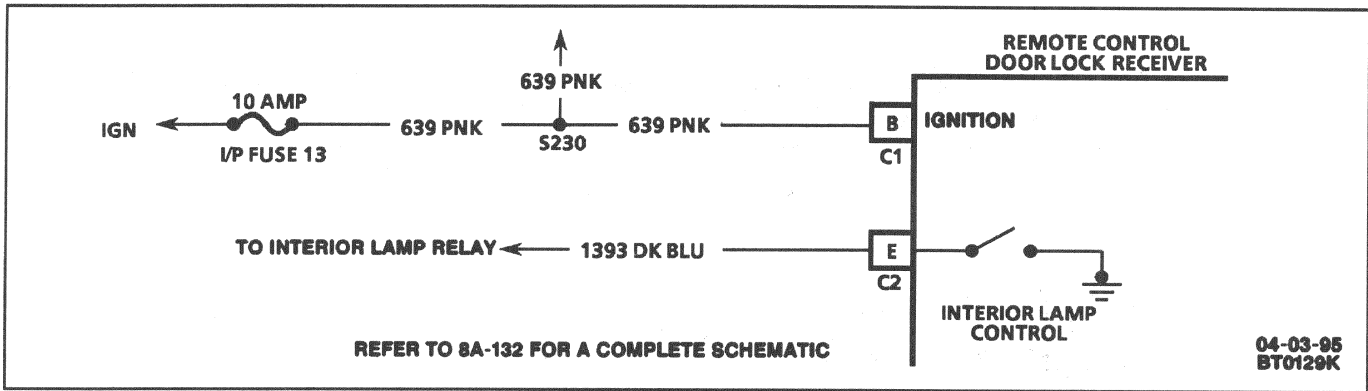
1. Check for an ignition input signal to the RCDLR.
2. Check for a false signal from the backup lamp and transmission position (PNP) switch or a short to voltage on CKT 275.

9K-4

REAR GLASS RELEASE AVAILABLE WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION OUT OF "PARK" (BUICK)



9K-14 REMOTE KEYLESS ENTRY



9K-5

COURTESY LAMPS DO NOT TURN "ON" WHEN UNLOCK FUNCTION IS OPERATED (COURTESY LAMPS TURN "ON" WHEN ANY DOOR IS OPEN) UNLOCK FUNCTION OPERATES NORMALLY (BUICK)

Circuit Description:

When the unlock button on the transmitter is pressed, the RCDLR grounds CKT 1393 to activate courtesy lamps relay and start an internal timer. If the internal timer reaches 30 seconds or the ignition switch is turned to "RUN," the RCDLR removes the ground on CKT 1393. The RCDLR senses voltage from I/P fuse 13 on CKT 639 when the ignition switch is turned to "RUN" to reset the internal timer.

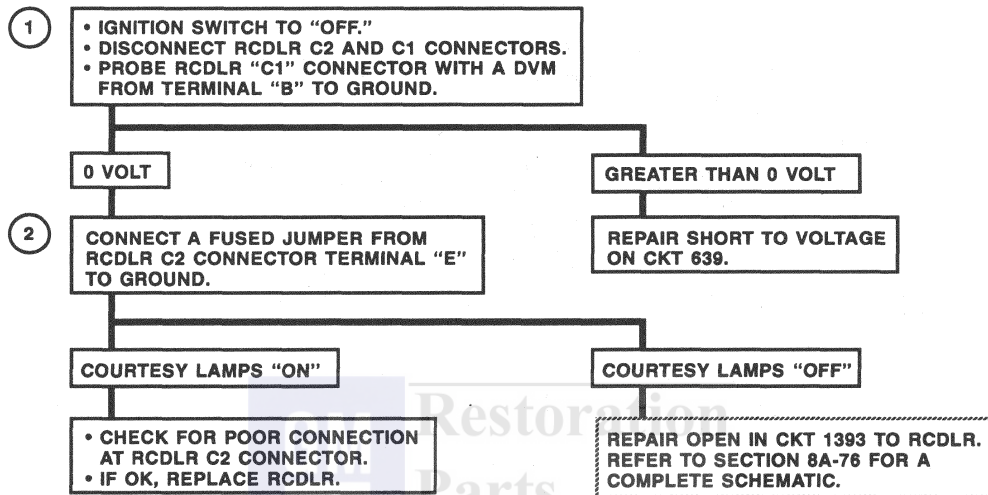
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Check for a false ignition "ON" signal to the RCDLR.
2. Check CKT 1393, courtesy lamp relay circuit to the RCDLR.

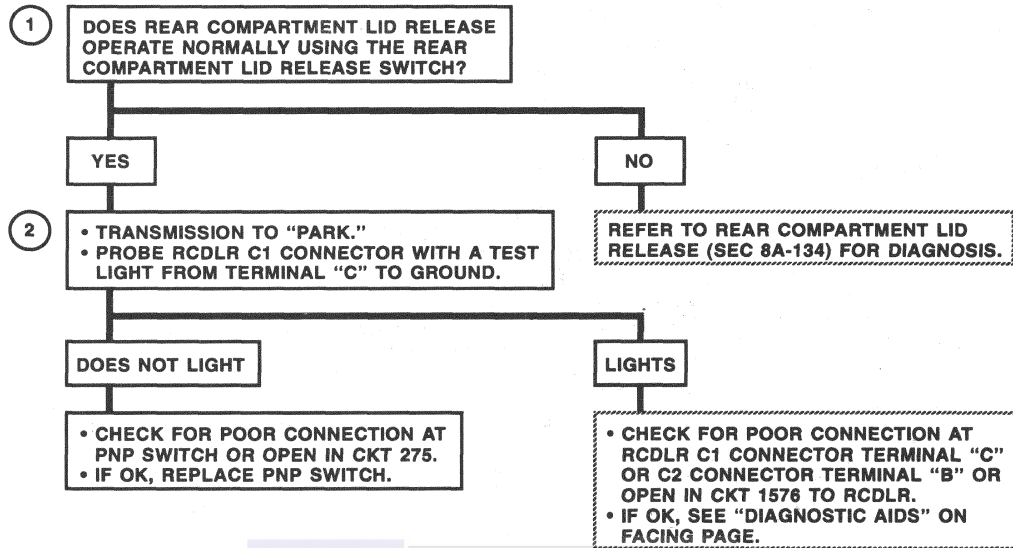
9K-5

COURTESY LAMPS DO NOT TURN "ON" WHEN UNLOCK FUNCTION IS OPERATED (COURTESY LAMPS TURN "ON" WHEN ANY DOOR IS OPEN) UNLOCK FUNCTION OPERATES NORMALLY (BUICK)

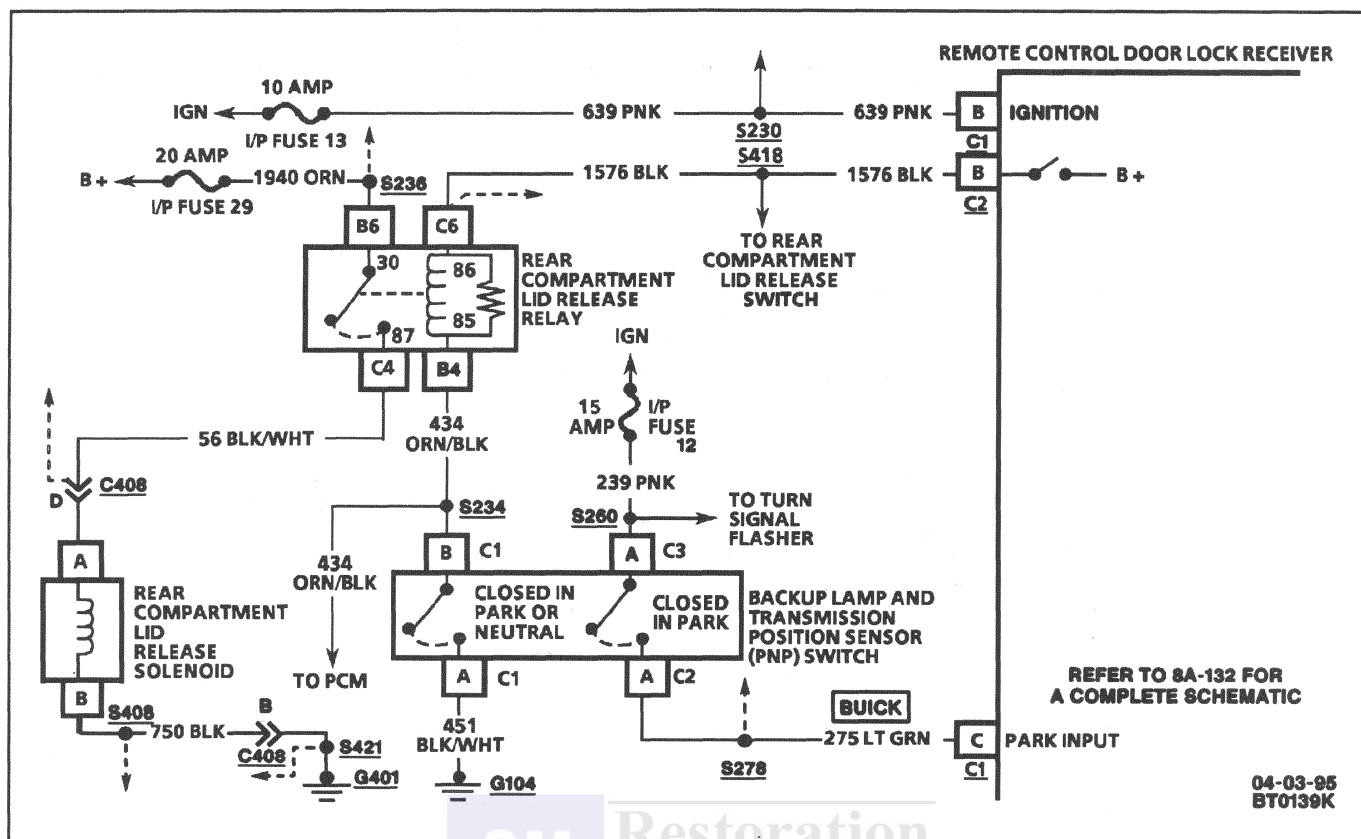


- [illegible]

9K-6 REAR COMPARTMENT LID RELEASE INOPERATIVE



9K-18 REMOTE KEYLESS ENTRY



9K-7

REAR COMPARTMENT LID RELEASE AVAILABLE WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION OUT OF "PARK"

Circuit Description:

When the RCDLR senses no voltage on CKT 639 and CKT 275, the rear compartment lid release function can be activated using the transmitter. When the RCDLR senses voltage on CKT 639 and CKT 275, (ignition switch in "RUN" and A/T in "PARK") the rear compartment lid release function can also be activated using the transmitter. When the RCDLR senses voltage on CKT 639 (ignition switch in "RUN") and no voltage on CKT 275 (A/T not in "PARK") the rear compartment lid release function cannot be activated by the transmitter.

Chart Test Description:

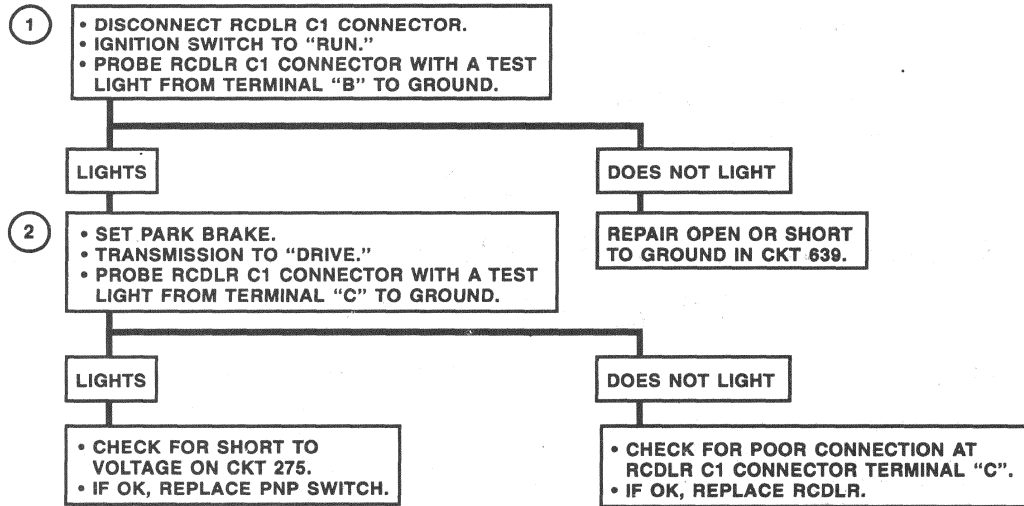
Number(s) below refer to circled number(s) on the diagnostic chart.

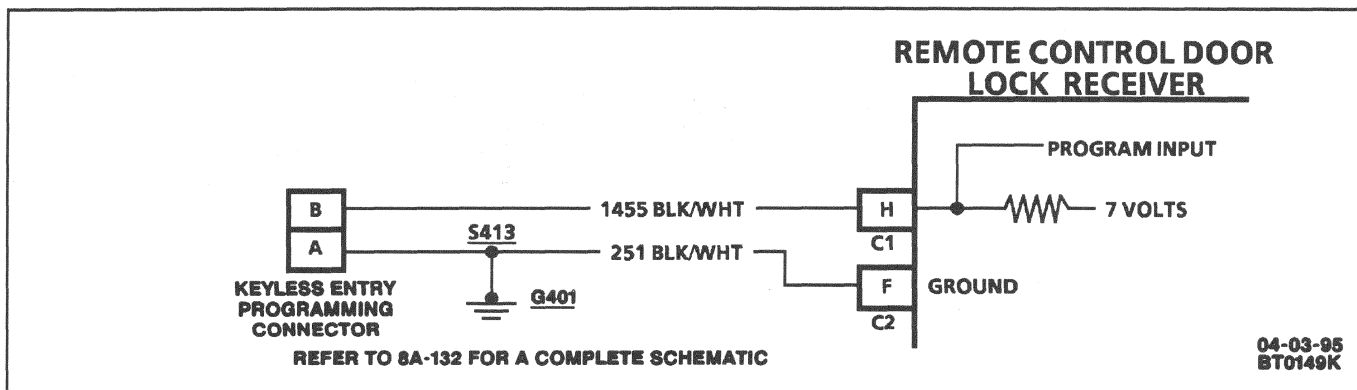
1. Check for an ignition input signal to the RCDLR.
2. Check for a false signal from the backup lamp and transmission position (PNP) switch or short to voltage on CKT 275.

Diagnostic Aids:

If voltage is absent at terminal "B" of RKE connector "C2" (with ignition "ON") and A/T out of "PARK," rear compartment lid release will be available using the transmitter.

9K-7
REAR COMPARTMENT LID RELEASE AVAILABLE
WITH IGNITION SWITCH IN "RUN" AND
TRANSMISSION OUT OF "PARK"





9K-8

REMOTE CONTROL DOOR LOCK RECEIVER/TRANSMITTER WILL NOT PROGRAM

Circuit Description:

The RCDLR applies voltage to CKT 1455. When the programming connector terminals "A" and "B" are shorted together, the RCDLR senses a voltage drop on CKT 1455. The RCDLR then cycles all door lock actuators once. The RCDLR then waits for input from the transmitter(s) or for the jumper to be removed from the keyless entry programming connector.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

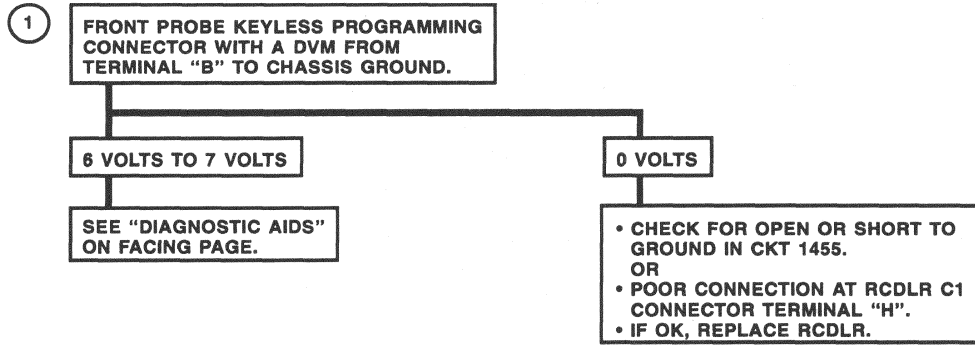
1. Check that the RCDLR applies voltage to CKT 1455.

Diagnostic Aids:

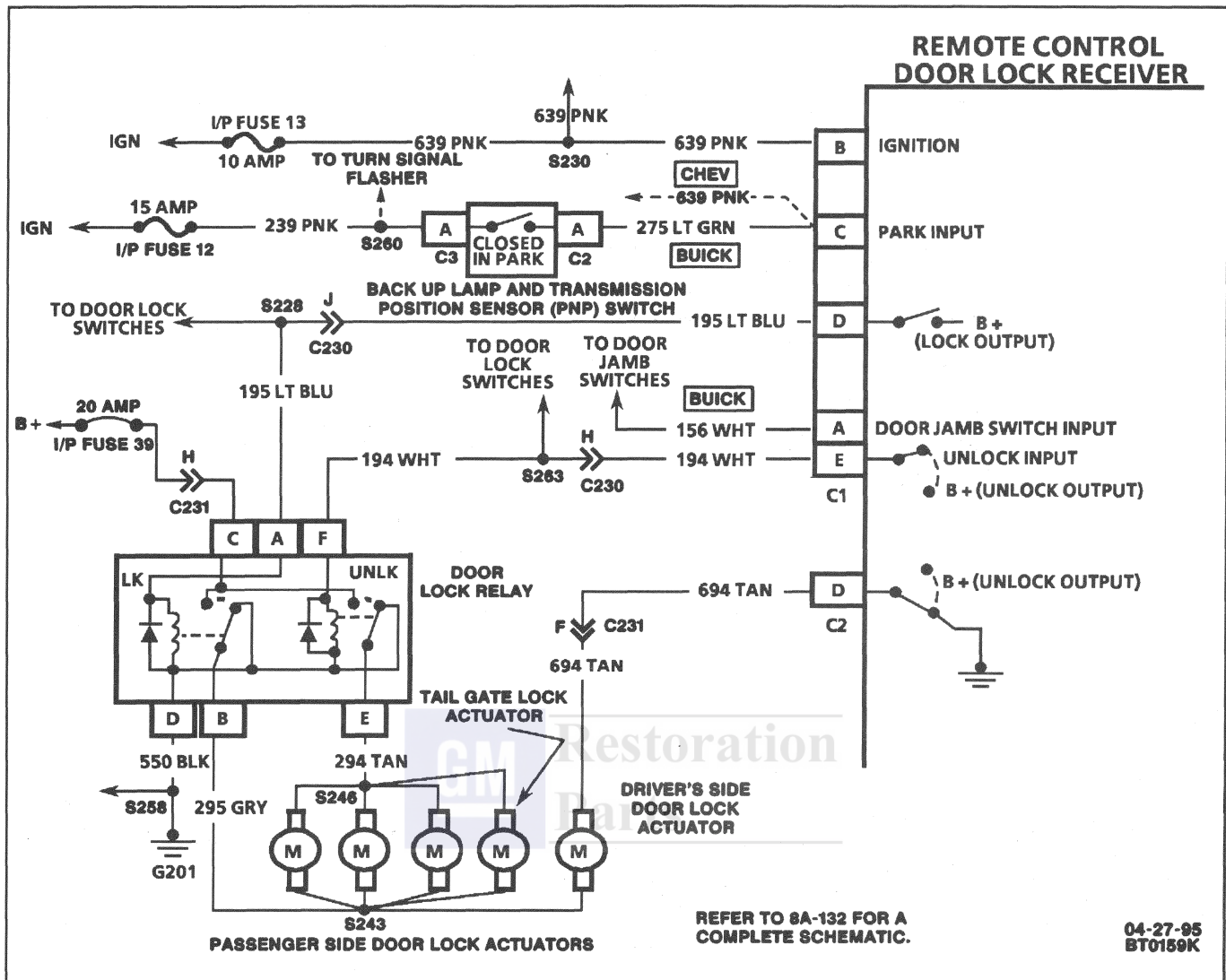
Program a known good transmitter (see procedure in this section), and test the RKE system. If the RKE system operates normally, the original transmitter was defective. If the RCDLR does not program, using a known good transmitter, replace the RCDLR.

9K-8

REMOTE CONTROL DOOR LOCK RECEIVER/TRANSMITTER WILL NOT PROGRAM



9K-22 REMOTE KEYLESS ENTRY



9K-9

DOORS DO NOT UNLOCK WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION IS SHIFTED TO "PARK" (BUICK)

Circuit Description:

When the A/T is shifted into "PARK," voltage is applied to the RCDLR on CKT 275. When the RCDLR senses voltage on CKT 639 (ignition switch in "RUN") and voltage on CKT 275, the RCDLR applies voltage to CKT 194. The door lock relay is energized to actuate the door lock actuators and unlock all doors.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Isolate a power door lock system fault or RKE system fault.

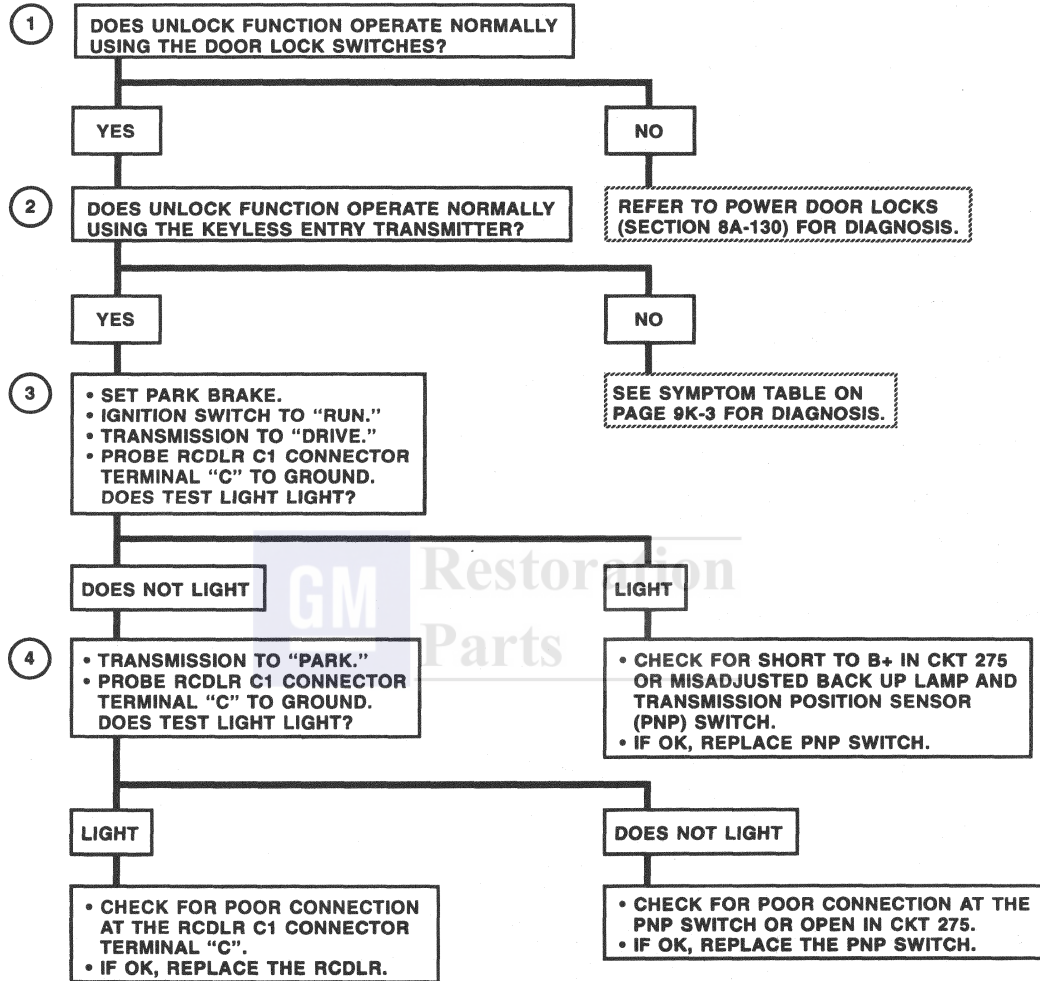
2. Isolate a RKE system functional failure.
3. Checks for short to voltage on CKT 275 when A/T is in "DRIVE."
4. Checks for proper operation of backup lamp and transmission position (PNP) switch.

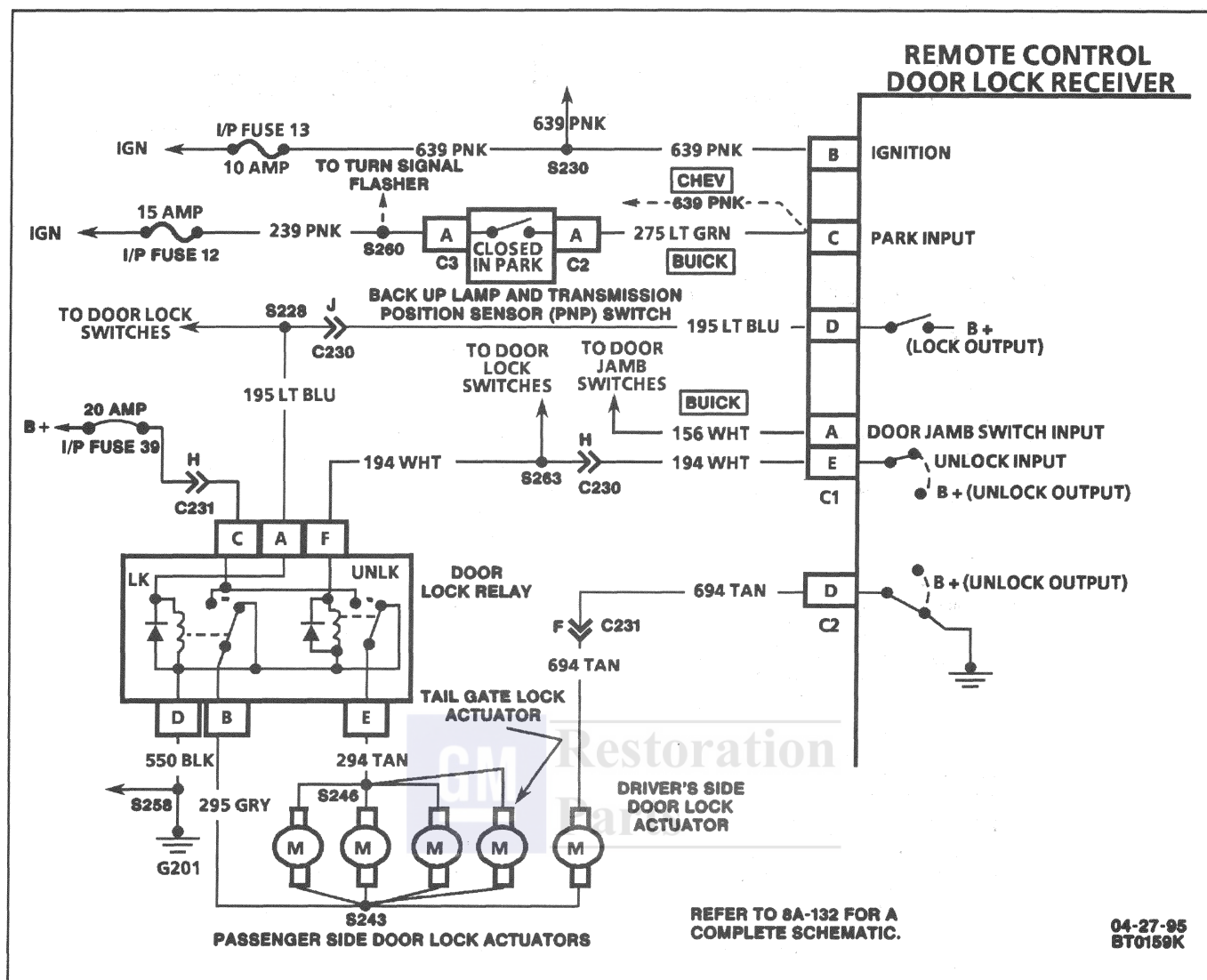
Diagnostic Aids:

RCDLR must receive voltage on CKT 639 when ignition is "ON" for auto door locks to work. Doors must be shut for normal operation of auto lock feature. (Courtesy lamps "OFF.")

9K-9

DOORS DO NOT UNLOCK WITH IGNITION SWITCH IN "RUN" AND TRANSMISSION IS SHIFTED TO "PARK" (BUICK)





9K-10

**DOORS DO NOT AUTOMATICALLY LOCK WHEN ALL
DOORS ARE CLOSED AND TRANSMISSION IS SHIFTED OUT
OF "PARK" WITH IGNITION SWITCH IN "RUN"**

Circuit Description

When the RCDLR senses voltage on CKT 639 (ignition switch in "RUN"), no voltage on CKT 275(trans. out of park) and the ground removed from CKT 156 (all door jamb switches open, all doors closed), the RCDLR applies voltage to CKT 195. The door lock relay is energized to activate the door lock actuators and lock all doors.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for normal operation of the RCDLR.

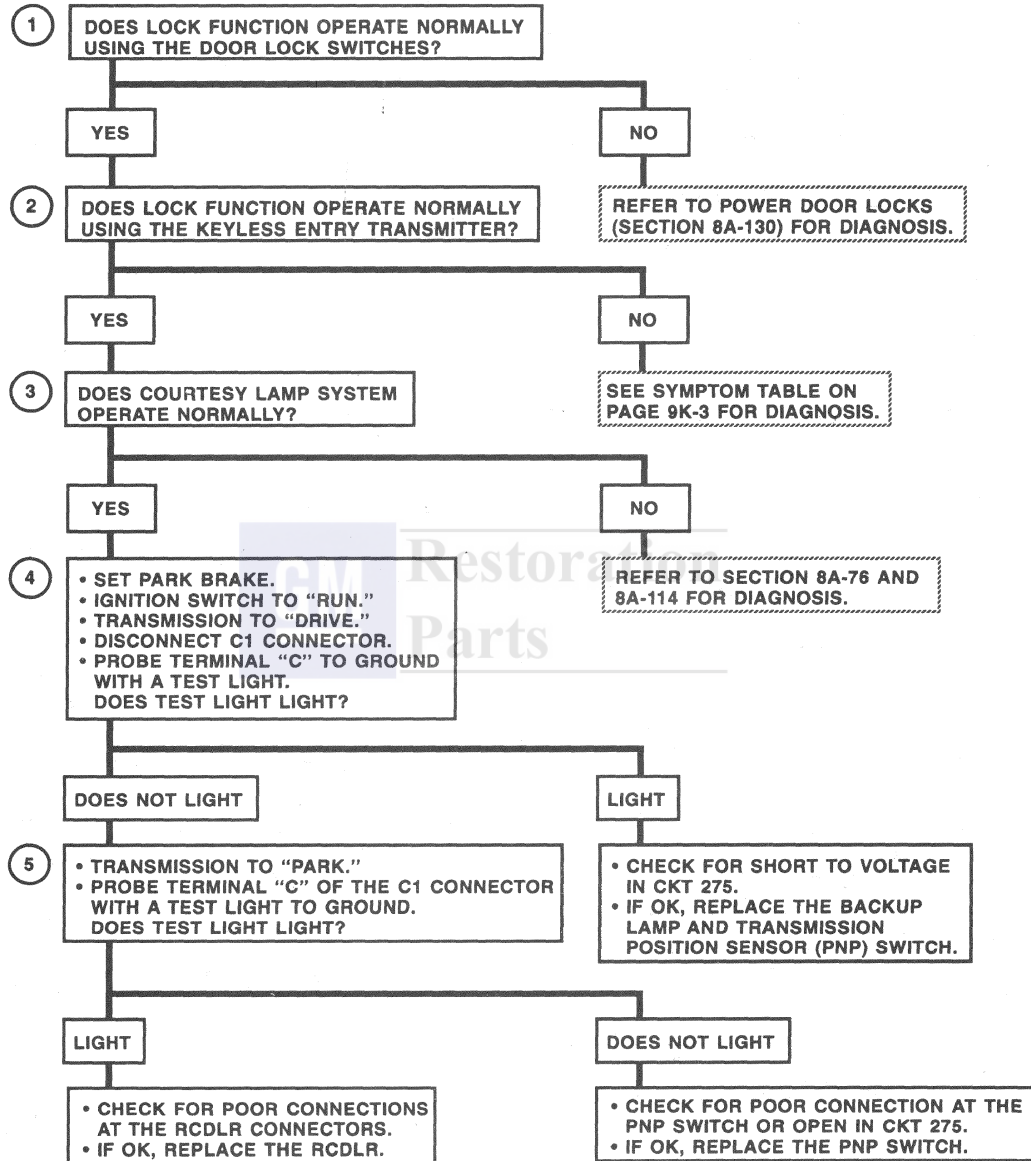
2. If the courtesy lamp function operates normally, CKT 156 to the RCDLR is not shorted to ground.
3. Checks for an unwanted voltage at terminal "C" of the "C2" connector with the A/T in "DRIVE."
4. Checks for voltage at terminal "C" of the "C2" connector with the A/T in "PARK."
5. Checks for voltage at CKT 275 through transmission position sensor switch (PNP).

Diagnostic Aids:

Terminal "B" of the "C2" connector must have voltage to it with the ignition switch "ON," for automatic function to operate.

9K-10

DOORS DO NOT AUTOMATICALLY LOCK WHEN ALL DOORS ARE CLOSED AND TRANSMISSION IS SHIFTED OUT OF "PARK" WITH IGNITION SWITCH IN "RUN" (BUICK)



ON-VEHICLE SERVICE

RECEIVER

(Sedan)

Figures 2 and 3
 Remove or Disconnect

For Chevrolet, access receiver (4) from underneath rear window panel through rear compartment using forward access hole.

For Buick, rear window panel trim must be removed to access receiver (4) (Figure 3). Refer to SECTION 10-8.

1. Rivets (10) attaching receiver (4) to rear window panel.
2. Electrical connectors from receiver (4).
3. Receiver (4).

 Install or Connect

NOTICE: Refer to "Notice" on page 9K-1 of this section.

1. Electrical connectors.
2. Receiver (4).
3. Rivets (10).
 - For Chevrolet, install from underneath panel (5).

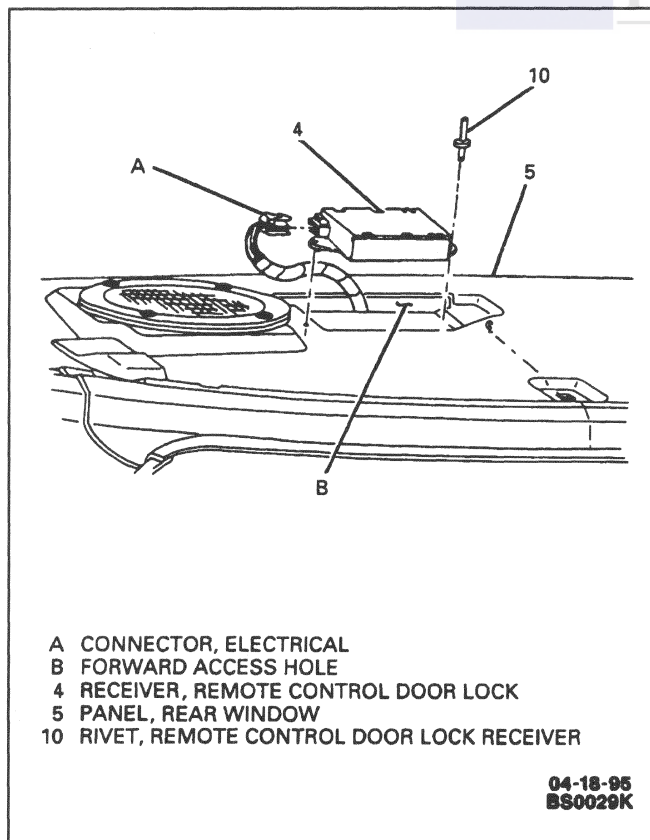


Figure 2 - Remote Control Door Lock Receiver -
(Chevrolet Sedan)

- For Buick, install from above panel (8).

4. Rear window panel trim, for Buick. Refer to SECTION 10-8.

(Buick Wagon)

Figure 4
 Remove or Disconnect

1. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.
2. Electrical connectors.
3. Receiver (4) and tape (11) from inner wheelhouse.

 Install or Connect

1. Tape (11) to bottom of receiver (4).
 - Strongly recommend using new tape to ensure adhesion over life of receiver. Do not use substitution.
2. Electrical connectors.
3. Align hole in tab on receiver (4) with gage hole in inner wheelhouse.
4. Press receiver firmly against inner wheelhouse.
5. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.

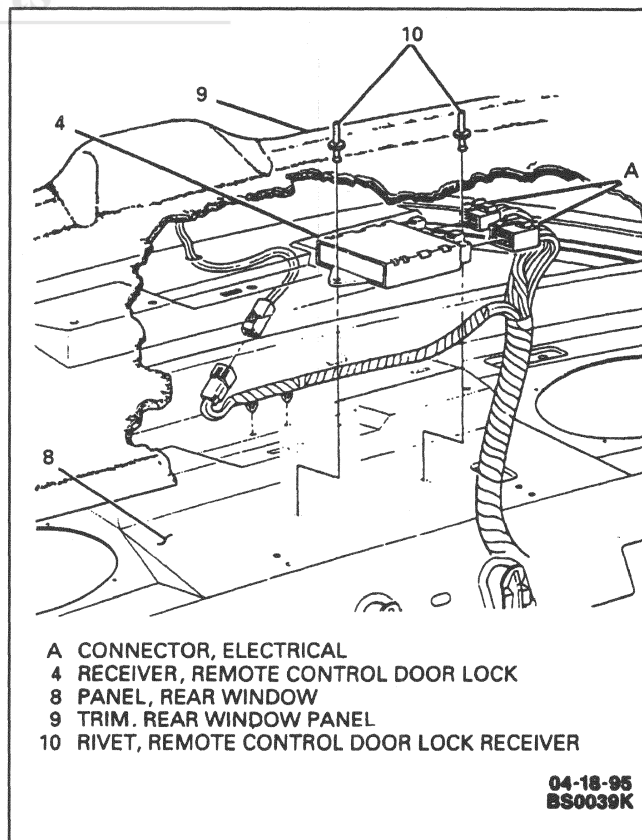


Figure 3 - Remote Control Door Lock Receiver -
(Buick Sedan)

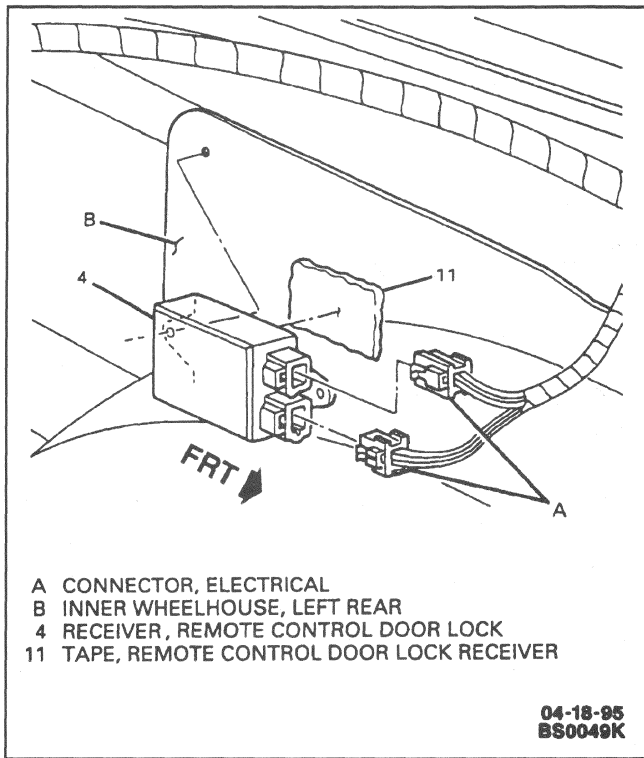


Figure 4 - Remote Control Door Lock Receiver -
(Buick Wagon)

Programming the Receiver

Figures 5 and 6

1. Reposition rear compartment trim to access the programming connector located at the left of the rear compartment, for sedan.
2. Remove left back body pillar finish panel to access programming connector, for wagon. Refer to SECTION 10-7.
3. Ground the programming connector by connecting the terminals together.
 - The system will verify this has occurred by performing a lock all, unlock drivers door/unlock all, and trunk/endgate cycle.
4. Press any key on either transmitter.
 - This step programs that particular transmitter to the receiver.
 - The system will verify by performing the same lock/unlock, lock/unlock cycle.
5. The Automatic Door Locking/Unlocking function is automatically enabled for this transmitter. To leave it enabled, skip to step 6. To disable the Automatic Door Locking/Unlocking function for this transmitter, perform the following sequence 3 times.
 - A. Press door lock button within 1 second of step C the 2nd and 3rd time through this sequence.
 - B. Press door unlock button within 1 second of step A.
 - C. Press trunk button within 1 second of step B.
 - The receiver will cycle through the lock, unlock, trunk sequence 3 times as verification.
6. To program a second transmitter to the receiver, repeat step 4 with the second transmitter. Otherwise, go to 7.

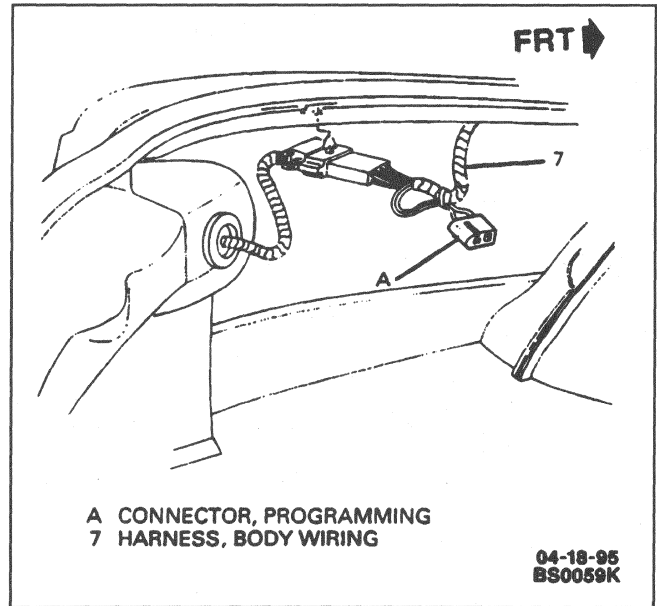


Figure 5 - Remote Control Door Lock Receiver
Programming Connector (Sedan)

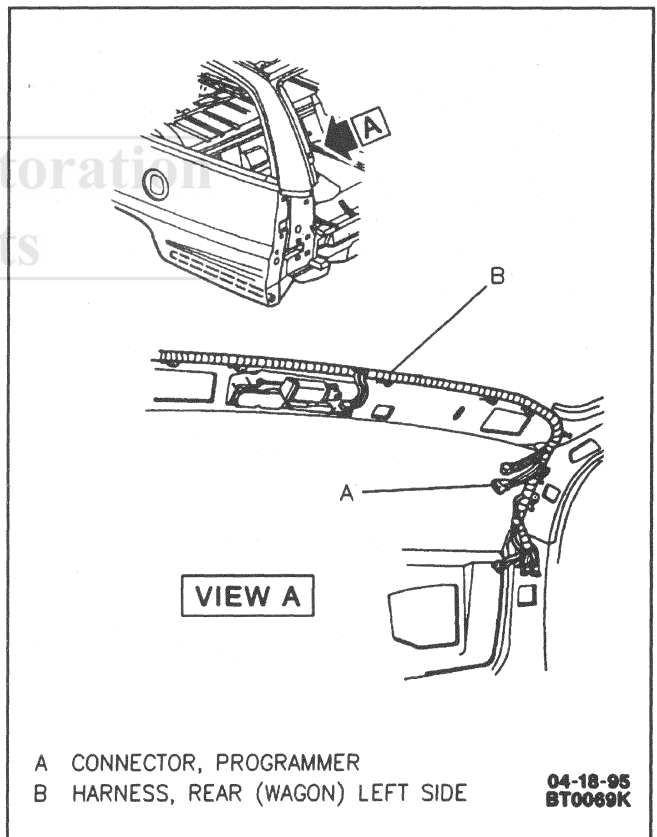


Figure 6 - Remote Control Door Lock Receiver
Programming Connector (Wagon)

7. Disconnect the programming connector.
 - System will not operate if ground connection is not removed.
8. Verify operation of each transmitter.
9. Reposition rear compartment trim, for sedan.
10. Install left back body pillar finish panel, for wagon. Refer to SECTION 10-7.

BLANK



SECTION 10-1

GENERAL BODY SERVICE

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: The theft deterrent label found on some major sheet metal must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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10-1-2 GENERAL BODY SERVICE

GENERAL DESCRIPTION

The information in this section provides body service procedures that apply to the entire vehicle.

WELDING ON THE BODY OR FRAME

Before welding on the body or frame, always disconnect the following components to prevent possible damage to sensitive electronic circuits:

- Sensing and Diagnostic Module (SDM). Refer to SECTION 9J.
- Powertrain Control Module (PCM). Refer to SECTION 6E3.
- Electronic Brake Control Module (EBCM). Refer to SECTION 5E1.
- Warning Audio Alarm Module. Refer to SECTION 8C.
- Cruise Control Module. Refer to SECTION 9B.
- Remote Control Door Lock Receiver. Refer to SECTION 9K.

ON-VEHICLE SERVICE

FASTENERS

Many aluminum components are used on present models. Aluminum in contact with steel may corrode rapidly if not protected by special finishes or isolators.

Such fasteners have a special finish meeting GM specifications, which provides adequate protection from corrosion. These special fasteners differ in color in order to more easily identify them from the standard metric fasteners, which are medium blue in color.

NOTICE: When replacing fasteners avoid substituting otherwise similar fasteners in locations which require the use of special fasteners GM P/N 6111-M, GM P/N 6047, GM P/N 6174M or equivalent for aluminum components. Failing to follow this precaution may result in premature corrosion of the sheet metal in the areas mentioned above.

Weld Stud Replacement

If during a repair procedure, a weld stud becomes damaged, the following procedure may be used to replace the weld stud.

1. Drill a hole into same location as damaged weld stud.
2. Drive a screw into drilled hole.

Important

- Make sure to apply proper anticorrosion materials as necessary.
3. Use the screw to retain clips, moldings, etc. in the same manner used with weld studs.
 4. If surface becomes marred, repair and/or paint to provide a smooth surface. Refer to "Metal Part Refinishing - Basecoat/Clearcoat" in this section.

LUBRICATION

Mechanical parts having contacting surfaces in relative motion with other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that these parts be lubricated at the basic service intervals shown in SECTION 0B, using the following lubricants:

- Door hinges - oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings.

Important

- Do not apply lubrication to hold-open link and roller contacting surfaces as this could cause improper roller operation.
- Compartment lid hinges and torque rod-to-hinge surfaces - Lubriplate Autolube A (GM P/N 1052196); Lubriplate Aerosol (GM P/N 1052349); Lithium Lubricant (3M P/N 8915) - Aerosol or equivalent.
- Hood latch, pivots, spring anchor and release pawl -grease, high temperature - water spray resistant GM P/N 12345996 or equivalent.
- All key lock cylinders should be lubricated with Multi-Purpose Lubricant GM P/N 12345120 or equivalent) or light machine oil.
- Seat mechanism, door hardware, and sunroof module are covered in their specific body sections in this manual.
- All weather-strips should be periodically lubricated with a silicone paste lubricant. A thin film of lubricant should be applied using a clean cloth.

STRIPES AND DECALS

Stripes and decals adhere to a painted surface using pressure sensitive adhesive.

The use of a wetting solution aids the technician in lifting and positioning the stripe or decal during installation. A wetting solution also ensures a better bond between stripe or decal and panel.

Stripe or decal replacement involving collision damage, or damage to underlying painted surface, requires that metal repair and/or refinish operations be completed before stripe or decal is installed.

NOTICE: Freshly painted surfaces must be allowed to dry thoroughly before installing stripe or decal. Residual solvents in fresh painted surfaces can lead to subsequent blistering problems if stripe or decal is applied before complete release of solvents. The stripe or decal material highlights vehicle surface imperfection. All dings, rough metal, paint defects and uneven two-tone paint break lines must be eliminated before stripe/decal application can take place.

Body surfaces, stripes and decals must be maintained between 21° C to 38° C (70° F to 100° F) during installation. Auxiliary heat sources to warm the body surfaces, stripes and decals are required if the temperature is below 21° C (70° F).

**Important**

- Never apply stripes or decals when temperatures are below 21° C (70° F). Stripes and decals may be applied “dry.” If this does not result in a consistent bubble free application, the “wet” method must be used as in the case of large graphics packages.

**Important**

- Stripes or decals that are applied on flexible surfaces (fascias, etc.) must be applied using the “wet” method. This will reduce the formation of bubbles under the stripe or decal due to the outgassing potential of the flexible materials.

REMOVAL AND INSTALLATION

The following equipment and materials are necessary when making a quality stripe or decal installation. Equivalent products may be used.

- Wetting solution - a foaming type window cleaner, that does not contain ammonia.
- Silicone, wax and grease remover.
- Isopropyl alcohol.
- Squeegee - 75 to 100 mm (3 to 4 inches) wide, plastic or hard rubber. De-burr any sharp or rough edges to prevent scratching of the stripe or decal.
- Water bucket and sponge or spray bottle.
- Sandpaper - 600 grit or finer, wet-or-dry type.
- Heat gun or infrared heat lamp.
- Clean, lint-free wiping rags.
- Sharp knife or razor blade.
- Scissors.
- Fine pin or needle.
- Marking pencil.

**Remove or Disconnect**

1. Necessary moldings or trim panels.
2. Wash and clean repair surfaces, adjacent panels and openings as required.
3. Molding attaching clips, handles, sidemarker reflectors and/or other stripe or decal overlapping parts.

NOTICE: To avoid damaging underlying paint finish, do not use pointed or sharp instruments for removal of stripe or decal from panel.

4. Stripe or decal by starting at one edge and peeling stripe or decal from panel assembly surface.
 - Application of heat to stripe or decal at point of removal aids removal operation.
5. All traces of adhesive residue from painted surfaces with a silicone, wax and grease remover.

**Install or Connect**

NOTICE: Always refer to manufacturer's packaged instructions to avoid damage.

1. Prepare surface.

**Important**

- If area where stripe or decal is to be applied has been refinished, remove any imperfections that would show through stripe or decal.

**Clean**

- A. Painted surface with silicone, wax and grease remover.
 - B. Area where stripe or decal will be applied with a 50-50 mixture of isopropyl alcohol and water.
 - Wipe panel surface with a clean cloth while solvent is still wet and allow to dry.
2. Apply wetting solution to area where stripe or decal is to be installed.
 3. Put wetting solution on adhesive side of stripe or decal.
 - Remove backing material of stripe or decal as necessary.
 4. Stripe or decal to panel. Wetting solution will allow movement of stripe or decal for proper positioning.
 - A. Working from center where possible, squeegee stripe or decal into position. Application of additional wetting solution may be necessary to ease installation of stripe or decal. Application of soapy wetting solution on top side of stripe or decal will ease pull of squeegee on stripe or decal and help to eliminate damage to it.
 - B. Apply heat to stripe or decal at recessed areas. Press stripe or decal into recess to obtain firm bond.

**Inspect**

- Stripe or decal from critical angle using adequate light reflection to detect any irregularities that may have developed during installation.
- C. Remove all air bubbles by piercing with a safety pin, needle or tool with same size piercing tip. Never use razor blade or knife edge.
 - Pierce bubble on its outer edge and force air out from opposite edge with blade of squeegee.
5. Previously removed parts and clean as required.

Woodgrain Transfers

Woodgrain transfers possess a 50-degree gloss or semi-gloss finish and are of all vinyl construction. They are designed to fasten to an acrylic painted surface by means of a pressure sensitive adhesive.

Service replacement transfers are available through service warehouses in suitably sized roll stock form. When placing orders for transfers, indicate division, model year, body style and applicable vehicle panel assembly usage.

The use of a wetting solution aids in lifting and positioning the transfer during installation. A wetting solution also insures a better bond between transfer and panel assembly.

Vinyl transfer replacement involving collision damage, or damage to underlying acrylic paint finish requires that metal repair and/or refinish operations be completed before the transfer is installed.

For quality results, the temperature of the transfer, panel assembly surface and work room should be in the range of 20° to 40° C (70° to 104° F). At temperatures below this range, the vinyl is less flexible and will not stretch easily to conform to body contours. Also, the vinyl transfer adhesive becomes low in tack, making it difficult to obtain good adhesion. At temperatures above this range, the adhesive becomes high in tack which may cause the transfer to adhere to the body before proper placement is achieved.

A proper squeegee sequence is of utmost importance. Start at top center of the transfer. Progress to right and left from center to establish alignment across the top. Then squeegee downward from this position in small increments across the transfer (Figure 1). Use firm, short, overlapping squeegee strokes to drive out all the water and air while achieving maximum transfer bond. Removal of all blisters and proper attention to edge detail make for a quality installation.

NOTICE: Heat is sometimes required at specific locations. This should be done with extreme care. Never use heat until all surrounding sections of the transfer are secured. Heat softens and allows stretching of the transfer.

REMOVAL AND INSTALLATION

Figure 1

The following equipment and materials are necessary to make a quality transfer installation:

- Wetting solution - prepare by mixing 38 ml (1 1/4 ounce) of liquid dish detergent to 3.8 liters (1 gallon) of water.

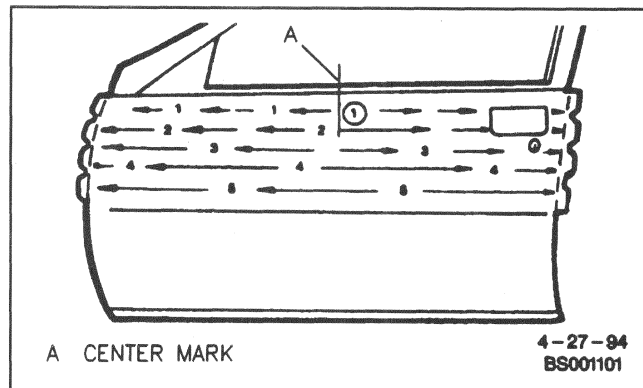


Figure 1 - Transfer Installation Sequence

- Silicone, wax and grease remover.
- Vinyl trim adhesive, brush or spray can.
- Squeegee - 75 to 100 mm (3 to 4 inches) wide, plastic or hard rubber. Smooth any sharp or rough edges to prevent scratching.
- Water bucket and sponge or spray bottle.
- Sandpaper - number 400, wet-or-dry type.
- Heat gun or infrared heat lamp and extension cord.
- Clean wiping rags or paper towels.
- Sharp knife.
- Scissors.
- Fine pin or needle.
- Marking pencil.

Remove or Disconnect

1. Necessary nameplates, moldings, molding attaching clips, tail lamps and any other overlapping parts. For removal procedures, refer to specific body section of this manual.

Clean

- Wash surfaces to be repaired, adjacent panels and openings as required.

NOTICE: To avoid gouging underlying paint finish, do not use pointed or sharp instruments for removal of transfer from panel.

2. Transfer by starting at one edge and peeling transfer as a sheet at a 90 degree angle from panel surface.
 - Application of heat to affected transfer at point of removal aids the removal operation.
3. All traces of adhesive residue from painted surfaces with a silicone, wax and grease remover.
 - Wipe panel surface with a clean, lint-free cloth while remover is still wet. Allow to dry.

**Install or Connect**

1. Prepare surface.

**Clean**

- A. Urethane painted surface with a silicone, wax and grease remover.
 - B. Wipe with clean cloth and allow to dry.
2. Scuff-sand acrylic and painted surface with number 400 sandpaper by dry sanding.
 - Freshly painted surfaces must be allowed to dry thoroughly before sanding. Residual solvents in fresh paint can lead to blistering problems if transfer is applied before paint is dry.

**Clean**

- A. Panel again.
 - B. Wipe surface with clean, lint-free cloth and allow to dry.
3. Make template to be used as a guide for transfer installation to panel surface.
 - A. Tape a suitable sheet of paper at top of panel, aligning top of paper with transfer on adjacent panels. This represents final upper trim line.
 - B. With template flush to panel, mark front, rear and bottom edges of panel on template.
 - C. Remove template from panel and place on clean flat surface. Draw lines outboard of front, rear and bottom of panel 16 to 19 mm (5/8 to 3/4 inch) from edges. Cut excess paper beyond front, rear and bottom drawn lines.
 - D. Punch small hole at front vertical edge of template to denote front. Mark underside of template.
 4. Unroll and position service transfer on clean flat surface with backing side up and woodgrain pattern running from left to right.
 5. Position prepared template on service transfer and mark perimeter cutlines on backing of service transfer. Make sure that underside of template is up, woodgrain pattern runs from left to right and is face down before marking trim line on service transfer.
 6. Cut out service transfer along trim line as required.
 7. Position and center transfer on panel for vertical and lateral alignment. Mark center of both transfer and panel (Figure 1).
 8. Lay transfer on a clean table and peel off paper backing.

**Important**

- Be sure to peel backing paper from transfer. Do not peel transfer from backing as this will cause transfer to stretch.
9. Soak sponge in wetting solution or use a spray bottle filled with wetting solution to apply ample amount of wetting solution to adhesive side of transfer and to panel surface.

NOTICE: Wetting solution should be used at all times as it ensures a better bond between transfer and painted surface.

10. Center and line up transfer cutouts with door handle and lock cylinders, and/or with transfers on adjacent panels.
 - A. Press down lightly across upper edge of transfer.
 - B. Squeegee transfer firmly at center for distance of 75 to 100 mm (3 to 4 inches). Then squeegee upward over same spot.
11. With cheese cloth, rub out all air bubbles and wetting solution in area of lock cylinder opening.
12. Upper edge of transfer.
 - A. Raise one side of transfer from panel up to secured area at top center.
 - B. Working from center, squeegee transfer into place, using firm, short, overlapping strokes.
 - C. Squeegee laterally first and then up when working across upper edge.
 - D. Complete securing opposite upper edge of transfer in similar fashion.
13. Lower area of transfer.
 - A. With one hand, lift unsecured lower area of transfer from panel.
 - If transfer sticks prematurely, break bond with fast, firm pull.
 - B. Reposition lower area of transfer at center of panel and squeegee laterally toward each end of panel.
 - C. Continue bonding transfer to panel with firm, overlapping strokes (Figure 1).
14. Periodically apply soapy wetting solution to panel to ease raising and positioning transfer during squeegee operations.
15. Work downward in small increments across transfer (Figure 1).
16. Cut 90 degree notches in transfer edges at lower corners as required. Cut "V" notches in transfer sides where necessary.
17. Apply light coating of vinyl trim adhesive to door hem flanges and rear body lock pillar facing where surface is covered by transfer. Avoid use of excessive adhesive.
18. With heat gun or heat lamp, heat inboard side of door hem flanges (or body lock pillar facing, etc.) and edges of transfer film to about 32° C (90° F).
19. Fold ends of transfer over door hem flanges (or over corners at panel ends) and press to secure edges of transfer to panel surfaces. Avoid undue pulling or stretching at ends as tearing could result.
20. Apply heat as required to transfer at door handle holes, side marker lamps and other recessed areas. Press transfer into recessed areas to obtain a firm bond.
21. With sharp knife, carefully cut out excess transfer as required.



Inspect

- Transfer installation from critical angle using adequate light reflection to detect any irregularities that may have developed during installation.
- 22. Remove all air or moisture bubbles by piercing each at an acute angle with a fine pin or needle and by pressing bubble down.
- 23. Previously removed parts and clean vehicle as required.

ADHESIVE NAMEPLATES/EMBLEMS

For information on adhesive nameplate and emblems, refer to SECTION 10-8.

ADHESIVE MOLDINGS

The moldings are attached to the body panels with adhesive tape. To ensure a good replacement of new or old moldings, the panel surface should be warm, 21° to 32° C (70° to 90° F), clean and free of any wax or oily film. Methods are listed to attach loose molding ends, completely removed moldings, and replacement moldings.

Secure Loose Moldings

1. Wash affected area with soap and water and wipe dry. Wipe panel and adhesive side of molding with clean rag using oil-free naphtha or alcohol.
If molding has been pulled loose from adhesive backing (tape remains on body panel), do not remove tape from body panel. Clean back of molding assembly and tape on body panel with oil-free naphtha or alcohol and proceed with step 3.
2. If needed, apply length of masking tape as molding guide. Straight edge may also be used.
3. Apply adhesive to back of molding and press in place. If adhesive (GM P/N 1052621 or equivalent), is used, apply constant pressure to molding for 30 seconds or until firm bond has been made.

Molding Completely Removed

Figure 2



Important

- Do not use this procedure if molding is dented or was pried from body panel.
- 1. Wash affected area with soap and water and wipe dry.
- 2. Remove all traces of adhesive from body panel and back of molding using oil-free naphtha or isopropyl alcohol.
- 3. Mark proper position of molding with length of masking tape (Figure 2). Use adjacent moldings as guide.
- 4. Warm body panel with heat lamp or heat gun to 21° C (70° F).

5. Apply double-coated foam tape (3M P/N 06380 or equivalent) to the molding.
6. Line up molding to tape guideline on body panel or use straight edge to align molding to front or rear moldings already on vehicle.
7. Peel backing from end of molding.
8. Press firmly into place while continuing to remove backing.
9. Hand roll molding to body panel to ensure proper adhesion.

Molding Replacement

Figure 2



Remove or Disconnect

- Molding.
 - A. Hold hot air gun 152 mm (6 inches) from surface of molding to be removed.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Place catgut or fishing line between molding and body panel. Using sawing motion, remove molding from panel surface.
 - D. Discard molding.



Install or Connect

- Molding.
 - A. Mark proper position of molding with length of masking tape or straight edge, aligning to front or rear moldings already on vehicle.



Clean

- Area with soap and water and wipe dry.
- Body panel using oil-free naphtha or isopropyl alcohol.
- B. If needed, warm body panel with heat lamp or heat gun to 21° C (70° F).
- C. Peel backing from front end of molding.
 - Do not touch adhesive backing.

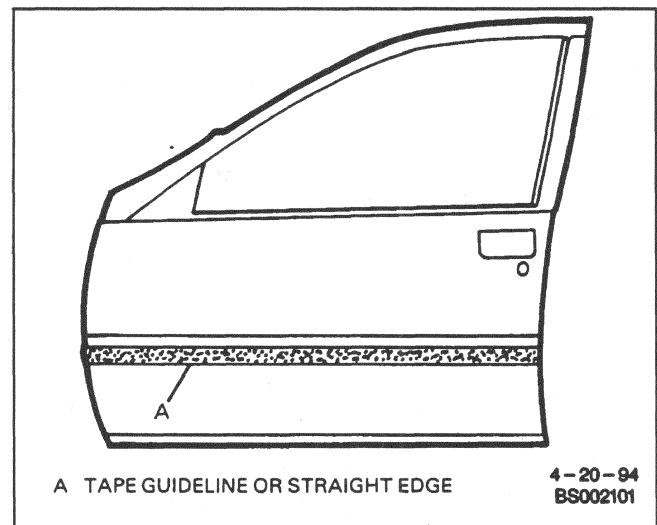


Figure 2 - Adhesive Molding Repair

- D. Press molding to body panel while continuing to remove backing.
- E. Hand roll molding to body panel to ensure proper adhesion.
- F. Molding ends should not overlap door edge, door edge guard, lock cylinder or body openings.



Inspect

- Molding ends for bonding.
- Hand roll loose ends.

WATERLEAK DIAGNOSIS AND REPAIR

Figures 3 and 4

GM vehicles are designed to operate under normal environmental conditions. The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications do not, and cannot, take into consideration all artificial conditions such as may be encountered in some high-pressure car washes.

The watertest procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.

Repairing body waterleaks is a problem of proper testing, diagnosis and repair through adjustment of misaligned components and/or application of proven repair materials. The first step in water leak diagnosis is finding the conditions under which the leak occurs.

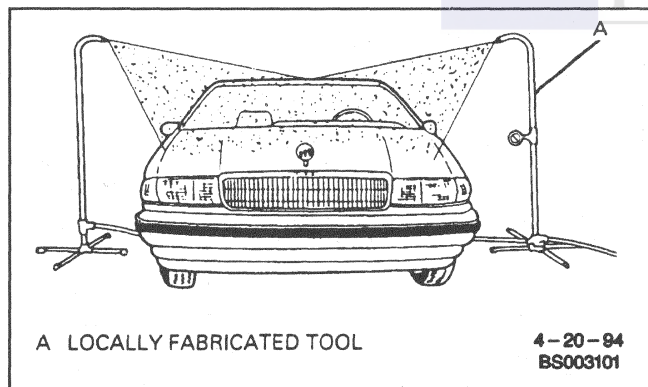


Figure 3 - Watertest Stands Positioned for Front Water Test

For example, the leak is noticed only when parked on an inclined drive, or when water is in the jack and spare tire stowage assembly.

If the general leak area can be found, the exact entry point can be quickly isolated by use of a localized test such as a water hose or air hose. If the leak source is not obvious, a testing method using watertest equipment should be used (Figures 3 and 4). It may be necessary to remove some interior trim panels or components to locate areas needing repairs.

Generalized Testing

The watertest stand must be constructed.

• Watertest stand specifications:

- Volume of flow should be 14 liters (3.7 gallons) per minute.
- Water pressure, measured at nozzle - 155 kPa (22 psi).
- Windshield and front body pillar - approximately 30 degrees down, 45 degrees toward rear and aimed at corner of windshield (Figure 4).
- Doors - approximately 30 degrees down, 45 degrees towards rear and aimed at center of rear door or rear quarter panel.
- Rear window and rear compartment lid - approximately 30 degrees down, 30 degrees toward front and aimed about 600 mm (24 inches) from corner of rear window.
- If specified water pressure of 155 kPa (22 psi) cannot be obtained because of a local situation, both test stands may be moved toward the body until water spray overlap can be obtained (Figure 3).

Localized Testing (Spot Test)

Localized testing may be made with either water or air. Begin the test at the base of the suspected area and move upward slowly until the leak is located.



Important

- Pinpoint leak area before any repair is made. Random repair may only temporarily restrict water entry and make future diagnosis and repair more difficult.

Continue localized testing in the same general area to confirm that all leaks have been located.

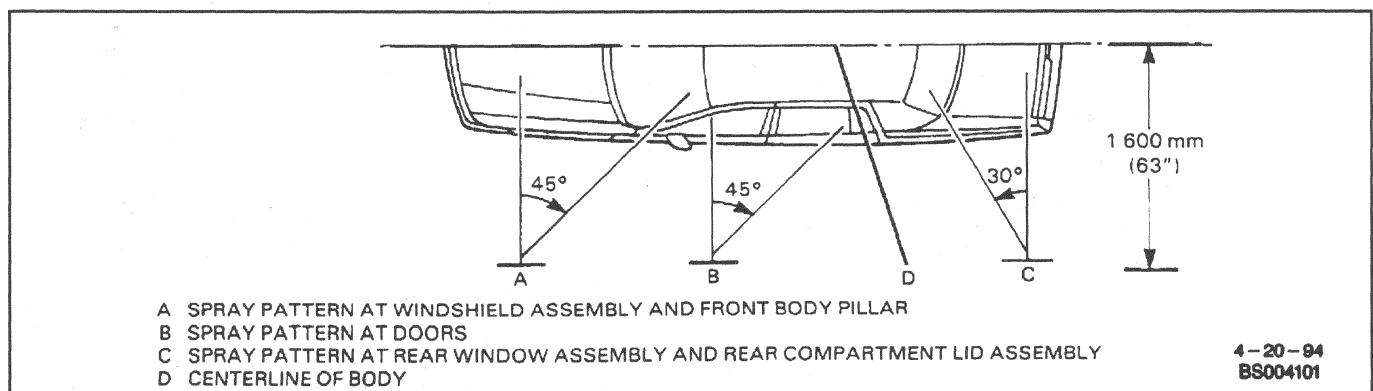


Figure 4 - Watertest Stand Specifications

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Water Hose Test

Figures 5 and 6

1. Have helper inside vehicle to detect actual leak point.
2. Use unrestricted water flow (no nozzle).
3. Begin at base of suspected leak area and move upward slowly.

Air Hose Test

Figures 7 and 8

1. Apply bubble solution (liquid soap) to suspected area.
2. Apply air pressure with an air hose from inside vehicle. Do not exceed 205 kPa (30 psi).
3. Observe for bubbles on outside at suspected leak area.

Waterleak Repair

Figures 9, 10 and 11

To locate the exact leak point or to repair the leak, it may be necessary to remove some interior trim panels or components. Waterleak repair is covered in the section covering the component. For example, for the repair procedure on stationary windows, refer to SECTION 10-2.

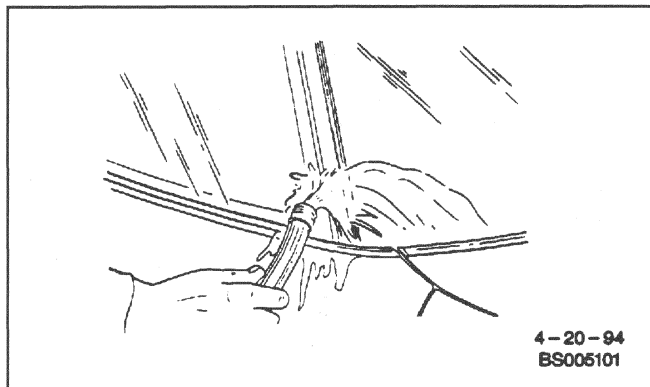


Figure 5 - Water Hose Test of Windshield pillar

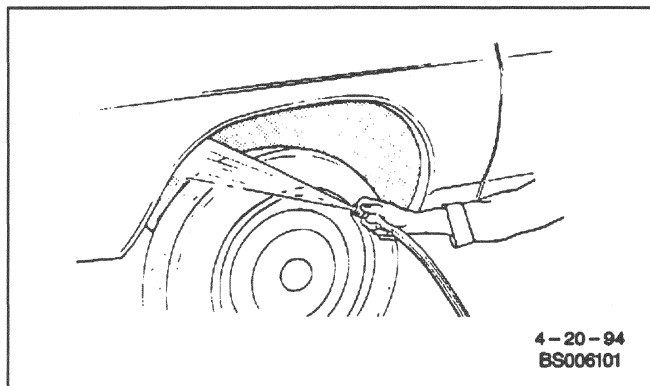


Figure 6 - Pressure Test of Wheelhouse

After completion of any water leak repair, the general area should be re-tested using the watertest stand. Do not use the air hose or water hose to test repaired areas as the repair material may dislodge under abnormal pressure.

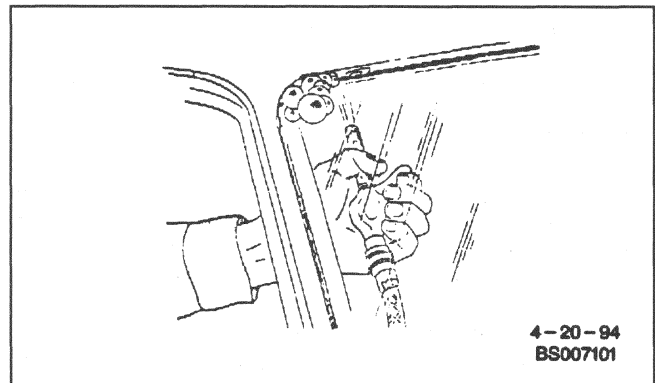


Figure 7 - Air Hose and Bubble Solution Test of Windshield Glass Sealant

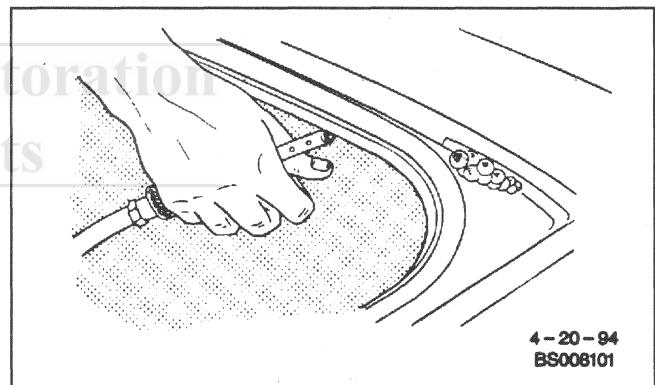


Figure 8 - Air Hose and Bubble Solution Test of Panel Joints

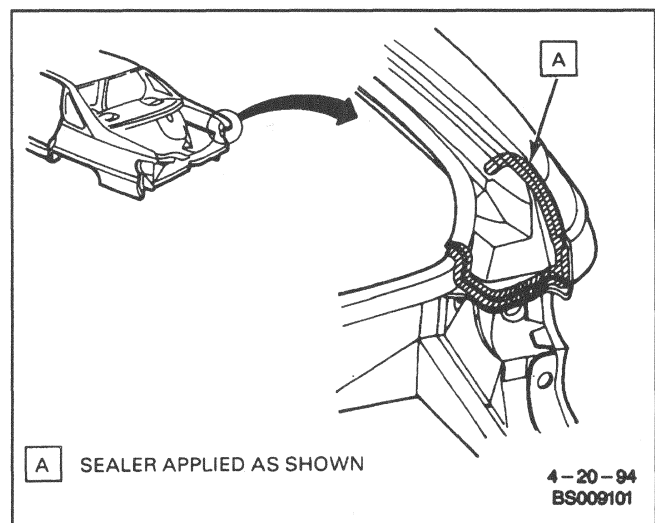


Figure 9 - Sealing Rear End To Prevent Waterleaks - (Sedan)

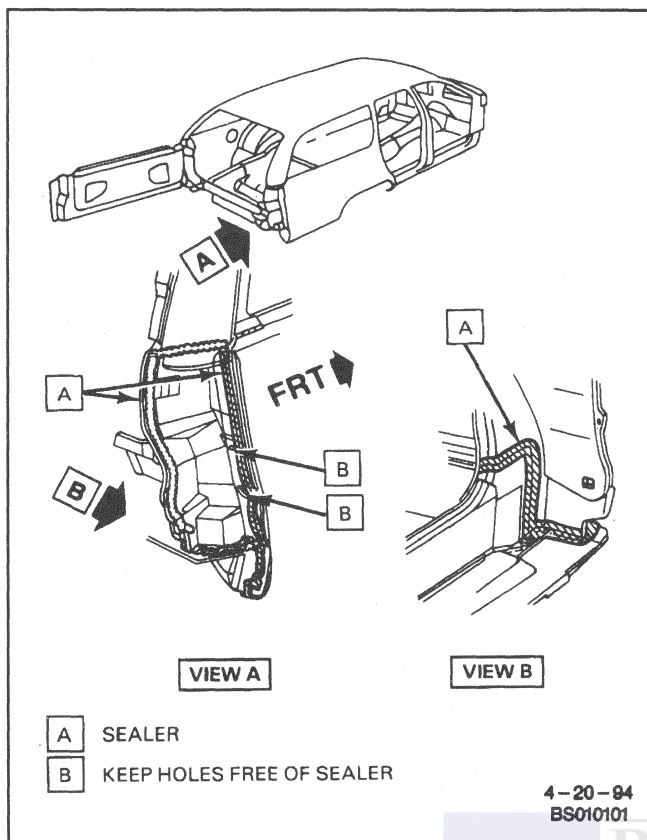


Figure 10 - Sealing Rear End To Prevent Waterleaks - (Wagon)

Material recommended for specific leak areas include:

- Urethane adhesive (GM P/N 12346284 or equivalent) for windshield, rear window and stationary window repair.
- Brushable seam sealer which can be painted for metal joints.
- Bedding and glazing compound for ventilation ducts and drip moldings.
- Drip-check sealer for small cracks and pin holes.
- All around automobile body sealant (3M P/N 8500 or equivalent) for large holes.
- Weatherstrip adhesive (3M P/N 08011 or equivalent) for weather-strips.
- Strip caulk for bolts, studs and screws.

WINDNOISE DIAGNOSIS AND REPAIR

Figures 7, 8, 12, 13 and 14

Many of the water leak diagnosis tests are also used for wind noise diagnosis.

- Visual inspection:
 - Misaligned components.
 - Loose fasteners.
 - Torn weather-strips.
 - Broken weld joints.
 - Sealer and/or adhesive skips.

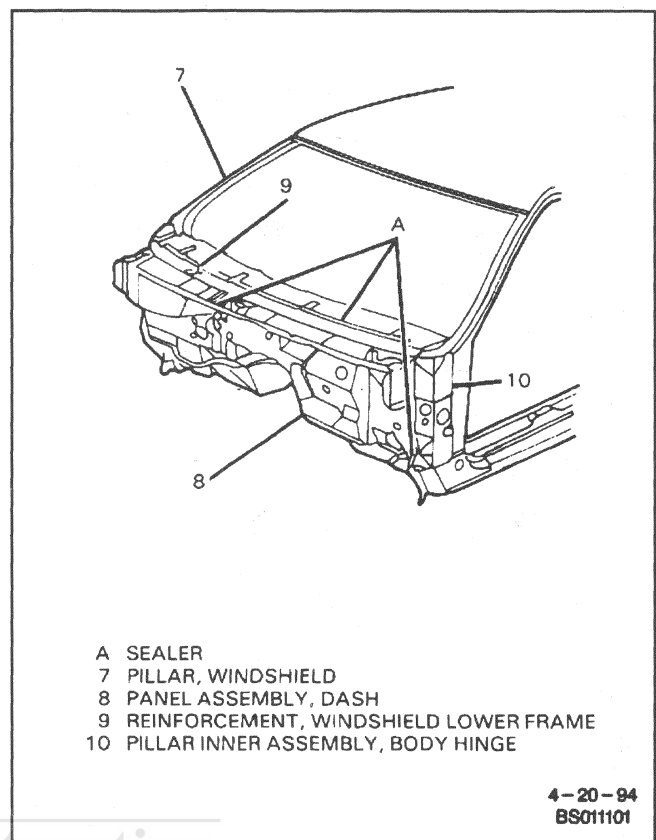


Figure 11 - Sealing Front End To Prevent Waterleaks

• Tracing powder or chalk test:

- A. Clean weather-strips and contact surfaces with solvent.
- B. Apply powder or chalk in an unbroken line to contact surface of weatherstrip around perimeter of rear compartment lid, door, side door window, or hood. Surrounding areas must be free of chalk or powder.
- C. Close panel completely. Do not slam. This presses weatherstrip firmly against mating surfaces.

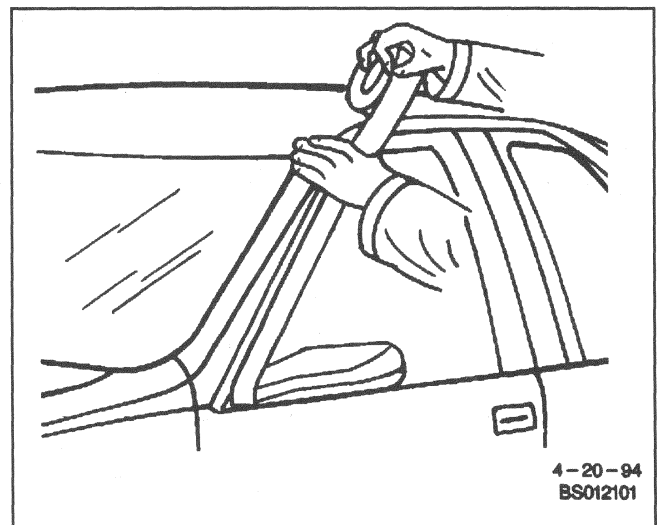


Figure 12 - Masking Tape Application to Identify Wind Noise

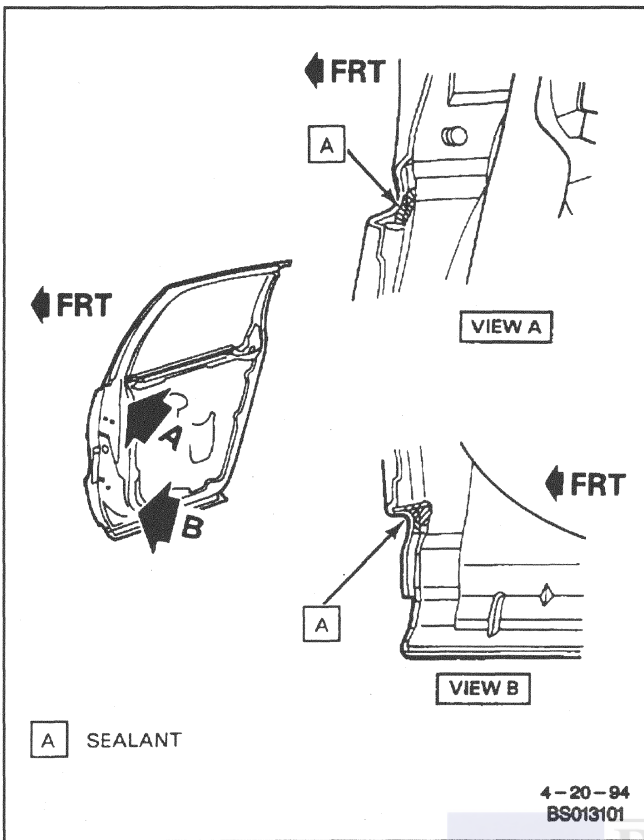


Figure 13 - Typical Sealing to Prevent Windnoise



Inspect

- Applied line on weatherstrip will be marred where contact is good. A corresponding imprint will be on mating surfaces.
- Gaps or irregularities in powder or chalk line indicate a poor seal.
- Air pressure test:
 - A. Mask off pressure relief valves.
 - B. Turn on vehicle's ventilation fan.
 - C. Close all openings - windows, doors, etc. An abnormal amount of high pressure will build up in vehicle and will escape through poor seals.

D. With stethoscope or length of heater hose, listen for escaping air along door and window seals.

- Smoke or dusting powder test can be used in same manner. Exact leak location can be seen as smoke or powder travels through bad seal.

- Soap suds or bubble test:

A. Pressurize interior of vehicle.

B. Apply soapy solutions to potential leak areas. Escaping air pinpoints leak area. Air pressure from air hose inside vehicle can be used instead of pressurizing vehicle's interior. Do not exceed 205 kPa (30 psi) when using air hose (Figures 7 and 8).

- External wind noise:

A. Road-test vehicle to determine source of noise.

- Wind roar is caused by outside air passing over an opening.
- Wind whistle is caused by inside air seeping through a bad seal, or by outside air passage over a protruding edge.
- Wind rush is outside air passing over vehicle's body.

B. Tape various moldings and gaps until noise is eliminated (Figure 12).

NOTICE: If masking the grille and headlamp capsule areas, care must be taken not to restrict airflow and cause vehicle overheating.

Windnoise leak repairs are very similar to waterleak repairs. The actual procedure depends on the type of seal being repaired (Figure 13).

Leaks around door opening weatherstrip do not always indicate a faulty weatherstrip. A door or window adjustment may resolve the condition (Figure 14). Refer to SECTION 10-6.

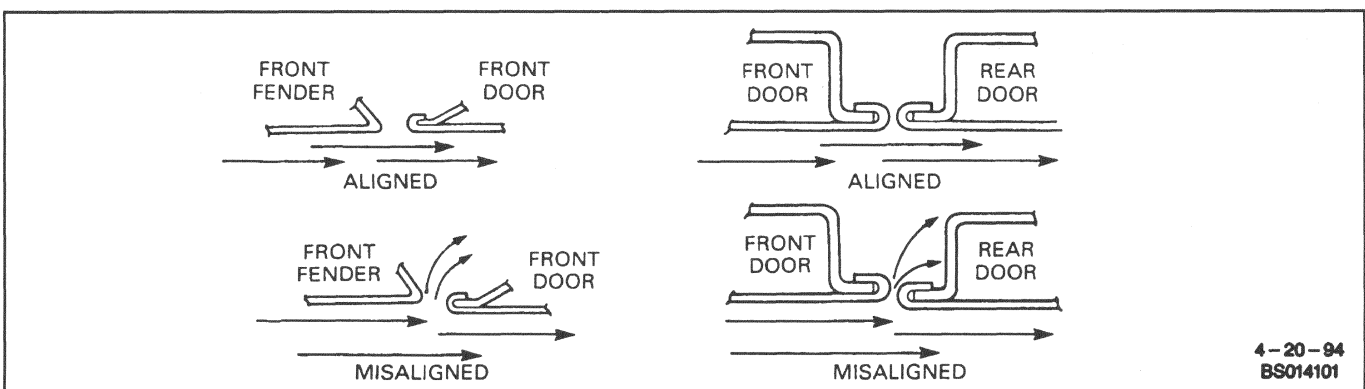


Figure 14 - Airflow over Align/Misaligned Surfaces

SQUEAK AND RATTLE DIAGNOSIS AND REPAIR

Basically, squeaks and rattles are caused by improperly controlled relative motion between components. There are three ways to prevent the squeak or rattle.

1. Attach component securely so there is no relative motion during operation.
2. Separate components so there is no contact under operating conditions.
3. Insulate components so that no squeaks or rattles occur with relative motion between components. Low uniform friction surfaces can be provided to eliminate "stick-slip" motion.

ANTICORROSION TREATMENT

Figures 15 through 25

CAUTION: When applying sound deadeners due care and preventive measures must be exercised to prevent any materials from being sprayed into door and quarter outer panel mechanisms such as door lock cylinders, channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody. After material application, be sure all body drain holes are open.

Anticorrosion materials are used on interior and exterior surfaces of metal panels providing rust resistance. These materials include metals such as one-sided and two-sided galvanized zincrometal and zinc-iron alloy steels. These treated metals are used on components such as fenders, doors, quarter outer panels, wheelhouses and other critical parts.

Metal conditioners and primers are used on interior and exterior surfaces along with protective waxes on interior surfaces in areas where moisture might accumulate. Sealers are applied along exposed joints and moisture-repelling asphaltic sound deadeners are applied inside the wheel wells and on some underbody components.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anticorrosion material is essential.

Metal conditioners and primer coatings are applied to all metal panels at the time of vehicle manufacture. After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and re primed using an acrylic chromate material. This operation is to be performed prior to the application of sealers, waxes, deadeners and anti-rust compounds.

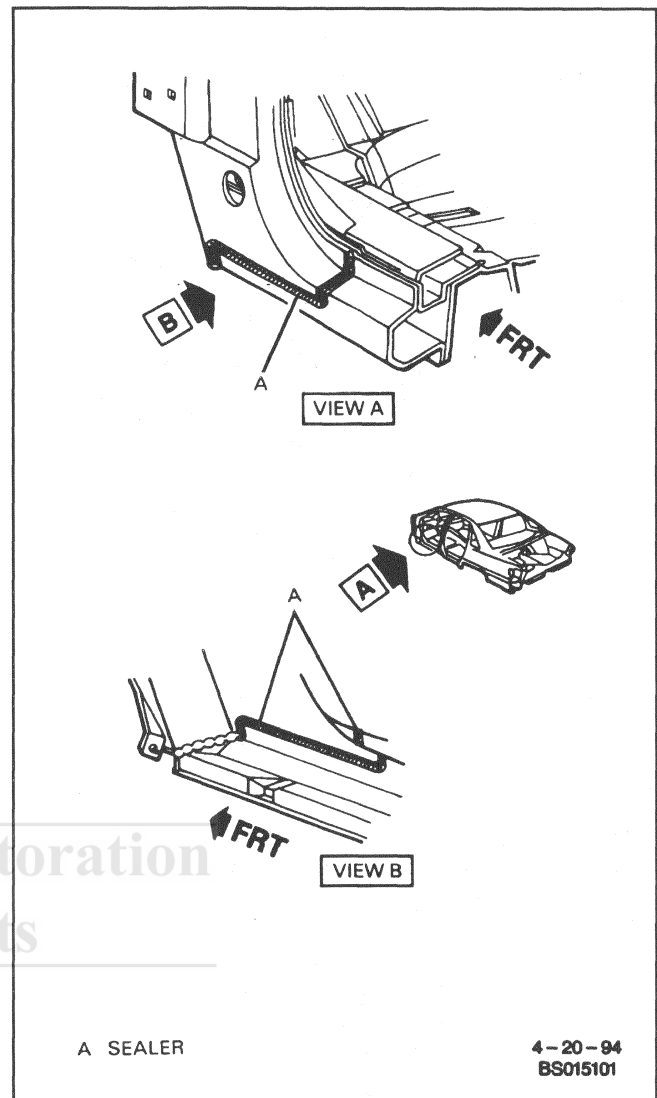


Figure 15 - Typical Sealer and Anticorrosion Compound Treatment

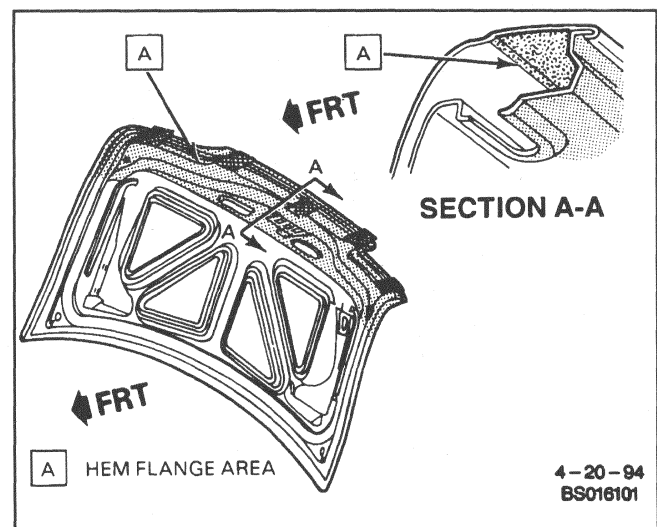


Figure 16 - Typical Anticorrosion Treatment of Rear Compartment

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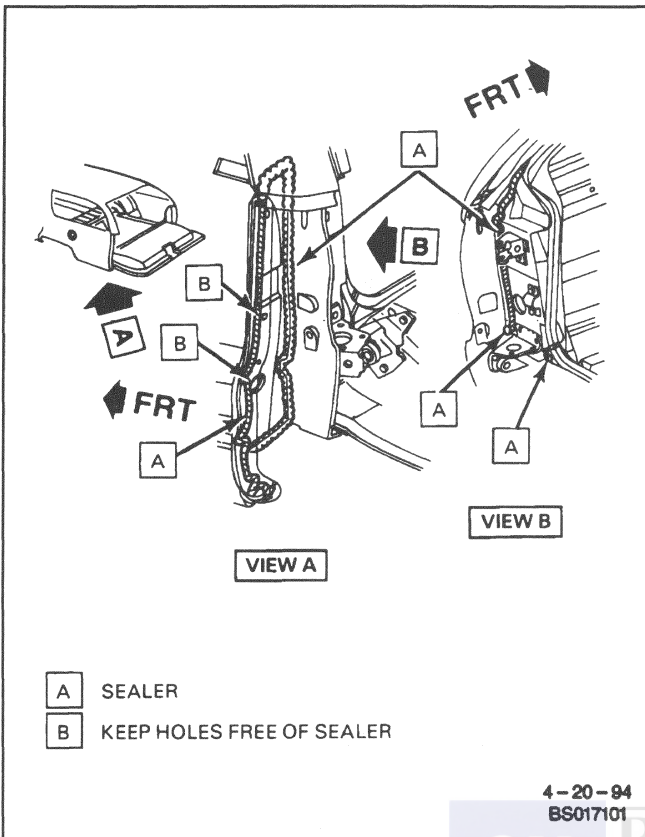


Figure 17 - Typical Anticorrosion of Rear Compartment - (Wagon)

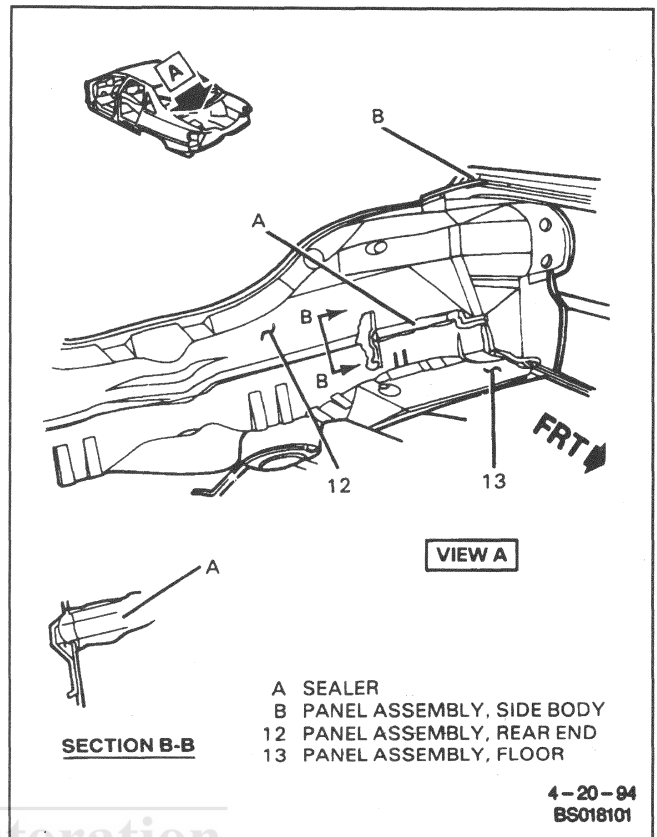


Figure 18 - Typical Joint Sealing, Rear End Area - (Sedan)

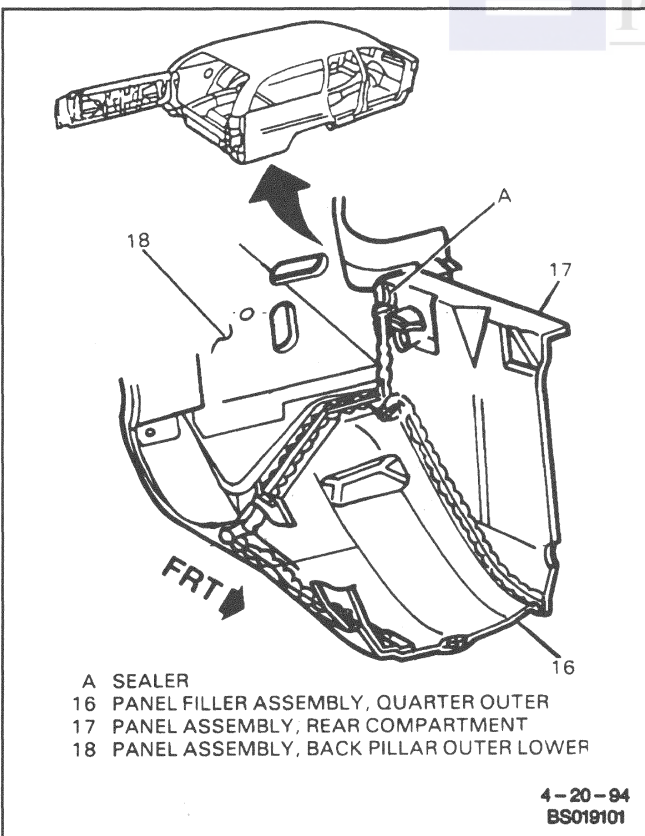


Figure 19 - Typical Joint Sealing, Rear End Area - (Wagon)

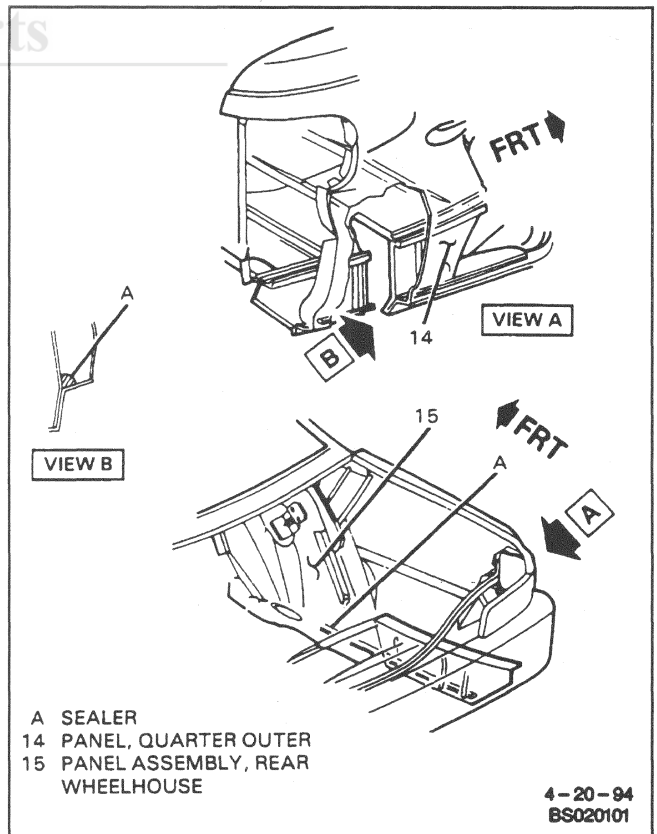


Figure 20 - Sealer Application to Rear Wheelhouse Panel to Prevent Fume Intrusion - (Wagon)

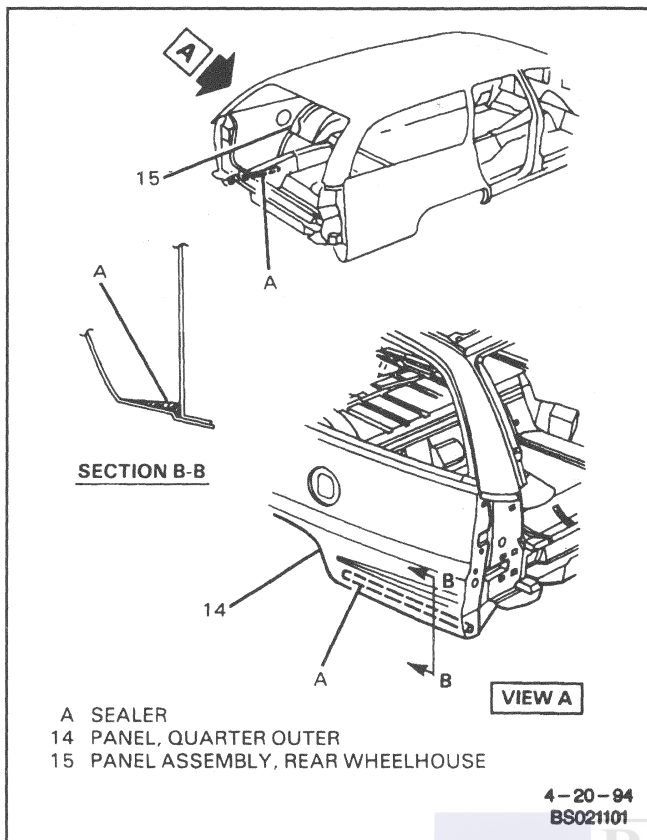


Figure 21 - Sealer Application to Wheelhouse Panel to Prevent Fume intrusion (Wagon)

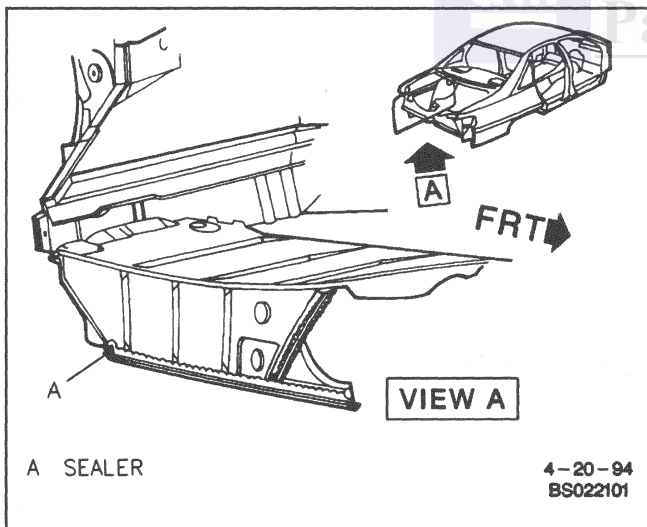


Figure 22 - Sealer Application to Rear Compartment to Prevent Fume Intrusion - (Sedan)

Sealers are applied to specific joints during manufacture. These sealers are intended to prevent water and dust from entering the vehicle and also are anticorrosion barriers. Sealers are applied to such areas as lid hem flanges, wheelhouse panel, quarter outer panel, floor panel, cowl, roof module and various other panel-to-panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing.

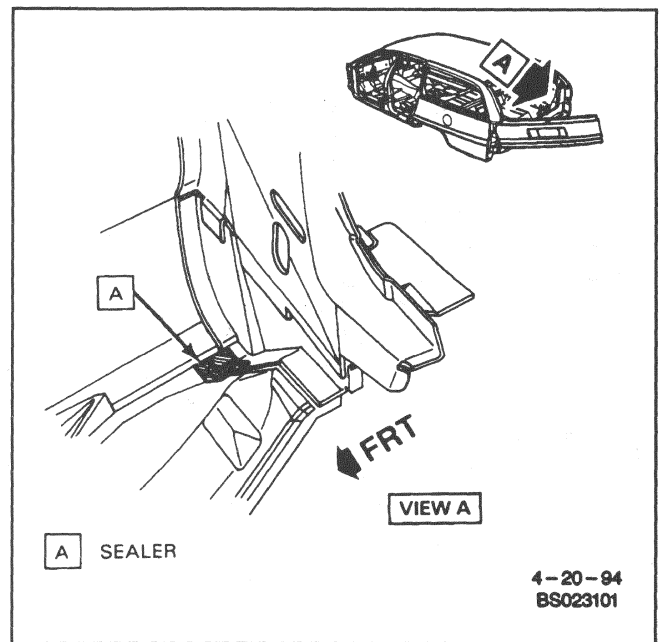


Figure 23 - Sealer Application to Rear Compartment to Prevent Fume Intrusion - (Wagon)

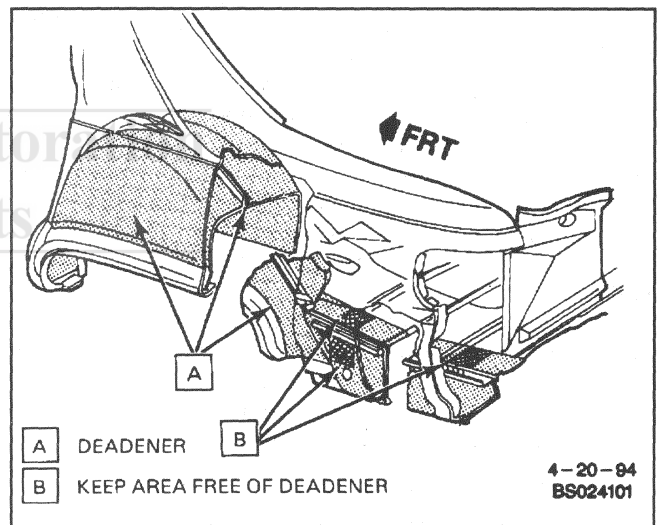


Figure 24 - Typical Acoustic Deadener Application, Wheelhouse Panel and Floor Extension Areas - (Sedan)

Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required to restore repaired areas such as the hood, fenders, doors, quarter outer panels, lids, roof module, engine compartment, underbody and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat build-up and color application techniques should be followed.

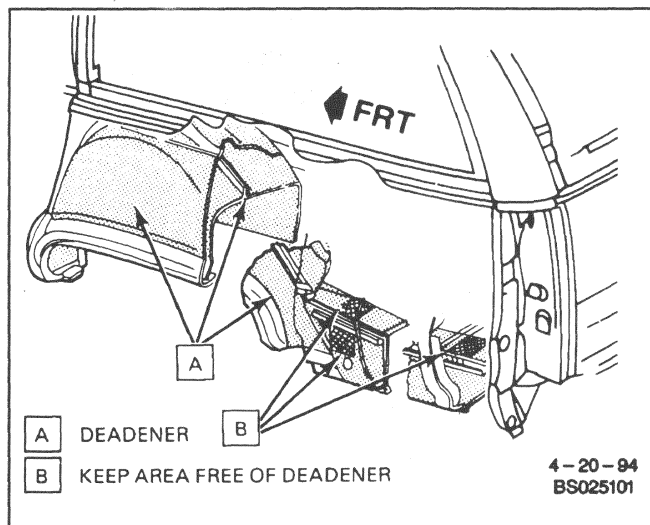


Figure 25 - Typical Acoustic Deadener Application
Wheelhouse Panel and Floor Panel Extension Areas -
(Wagon)

Deadener materials (spray-on type) are used on various metal panels to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Anticorrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces.

Conventional undercoating is recommended to coat large areas such as replacement quarter outer panels, floor panel assemblies, etc.

The sequence of application steps for anticorrosion materials is as follows:

1. Clean and prepare metal.
2. Apply primer (acrylic chromate).
3. Apply sealers at all previously sealed joints.
4. Apply color in areas where color is required, such as hem flanges, exposed joints and underbody components.
5. Apply deadeners as indicated by original application pattern.
6. Apply anticorrosion compounds.
7. Apply underbody rustproofing material.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anticorrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces. One or more of the following methods will remove the residue.

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

- Where access is possible, scraping can be used. If a standard putty knife or scraper will not fit into the affected area, fabricate a small, flexible scraper from a narrow piece of sheet metal.
- A jet of compressed air will remove most residue and could be effective in limited-access areas. Eye protection is absolutely necessary in an operation of this type.
- Sandblasting is most effective and should be used when the equipment is available and access to the area is good. Sandblasting is an excellent method for cleanup and preparation of open joints, underbody components and hem flange areas.
- Wire brushing (power and by hand).
- When access is good, sandpaper and steel wool can be used.

CORROSION REPAIR

Prior to replacing exterior body parts, check condition of paint on all covered or hidden interior surfaces. If corrosion is found in these areas, proceed as follows:

1. Remove corrosion with suitable wire brush, abrasive or liquid corrosion removing agent. Follow label directions.
2. If necessary, wash with detergent, rinse and dry.
3. Apply a heavy coating of anticorrosion compound to all cleaned hidden surfaces before installing exterior body parts. Also, apply anticorrosion compound to all inner surfaces of exterior body parts being installed.

ANTI-CHIP COATING MATERIAL

An anti-chip coating material is applied to specific lower areas of the body prior to the color coat application. The presence of the applied material can be detected through visual inspection. If the production-applied anti-chip coating requires replacement, a chip resistant air dry vinyl that is solvent borne and sprayable is available for field use.

Materials and equipment necessary for repair:

VINYL GRAVEL GUARD

- Sandpaper - 80 grit.
- Portable heat lamp or heat gun.
- Extension cord.
- Clean shop towel.
- Conventional hand spray gun with pressure feed cup attached.
- Putty knife.

METAL PART REFINISHING - BASECOAT/CLEARCOAT

CAUTION: Many paint repair systems require additives containing isocyanates. It is essential that all recommendations and warnings listed on the container label for materials selected be followed. It is mandatory that adequate respiratory protection such as air line respirators with a full hood be worn. Such protection should be worn during the entire mixing and painting process. Persons with respiratory problems or those allergic to isocyanates must not be exposed to isocyanate vapors or spray mist.

Basecoat/clearcoat paint is factory applied in four layers: a cathodic immersion primer, a primer surfacer, base color of high solids acrylic enamel (basecoat), and a clear acrylic top coat (clearcoat) to give the finish a high-gloss look.

Clearcoat Repair without Repainting

Figure 26

If the damage or imperfection can be sanded or polished out without reaching the basecoat, you don't have to repaint.

1. Thoroughly wash repair area with a mild detergent.
2. Apply a small amount of medium to fine machine rubbing compound to repair area and smear evenly with compounding pad.
3. With polisher running at approximately 1,700 rpm, compound repair area. Keep pad flat against panel while applying light pressure. Feature lines and panel edges should be hand-rubbed to avoid burn-through. Check repair area frequently and, if necessary, add more compound.
4. If sanding is required, proceed to step 6; if not, apply polish to repair area and evenly smear with polishing pad.
5. Keep pad flat to panel and allow weight of polisher to do the work. Use polish sparingly to achieve original shine. Machine or hand polish repair area first, then blend in with rest of panel.
6. If repair is near adjacent panels, mask adjacent panel to protect against sand scratches and burn-through of panel edges.
7. Saturate a piece of micro-fine sandpaper in a container of water and attach to a sanding pad. The addition of a small amount of liquid detergent to the water will improve wet-out and sanding performance.
8. Keep repair area wet while sanding. Sand lightly and evenly in one direction only, using straight strokes.

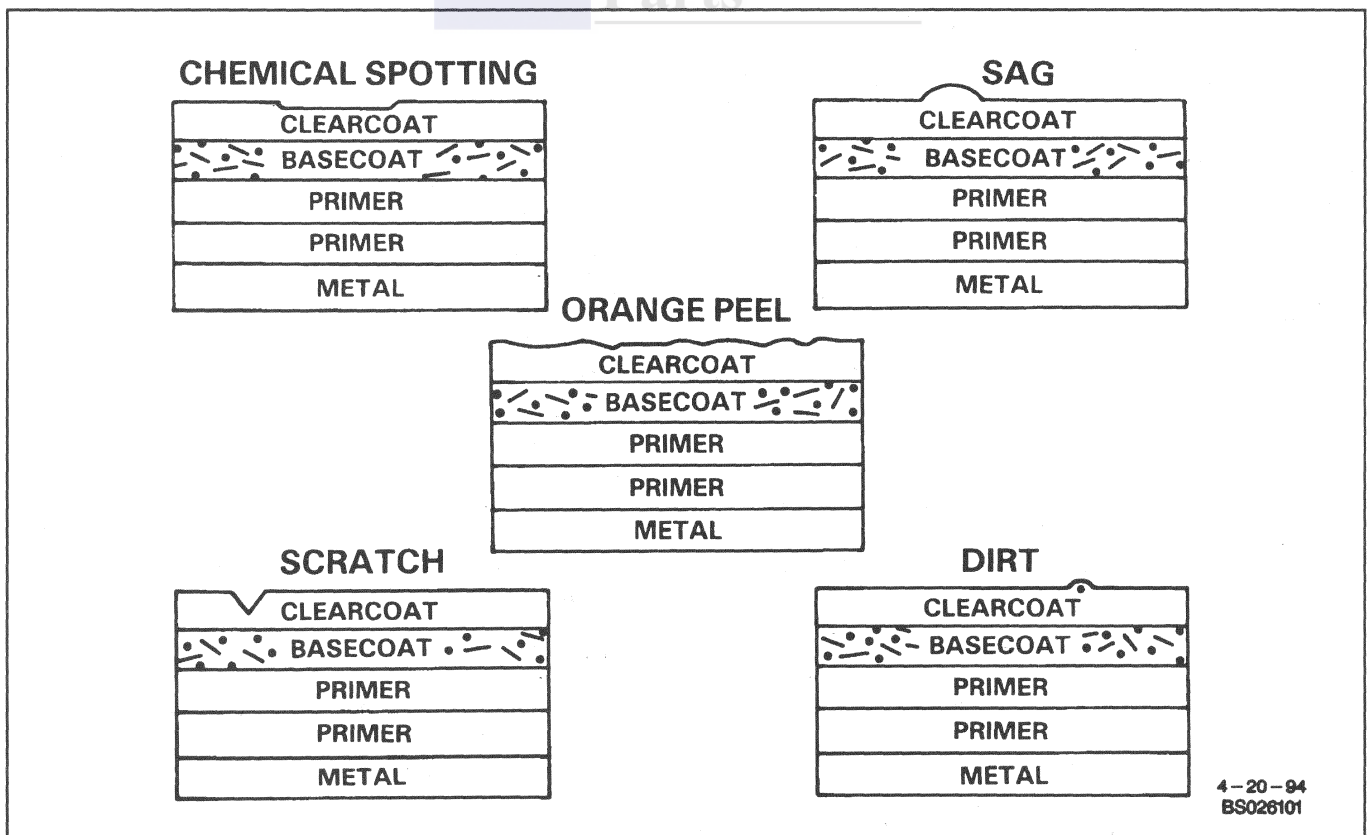


Figure 26 - Minor Paint Defects That Can Be Repaired without Repainting

Important

- Frequently wipe or squeegee repair to determine when defect has been removed. Sand only enough clearcoat to remove defect. Sanding below clearcoat requires repainting.
- 9. Using a clean cloth, wipe repair area clean of water and clearcoat residue.
- 10. Compound and polish as necessary. Often, hand compounding and polishing of a small repair area is all that is necessary to restore appearance.

Basecoat/Clearcoat Preparation

1. Wash with detergent and water.
2. Clean with solvent.
3. Repair and feather-edge damaged areas.
4. Treat metal surface with metal conditioner and conversion coating. Allow to dry.
5. Apply primer-surfacer. Dry 20 to 30 minutes.
6. Sand basecoat paint area with 400 grit paper. (For clearcoat only, wet sand with 600 grit or finer paper or hand compound.)
7. Clean with solvent and tack wipe.

Important

- Do not do step 8 if basecoat enamel used for repair does not require it. Always refer to manufacturer's label directions.
- 8. Apply one or two coats of adhesion promoter:
 - A. Within moldings or breaklines.
 - B. Onto adjacent panel 100 to 150 mm (4 to 6 inches) if repair is not confined and beyond area to be covered by clearcoat.
 - C. Allow to flash at least 30 minutes before applying clearcoat.

Basecoat Application - Polyurethane Enamel

CAUTION: Refer to "Caution" under "Metal Part Refinishing - Basecoat/Clearcoat."

1. Activate enamel material per manufacturer's instructions.
2. Mix thoroughly.
3. Reduce basecoat per manufacturer's instructions.
4. Check viscosity with a Zahn number 2 viscosity cup, equivalent, or a measuring stick.
5. Spray only enough basecoat color to achieve full hiding and color match. Do not spray a heavy, wet coat.
6. Cure per manufacturer's instructions.

Clearcoat Application - Polyurethane Enamel

CAUTION: Refer to "Caution" under "Metal Part Refinishing - Basecoat/Clearcoat."

1. Activate materials per manufacturer's instructions.
2. Mix thoroughly.
3. Reduce clearcoat per manufacturer's instructions.
4. Check viscosity with a Zahn number 2 viscosity cup, equivalent, or a measuring stick.
5. Spray at 50 psi gun pressure. Apply 2 medium-wet coats, 15 to 20 minutes apart.
 - Cover entire panel wherever possible.
 - When there are no breaklines, blend spray within adhesion promoter area.

Important

- Clean spray equipment immediately after use with lacquer thinner.

INDUSTRIAL FALLOUT (ACID RAIN)

Important

- The following information regards the use of finesse type repairs to environmental (industrial fallout) and rail dust damage of basecoat/clearcoat paint finishes.

Since the severity of the condition varies from area to area, proper diagnosis of the damage extent is critical to the success of repairs. Diagnosis should be performed under high intensity florescent lighting, on horizontal surfaces (hood, roof panel, rear compartment lid) after they have been properly cleaned.

There are three basic types of acid rain damage:

- Surface level contamination - may be repaired by simply washing the vehicle, cleaning the surface with a wax and grease remover, neutralizing acidic residue and finesse polishing.
- Clearcoat etching - slight etching still noticeable after the above washing and finesse polishing procedure.
- Basecoat etching - severe etching beyond the clearcoat into the basecoat.

Surface Level Contamination Repair

1. Wash vehicle with standard car detergent and water, and dry thoroughly.
2. Clean affected area with wax and grease remover.
3. Neutralize left over acidic residue by cleaning damaged areas with a mixture of baking soda and water (one tablespoon per one quart of water), rinse thoroughly and dry the panels completely.
4. Apply finesse type polish with a foam pad.

Clean

- If the damage has been repaired, remove any swirl marks with a dual action orbital polisher and foam pad.
- If some damage remains, proceed to "Slight Clearcoat Damage - Wet Sanding, Finesse Polishing" in the following procedure.

Slight Clearcoat Damage - Wet Sanding, Finesse Polishing

1. Select a small test area on a damaged panel.
2. Wet sand the damaged area with an American Grade ultra fine sandpaper of 1,500 to 2,000 grit and a rubber sponge sanding block. During the wet sand process:
 - A. Use ample amounts of clean water.
 - B. Go slow to prevent removing too much clearcoat.

Important

- Be sure to use American sandpaper. European sandpaper has a P before the grit number and European grits do not align with American grits the majority of the time.
3. Remove excess water with a rubber squeegee and inspect the area.
 - If this has repaired the damage, continue the sanding procedure on the entire panel, apply a finesse type polish with a foam pad and remove any swirl marks with a dual action orbital polisher and foam pad.
 - If (during the repair) it is suspected or observed that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding or base color is transferred to pad during polishing, the affected areas may require re-clearcoating/colorcoating or refinishing. Refer to "Clearcoat Application - Polyurethane Enamel," "Metal Part Refinishing," "Flexible Plastic Part Refinishing" and/or "Rigid Plastic Part Refinishing" later in this section.
 4. Polish entire vehicle after all damage has been repaired.

Clearcoat Thickness

The clearcoat on the vehicle is typically 1.5 to 2 mm (0.06 to 0.08 inch) thick. At least 1 mm (0.04 inch) thickness is required to provide lasting protection to the vehicle basecoat.

Paint Gages

The best way to accurately measure how much clearcoat has been removed is to use a paint gage before, during and after the sanding process. Paint gages measure the total thickness of the finish and when used, can determine how much clearcoat has been removed during the repair process. Paint gages range from magnetic pull types to sophisticated electronic types and are available from a variety of sources.

The older magnetic type gages, at best, have a $\pm$ 5 percent accuracy range and are not sensitive enough to detect removal of 0.5 mm (0.02 inch) clearcoat. The newer type magnetic gages have improved accuracy ranges. Most gages are confined to checking either a ferrous metal (steel) or non-ferrous metal (aluminum) panels. At this time, there are no viable gages for reading film thickness on non-metallic panels.

The more sophisticated digital type gages are able to read film thickness on both ferrous and nonferrous metal panels. Digital gages can have an accuracy range of $\pm$ 1 percent and includes thickness standards for re-calibration.

Rail Dust Damage Repair

CAUTION: Rail dust remover (oxalic acid) is an acidic substance containing chemicals that will break down the iron particles embedded in the finish. When working with it, use the necessary safety equipment, including gloves and goggles. Follow the manufacturer's directions closely because it may require special handling and disposal.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust color spots in the paint.

1. Wash vehicle with soap and water, dry it and clean affected area with wax and grease remover.
2. Rinse surface with cold water, keeping vehicle in cool or shaded area.
3. Soak several terry cloth towels in container of rail dust remover solution and, after damaged areas have been rinsed with cold water, lay wet towels on damaged areas.
4. Allow towels to remain in place for 20 minutes, keeping them moist by spraying with water and not allowing to dry on surface of vehicle.
5. After 20 minutes of applying towels, remove them and rinse area thoroughly with cold water. Inspect affected area to ensure dust has been removed. Use both touch (feeling for bumpy surface) and sight (magnifying glass for close inspection).
6. If, upon inspection, some particles are still present, process of applying towels can be repeated 3 times.
7. Select test area and hand wet sand with American ultra fine 1,500 grit to 2,000 grit sandpaper to repair damage (surface pitting from dust). Use ample amounts of clean water and go slow to prevent removing too much clearcoat.

NOTICE: Use a paint gage to determine the amount of clearcoat removed. If too much has been removed, additional clearcoat will have to be applied.

Important

- If rail dust has penetrated into the basecoat, the panel requires refinishing. Make sure all rail dust has been removed prior to refinishing or the rust spots will return, causing customer comebacks.

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8. If damage has been repaired, complete repair to entire panel.
9. Polish entire vehicle after all damage has been repaired.

Preventing Industrial Fallout Damage

Customers should be urged to wash and dry their vehicles frequently and garage them, or at least cover them with a quality car cover when not in use.

Vehicles in dealer inventories should be kept clean and dry. A vehicle that sits unattended, especially after the sun has dried any water on the body surface, is a target for acid rain damage.

PLASTIC PART IDENTIFICATION

HOW TO IDENTIFY PLASTIC PARTS

Figures 27 through 30

CAUTION: General Motors does NOT recommend using a plastic "Burn Test" to distinguish different types of plastics. This test produces vapors that can be harmful to your health.

Plastics which may be used on this vehicle are shown in the plastics identification charts. The procedures provided in this section classify the plastics into two groups; flexible and rigid. Refer to the figures to identify the parts and the repair/refinish procedure to use.

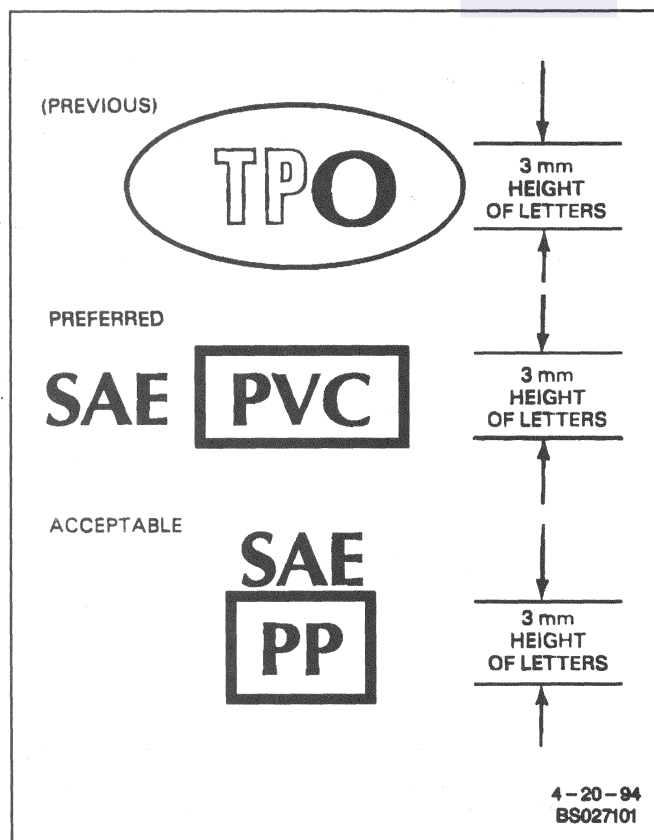


Figure 27 - Typical Plastic Marking Symbol

The following information can be used to specifically identify plastic parts when necessary.

1. Look on back of part for International Organization for Standardization (ISO) code marking as shown in Figure 27.
2. Refer to The Charts of Plastic Parts Identification and Refinishing Systems. Match ISO code found on parts with those on charts.
3. Use chart to identify special handling procedures and repair/refinish classification (rigid or flexible) (Handling Precautions for plastics).

FLEXIBLE PLASTIC PART REPAIR AND REFINISHING

Repair Materials

Important

- Use supplies and repair materials from the same manufacturer for the best results. Do not intermix systems.

These flexible plastic panel repair procedures require the use of GM Goodwrench Compoxy Repair Material (GM P/N 12345744) or equivalent such as Loctite® CMR-8 Composite Material Repair (P/N 82091).

Fabricating a Patch Panel

Flexible plastics requiring splicing or sustaining major damage may need a reinforcement panel or patch panel. If possible, obtain this part by cutting a piece from the original damaged panel. If a piece of the original damaged panel is used for reinforcement backing, be sure the surfaces are sanded and cleaned to completely remove any paint or finish material because it will inhibit proper bonding. The piece should be 75 to 100 mm (3 to 4 inches) in width if the damage is a split or break. If a part of the damaged panel is missing, the reinforcement panel or patch should extend 75 to 100 mm (3 to 4 inches) beyond the edges of the damaged area. An adequate reinforcement may be made as follows:

1. Lay out piece of wax paper larger than damaged area on panel.
2. Apply layer of GM Goodwrench Compoxy Repair Material (GM P/N 12345744) or equivalent.
3. Cut piece of reinforcement mat material to desired size and shape, and place over repair material.
4. Apply coat of repair material as necessary.
5. Place piece of wax paper over mat material and roll with saturation roller to ensure saturation of mat.
6. Remove wax paper from panel.
7. Apply patch to inner side of damaged area, working out any air pockets.
8. Allow to cure.

When cleaning your work area after completing a repair, be sure to save any leftover pieces of repair material that may be of useful size. They can be used later for reinforcing the back of small damaged areas and puncture repairs.

CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS

Identifying Symbol Old Symbol in ()	Chemical Composition or Plastic "Family" Name	Typical Area(s) Where Part Used	Examples of Common and/or Trade Names	Typical Paint Repair System
UP	Polyester/Thermoset	Fender extensions Hoods Roofs Deck lids Instrument housings Ventilation grids Air scoops Air spoilers	SMC, Premi-glas, Selectron, Vibrinmat, "Fiberglass"	#1 and #4
PE	Polyethylene	Inner Fender Panels Valances, Spoilers, Interior Trim Panels, Safety Belt Covers, Gas Tank Shields	Dylan, Fortiflex, Marlex, Alathon, Hi-fax, Hosalen, Paxon	#7
PS	Polystyrene	Dash Panels Door Panels	Lustrex, Dylan Styron, Durathon, Polystyrol	#7
PPE (PPO)	Polyphenylene Ether	Chromed Plastic parts; Headlamp Doors Ornaments, Bezels	Noryl, Oleflo, Preveex	N/A
PP	Polypropylene	Door Panels, Load Floors, Kick Panels, Deflector Panels, Cowl Panels, Wheel Covers, Interior Moldings, Radiator Shrouds, Inner Fenders, Bumper Fascia	Profax, Oleflo, Marlex, Azdel, Novolen, Tenite, Daplen, Escorene	#2, #3, #5 and #7
TPU (TPUR)	Polyurethane, Thermoplastic	Bumper Fascia, Soft Filler Panels, Glass Moldings, Gravel Deflectors	Pellethane, Estane, Rolyar, Toxin	#2, #3, #5 and #7
PUR	Polyurethane, Thermoset (Unsaturated)	Bumper Fascia Front and Rear Body Panels, Filler Panels	Castethane, Bayflex, (Commonly referred to as RIM AND RRIM)	#2 and #5
ABS	Acrylonitrile, Butadiene/Styrene	Instrument Clusters Trim Moldings Consoles Armrest Supports Steering Column Brackets Steering Column Jackets	ABS, Cicolac, Abson, Kralastic, Lustran, Absafil, Dyel	#1, #4 and #6
ABS + PC	Acrylonitrile/Butadiene Styrene + Polycarbonate	Instrument Panels, Instrument Clusters	Baybland, Proloy, Cycology, KHA	#1, #4 and #6
ABS/PVC	ABS/Vinyl -(Soft)	Head Restraint Covers Instrument Panel Pads Trim Moldings Trim Panels	ABS Vinyl	#7 and #8

Figure 28 - Plastics Identification Chart (1 of 2)

CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS (cont'd)

Identifying Symbol Old Symbol in ()	Chemical Composition or Plastic "Family" Name	Typical Area(s) Where Part Used	Examples of Common and/or Trade Names	Typical Paint Repair System
TEO (EP, EPM, TPO)	Ethylene/Propylene (Rubber)	Bumper Fascia Valance Panels Air Dams	TPO, TPR, (Thermoplastic Rubber) EPI, EPII	#3 and #5
EPDM	Ethylene Propylene Diene Monomer	Bumper Impact Strips Body Panels	EPDM, Nordel	#2, #3 and #5
EVA (EVAC)	Ethylene/Vinyl Acetate	Head Restraint Cover Miscellaneous Soft Trim Components	Elvax, Microthane	#7 and #8
PA + PPE	Polyamide + Polyphenylene Ether	Fenders, Exterior Trim	GTX	#2, #3 and #5
IMPORTANT: Follow selected paint manufacturer's product label directions. Observe all warnings on material container labels.				

Figure 28 - Plastics Identification Chart

T5428 (Cont'd)



CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS

Identifying Symbol Old Symbol in ()	Chemical Composition or Plastic "Family" Name	Typical Area(s) Where Part Used	Examples of Common and/or Trade Names	Typical Paint Repair System
PVC	Polyvinyl chloride (Vinyl)	Interior Soft Trim, Instrument Panel Skins, Roof Covers	Geon, Vinylite, Pliovic, "Vinyl", Vinoflex, Unichem	#8
SAN (SA)	Styrene-Acrylonitrile	Center Consoles Glove Box Doors Interior Trim Panels	Lustran, Tyril, Foracryl	#6 and #7
PC + PETP	Polycarbonate + Polybutylene Terephthalate	Bumper Covers	Xenoy, Valox, Macroblend	#1, #2, #4 and #5
PA PAG PAGG	Polyamide	Headlamp bezels Quarter panel exits Exterior Finish Trim Panels	Nylon, Capron, Zytel Rilsan, Minlon, Vydyne, Wellamid	#1 and #4
PBT + TEEE (PBTP + EEBC)	Polybutylene Terephthalate + Ether Ester Block Copolymer	Rocker Cover Mldgs. Fascias	Bexloy "M"	#1 and #4
PC	Polycarbonate	Interior Hard (Rigid) Trim Panels Valance Panels	Lexan, Merlon, Calibre	#1, #4 and #6
PF	Phenol - Formaldehyde	Ash Trays	Phenolic, Bakelite, Durez, Genal, Resinox, Amberol, Plyphen	#6

FOR SYMBOLS NOT LISTED IN THIS CHART, CONTACT THE SOCIETY OF AUTOMOTIVE ENGINEERS,
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096-0001 FOR A COPY OF SAE J1344.

() = OLD IDENTIFYING SYMBOLS IN ABOVE CHARTS.

PVC = TYPICAL ISO MARKING SYMBOL FOUND ON PLASTIC PARTS.

SAE **PVC** = TYPICAL NEW SAE MARKING SYMBOL FOUND ON PLASTIC PARTS.

SUGGESTED PLASTIC PARTS PAINT REPAIR SYSTEMS

- SYSTEM #1 (Exterior)
Conventional Lacquer/Enamel *Acrylic Urethane
- SYSTEM #2 (Exterior)
*Flexible/Lacquer/Enamel/*Acrylic Urethane
- SYSTEM #3 (Exterior)
Polypropylene Primer and *Special Topcoat
- SYSTEM #4 (Exterior)
Base Color Coat with Acrylic Lacquer or *Acrylic Urethane Clear Coat
- SYSTEM #5 (Exterior)
Base Color Coat with *Flexible Urethane Clear Coat
- SYSTEM #6 (Interior)
Conventional (Standard) Interior Acrylic Lacquer
- SYSTEM #7 (Interior)
Polypropylene Primer and Standard Interior Topcoat
- SYSTEM #8 (Interior)
Vinyl Interior Color

*Contains Isocyanates - Use recommended respiratory protection.

Figure 29 - Plastics Identification Chart (2 of 2)

HANDLING PRECAUTIONS FOR PLASTICS

Abbreviation	Material Name	Heat Resisting Temperature C° (F°)	Resistance to Gasoline and Solvents	Other Cautions
PE	Polyethylene	80 (176)	Gasoline and most solvents are harmless.	Flammable
PVC	Polyvinyl chloride	90 (194)	Gasoline and most solvents are harmless if applied for a very short time (wipe up quickly).	Poison gas is emitted when burned.
PP	Polypropylene	90 (194)	Gasoline and most solvents are harmless.	Flammable
ABS	Acrylonitrile butadiene styrene resin	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
AES	Acrylonitrile ethylene styrene	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
PMMA	Polymethyl methacrylate	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
PUR	Polyurethane	90 (194)	Gasoline and most solvents are harmless.	Avoid brake fluid.
AAS	Acrylonitrile acrylic rubber styrene	95 (203)	Avoid gasoline and solvents.	Avoid brake fluid.
PPE	Polyphenylene, ether	110 (230)	Avoid gasoline and solvents.	
POM	Polyacetal	120 (248)	Gasoline and most solvents are harmless.	Avoid battery acid.
PC	Polycarbonate	120 (248)	Avoid gasoline and solvents.	
PA, PAG, PAGG	Polyamide (Nylon)	150 (302)	Gasoline and most solvents are harmless.	Avoid immersing in water.
FRP	Fiber reinforced plastics	170 (338)	Gasoline and most solvents are harmless.	
PPC	Polypropylene composite	115 (239)	Gasoline and most solvents are harmless.	Flammable
PBT	Polybutylene terephthalate	140 (284)	Gasoline and most solvents are harmless.	
TPR	Thermoplastic rubber	80 (176)	Avoid gasoline and solvents.	
TPE	Thermoplastic elastomer	80 (176)	Avoid gasoline and solvents.	
1. When repairing and painting a portion of the body adjacent to plastic parts, consider their characteristics (influence of heat and solvent) and remove them if necessary or take suitable measures to protect them. 2. Plastic parts should be repaired and painted using methods suiting the materials.				

Figure 30 - Plastics Handling Precautions

T5430

When using mat reinforcement to repair the inner or outer surface of a panel, be sure there are no strands of the mat left uncovered or unsaturated by the

repair material. If exposed, the mat may act as a wick, and will draw moisture into the repaired area affecting the integrity and finish.

Flexible Plastic Part Repair

Figures 31 through 38

1. Clean and inspect damaged area as required (Figure 31).
2. Support and align parts as necessary using tape for minor damage (Figure 32). Fabricate a patch panel if necessary. Refer to "Fabricating a Patch Panel" in this section.
3. Begin reinforcement repair to inner surface of panel by abrading area with an 80 grit disc on an orbital sander or by hand if access is limited.

! Important

- Use only compressed air or a clean dry cloth to remove residue.
4. If necessary, cut piece of reinforcement mat (porous or unidirectional) to desired shape. Extend mat 13 to 50 mm (1/2 to 2 inches) beyond repair area (Figure 33).
 5. Mix and apply a skim coat of GM Goodwrench Compoxy Repair Material (GM P/N 12345744) or equivalent.
 6. Lay pre-cut piece of reinforcement mat into skim coat of repair material using applicator to press mat so it becomes saturated. Make sure all trapped air is forced out.
 7. If mat is not screen type, use saturation roller to ensure mat is completely saturated and there are no exposed fibers or trapped air.
 8. Apply second coat of flexible repair material making sure mat is completely saturated and there are no exposed fibers or trapped air (Figure 34).
 9. Allow to cure per manufacturer's instructions.
 10. Remove tape or clamps used for maintaining alignment and contours.
 11. At outer surface of panel, bevel damaged area with a 50 grit Roloc disc. This step extends contact between repair material and substrate (Figure 35).
 12. Using a 180 grit disc on an orbital sander, feather out several inches beyond damaged area to remove any paint or primer from substrate. This provides proper surface for adhesion (Figure 36).
 13. Apply light coat of repair material to damaged area, taking care to apply it smoothly. Repair material should be level and slightly above surrounding contour (Figure 37).
 14. Allow to cure per manufacturer's recommendations.
 15. Rough out surface with an 80 grit disc on an orbital sander.
 16. Finish contour sanding with 220 to 320 grit (wet or dry) sandpaper on a sanding block (Figure 38).

Flexible Plastic Part Refinishing

To refinish repaired flexible parts, it is very important to follow the paint manufacturer's system regarding preparation, priming, and refinishing. Because these parts are flexible, they may require special additives in the primers and topcoat to prevent cracking and poor adhesion. Always use manufacturer's recommended materials and never intermix with other systems.

RIGID PLASTIC PART REPAIR AND REFINISHING

Repair Materials

! Important

- Use supplies and repair materials from the same manufacturer for the best results. Do not intermix systems.

These rigid plastic panel repair procedures require the use of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent such as Lord's Fusor Body Panel Repair Adhesive (P/N 320-322 PK).

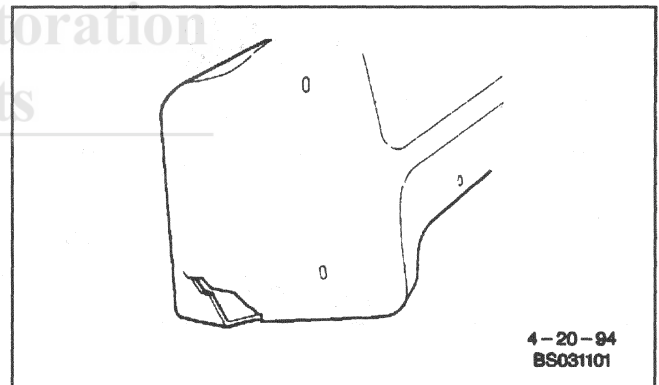


Figure 31 - Inspect Damaged Area

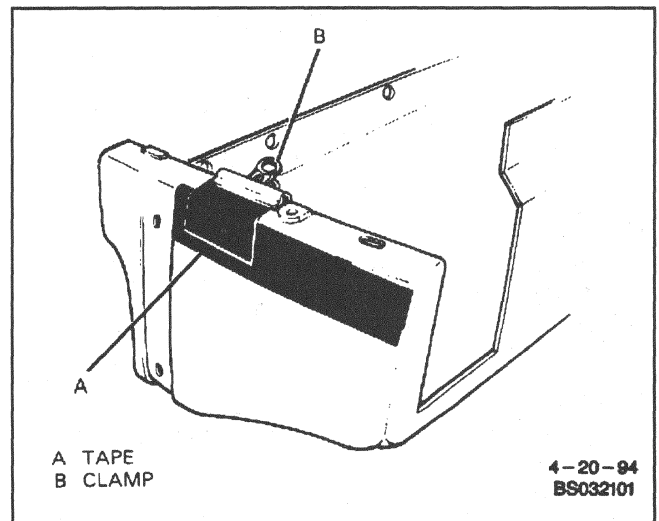


Figure 32 - Aligning Damage With Tape and Clamp

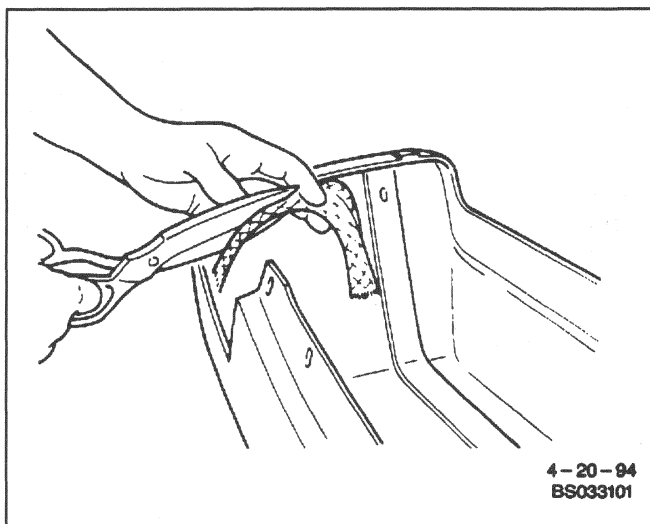


Figure 33 - Cutting Fiberglass Cloth to Size

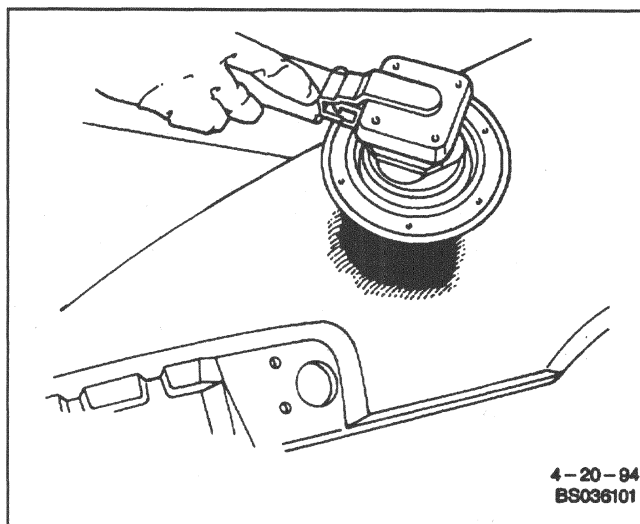


Figure 36- Panel Feathering

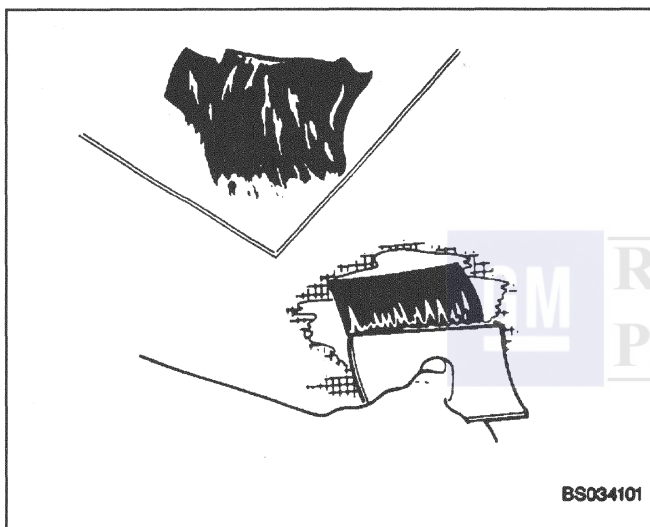


Figure 34 - Applying Repair Material

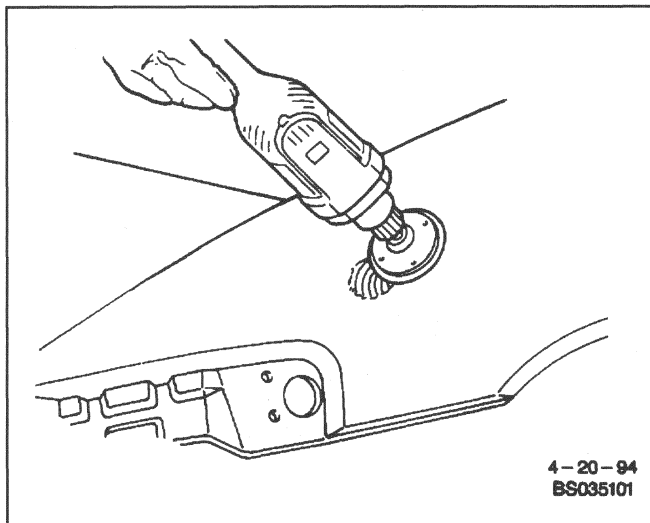


Figure 35 - Panel Beveling

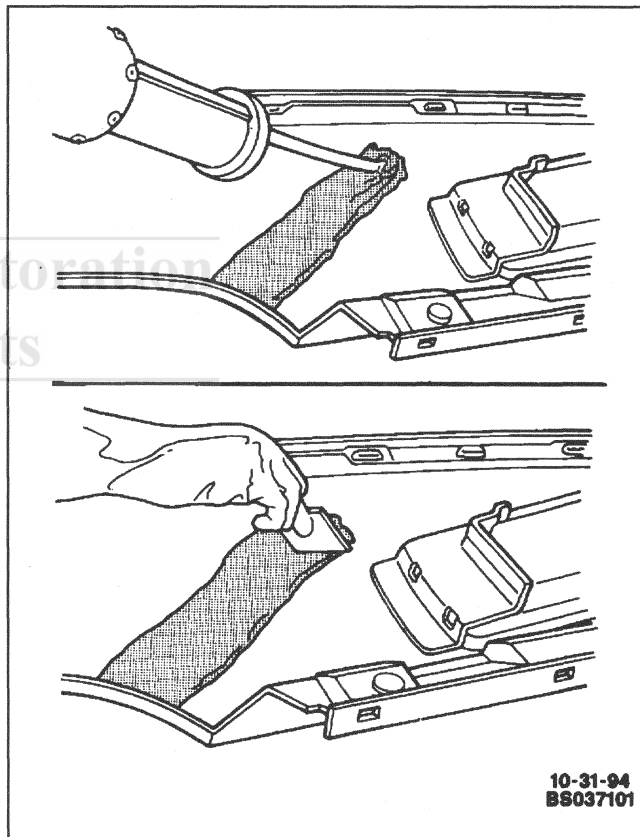


Figure 37 - Bonding Epoxy Application

Rigid Plastic Part Repair**Figures 31, 32, and 39 through 42**

1. Clean and inspect damaged area as required (Figure 31).
2. Support and align parts as necessary, using tape for minor damage (Figure 32).
3. Begin reinforcement repair to inner surface of panel by scuffing area with an 80 grit disc on an orbital sander or by hand if access is limited. Do not heavily abrade substrate of panel.

! Important

- Use only compressed air or a clean dry cloth to remove residue.
4. If damaged area is small, cut piece of reinforcement mat to desired shape. Extend mat 38 to 50 mm (1 1/2 to 2 inches) beyond either side of repair area (Figure 39).
 5. Apply skim coat of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent (Figure 40).
 6. If using backing panel, lay backing panel onto coat of bonding epoxy and use clamps or props to apply slight pressure until curing is complete



Figure 38 - Block Sanding for Accurate Contour

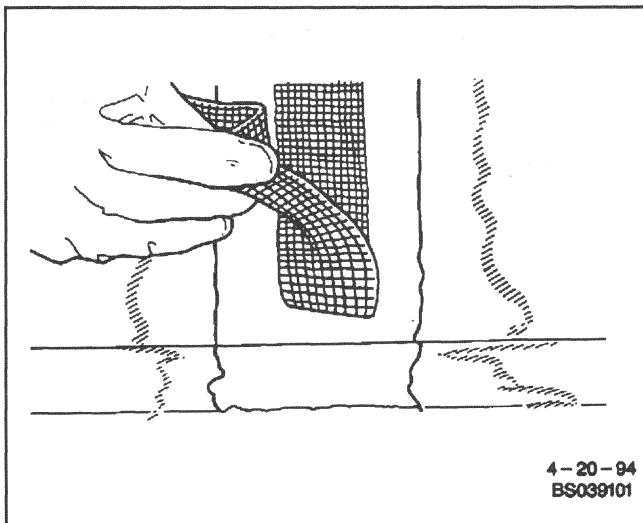


Figure 39 - Reinforcement Mat

(Figure 41). Do not use excessive force because this may cause distortion of panel, and may also squeeze out epoxy.

7. If pre-cut reinforcement mat is used in repair, press it into skim coat of binding epoxy using applicator to press mat so it becomes saturated, and all trapped air is forced out.
8. If mat is not screen type, use saturation roller to ensure mat is saturated. Make sure all trapped air is forced out.
9. When using backing panel from original damaged panel or when using pre-made rigid backing panel to reinforce repair area, make sure there are no voids at edges of repair area that may allow entry of water or chemicals.
10. When using piece of reinforced mat material for backing, apply second coat of bonding epoxy, making sure mat is completely saturated and there are no exposed fibers or trapped air.
11. Allow to cure per manufacturer's instructions.
 - Bonding epoxy can be force dried at temperatures of 65° C (150° F) minimum to 121° C (250° F) maximum for 45 minutes.
 - Force drying speeds cure time and increases bond strength.
 - Use uniform heat source.
 - Allow panel to return to room temperature.
12. Remove tape or clamps used for maintaining alignment and contours.
13. At outer surface of panel, bevel damaged area with 50 grit disc on Roloc sander. This step extends contact between repair material and substrate (Figure 35).
14. Using 180 grit disc on an orbital sander, feather out several inches beyond damaged area to remove any paint or primer from substrate. This provides proper surface for adhesion (Figure 36).
15. Apply light coat of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent (Figure 40).
16. Apply bonding epoxy smoothly. Bonding epoxy should be level and slightly above surrounding area (Figure 42).
17. Lay pre-cut piece of reinforcement mat into bonding epoxy. Use applicator to saturate and remove all trapped air (Figure 41).
18. Apply second coat of bonding epoxy, making sure mat is fully enclosed, and no air is trapped. Smooth surface with applicator.
19. Place second layer of reinforcement mat over second coat of bonding epoxy, working it smooth and removing all trapped air.
20. Apply final coat of bonding epoxy, and place sheet of wax paper over it. Use saturation roller to ensure full penetration of bonding epoxy into mat.
21. Cure bonding epoxy by force drying for 45 minutes at no more than 121° C (250° F). If second coat of bonding epoxy is necessary, it does not require saturation rolling, but does require force drying at 121° C (250° F) or less for 45 minutes. Allow panel to return to room temperature.

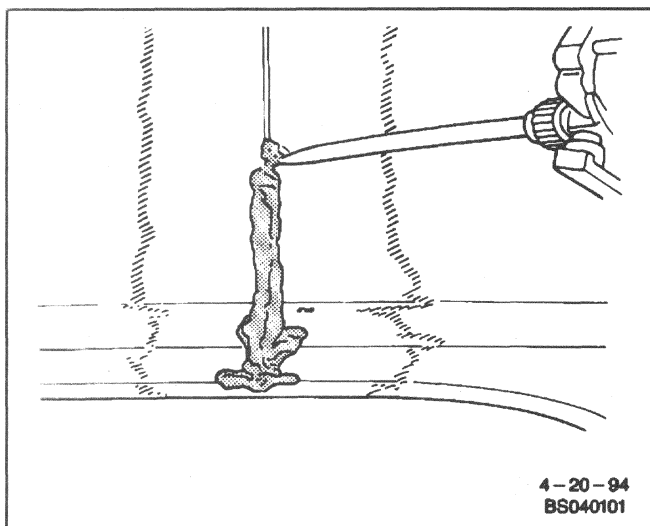


Figure 40 - Bonding Epoxy

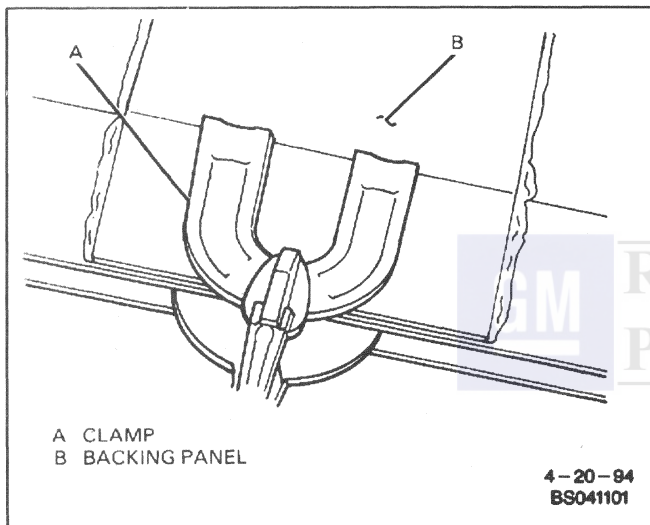


Figure 41 - Secure Backing Panel

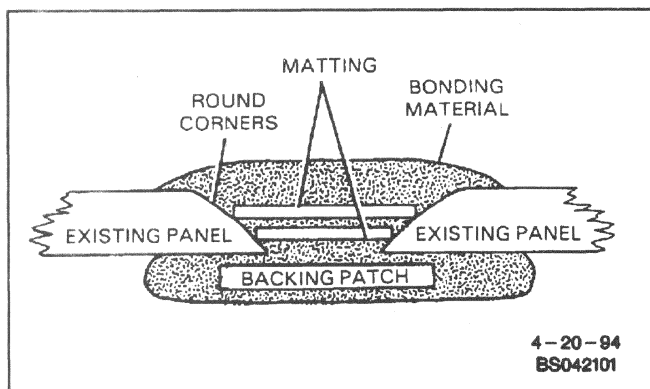


Figure 42 - Cross-Section of Splice

22. Rough out surface with 80 grit disc on an orbital sander.
23. Finish contour sanding with 220 to 320 grit (wet or dry) sandpaper on sanding block.

Rigid Plastic Part Refinishing

To refinish repaired rigid parts, it is very important to follow the paint manufacturer's directions regarding preparation, priming, and refinishing. Some rigid parts like Thermo Plastic Olefin (TPO) and Ethylene/Propylene (E/P) require special polypropylene primers for adhesion. Always use manufacturer's recommended materials and never intermix with other systems.

CARPET INSERT REATTACHMENT

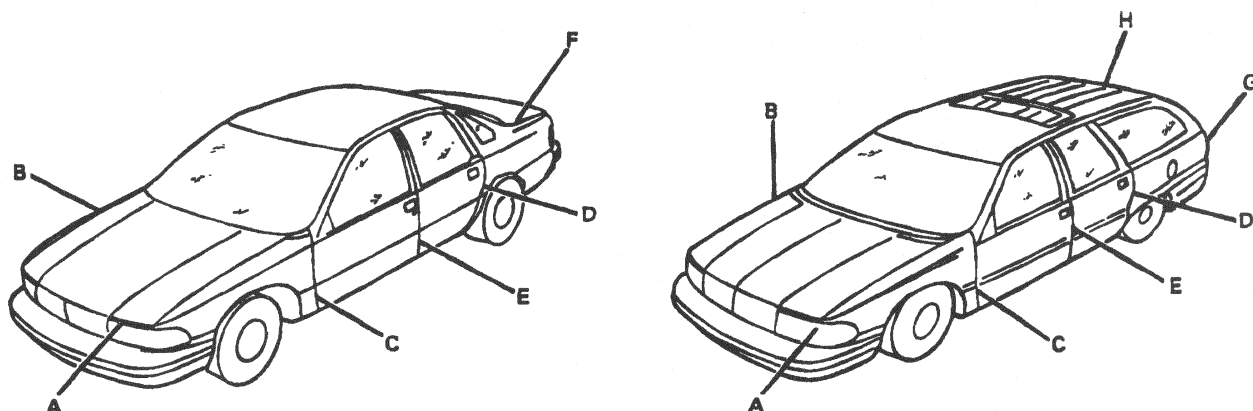
Carpet inserts attached to body sides, doors and quarter trim panels which have become loose may be reattached with general trim adhesive (3M P/N 08080 or equivalent).

Use the following procedure:

1. Remove trim panel when necessary and place on clean work surface. Mask off trim panel to prevent glue over spray.
2. Sand areas of trim panel where carpet is to be re glued using a coarse grit sandpaper. Polypropylene panels should have a rough surface for best adhesion. Remove all sanding debris.
3. Spray general trim adhesive (3M P/N 08080 or equivalent) on sanded surface and back side of carpet following manufacturer's instructions.
4. When both sprayed surfaces become tacky to the touch, press carpet in place, smooth out any irregularities.
5. Remove masking materials and reinstall panel.

BODY PANEL ADJUSTMENT AND ALIGNMENT

Use Figure 43 as a maximum and minimum gap reference.



LOCATION	CLEARANCE GAP* MILLIMETERS	FLUSHNESS* MILLIMETERS
A. HOOD TO HEADLAMP CAPSULE	11.0 (+1.5/-2.0) [PARALLEL WITHIN 2.0] — EXCEPT BUICK SEDAN 9.6 (+1.5/-2.0) — BUICK SEDAN	± 2.5 [PARALLEL WITHIN 1.5]
B. HOOD TO FRONT FENDER	4.0 (+1.0/-1.5) [PARALLEL WITHIN 2.0] — WAGON 4.35 (+1.0/-1.5) — SEDAN	+ 0.5/ - 1.5
C. FRONT SIDE DOOR TO FRONT FENDER	5.0 (± 1.0)	+ 1.5 (OUTBOARD)/ - 0.0 (INBOARD)
D. REAR SIDE DOOR TO QUARTER OUTER PANEL	5.0 (± 1.0)	+ 1.5/ - 0.0
E. FRONT SIDE DOOR TO REAR SIDE DOOR	5.0 (± 1.0)	+ 1.5/ - 0.0
F. REAR COMPARTMENT LID TO QUARTER OUTER PANEL (SEDAN ONLY)	5.0 (± 1.5)	+ 0.5/ - 1.5
G. TAILLAMP INBOARD TO QUARTER OUTER PANEL (WAGON ONLY)	0.8 (± 2.0)	± 2.0
H. END GATE TO REAR FASCIA (WAGON ONLY)	15.5 (+ 4.0/ - 0.0) [PARALLEL WITHIN 4.0]	+ 1.0/ - 2.0

* OPENINGS MUST BE PARALLEL WITHIN 1.0mm UNLESS NOTED OTHERWISE, EXCEPT FOR SEDAN WHICH MUST BE PARALLEL WITHIN 2.0mm.

Figure 43 - Body Panel Fit Requirement



SECTION 10-2

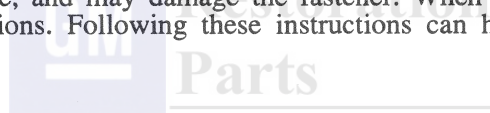
STATIONARY WINDOWS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When replacing a windshield, back window, or hatch roof window, urethane adhesive (GM P/N 12346284 or equivalent) must be used to maintain original installation integrity. Failure to use urethane adhesive GM P/N 12346284 or equivalent will result in poor retention of the windshield which may allow unrestrained occupants to be ejected from the vehicle with resulting personal injury. For vehicles with air bag systems, windshields must be replaced properly so that occupant protection provided by the air bag system is maintained.

CAUTION: Electrochromic material may irritate eyes and skin. In case of contact, take the following actions: Eye contact-rinse thoroughly with water. Skin contact - wash with soap and water. If ingested - consult a physician immediately.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



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10-2-2 STATIONARY WINDOWS

GENERAL DESCRIPTION

STATIONARY WINDOWS

The windshield, rear window, and quarter window are installed from outside the body, using self-curing urethane adhesive. Replacement of the windshield or rear window requires removal of components and the cutting of the window away from the urethane adhesive.

Replacement of the rear side door vent window requires removal of the rear side door components. Replacement of the roof stationary window requires removal of the headlining panel and cutting of the roof stationary window away from the urethane adhesive.

QUARTER WINDOW

Replacement of the quarter window requires removal of interior trim components, quarter window nuts, and cutting of the quarter window away from the urethane adhesive. If a stud is damaged during shipping or installation, it can be replaced with a flat washer and self-tapping screw.

The quarter window has a reveal molding around the perimeter as part of the quarter window. The quarter window reveal molding can only be replaced by installing a new quarter window.

URETHANE ADHESIVE

The urethane adhesive (GM P/N 12346284) is used for window adhesive service operations and leak repair. This kit includes urethane adhesive and primers.

Failure to use urethane adhesive (GM P/N 12346284) or an equivalent, when indicated, will result in poor retention of the windows.

REVEAL MOLDINGS

Figures 1 through 6

Two types of reveal moldings are used on the windshield and rear window.

The windshield has right and left windshield side reveal moldings, which are fastened by reveal molding bolts/screws to the windshield pillars. The windshield upper reveal molding is flexible plastic and is hand pressed along the upper edge of the window before windshield installation. The windshield upper reveal molding can be replaced without removing the windshield.

The rear window has a rear window reveal molding that wraps around the window. It is flexible plastic and is hand pressed along the sides and upper and lower edges of the window before rear window installation. The rear window reveal molding cannot be replaced without removing the rear window.

The roof stationary window has a reveal molding around the perimeter. The roof stationary window reveal molding can only be replaced by installing a new roof stationary window.

ON-VEHICLE SERVICE

REVEAL MOLDINGS

Windshield Side Reveal Molding

Figure 5

Remove or Disconnect

1. Open front side door for access.
2. Weatherstrip (7) from pinch-weld flange.
 - Grasp with hand near upper end of reveal molding (9) and pull outward and toward lower end.
3. Bolts/screws (10, 49, 51, 52 if police or taxi vehicle, and 48) and molding (9) from windshield pillar.

Clean

- Windshield (2) and molding (9) with soap and water before reinstallation or replacement.

Install or Connect

NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Molding (9), and bolts/screws (48, 52 if police or taxi vehicle, 51, 49 and 10).
 - A. Align bolt/screw holes in molding (9) to bolt/screw holes in windshield pillar.
 - B. Install bolts/screws in the following order: 48, 52, 51, 49 and 10.

Tighten

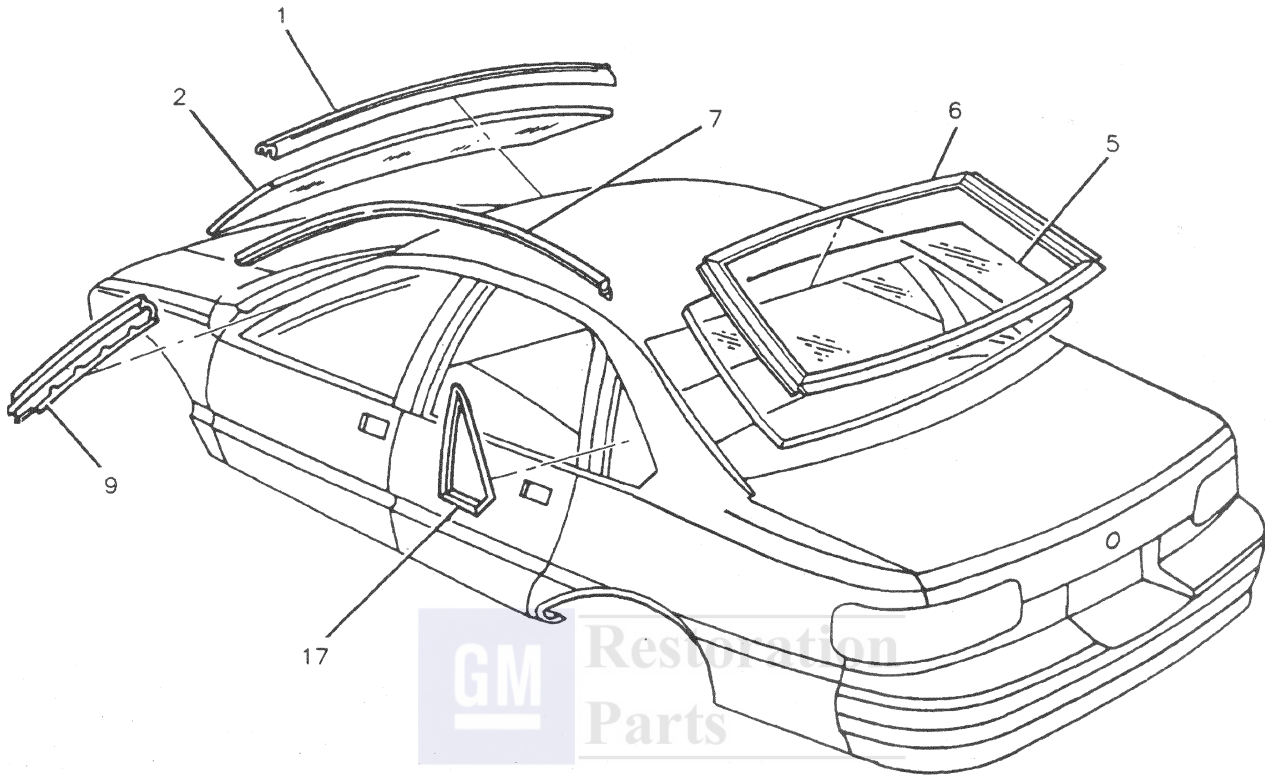
- Bolts/screws (48, 52, 51, 49 and 10) in sequence to 1.3 N·m (12 lb. in.).
2. Weatherstrip (7).
 - Press onto pinch-weld flange. Work from still-fastened portion to loose end.
 - Ensure that weatherstrip (7) is behind reveal molding lip and weatherstrip bead.
 3. Close front side door.

Windshield Upper Reveal Molding

Figure 4

The windshield upper reveal molding can be replaced without removing the windshield. The original molding cannot be reused and must be replaced with a new service part.

If the windshield is also being removed, then follow the windshield service procedure under "Windshield and Rear Windows" in this section.

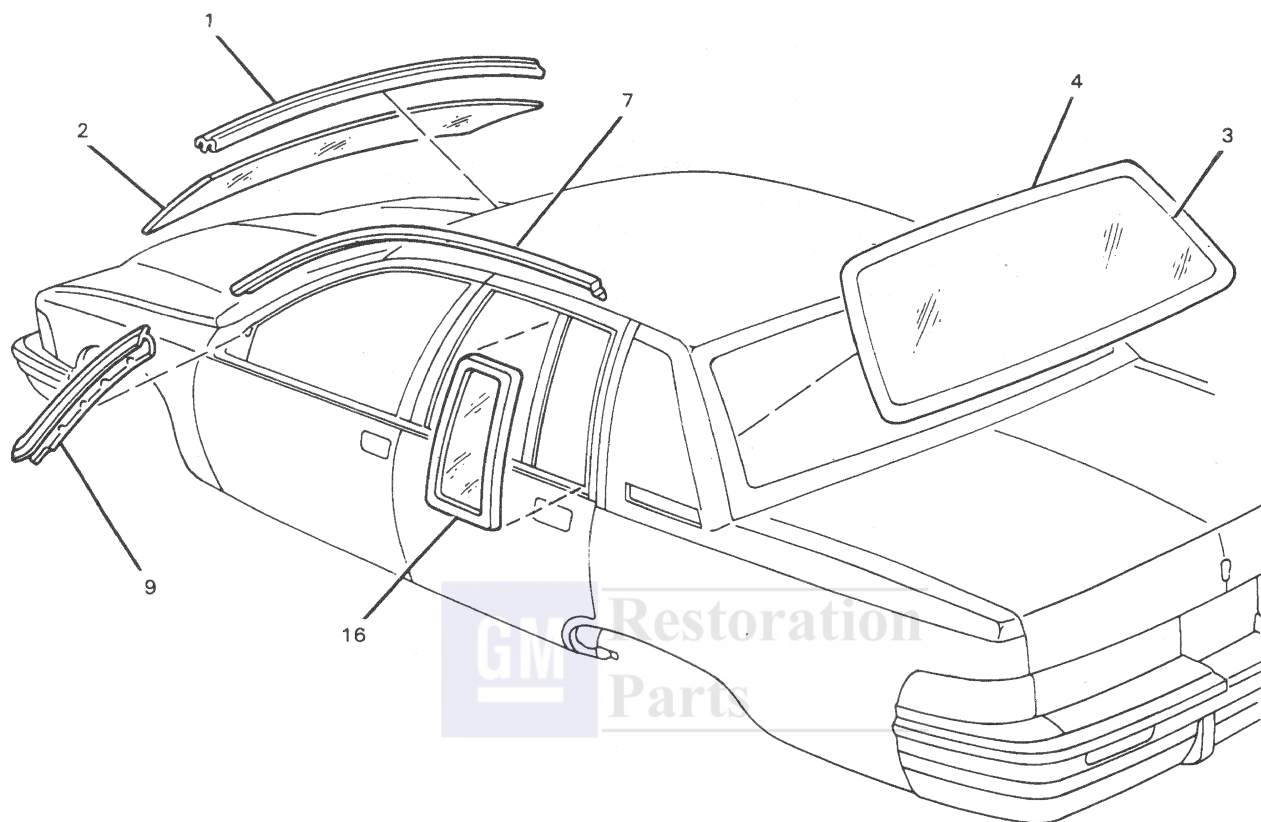


- 1 MOLDING, WINDSHIELD UPPER REVEAL
- 2 WINDSHIELD
- 5 WINDOW, REAR
- 6 MOLDING, REAR WINDOW REVEAL
- 7 WEATHERSTRIP, ROOF SIDE RAIL AUXILIARY
- 9 MOLDING, WINDSHIELD SIDE REVEAL
- 17 WINDOW, QUARTER

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BS001102

Figure 1 - Typical Stationary Windows and Reveal Moldings - (Chevrolet Sedan)

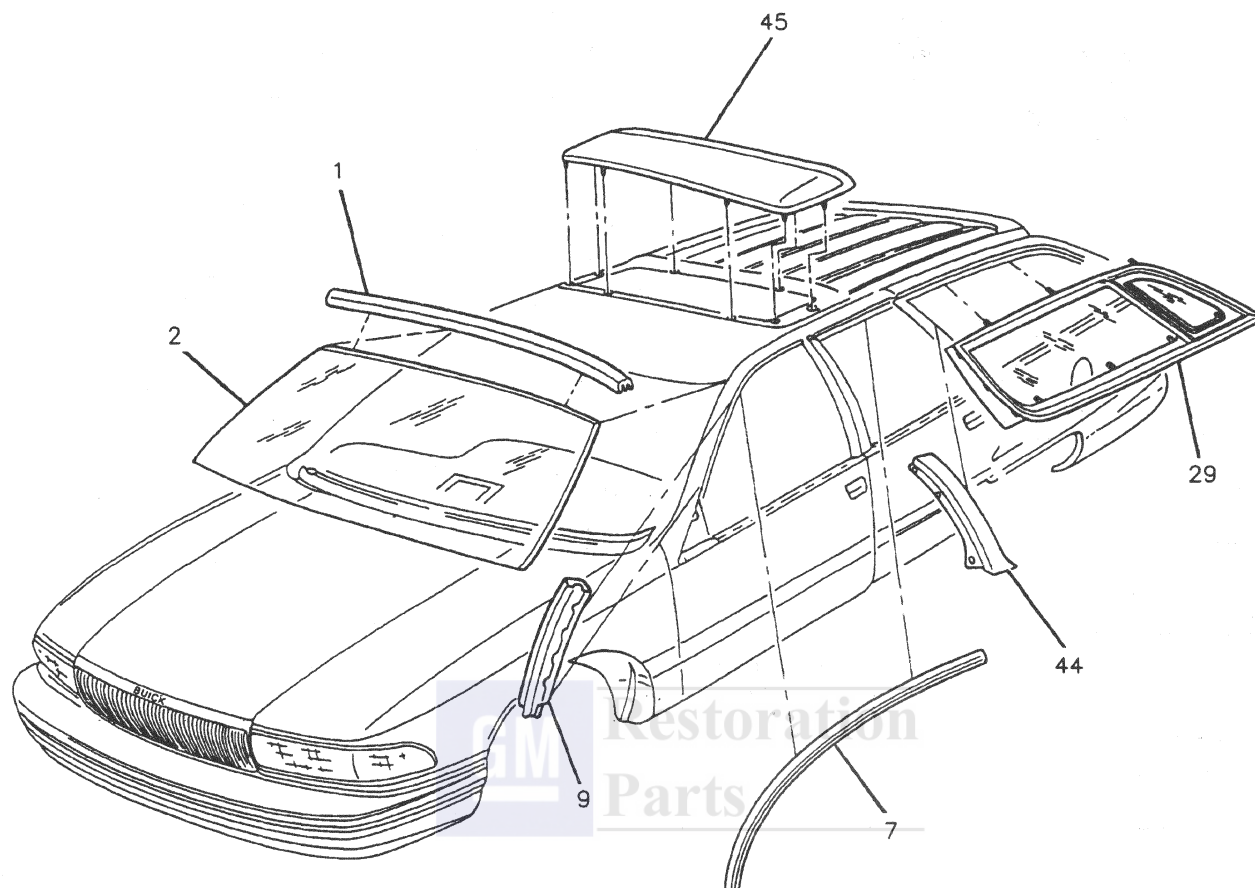
10-2-4 STATIONARY WINDOWS



- 1 MOLDING, WINDSHIELD UPPER REVEAL
- 2 WINDSHIELD
- 3 WINDOW, REAR
- 4 MOLDING, REAR WINDOW REVEAL
- 7 WEATHERSTRIP, ROOF SIDE RAIL AUXILIARY
- 9 MOLDING, WINDSHIELD SIDE REVEAL
- 16 WINDOW, REAR SIDE DOOR VENT

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BS002102

Figure 2 - Typical Stationary Windows and Reveal Moldings - (Buick Sedan)



- 1 MOLDING, WINDSHIELD UPPER REVEAL
- 2 WINDSHIELD
- 7 WEATHERSTRIP, ROOF SIDE RAIL AUXILIARY
- 9 MOLDING, WINDSHIELD SIDE REVEAL
- 29 WINDOW, QUARTER
- 44 APPLIQUE, BODY LOCK PILLAR (BUICK)
- 45 WINDOW, ROOF STATIONARY (BUICK)

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Figure 3 - Typical Stationary Windows and Reveal Moldings - (Wagon)

10-2-6 STATIONARY WINDOWS

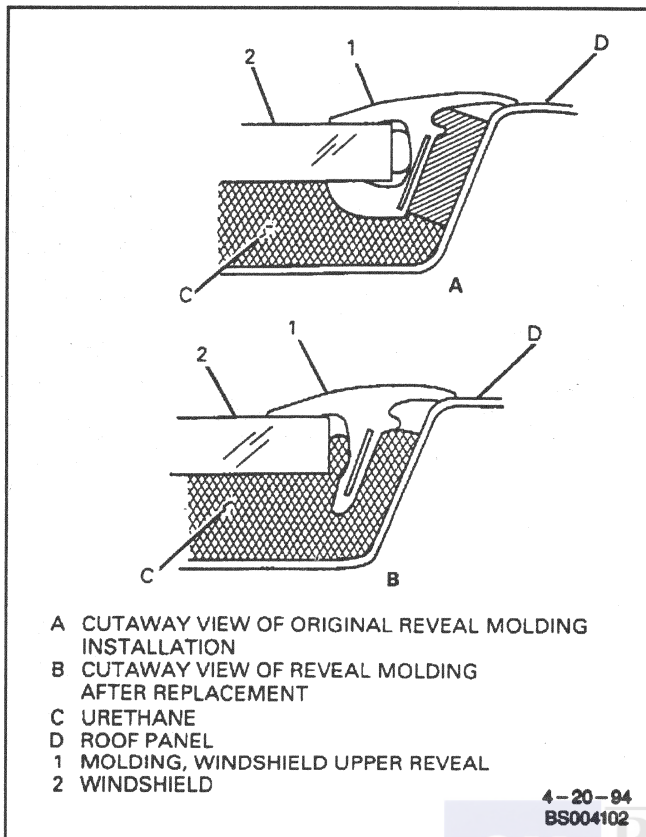


Figure 4 - Windshield Upper Reveal Molding



Remove or Disconnect

1. Windshield side reveal moldings. Refer to "Windshield Side Reveal Molding" in this section.
2. Windshield upper reveal molding (1).
 - Grasp molding end and rotate forward while removing from cavity.
3. Cut bottom edge of new windshield upper reveal molding (1) (Figure 4).



Inspect

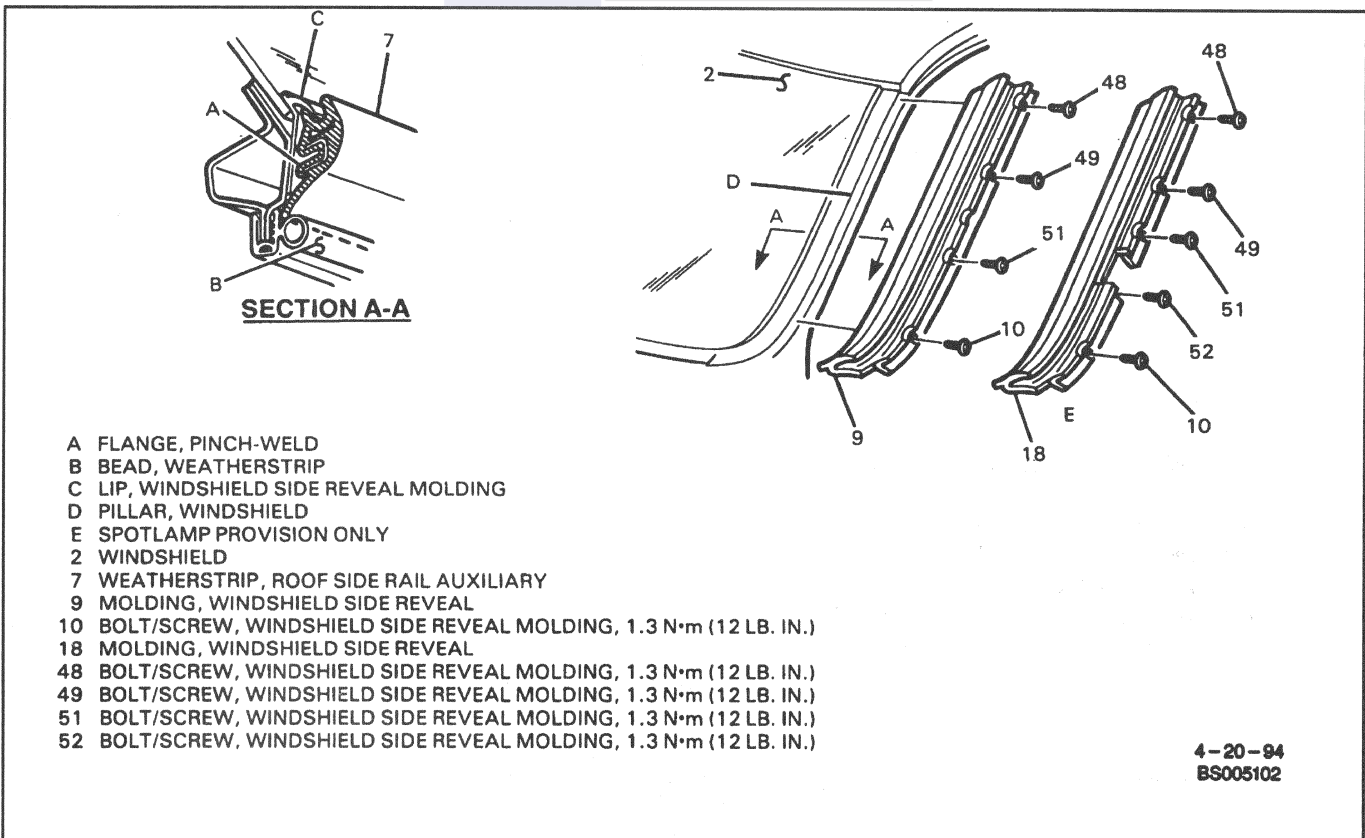
- Dry fit of new molding into cavity. New molding must sit flush on both windshield and roof panel. If any gaps are present, trim urethane adhesive as necessary until molding is flush.



Install or Connect

1. Apply clear primer GM P/N 9981570 to underside of windshield upper reveal molding (1).
2. Apply urethane adhesive GM P/N 12346284 into cavity up to bottom side of windshield (2).
3. Windshield upper reveal molding (1).

- Tape windshield upper reveal molding (1) to body using masking tape.
- Allow urethane adhesive to cure before removing tape.



- SECTION A-A**
- A FLANGE, PINCH-WELD
 - B BEAD, WEATHERSTRIP
 - C LIP, WINDSHIELD SIDE REVEAL MOLDING
 - D PILLAR, WINDSHIELD
 - E SPOTLAMP PROVISION ONLY
 - 2 WINDSHIELD
 - 7 WEATHERSTRIP, ROOF SIDE RAIL AUXILIARY
 - 9 MOLDING, WINDSHIELD SIDE REVEAL
 - 10 BOLT/SCREW, WINDSHIELD SIDE REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
 - 18 MOLDING, WINDSHIELD SIDE REVEAL
 - 48 BOLT/SCREW, WINDSHIELD SIDE REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
 - 49 BOLT/SCREW, WINDSHIELD SIDE REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
 - 51 BOLT/SCREW, WINDSHIELD SIDE REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
 - 52 BOLT/SCREW, WINDSHIELD SIDE REVEAL MOLDING, 1.3 N·m (12 LB. IN.)

Figure 5 - Windshield Side Reveal Molding

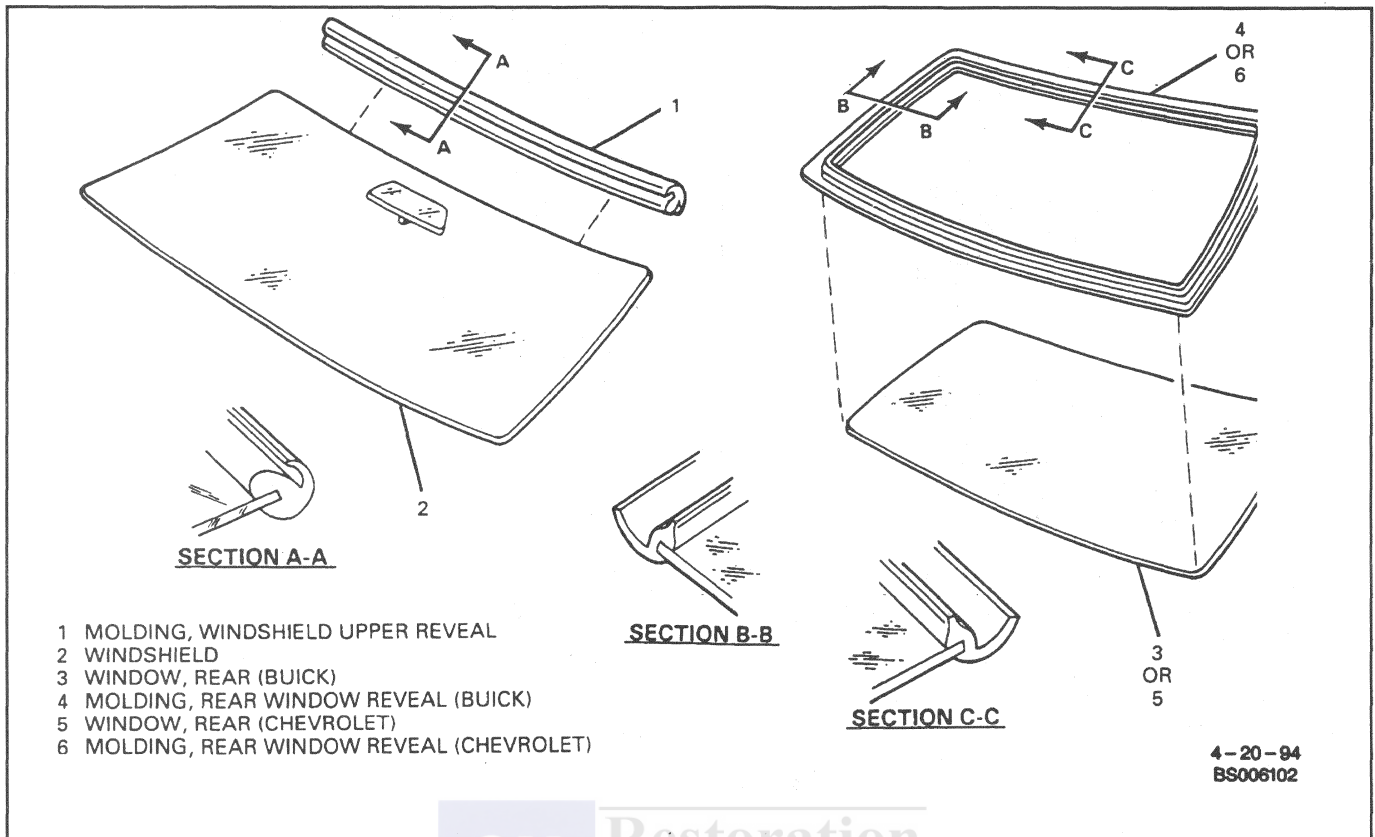


Figure 6 - Windshield and Sedan Rear Window Reveal Molding

4. Windshield side reveal moldings. Refer to "Windshield Side Reveal Molding" in this section.

Rear Window Reveal Molding

Figure 6

The rear window reveal molding cannot be replaced without removing the rear window. The original reveal molding cannot be reused and must be replaced with a new service part.

↔ Remove or Disconnect

1. Rear window. Refer to "Windshield and Rear Window" in this section.
2. Rear window reveal molding (4 or 6) from rear window (3 or 5).
 - Heat lamps may be used to make rear window reveal molding (4 or 6) more pliable.
 - Remove any pieces of rear window reveal molding (4 or 6) remaining on window after removal of rear window (3 or 5).



Clean

- Rear window (3 or 5) of all traces of urethane adhesive, using an alcohol-dampened cloth.

→ Install or Connect

1. Rear window reveal molding (4 or 6) onto rear window (3 or 5).

- A. Position lower left and right corners of rear window reveal molding (4 or 6) to lower left and right corners of rear window (3 or 5).
- B. Press rear window reveal molding (4 or 6) onto edge of rear window (3 or 5).
- C. Work from lower corners to center line on upper edge of rear window (3 or 5).
- D. Heat lamps may be used to make rear window reveal molding (4 or 6) more pliable.

2. Rear window. Refer to "Windshield and Rear Windows" in this section.

Quarter Window and Roof Stationary Window Reveal Moldings

Figure 3

The quarter window and roof stationary window reveal moldings are an integral part of their respective assemblies. Replacement of these reveal moldings will require replacing the whole window. Refer to "Quarter Window" or "Roof Stationary Window" in this section.

BODY LOCK PILLAR APPLIQUE

BUICK WAGON

Figure 7

↔ Remove or Disconnect

1. Open rear side door.

10-2-8 STATIONARY WINDOWS

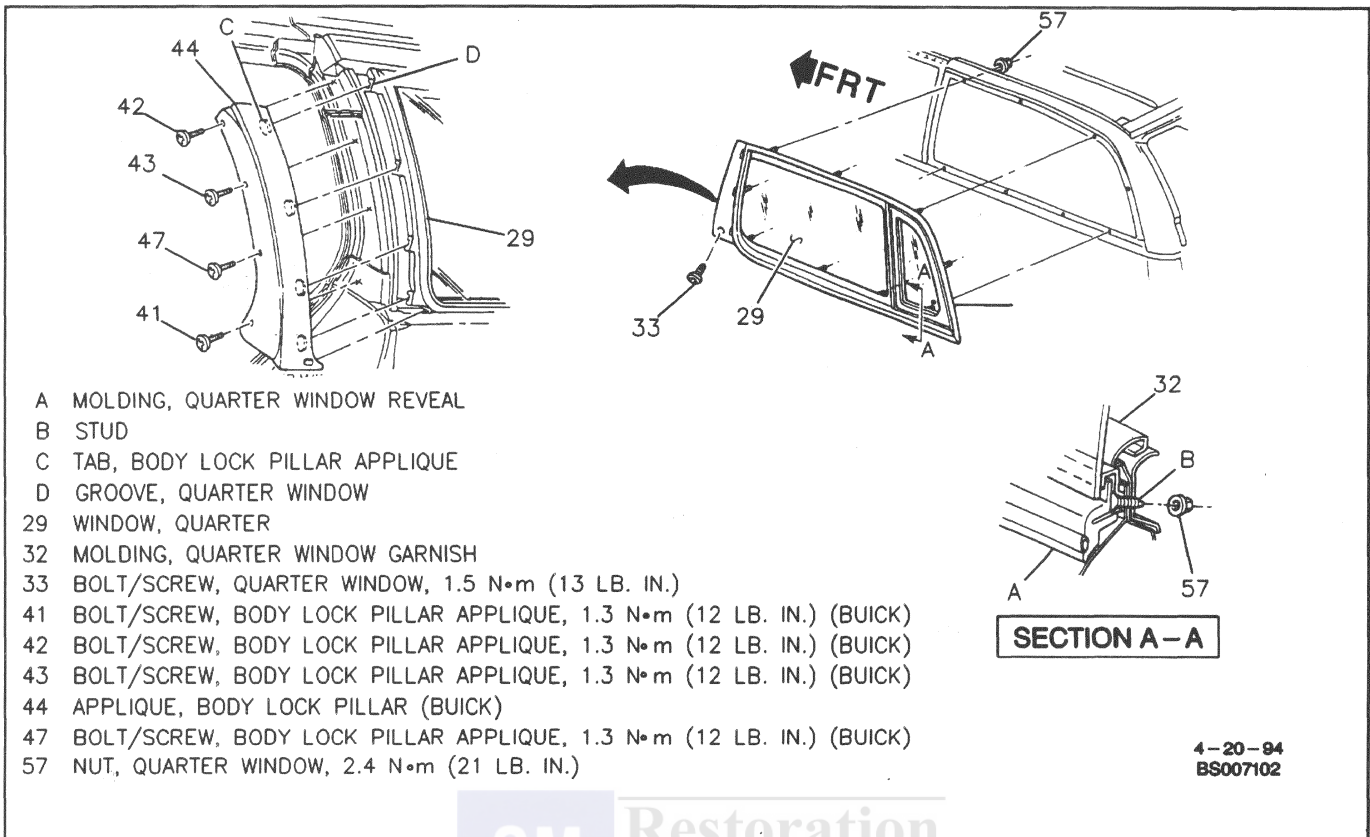


Figure 7 - Quarter Window - (Wagon)

2. Body lock pillar applique bolts/screws (47, 43, 42 and 41) in sequence.
3. Applique (44).

- Pry applique (44) from quarter window, being careful not to damage surrounding surfaces.



Clean

- Area with general purpose cleaner.



Install or Connect

NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Tabs, if missing or damaged.
2. Applique (44).
 - A. Align tabs with grooves in quarter window.
 - B. Press to engage tabs into grooves.
3. Roll front and rear edges of applique (44) to secure adhesive tape. Bottom of applique (44) should be within 1 mm (1/32 inch) of horizontal door surface.
4. Body lock pillar applique bolts/screws (41, 42, 43 and 47) in sequence.



Tighten

- Bolts/screws (41, 42, 43 and 47) in sequence to 1.3 N·m (12 lb. in.).
5. Close rear side door.

STATIONARY WINDOWS

Windshield and Rear Windows

All windshields and sedan rear windows are installed from outside the body using self-curing urethane adhesive. To replace a windshield or sedan rear window installed with urethane adhesive requires either partial or complete replacement of the windshield or rear window urethane adhesive. Partial replacement of the windshield or rear window urethane adhesive is known as the short method. Complete replacement of the windshield urethane adhesive is known as the extended method.

Reusing Window

Occasionally, there are reasons for window removal other than replacement. In these cases, it is possible to reuse the window if it was removed carefully. Refer to the following when preparing window for reinstallation.

- Trim and level remaining urethane adhesive leaving 1 to 2 mm of urethane adhesive on window.
- If remaining urethane adhesive is loose, damaged or has voids, remove all urethane adhesive from window and scrape all traces of black primer from window. Apply new primers and urethane adhesive as though it were a new window.

Short Method

Figures 8 through 12

Tools Required:

J 24402-A Glass Sealant Remover (Cold Knife)

- or -

J 24709-01 or J 24899-01 Urethane Glass Sealant Remover (Hot Knife)

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Remove or Disconnect

1. Place protective coverings around area where window is being removed.
 2. Inside rearview mirror, if replacing windshield. Refer to "Inside Rearview Mirror" in this section.
 3. Wiper arm and wiper blades, if replacing windshield. Refer to SECTION 8E.
 4. Air inlet grille panels, if replacing windshield. Refer to SECTION 10-5.
 5. Windshield side reveal moldings, if replacing windshield. Refer to "Windshield Side Reveal Molding" in this section.
 6. Bolts/screws (54) and supports (13), if replacing windshield (2).
 7. Quarter window garnish moldings (Chevrolet) or quarter upper trim (Buick). Refer to SECTION 10-7.
 8. Electrical connector from terminal on defogger grid bus bar, if replacing rear window (3 or 5) (Figure 9).
 9. Reposition rear compartment front trim to access ground wire.
 10. Bolt/screw (15) and ground wire from upper right corner of rear compartment (Figure 10).
 11. Mask area around window opening to protect painted surfaces and to aid in cleanup after installation.
 - Tape must not touch window sealant surface.
 12. Using commercial razor knife, make preliminary cut into urethane adhesives and reveal molding around entire perimeter of window, staying as close to edge of window as possible.
 13. Pull away portion of reveal molding between window and body, if necessary.
 14. Cut out windshield (2) or rear window (3 or 5), using J 24402-A, J 24709-01 or J 24899-01.
 - Keep blade as close to edge of window as possible. After removal of window, trim remaining urethane adhesive bead (on body opening).
 - Windshield: Cut, or trim, the bead flat - leaving 3 to 5 mm thickness.
 - Rear Window: Cut, or trim the bead flat - leaving a 1 mm thickness.
- This is required for rear window replacement due to molding encapsulation of window.

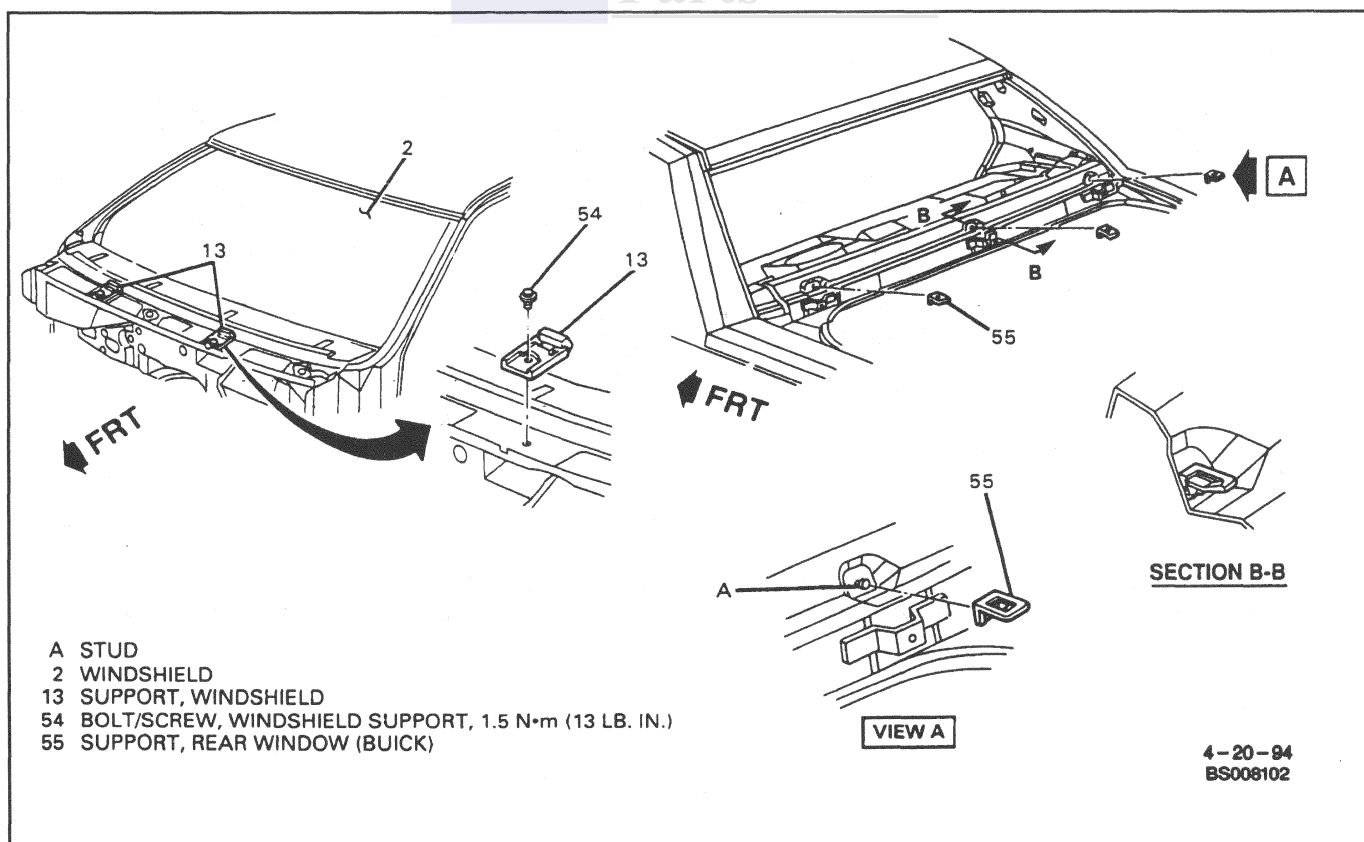


Figure 8 - Windshield Supports and Sedan Rear Window Supports

10-2-10 STATIONARY WINDOWS

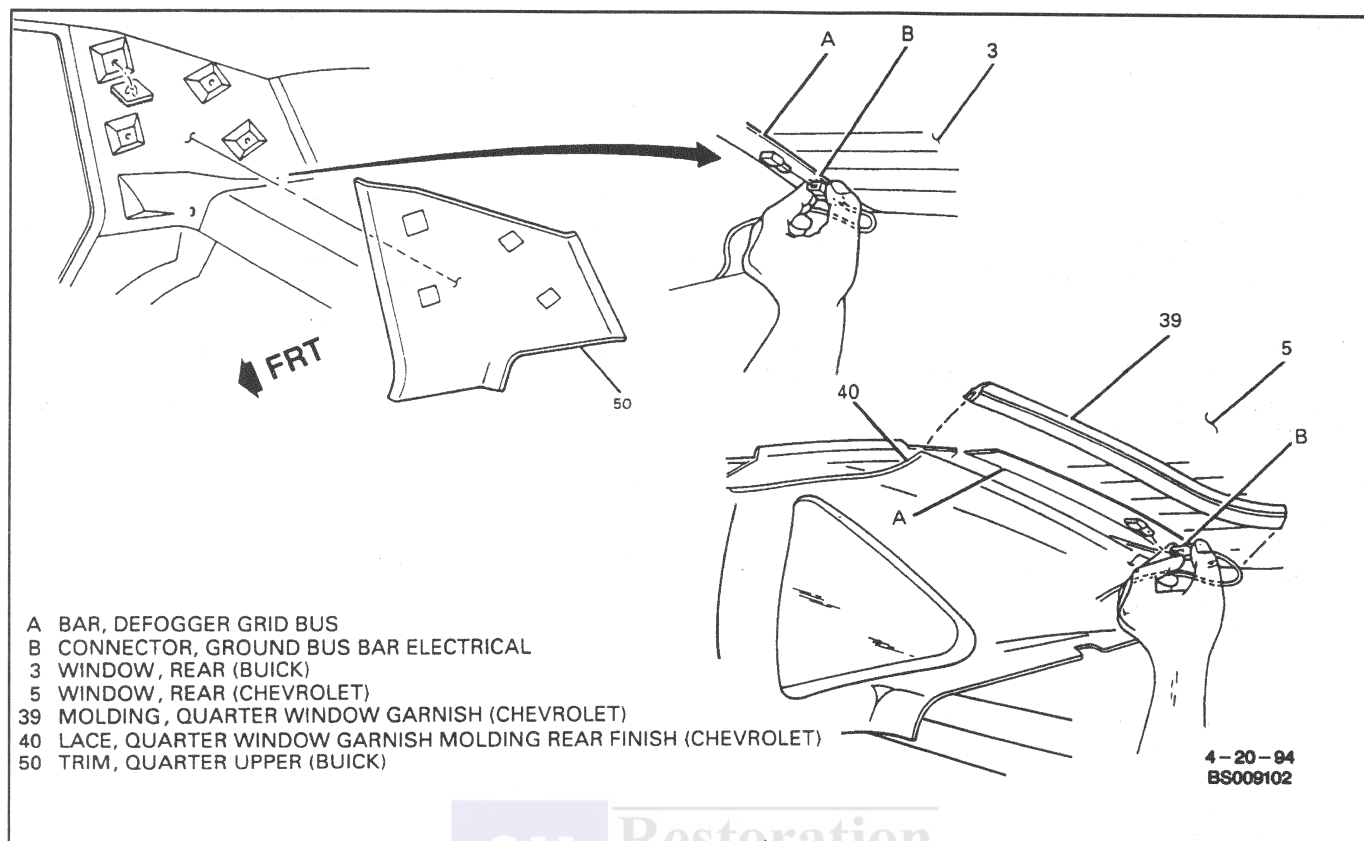


Figure 9 - Rear Window Defogger Electrical Connectors

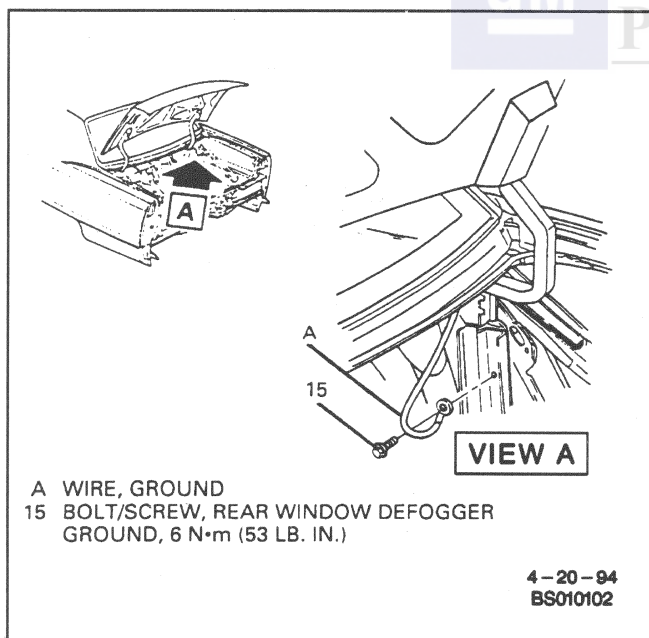


Figure 10 - Rear Window Defogger Ground Wire

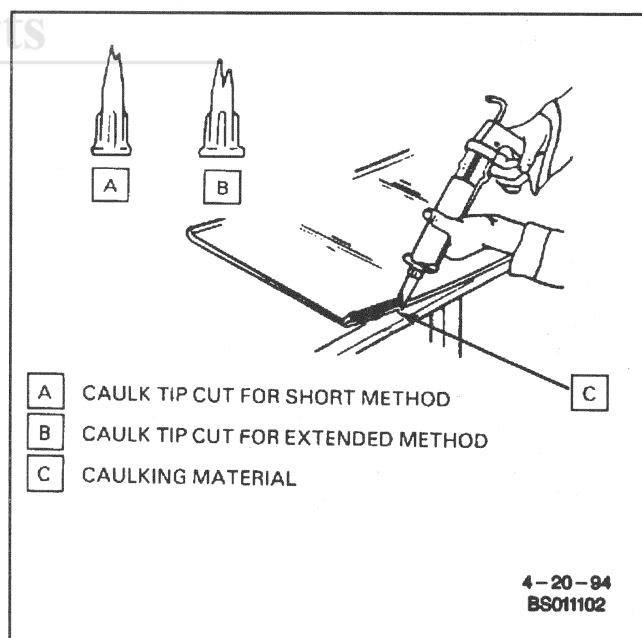


Figure 11 - Applying Urethane Adhesive Material

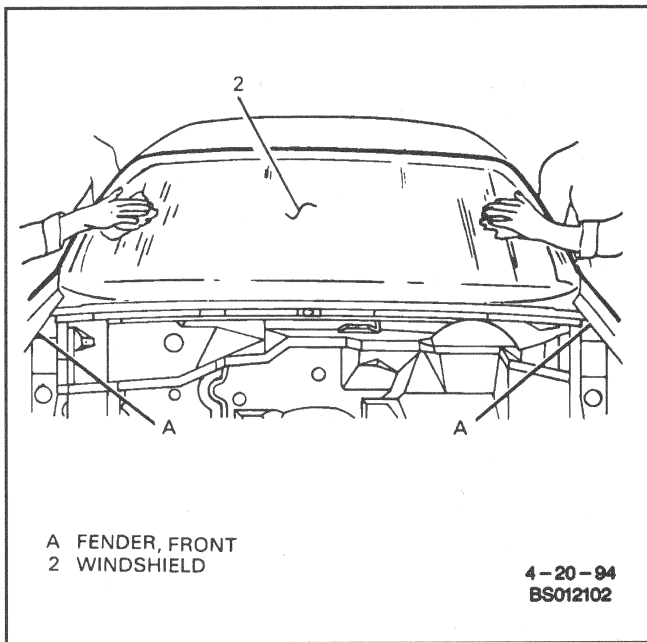


Figure 12 - Installing Windshield

Molding cross-section incorporates a “spacer ridge” along lower edge that could require previous urethane adhesive to be cut close to lower bond flange in order to “flush out” window to opening flanges.

During “dry fitting” of new window to body, it may be necessary to trim that “spacer ridge” to accommodate flush fit in opening.

15. Windshield (2) or rear window (3 or 5).



Clean

- Window opening of any loose material. Use an alcohol-dampened cloth to clean remaining urethane adhesive on window and bond surface, wiping entire bond area.



Install or Connect

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

NOTICE: Refer to “Notice” on page 10-2-1 of this section.

1. Using touch up paint of appropriate color, or body primer if repair will not be visible, repair any areas on window frame nicked during window removal to prevent corrosion. Do not get paint or any other contamination on remaining urethane adhesive base, or in urethane adhesive bond area.
2. If window is to be reused, refer to “Reusing Window” in this section, before proceeding with installation.



Inspect

- Window frame for any metal damage or irregularity of the metal surface. If these or similar conditions exist, it will be necessary to follow extended method for window replacement.
3. Supports (13) and bolts/screws (54) if replacing windshield (2).



Tighten

- Bolts/screws (54) to 1.5 N.m (13 lb. in.).
4. Windshield upper reveal molding, if installing windshield. Refer to “Windshield Upper Reveal Molding” in this section.
 5. Rear window reveal molding, if installing rear window. Refer to “Rear Window Reveal Molding” in this section.
 6. Windshield (2) or rear window (3 or 5) in opening for fit.
 - A. With aid of helper, properly position window in opening and apply a piece of masking tape over each edge of windshield (2) or rear window (3 or 5) and adjacent body pillars.
 - B. Slit tape vertically at edge of window.
 - C. During installation, tape on windshield (2) or rear window (3 or 5) can be aligned with tape on body to guide windshield (2) or rear window (3 or 5) into desired position.
 7. Remove windshield (2) or rear window (3 or 5). Adjust height of remaining urethane adhesive base as necessary.



Clean

- A. Surface of window to which urethane adhesive will be applied (around edge of inside surface) by wiping with clean, alcohol-dampened cloth.
 - B. Allow to air dry.
8. Clear and black primers from urethane adhesive, GM P/N 12346284 or equivalent.
 - Windshield (2) - Clear primer is used on windshield prior to black primer. Apply clear primer around entire perimeter of windshield edge and 6 mm (1/4 inch) inboard on inner surface. Apply black primer over clear primer within 30 minutes of clear primer application and allow to dry for five minutes.
 - Rear Window (3 or 5) - Clear primer is used on rear window (3 or 5) prior to black primer. Apply clear primer around entire perimeter of rear window encapsulation. Apply black primer over clear primer within 30 minutes of clear primer application and allow to dry for five minutes.



Important

- Maximum body temperature must not exceed 49°C (120°F) at time of primer application.

10-2-12 STATIONARY WINDOWS

9. Urethane Adhesive from kit.

- With household cartridge-type caulking gun and nozzle, apply smooth continuous bead of adhesive, approximately 4.5 mm (1/8" to 3/16") diameter, around edge of window where primed in previous step. A caulk tip cut for short method should be used (Figure 11).

10. Windshield (2) or rear window (3 or 5) into window opening with aid of a helper.

- Vacuum cups will be needed to position rear window (3 or 5) in opening.
- For the windshield (2), carry with one hand on inside of window and one hand on outside (Figure 12). Guide windshield (2) along rear edge of front fender to avoid smearing fresh windshield adhesive on instrument panel upper trim pad. At window opening, put windshield (2) in horizontal position. While one person holds windshield (2) in this position, second person can reach one arm around body pillar and support it while other person assumes same position.

- For rear window (3 or 5), position upper corners of rear window (3 or 5) to upper corners of rear window opening. Lay rear window (3 or 5) into body opening, pushing up on bottom of rear window (3 or 5) so upper edge of rear window (3 or 5) is firmly positioned to upper body opening.

11. Windshield (2) onto windshield supports or rear window (3 or 5) onto rear window supports.

- Center in opening.
- Use tape guides previously applied to place windshield (2) or rear window (3 or 5) in proper position.

12. Press window firmly to wet-out and set urethane adhesive.

- Use care to avoid squeezing out excessive amounts of adhesive that would cause an appearance problem.

13. Using small disposable brush or flat, soft fiberglass tool, paddle material around edge of window to ensure watertight seal.

- If necessary, paddle additional material to fill voids in seal.

14. Water test vehicle at once, using soft spray.

- Use cold water.
- Do not direct hard stream of water at fresh adhesive material.
- Water applied on top of urethane adhesive, either during water test or as separate operation, will speed up cure of urethane adhesive.



Inspect

- For leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.

15. Ground wire and bolt/screw (15) to hole in upper right corner of rear compartment (Figure 10).



Tighten

- Bolt/Screw (15) to 6 N.m (53 lb. in.).

16. Electrical connector, if disconnected.

- Connect electrical connectors to terminals on defogger grid bus bars (Figure 9).

17. Quarter window molding garnish (Chevrolet) or quarter upper trim (Buick), tucking rear window defogger electrical connectors under panels. Refer to SECTION 10-7.

18. Windshield side reveal moldings, if replacing windshield. Refer to "Windshield Side Reveal Molding" in this section.

19. Air inlet grille panels, if removed. Refer to SECTION 10-5.

20. Wiper arm and wiper blades, if removed. Refer to SECTION 8E.

21. Inside rearview mirror, if removed. Refer to "Inside Rearview Mirror" in this section.



Important

- On windshield (2) and rear window (3 or 5) installations, vehicle must remain at normal room temperature for six hours to complete proper cure of windshield or rear window urethane adhesive.

Extended Method

Figures 8 through 13

The window removal method is the same for both the short and extended installation methods with one exception. Use more care with the short method during cutout to make certain that an even bead of windshield or rear window urethane adhesive remains on the window opening to serve as a base for the new urethane adhesives. Refer to "Short Method" in this section.

The extended method is used only for extreme cases such as:

- When the old urethane adhesive can no longer serve as a good base.
- When there is damage to the window frame.
- When there is a need for the window frame to be repainted in a body shop.

Windshield spacers are used to maintain the correct windshield-to-pinch-weld flange dimensions. For the same reason, spacers are used on the rear window on sedans with vinyl tops only. The spacers are specific to certain vehicle styles and can be found in the service parts manual. Spacers should be reused or replaced before installing the windshield or rear window.



Clean

- Window opening.

— Using a sharp scraper or chisel, remove old adhesive material from window opening pinch-weld flange.

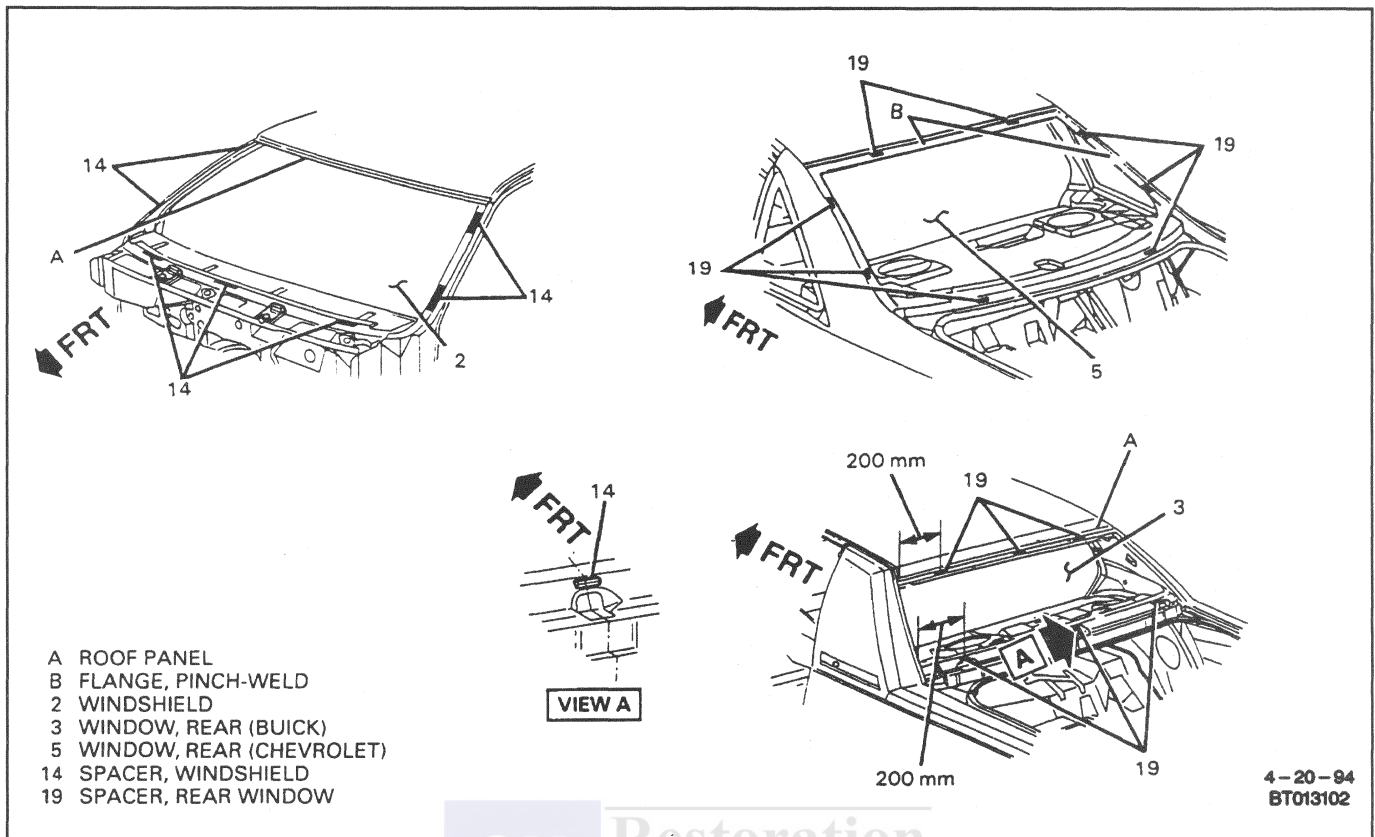


Figure 13 - Windshield and Sedan Rear Window Spacer Locations

— On urethane adhesive installations, all traces of material need not be removed, but there should not be any mounds or loose pieces left.

Install or Connect

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

NOTICE: Refer to “Notice” on page 10-2-1 of this section.

1. Supports (13) and bolts/screws (54) in their original position or supports (55) over studs, sliding down to secure.

Tighten

- Bolts/screws (54) to 1.5 N·m (13 lb. in.).
2. Windshield upper reveal molding, if removed. Refer to “Windshield Upper Reveal Molding” in this section.
 3. Rear window reveal molding, if removed. Refer to “Rear Window Reveal Molding” in this section.
 4. Windshield (2) or rear window (3 or 5) in opening for fit.
 - Check relationship of new windshield (2) or rear window (3 or 5) to urethane adhesive of pinch-weld flange. Excessive gaps must be

corrected by locating windshield spacers (14 or 19) or by applying more urethane adhesive than specified.

5. Piece of masking tape over each edge of windshield (2) or rear window (3 or 5) and adjacent body pillars.
 - Slit tape vertically at edge of window.
 - During installation, tape on windshield (2) or rear window (3 or 5) can be aligned with tape on body to guide windshield (2) or rear window (3 or 5) into desired position.
6. Remove windshield (2) or rear window (3 or 5).

Clean

- A. Surface of window and body opening to which windshield or rear window urethane adhesive will be applied (around edge of inside surface) by wiping with clean, alcohol-dampened cloth.
 - B. Allow to air dry.
7. Clear and black primers from urethane adhesive, GM P/N 12346284 or equivalent.
 - Windshield (2) - Clear primer is used on windshield prior to black primer. Apply clear primer around entire perimeter of windshield edge and 13 mm (1/2 inch) inboard on inner surface. Apply black primer over clear primer within 30 minutes of clear primer application and allow to dry for five minutes.
 - Rear Window (3 or 5) - Clear primer is used on rear window (3 or 5) prior to black primer. Apply clear primer around entire perimeter of

10-2-14 STATIONARY WINDOWS

rear window encapsulation. Apply black primer over clear primer within 30 minutes of clear primer application and allow to dry for five minutes.

Important

- Maximum body temperature must not exceed 49° C (120° F) at time of primer application.
- 8. Black primer to window opening flange. Do not apply over existing urethane adhesive.
- 9. Urethane Adhesive.
 - With household cartridge-type caulking gun and nozzle, apply smooth continuous bead of adhesive, 4.5 mm wide x 10.0 mm high (3/16" x 3/8") around edge of window where primed in previous step. A caulk tip cut for extended method should be used (Figure 11).
- 10. Windshield (2) or rear window (3 or 5) into window opening with aid of helper.
 - Vacuum cups will be needed to position rear window (3 or 5) in opening.
 - For windshield (2), carry with one hand on inside of window and one hand on outside (Figure 12). Guide windshield (2) along rear edge of front fender to avoid smearing fresh windshield adhesive on instrument panel upper trim pad. At window opening, put windshield (2) in horizontal position. While one person holds windshield (2) in this position, second person can reach one arm around body pillar and support it while other person assumes same position.
 - For rear window (3 or 5), position upper corners of rear window (3 or 5) to upper corners of rear window opening. Lay rear window (3 or 5) into body opening pushing up on bottom of rear window (3 or 5) so upper edge of rear window (3 or 5) is firmly positioned to upper body opening.
- 11. Windshield (2) on windshield supports (13) or rear window (3 or 5) on lower supports (55).
 - Center in opening.
 - Use tape guides previously applied to place windshield (2) or rear window (3 or 5) in proper position.
- 12. Press window firmly to wet-out and set adhesive.
 - Use care to avoid squeezing out excessive amounts of adhesive that would cause an appearance problem.
- 13. Using small disposable brush or flat, soft fiberglass tool, paddle material around edge of window to ensure watertight seal.
 - If necessary, paddle additional material to fill voids in seal.
- 14. Water test vehicle at once, using soft spray.
 - Use cold water.
 - Do not direct hard stream of water at fresh adhesive material.
 - Water applied on top of adhesive, either during water test or as separate operation, will speed up cure of urethane adhesive.



Inspect

- For leaks. Paddle in extra adhesive at leak point, using a small disposable brush or flat, soft fiberglass tool.
15. Ground wire and bolt/screw (15) to hole in upper right corner of rear compartment (Figure 10).



Tighten

- Bolt/screw (15) to 6 N.m (53 lb. in.).
16. Electrical connectors, if disconnected.
 - Connect electrical connectors to terminals on defogger grid bus bars (Figure 9).
17. Quarter window garnish moldings (Chevrolet) or quarter upper trim (Buick), tucking electrical connectors under molding or panel. Refer to SECTION 10-7.
18. Windshield side reveal moldings, if removed. Refer to "Windshield Side Reveal Molding" in this section.
19. Air inlet grille panels, if removed. Refer to SECTION 10-5.
20. Wiper arm and wiper blades, if removed. Refer to SECTION 8E.
21. Inside rearview mirror, if removed. Refer to "Inside Rearview Mirror" in this section.



Important

- On windshield (2) and rear window (3 or 5) installations, vehicle must remain at normal room temperature for six hours to complete proper cure of adhesive.

Quarter Window

CHEVROLET SEDAN

Figures 14 and 15

Tool Required:

J 24402-A Glass Sealant Remover (Cold Knife)

- or -

J 24709-01 or J 24899-01 Urethane Glass Sealant Remover (Hot Knife)

The quarter window is made of solid tempered safety plate glass with reveal molding and fastening studs attached. Quarter windows are installed from the outside of the vehicle. Once the quarter window has been removed from the vehicle, it cannot be reinstalled into the vehicle. A new quarter window must be used.

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chances of personal injury.

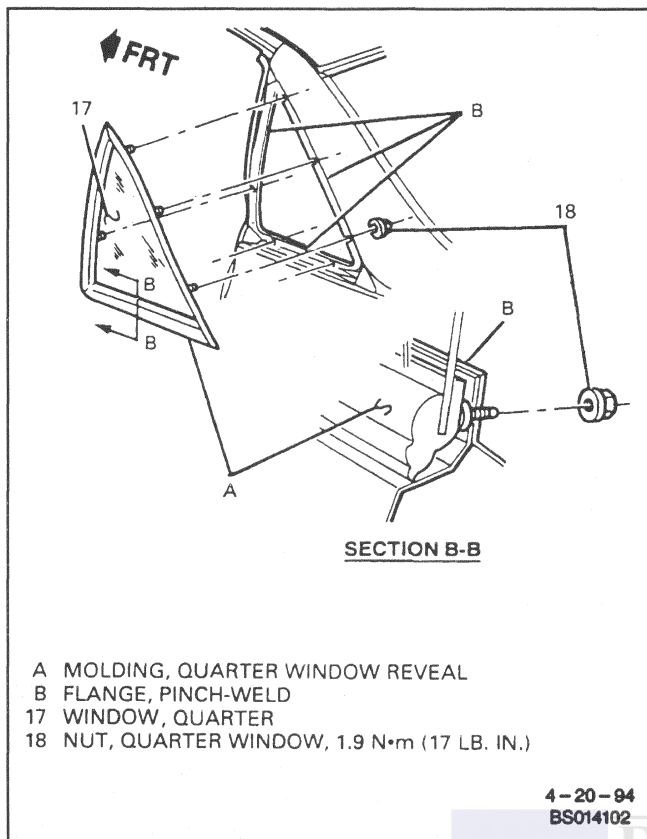


Figure 14 - Quarter Window - (Chevrolet Sedan)

Remove or Disconnect

1. Radio rear speaker grilles. Refer to SECTION 10-8.
2. Quarter window garnish moldings. Refer to SECTION 10-7.
3. Rear seat and seatback cushions. Refer to SECTION 10-10.
4. Rear side door lock pillar garnish moldings. Refer to SECTION 10-7.
5. Rear window panel trim by pulling forward.
6. Nuts (18).
7. Quarter window (17).
 - Cut out quarter window (17) from inside using J 24402-A or J 24709-01 or J 24899-01. Quarter window (17) will not be used again.

Clean

- Window opening of any loose material.

Install or Connect

NOTICE: Refer to “Notice” on page 10-2-1 of this section.

1. Quarter window (17) into opening.
 - Be sure to install new quarter window (17). Do not reuse old quarter window (17).
2. Masking tape over each edge of reveal molding and adjacent body panels.

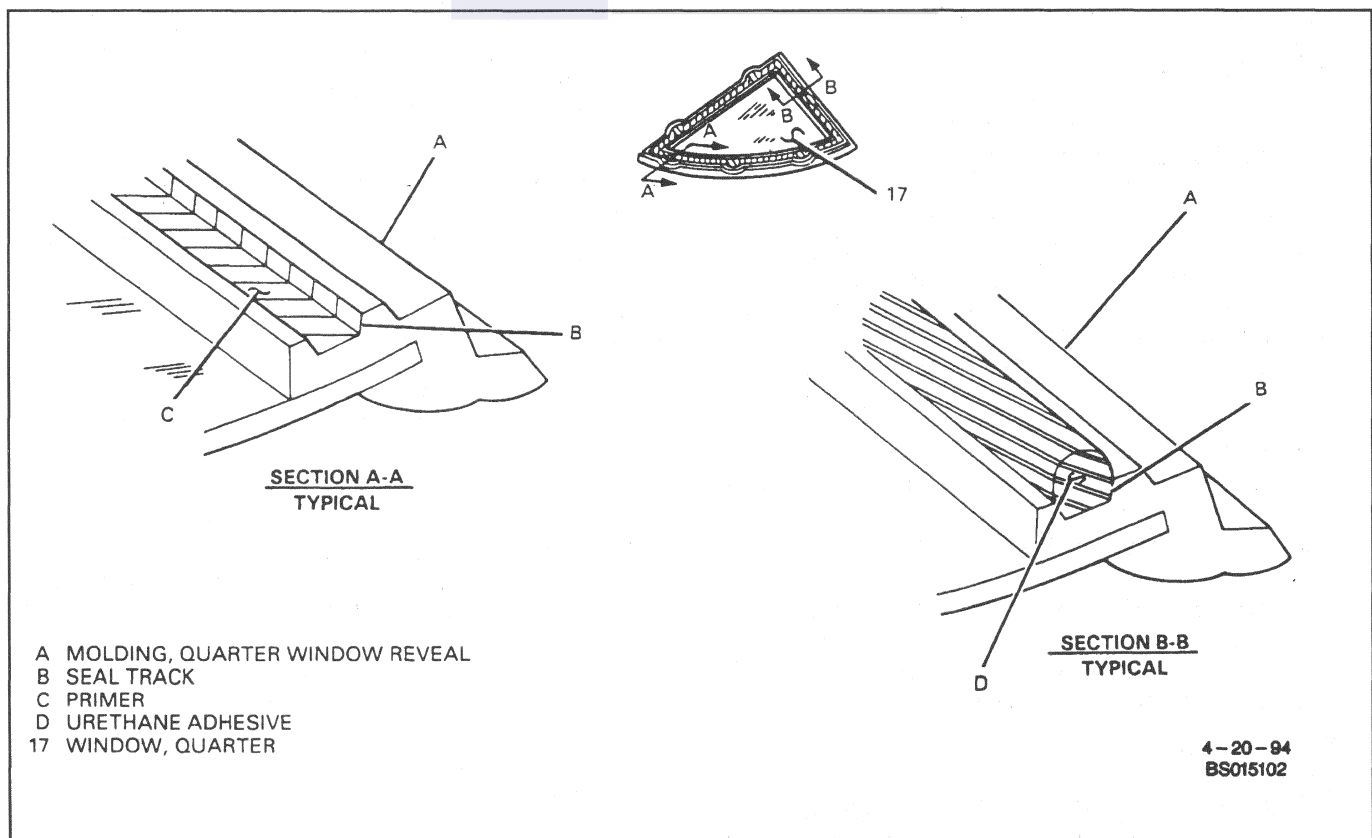


Figure 15 - Applying Primer and Adhesive to Quarter Window - (Chevrolet Sedan)

10-2-16 STATIONARY WINDOWS

3. Slit tape at edge of reveal molding.
4. Align tape on reveal molding to tape on body.
5. Remove quarter window (17).
6. Primer from urethane adhesive, GM P/N 12346284, or equivalent, in and around perimeter of reveal molding seal track. Allow primer to dry five minutes.
 - Two primers are used in urethane adhesive.
 - Clear primer is used in reveal molding seal track prior to application of urethane adhesive. This primer acts as agent that will bond urethane adhesive to quarter window (17).
 - Black primer is used on window opening pinch-weld flange if paint has been exposed during window removal or cleaning, or if painting or refinishing is required. The primer acts as agent that will bond urethane adhesive to body surface.

Important

- Maximum body temperature must not exceed 95° C (120° F) at time of primer application.
7. Urethane adhesive from kit to primed reveal molding seal track with cartridge caulking gun and nozzle.
 - Use smooth, continuous line of adhesive 6 mm (1/4-inch) wide and 13 mm (1/2-inch) high.
 8. Quarter window (17) into opening.
 - If, during installation or shipping, a stud is damaged or broken off, replace it with a flat washer and self-tapping screw.

Tighten

- Self-tapping screw to 2 N.m (18 lb. in.).
9. Use tape guides to align quarter window (17) to pinch-weld flange.
 10. Press window firmly to pinch-weld surface to wet and set adhesive.
 - Be careful to avoid squeezing out excessive amounts of adhesive that could cause an appearance problem.
 11. Using a small, disposable brush or flat, soft fiberglass tool, paddle adhesive into gap between pinch-weld flange and reveal molding for a watertight seal.
 12. Paddle in additional adhesive to fill any voids in seal.
 13. Water test vehicle with soft spray.
 - Use cold water.
 - Do not direct hard stream of water at fresh adhesive.
 - Water applied on top of urethane adhesive will speed up cure of adhesive.

Inspect

- Window installation for leaks. Paddle in extra adhesive at leak point, using a small disposable brush or flat, soft fiberglass tool.

14. Quarter window garnish molding to bottom four studs on quarter window. Refer to SECTION 10-7.
15. Nuts (18).

Tighten

- Nuts (18) to 1.9 N.m (17 lb. in.).
16. Rear window panel trim by pulling forward.
 17. Rear side door lock pillar garnish moldings. Refer to SECTION 10-7.
 18. Rear seat and seatback cushions. Refer to SECTION 10-10.
 19. Quarter window garnish moldings. Refer to SECTION 10-7.
 20. Radio rear speaker grilles. Refer to SECTION 10-8.

WAGON

Figures 7 and 16

Tool Required:

J 24402-A Glass Sealant Remover (Cold Knife)

- or -

J 24709-01 or J 24899-01 Urethane Adhesive Glass Sealant Remover (Hot Knife)

This procedure is for replacing the whole quarter window, including stationary quarter window, moveable quarter window and reveal molding. If only the moveable quarter window needs replacing, refer to SECTION 10-7.

The quarter window is made of solid tempered safety plate glass with reveal molding and fastening studs attached. It is installed from outside of the vehicle.

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Remove or Disconnect

1. Body lock pillar applique, if Buick. Refer to "Body Lock Pillar Applique" in this section.
2. Open quarter window.
3. Quarter window latch pin connecting quarter window latch bearing to quarter window latch.
4. Quarter inner rear trim finish panel, back body pillar finish panel, body lock pillar trim finish panel and quarter window garnish molding. Refer to SECTION 10-7.
5. Headlining panel. Refer to SECTION 10-9.
6. Quarter window nuts (57) from studs.
7. Quarter window bolt/screw (33) from quarter window (29).
8. Quarter window (29).
 - Cut out quarter window (29) from inside using J 24402-A or J 24709-01 or J 24899-01.

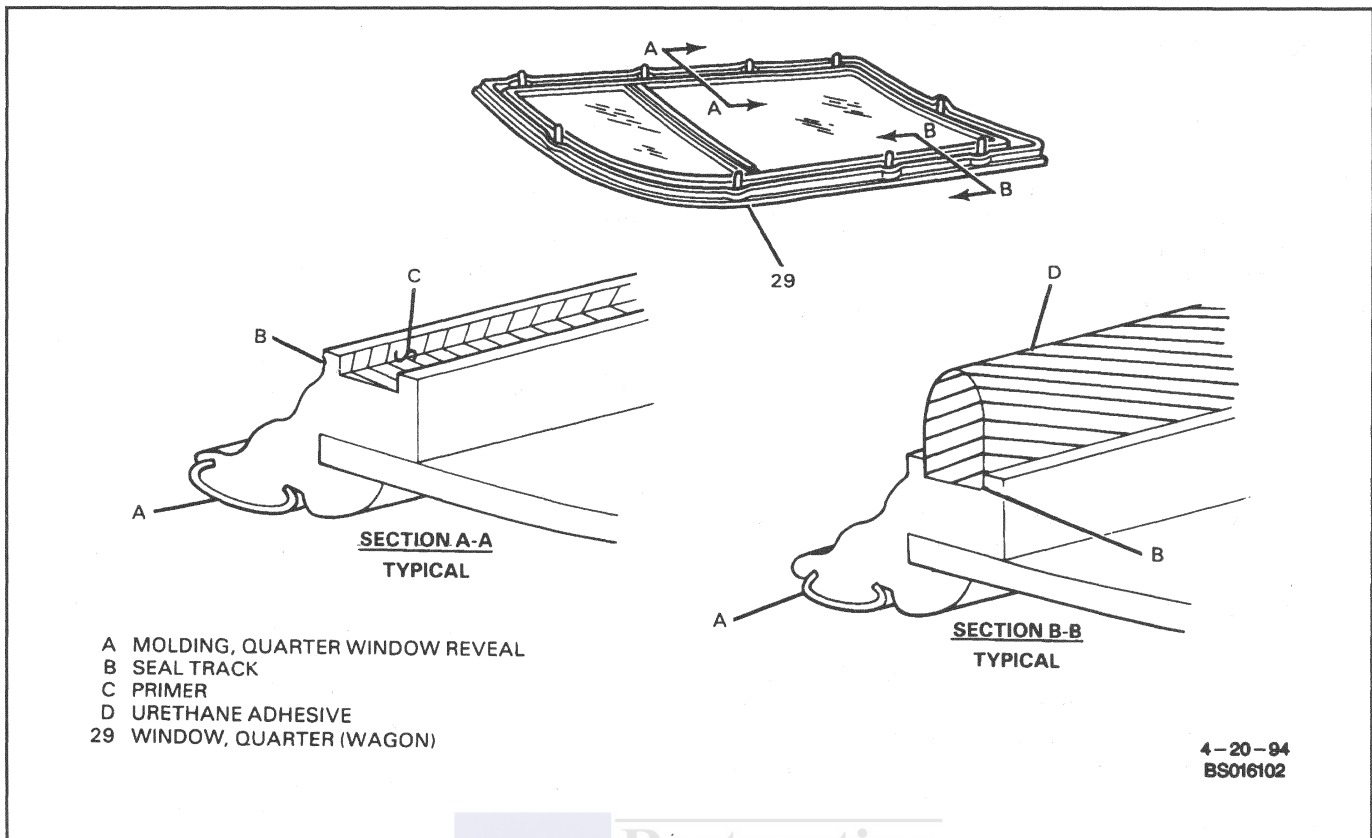


Figure 16 - Applying Primer and Adhesive to Quarter Window - (Chevrolet Wagon)

**Clean**

- Window opening of any loose material. Remove all adhesive with an alcohol-dampened cloth.

**Install or Connect**

NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Quarter window (29) into opening.
2. Body lock pillar applique, if removed. Refer to "Body Lock Pillar Applique" in this section.

**Adjust**

- Quarter window (29) in opening.
3. Masking tape over each edge of reveal molding and adjacent body panels.
 4. Slit tape at edge of reveal molding.
 5. Align tape on reveal molding to tape on body.
 6. Remove body lock pillar applique, if necessary. Refer to "Body Lock Pillar Applique" in this section.
 7. Remove quarter window (29).
 8. Primer from urethane adhesive, GM P/N 12346284, or equivalent, in and around perimeter of reveal molding seal track. Allow primer to dry five minutes.
 - Two primers are used in urethane adhesive.

- Clear primer is used in reveal molding seal track prior to application of urethane adhesive. This primer acts as agent that will bond urethane adhesive to quarter window (29).
- Black primer is used on window opening pinch-weld flange if paint has been exposed during window removal or cleaning, or if painting or refinishing is required. The primer acts as agent that will bond urethane adhesive to body surface.

**Important**

- Maximum body temperature must not exceed 49° C (120° F) at time of primer application.
9. Urethane adhesive from kit to primed reveal molding seal track with cartridge caulking gun and nozzle.
 - Use a smooth, continuous line of adhesive 6 mm (1/4-inch) wide and 12 mm (1/2-inch) high.
 10. Quarter window (29) into opening.
 - If, during installation or shipping, a stud is damaged or broken off, replace it with a flat washer and self-tapping screw.

**Tighten**

- Self-tapping screw to 2 N.m (18 lb. in.).
11. Use tape guides to align quarter window (29) to pinch-weld flange.

10-2-18 STATIONARY WINDOWS

12. Press window firmly to pinch-weld surface to wet and set adhesive.
 - Be careful to avoid squeezing out excessive amounts of adhesive that could cause an appearance problem.
13. Using small, disposable brush or flat, soft fiberglass tool, paddle adhesive into gap between pinch-weld flange and reveal molding for a watertight seal.
14. Paddle in additional adhesive to fill any voids in seal.
15. Water test vehicle with soft spray.
 - Use cold water.
 - Do not direct hard stream of water at fresh adhesive.
 - Water applied on top of urethane adhesive will speed up cure of adhesive.



Inspect

- Window installation for leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.
16. Quarter window garnish molding to bottom four studs on quarter window. Refer to SECTION 10-7.
 17. Quarter window nuts (57).



Tighten

- Nuts (57) to 2.4 N·m (21 lb. in.).
18. Quarter window bolt/screw (33), if removed, through quarter window (29) into body.



Tighten

- Quarter window bolt/screw (33) to 1.5 N·m (13 lb. in.).
19. Apply sealant (GM P/N 9981111 or equivalent) to head of quarter window bolt/screw (33). Spread to completely cover bolt/screw head and area.
 20. Headlining panel. Refer to SECTION 10-9.
 21. Body lock pillar trim finish panel, back body pillar finish panel and quarter inner rear trim finish panel. Refer to SECTION 10-7.
 22. Quarter window latch pin connecting quarter window latch bearing to quarter window latch.
 23. Close quarter window.
 24. Body lock pillar applique, if removed. Refer to "Body Lock Pillar Applique" in this section.

Rear Side Door Vent Window

BUICK SEDAN

Figure 17

The rear side door vent window is made of solid tempered safety plate glass with a seal around the perimeter. Rear side door vent windows are installed from the inside of the vehicle.

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.



Remove or Disconnect

1. Rear side door right/left trim. Refer to SECTION 10-6.
 - Move rear side door water deflector to gain access.
2. Rear side door window. Refer to SECTION 10-6.
3. Upper support, belt support, and lower support bolts/screws (30, 31 and 34) and spacer (56).
4. Division channel (35) from front channel (38).
5. Division channel (35) from rear side door (36).
6. Vent window (16).
7. Seal from vent window (16), if necessary.



Install or Connect

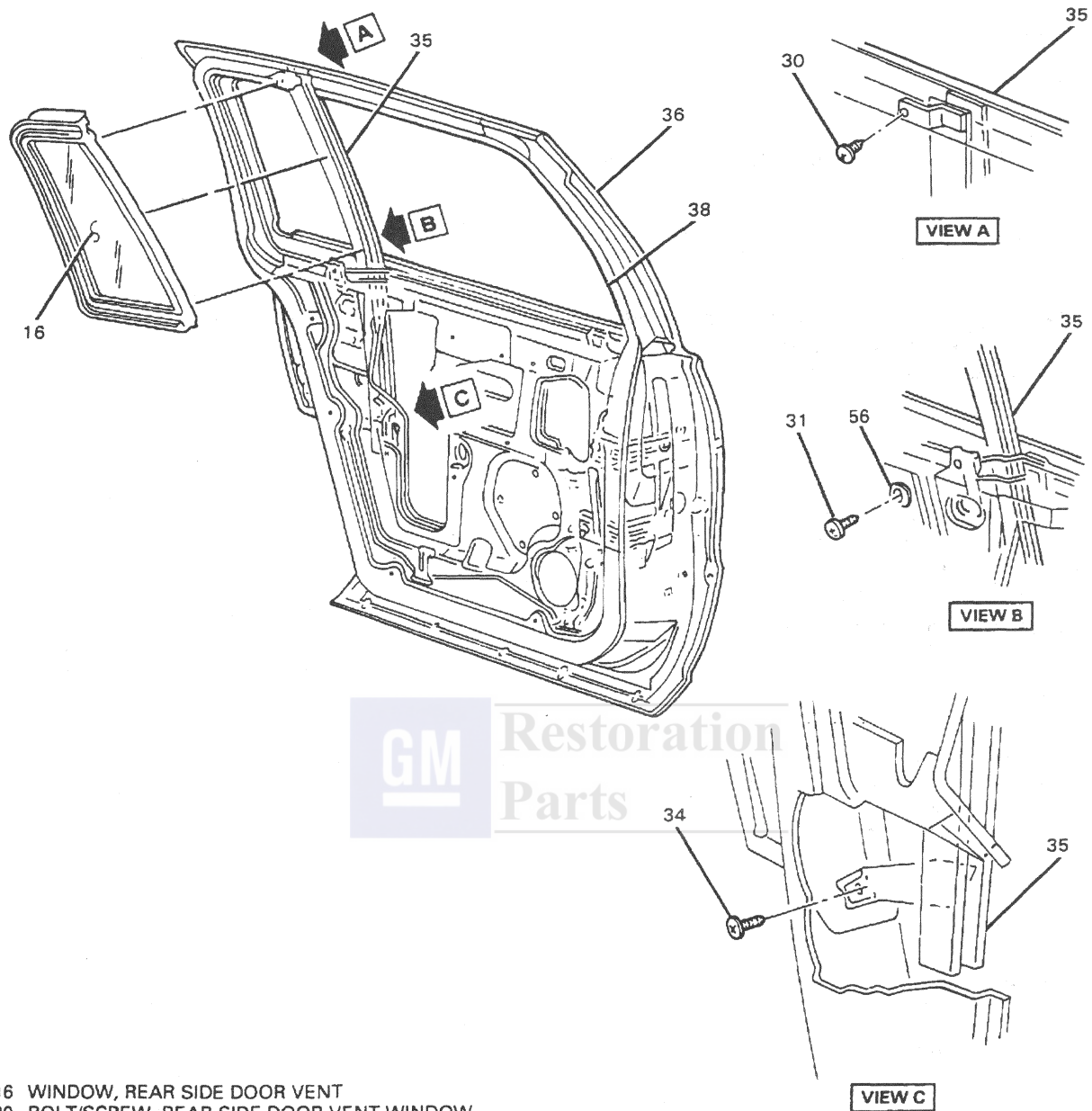
NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Seal to vent window (16), if removed.
 - Use rubber mallet to seat seal around window.
2. Vent window (16).
 - Apply soapy water solution around seal to aid in installation.
3. Division channel (35) to rear side door (36).
4. Division channel (35) to front channel (38).
5. Spacer (56) and upper support, lower support, and belt support bolts/screws (30, 34, and 31), in sequence.



Tighten

- A. Upper support bolt/screw (30) to 1.9 N·m (17 lb. in.).
- B. Lower support bolt/screw (34) to 10 N·m (89 lb. in.).
- C. Belt support bolt/screw (31) to 10 N·m (89 lb. in.).
6. Rear side door window. Refer to SECTION 10-6.
7. Reposition rear side door water deflector.
8. Rear side door right/left trim. Refer to SECTION 10-6.



- 16 WINDOW, REAR SIDE DOOR VENT
- 30 BOLT/SCREW, REAR SIDE DOOR VENT WINDOW DIVISION CHANNEL UPPER SUPPORT, 1.9 N·m (17 LB. IN.)
- 31 BOLT/SCREW, REAR SIDE DOOR VENT WINDOW DIVISION CHANNEL BELT SUPPORT, 10 N·m (89 LB. IN.)
- 34 BOLT/SCREW, REAR SIDE DOOR VENT WINDOW DIVISION CHANNEL LOWER SUPPORT, 10 N·m (89 LB. IN.)
- 35 CHANNEL, REAR SIDE DOOR VENT WINDOW DIVISION
- 36 DOOR, REAR SIDE
- 38 CHANNEL, REAR SIDE DOOR WINDOW FRONT
- 56 SPACER, REAR SIDE DOOR VENT WINDOW DIVISION CHANNEL

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Figure 17 - Removing Rear Side Door Stationary Window and Window Division Channel - (Buick Sedan)

10-2-20 STATIONARY WINDOWS

Roof Stationary Window

BUICK WAGON

Figures 18 and 19

Tool Required:

J 24402-A Glass Sealant Remover (Cold Knife)

- or -

J 24709-01 or J 24899-01 Urethane Adhesive Glass Sealant Remover (Hot Knife)

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce chance of personal injury.

Remove or Disconnect

1. Headlining panel. Refer to SECTION 10-9.
2. Roof stationary window nuts (46) from studs on roof stationary window (45).
3. Roof stationary window (45).
4. Cut out roof stationary window (45) from inside using J 24402-A, J 24709-01 or J 24899-01.



Clean

- Window opening of any loose material. Remove all adhesive with an alcohol-dampened cloth.



Install or Connect

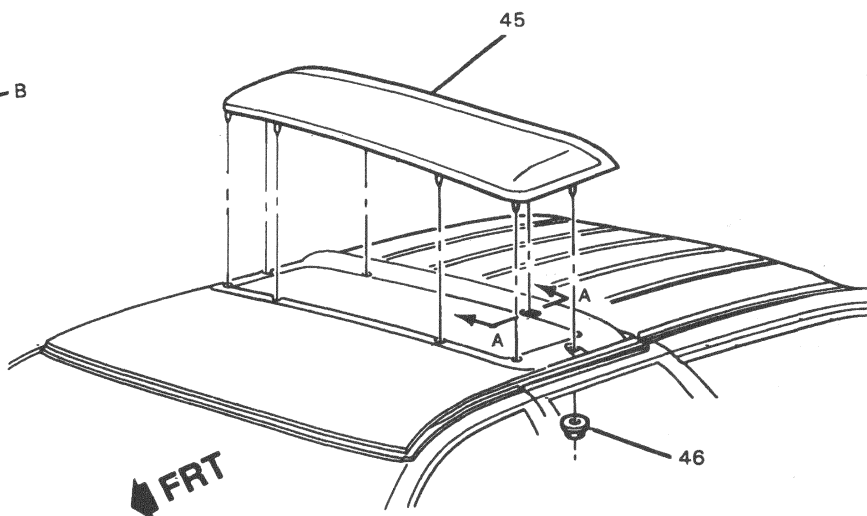
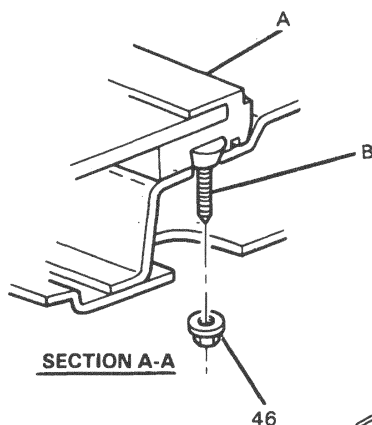
NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Roof stationary window (45) into opening.
2. Masking tape over each edge of reveal molding and roof.
3. Slit tape at edge of reveal molding.
 - During installation, align tape on reveal molding to tape on roof.
4. Remove roof stationary window (45).
5. Primer from urethane adhesive, GM P/N 12346284, or equivalent, in and around perimeter of reveal molding seal track. Allow primer to dry five minutes.

- Two primers are used in urethane adhesive.

— Clear primer is used in reveal molding seal track prior to application of urethane adhesive. This primer acts as an agent that will bond the urethane adhesive to roof stationary window (45).

— Black primer is used on window opening pinch-weld flange if paint has been exposed during window removal or cleaning, or if painting or refinishing is required. Primer acts as agent that will bond urethane adhesive to body surface.



- A REVEAL MOLDING, ROOF STATIONARY WINDOW
B STUD, ROOF STATIONARY WINDOW
45 WINDOW, ROOF STATIONARY
46 NUT, ROOF STATIONARY WINDOW, 2.4 N•m (21 LB. IN.)

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Figure 18-Roof Stationary Window-(Buick Wagon)

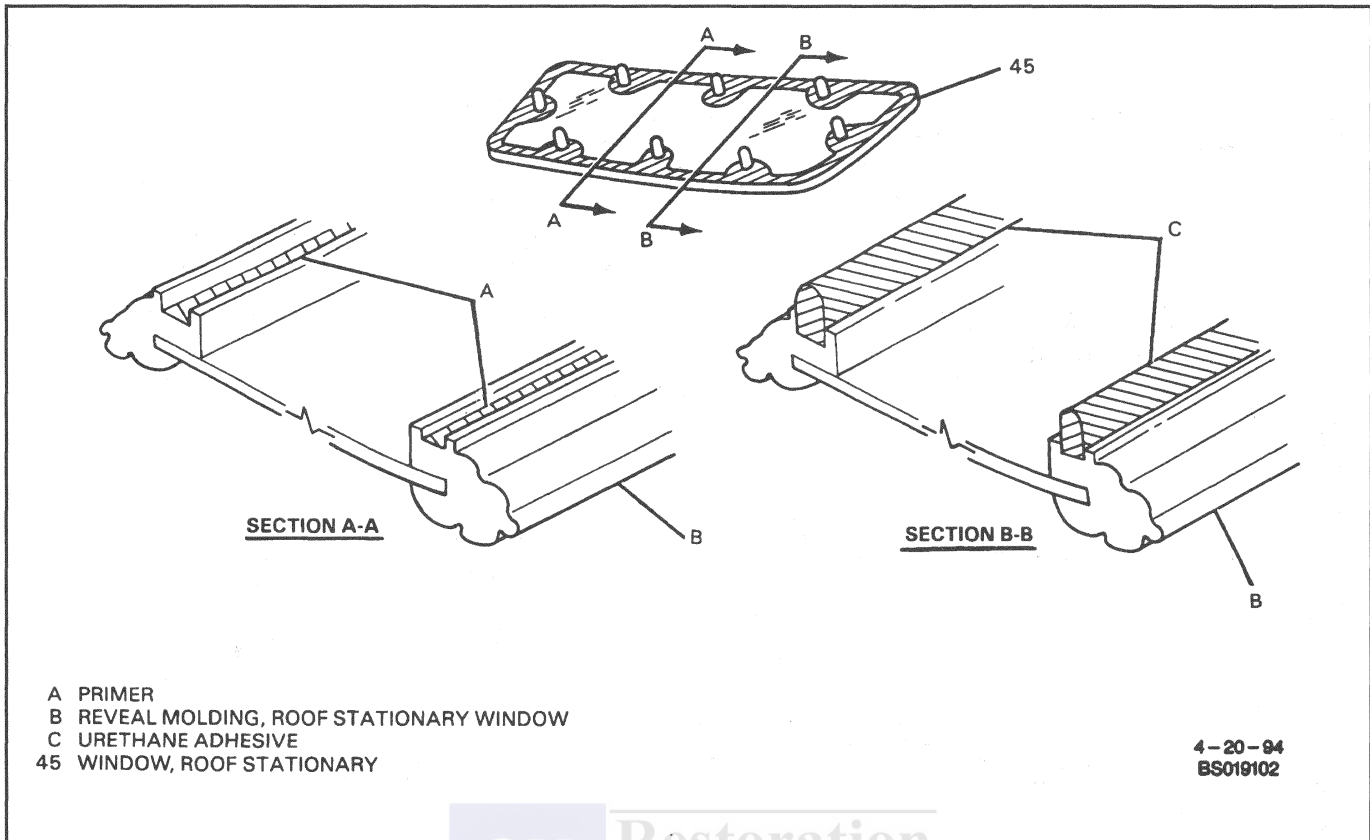


Figure 19-Applying Primer and Adhesive to Roof Stationary Window-(Buick Wagon)

! Important

- Maximum body temperature must not exceed 49° C (120° F) at time of primer application.
- 6. Urethane adhesive from kit to primed reveal molding seal track with cartridge caulking gun and nozzle.
 - Use smooth, continuous line of adhesive 13 mm (1/2-inch) wide and 12 mm (1/2-inch) high.
- 7. Roof stationary window (45) into opening.
 - Use tape guides to align roof stationary window (45) to pinch-weld flange.
- 8. Press roof stationary window (45) firmly to pinch-weld surface to wet and set adhesive.
 - Be careful to avoid squeezing out excessive amounts of adhesive that could cause an appearance problem.
- 9. Using a small, disposable brush or flat, soft fiberglass tool, paddle adhesive into gap between pinch-weld flange and reveal molding for a watertight seal.
- 10. Paddle in additional adhesive to fill any voids in seal.
- 11. Water test vehicle with a soft spray.
 - Use cold water.
 - Do not direct a hard stream of water at fresh adhesive.
 - Water applied on top of urethane adhesive will speed up cure of adhesive.

🔍 Inspect

- Window installation for leaks. Paddle in extra adhesive at leak point, using a small disposable brush or flat, soft fiberglass tool.
- 12. Roof stationary window nuts (46) to studs on roof stationary window (45).

🔧 Tighten

- Roof stationary window nuts (46) to 2.4 N.m (21 lb. in.).
- 13. Headlining panel. Refer to SECTION 10-9.

WATERLEAK CORRECTION

Figure 20

Where accessible, waterleaks can be corrected without removing and reinstalling the window. This method applies only to urethane adhesive installed windows and use of urethane adhesive furnished in urethane adhesive GM P/N 12346284 or equivalent.

1. Remove reveal moldings in area of leak.
 - In some cases, it may become necessary to remove interior moldings or finishing lace to locate the source of leak.
2. Mark location of leak(s).
 - A. Carefully push outward on window in area of leak to determine extent of leak.
 - B. This operation should be performed while water is being applied to leak area.
 - C. Mark extent of leak area.

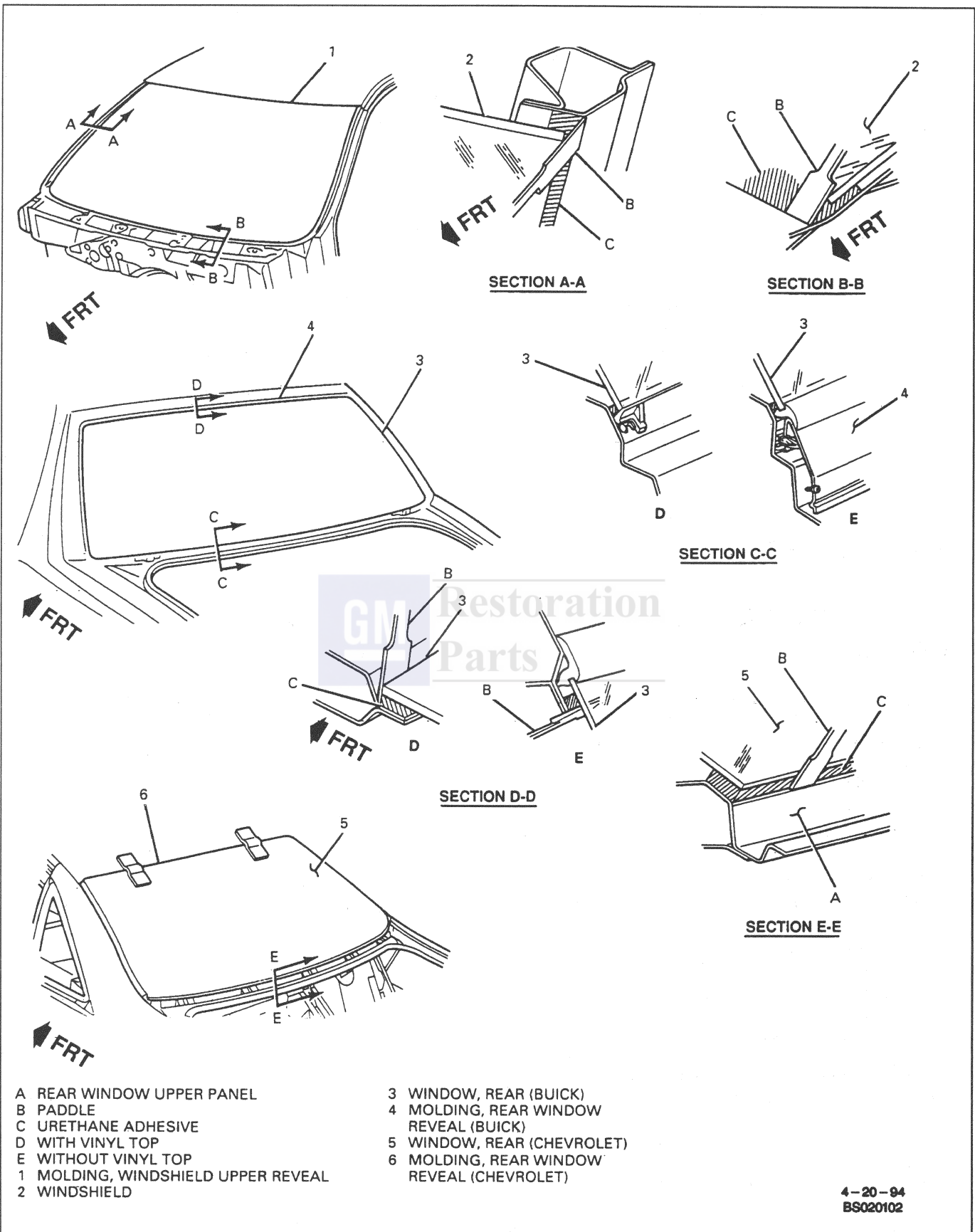


Figure 20 - Window Adhesive Waterleak Correction - (Typical)

3. Using sharp knife, trim off uneven edge of adhesive at leak point and 76 mm to 102 mm (3 inches to 4 inches) on both sides of leak point or beyond limits of leak area.
4. Clean dirt or foreign material from leak area with water (outside body). Dry area with air hose.
5. Apply urethane adhesive from kit at leak point and 76 mm to 102 mm (3 inches to 4 inches) on both sides of leak point or beyond limits of leak area.
6. Right after performing previous step, use a flat stick or other suitable flat, soft fiberglass tool to work adhesive material well into leak point and into joint of original material and body. This will ensure a watertight seal along entire length of material application.
7. Using cold water, spray test to assure that leak has been corrected.
 - Do not run heavy stream of water directly on freshly applied urethane adhesive.
8. If leak still exists, use a flat, soft fiberglass tool and paddle additional adhesive material into leak point.
9. Replace all previously removed parts.

INSIDE REARVIEW MIRROR

Figures 21 and 22

The inside rearview mirror is fastened to an inside rearview mirror support that is secured to the windshield.

Both the conventional and electronic mirrors offered on this vehicle are "breakaway" type. Breakaway rearview mirrors are designed to detach from the windshield in the event of an inflatable restraint deployment. Both styles of mirror attach to the support on the windshield, but break away in different manners. The electrochromic mirror separates at the mirror support, while the conventional mirror arm separates from the base. Be sure to follow the appropriate procedure when servicing the rearview mirror.

The electrochromic day/night mirror adjusts for glare by using a chemical sensitive to light. The mirror is designed to keep annoying glare from reflecting into the driver's eyes when a vehicle with bright lights is in the rear. Once in the "auto" position, it never has to be turned off.

For further information on the electrochromic day/night mirror, refer to SECTION 8A.

Electrochromic Day/Night Rearview Mirror

Figures 21 and 22

CAUTION: Electrochromic material may irritate eyes and skin. In case of contact, take the following actions: Eye contact -rinse thoroughly with water. Skin contact - wash with soap and water. If ingested - consult a physician immediately.

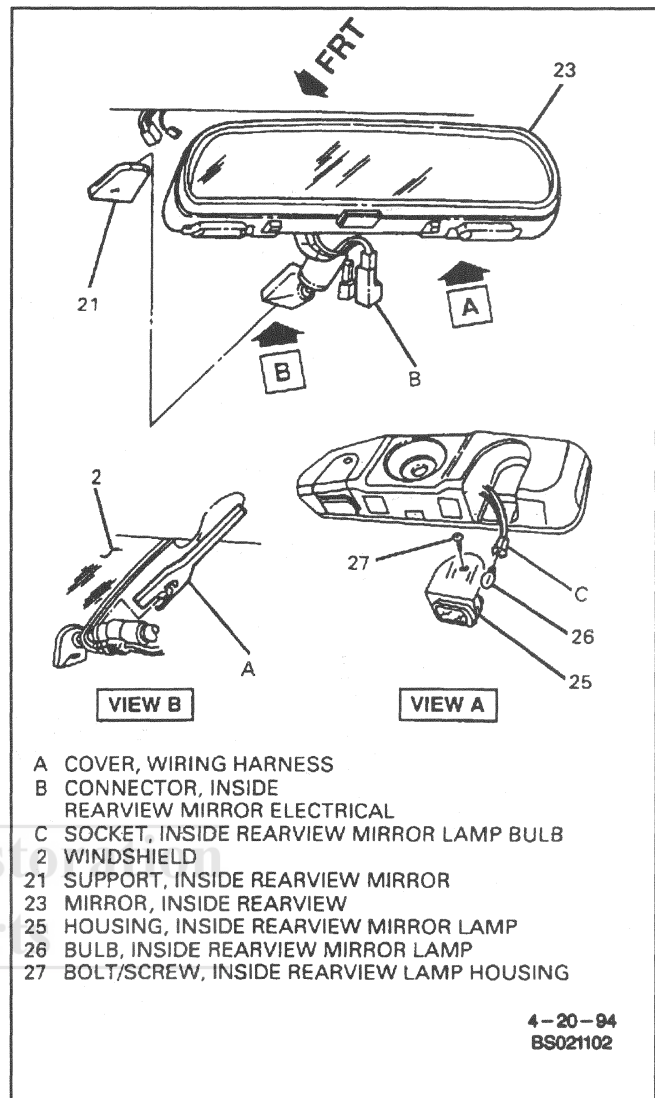


Figure 21 - Electrochromic Rearview Mirror

NOTICE: Do not use ammonia-based cleansers on the electrochromic inside rearview mirror.



Remove or Disconnect

1. Wiring harness cover.
 - A. Near top, slide from under headlining trim finish panel by pivoting 90 degrees.
 - B. Wires from channel and pull wiring harness cover away from ball joint.
2. Electrical connector.

NOTICE: Do not use tools or other objects to pry mirror support or inside rearview mirror away from windshield. Use of tools or other objects may damage mirror support.

3. Inside rearview mirror (23) from mirror support (21).
 - A. Use one hand to support one end of inside rearview mirror (23) against windshield (2).

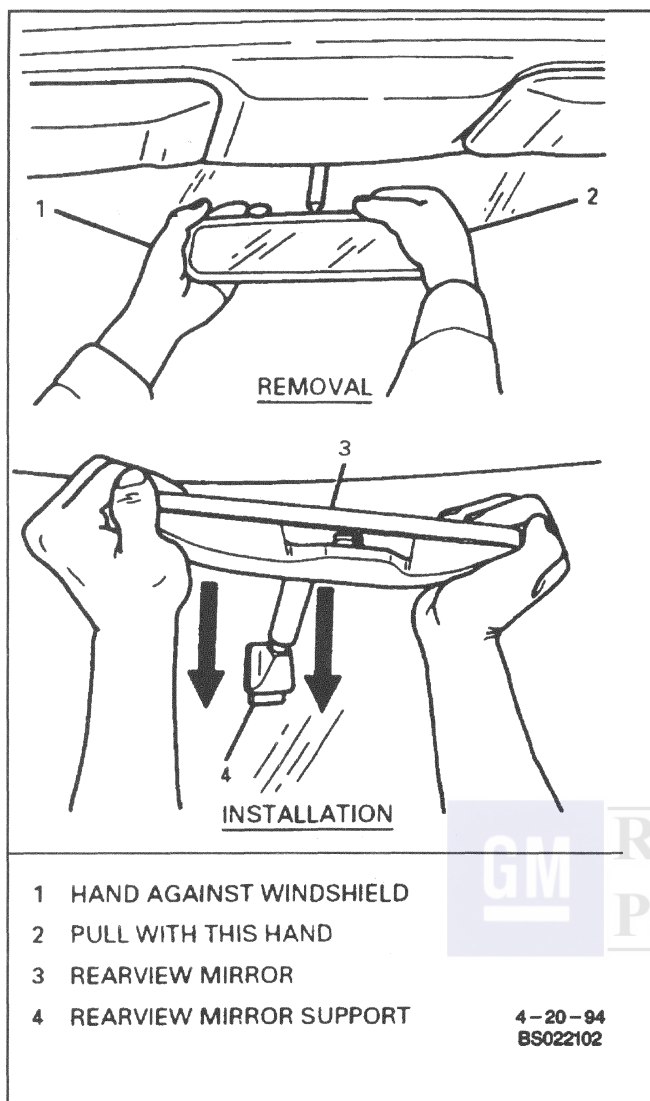


Figure 22 - Removing Electrochromic Inside Rearview Mirror

B. Use other hand to pull inside rearview mirror (23) away from mirror support (21).

Install or Connect

NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Inside rearview mirror (23) to mirror support (21).
 - A. Center bottom of inside rearview mirror (23) to top of mirror support (21).
 - B. Slide inside rearview mirror (23) onto mirror support (21), keeping inside rearview mirror (23) parallel to windshield (2).
 - C. Apply at least 90 N (20 pounds) of force to fully seat inside rearview mirror (23) onto mirror support (21). Audible click will be heard when inside rearview mirror (23) is fully seated.
2. Electrical connectors.
3. Wiring harness cover.

- A. Position cover to inside rearview mirror (23) at a 90-degree angle from vertical position.
- B. Push cover onto ball joint.
- C. Position wiring in channel. Pivot 90 degrees to vertical position to fit under headlining trim finish panel.

Inside Rearview Mirror Lamp Bulb Replacement

Figure 21

There are two inside rearview mirror lamps (left and right) on the inside rearview mirror. These lamps have replaceable bulbs.

CAUTION: Electrochromic material may irritate eyes and skin. In case of contact, take the following actions: Eye contact - rinse thoroughly with water. Skin contact - wash with soap and water. If ingested - consult a physician immediately.

Remove or Disconnect

1. Inside rearview mirror lamp housing bolt/screw (27).
2. Inside rearview mirror lamp housing (25).
3. Inside rearview mirror lamp bulb (26).

Install or Connect

1. New inside rearview mirror lamp bulb (26).
2. Inside rearview mirror lamp housing (25).
3. Inside rearview mirror lamp housing bolt/screw (27). Snug, (do not strip).

Conventional Rearview Mirror

Figure 23

Remove or Disconnect

1. Set screw (8) at base of mirror (10).
2. Mirror (10) from support (21).
3. Bolt/screw (11) and retainer (12) if mirror was detached at base.

Install or Connect

NOTICE: Refer to "Notice" on page 10-2-1 of this section.

1. Bolt/screw (11) and retainer (12).
 - Tighten until snug.
2. Mirror (10) to support (21).
3. Set screw (8) at base of mirror (10).
 - Tighten until snug.

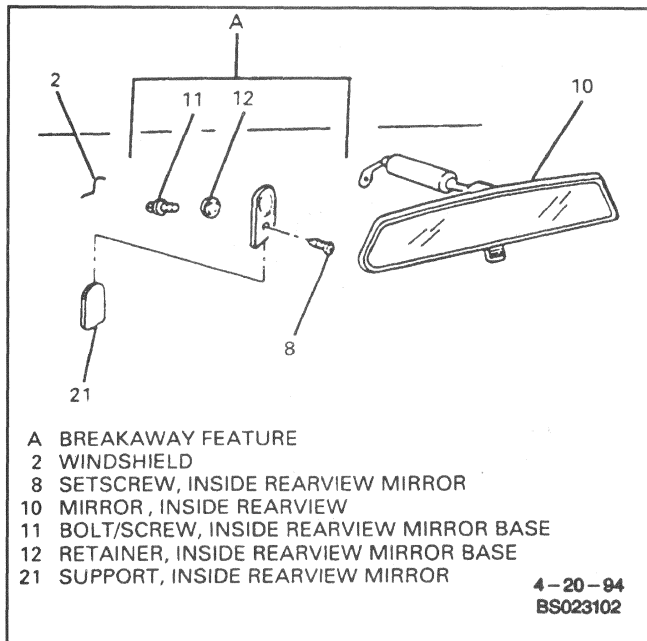


Figure 23 - Conventional Inside Rearview Mirror

Inside Rearview Mirror Support

Figures 21 through 24

CAUTION: Electrochromic material may irritate eyes and skin. In case of contact, take the following actions: Eye contact - rinse thoroughly with water. Skin contact - wash with soap and water. If ingested - consult a physician immediately.

The inside rearview mirror support is secured to the windshield glass. This support is installed by the window supplier, using a plastic polyvinyl butyl adhesive.

Service replacement windshield glass has the inside rearview mirror support bonded to the windshield. To install a detached support or install a new part, the following items are needed.

- GM P/N 1052369, Loctite® 312 Adhesive kit, two-component pack or equivalent.
- Inside rearview mirror support.
- Wax marking pencil or crayon.
- Window cleaning solution or window polishing compound.
- Rubbing alcohol.
- Clean paper towels.
- Fine grit emery cloth or sandpaper, number 320 or number 360.
- Clean toothpick.



Measure

- Distance from bottom of windshield (2) to bottom of support (21) to determine location of support (21).
- A. Mark location on outside of windshield (2) with wax pencil or crayon.

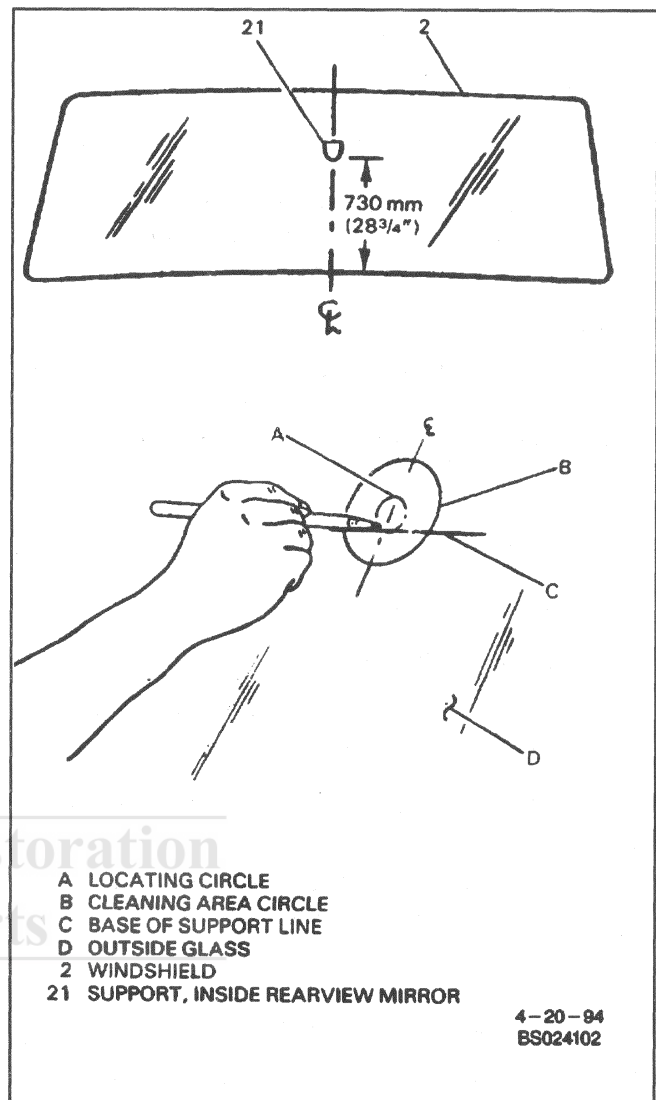


Figure 24 - Inside Rearview Mirror Support Placement

- B. Make a larger diameter circle around support circle on outside windshield surface (Figure 23).



Clean

- Large circle on inside windshield surface with paper towel and window cleaning solution or window polishing compound.
 - A. Rub until area is completely clean and dry.
 - B. When dry, clean area with an alcohol-saturated paper towel to remove any traces of cleaning solution or polishing compound.
 1. Sand bonding surface of new support (21) or factory installed support with a piece of fine grit emery cloth or sandpaper, number 320 or number 360.
- If original support (21) is to be reused, all traces of factory installed adhesive must be removed prior to installation.
 2. Wipe sanded support (21) with clean paper towel saturated with alcohol and allow to dry.

10-2-26 STATIONARY WINDOWS

Install or Connect

- Support (21) to windshield (2).
 - A. Follow directions on adhesive kit to prepare mirror support (21) prior to installation on windshield (2).
 - B. Lightly apply adhesive accelerator to bonding surfaces of support (21) and windshield (2) and allow to dry completely.

Important

- Due to rapid bonding of adhesive, the following steps must be performed without hesitation.
 - A. Apply two drops of adhesive to support (21).
 - B. Use toothpick to evenly distribute adhesive over entire bonding surface of support (21).
 - C. Properly position support (21) to its pre-marked location, with rounded end pointed upward.
 - D. Press mirror support (21) against window for 30 to 60 seconds, exerting steady pressure against windshield (2).
 - E. After five minutes, remove excess adhesive with an alcohol-moistened paper towel or window cleaning solution.

REAR WINDOW AND END GATE WINDOW DEFOGGER

The rear window defogger system on the sedan and the end gate window defogger system on the wagon consist of tinted windows that have a number of horizontal ceramic silver compound element lines, and two vertical bus bars baked into the inside surface during the window forming operation. The feed wire or terminal is soldered to the feed bus bar on the left side. The ground wire or terminal is soldered to the ground bus bar on the right side.

Both systems operate on 12 volts. Under some conditions, heat from the window may not be detected by finger touch. The length of time required to remove interior fog from the back window will vary with such conditions as vehicle speed, outside window temperature, atmospheric pressure and number of passengers.

Both systems use a heater and air conditioning control mounted switch with an integral indicator lamp and will operate for five to ten minutes, automatically turning off through the use of a timer. Both systems can be turned off during this operation period by pressing the defogger switch or turning ignition switch to "OFF."

Testing Grid Lines

Figures 25 and 26

To locate inoperative grid lines, start the engine and turn on the rear window or end gate window defogger system. Ground one test lamp lead and lightly touch other probe to each grid line. Figure 24 illustrates pattern of test lamp brilliance to be expected with a properly functioning grid.

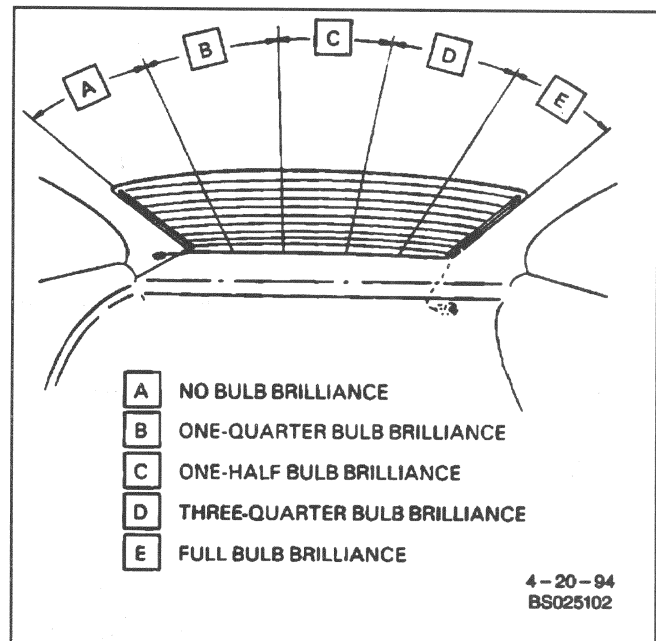


Figure 25 - Normal Test Lamp Bulb Brilliance Zones

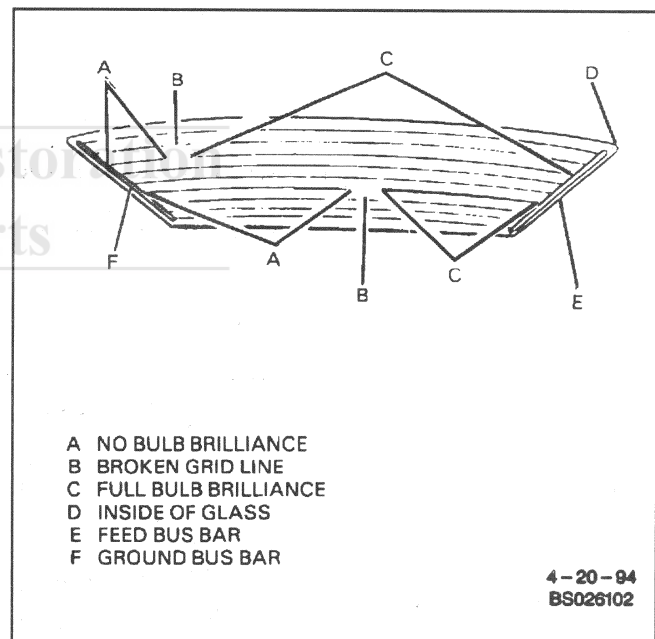


Figure 26 - Test Lamp Bulb Brilliance with Broken Grid Lines

If test lamp bulb shows full brilliance at both ends of grid lines, check for loose ground wire contact to body metal.

The range of zones of bulb brilliance may vary slightly from one window to another. Bulb brilliance will decrease proportionately to increased resistance in grid line as probe is moved from feed bus bar to the ground bus bar.

All grid lines must be tested in at least two places to eliminate the possibility of bridging a break. For best results, contact each grid line a few centimeters (inches) either side of window centerline. If an abnormal lamp reading is apparent on a specific grid line, place test lamp probe on that grid at the feed

bus bar and move probe toward the ground bus bar until the lamp goes out. This will indicate a break in the continuity of the grid line (Figure 25).

If no break in continuity is found and braided lead wire repairs are not needed but system is still inoperative, refer to SECTION 8A for electrical diagnosis.

CAUTION: To avoid personal injury

- Do not allow the repair material to come in contact with skin or eyes and avoid breathing vapor.
- Do not use near heat, sparks or open flame.

Grid Line Repair

Figures 27 and 28

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

- Battery negative cable.

Inspect

1. Rear window or end gate window defogger grid lines.
2. Mark grid line breaks on outside of window with grease pencil.

Clean

1. Grid line area to be repaired.
2. Buff with fine steel wool and wipe clean, using cloth dampened with alcohol.

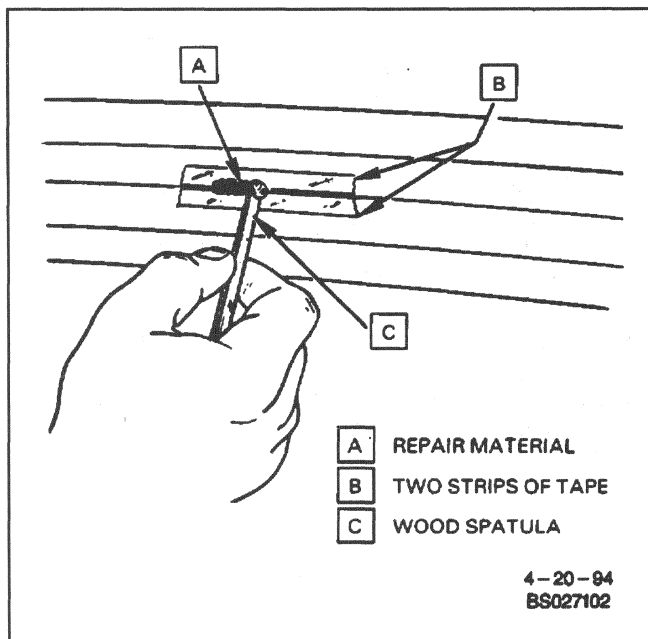


Figure 27 - Applying Repair Material to Broken Grid Line

- Buff and clean about 6 mm (1/4 inch) beyond each side of break in grid line.

Install or Connect

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

1. Grid line repair decal or two strips of tape positioned above and below repair area.
 - Repair decal or tape must be used to control width of repair area.
 - If decal is used, be sure die-cut metering slot is same width as grid line.
2. Mix grid repair material according to manufacturer instructions.
3. Grid repair material, at room temperature, to repair area, using small wood stick or spatula.
4. Carefully remove decal or tape.

NOTICE: Grid line repair material must be cured with heat. To avoid heat damage to interior trim, protect trim near repair area where heat is to be applied.

5. Apply heat to repair area for one or two minutes with heat gun capable of reaching 260° C (500° F).
 - Hold heat gun nozzle 25 mm (1 inch) from surface.
 - A minimum temperature of 149° C (300° F) is required.
6. Battery negative cable.

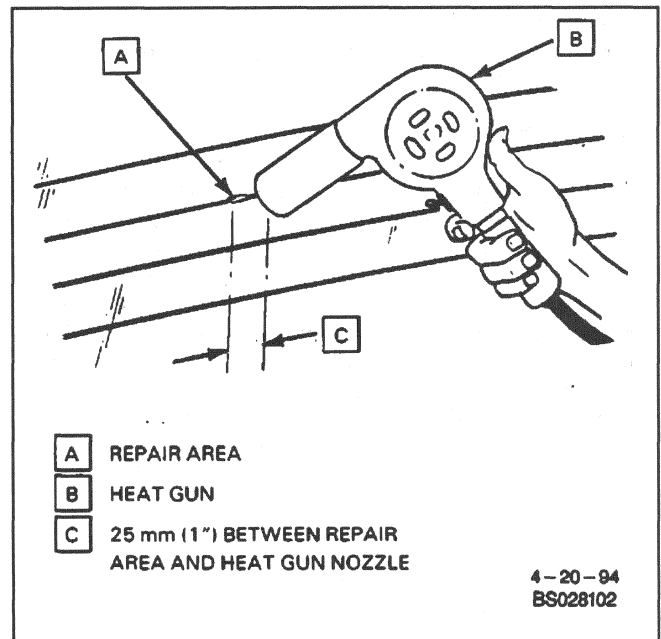


Figure 28 - Applying Heat to Grid Line Repair

**Inspect**

1. Grid line repair area.
 - A. If repair appears discolored, apply coating of tincture of iodine to repair area, using a pipe cleaner or fine brush.
 - B. Allow iodine to dry for about 30 seconds and carefully wipe off excess with lint-free cloth.
2. Test rear window or end gate window defogger operation to verify grid line repair. Refer to "Testing Grid Lines" in this section.

NOTICE: At least 24 hours are required for complete curing of repair materials. Unit should not be physically disturbed until after that time, or repair may not hold.

Braided Lead Wire Repair**Figure 29**

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

The rear defogger bus bar lead wire or terminal can be reattached by re-soldering, using a solder containing 3 percent silver and a rosin flux paste.

**Remove or Disconnect**

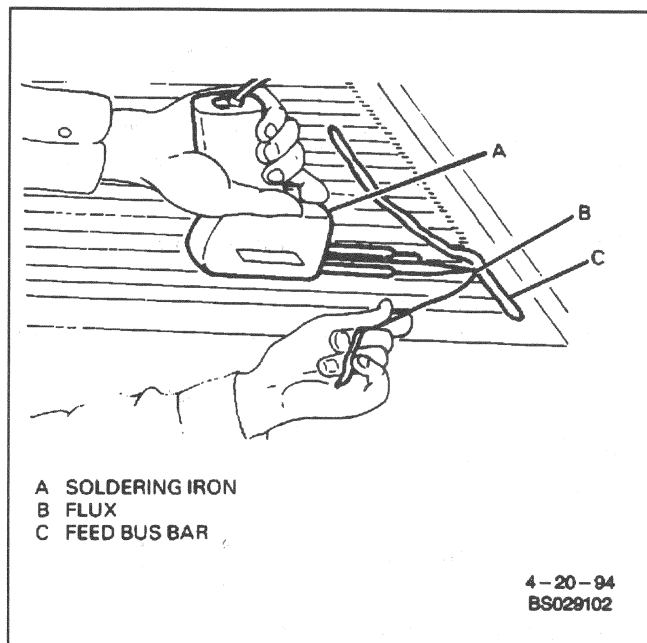
CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Quarter upper trim or quarter window garnish molding from affected side, if sedan. Refer to SECTION 10-7.
3. End gate window strut on repair side, if necessary, on wagon.

**Clean**

- Buff repair area with fine steel wool to remove the oxide coating formed during window manufacture.

NOTICE: To prevent burning bus bar, soldering iron tip temperature should be just enough to melt solder and allow it to run freely. Iron should be in contact with bus bar as short a time as possible.

**Figure 29 - Bus Bar Repair****Install or Connect**

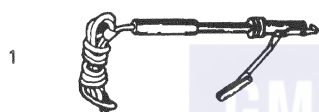
1. Paste-type rosin flux in small quantities to wire lead and bus bar repair, using a brush.
 - Soldering iron tip should be coated with solder beforehand.
2. Solder to feed bus bar or ground bus bar.
 - A. Protect surrounding interior trim from possible damage from hot solder.
 - B. Draw soldering iron tip across fluxed area, thinly coating bus bar with solder.
3. Small amount of flux to underside of lead wire braid.
 - Align spots with fluxed and tinned spots on feed bus bar or ground bus bar.
4. Coat tip of soldering iron with solder.
5. Solder to underside of lead wire braid.
 - Draw iron across fluxed spot, thinly coating spot with solder.
6. Solder spot on braid against spot on feed bus bar or ground bus bar.
 - A. Apply heat to top of lead wire braid, causing solder spots to melt and fuse together.
 - B. Holding force should not be removed until solder has solidified.
7. Wipe off excess flux with solvent.
8. Quarter upper trim or quarter window garnish molding, if removed. Refer to SECTION 10-7.
9. End gate window strut on repair side, if disconnected, on wagon.
10. Battery negative cable.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Body Lock Pillar Applique Bolt/Screw	1.3 N.m (12 lb. in.)
Quarter Window Self-Tapping Screw	2 N.m (18 lb. in.)
Quarter Window Bolt/Screw	1.5 N.m (13 lb. in.)
Quarter Window Nut (Chevrolet Sedan)	1.9 N.m (17 lb. in.)
Quarter Window Nut (Wagon)	2.4 N.m (21 lb. in.)
Rear Side Door Vent Window Division Channel	
Belt Support Bolt/Screw	10 N.m (89 lb. in.)
Lower Support Bolt/Screw	10 N.m (89 lb. in.)
Upper Support Bolt/Screw	1.9 N.m (17 lb. in.)
Rear Window Defogger Ground Bolt/Screw	6 N.m (53 lb. in.)
Roof Stationary Window Nut	2.4 N.m (21 lb. in.)
Windshield Side Reveal Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Windshield Support Bolt/Screw	1.5 N.m (13 lb. in.)

SPECIAL TOOLS



1

J 24709-01

OR

J 24899-01



2

J 24402-A

- 1 URETHANE GLASS SEALANT REMOVER (HOT KNIFE)
2 GLASS SEALANT REMOVER (COLD KNIFE)

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BLANK



SECTION 10-3

BODY DIMENSIONS, FRAME AND UNDERBODY

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This reduce the possibility of the vehicle falling off the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: The theft deterrent label found on some major sheet metal must be masked prior to painting, rustproofing, undercoating, etc. The mask must be moved following the above operations. Failure to keep the label clean and readable may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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GENERAL DESCRIPTION

GENERAL FRAME CONSTRUCTION

Figure 1

Frames consist of full-length right and left side members joined laterally by front and rear suspension crossmembers. Several different frames are used to meet various vehicle size and function requirements, but the basic shape for each line is the same. Differences between frames in a given line exist only in metal gage, part size and numbers of parts necessary to meet the particular structural requirements

of the models involved. There is a wax base coating on the frame for corrosion protection.

The body of the vehicle is mounted to the chassis with body mounts. Thick rubber insulators, or cushions, are between each mount and the chassis to absorb road noise and suspension vibration.

DIAGNOSIS

To determine the extent of frame damage from a collision, use the dimension illustration chart (Figures 2 and 3). Any good frame measuring equipment may be used to measure the frame. Any reputable frame straightening equipment may be used to bring a frame

10-3-2 BODY DIMENSIONS, FRAME AND UNDERBODY

back to its original specifications. Use the procedures with the equipment to prevent damage to the body and frame attachments.

Improperly installed insulators (using the wrong part or the wrong torque on the body mount) may cause structural shake, road noise or squeaks.

Body mounts with locator tabs must be positioned so the tab rests in the frame notch. Improperly located insulators may cause squeaks by rubbing on the frame rail.

ON-VEHICLE SERVICE

FRAME INSPECTION

Inspect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Inside, top, and ends of frame rails for loose dirt, rust, and corrosion.
3. Frame box sections for accumulation of debris. Remove if present.
4. Lower vehicle.

UNDERBODY INSPECTION

Inspect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Floor panel for damage.

3. Inside of floor panel and frame rail access holes for loose dirt and rust.

- This is first indication of corrosion in hidden areas. Repairs may be necessary before final cleaning and protective treatment.

4. Drain holes in floor panel with chisel to make sure they are open.

5. Drain holes in body side panels to make sure they are open.

- Body side panel drain holes are in rear section of rocker inner panels and in lower rear quarter panels. If blocked, open with punch or drift.

6. Lower vehicle.

UNDERBODY FLUSH

Due to buildup of road salts and corrosives on the vehicle's underbody, the underbody (including suspension, exhaust and fuel line areas) should be flushed with clean water annually, preferably each spring. This will increase the life and strength of the underbody components.

ALIGNMENT CHECKING

Frame Repair

Figures 2 and 3

Vehicles involved in an accident of any nature which might result in a "bent" or "sprung" frame should always be checked for proper frame alignment, in addition to steering geometry and tire and wheel alignment.

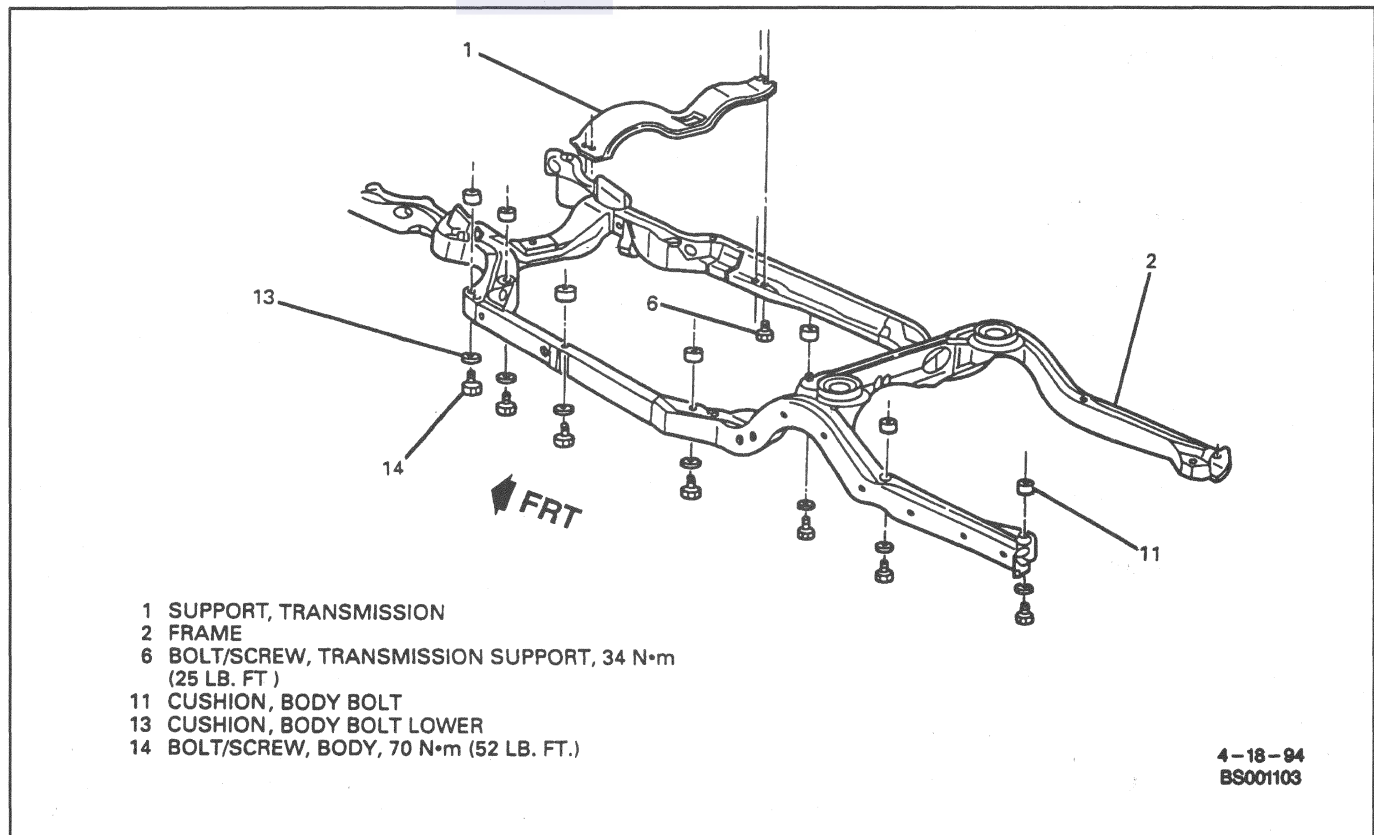
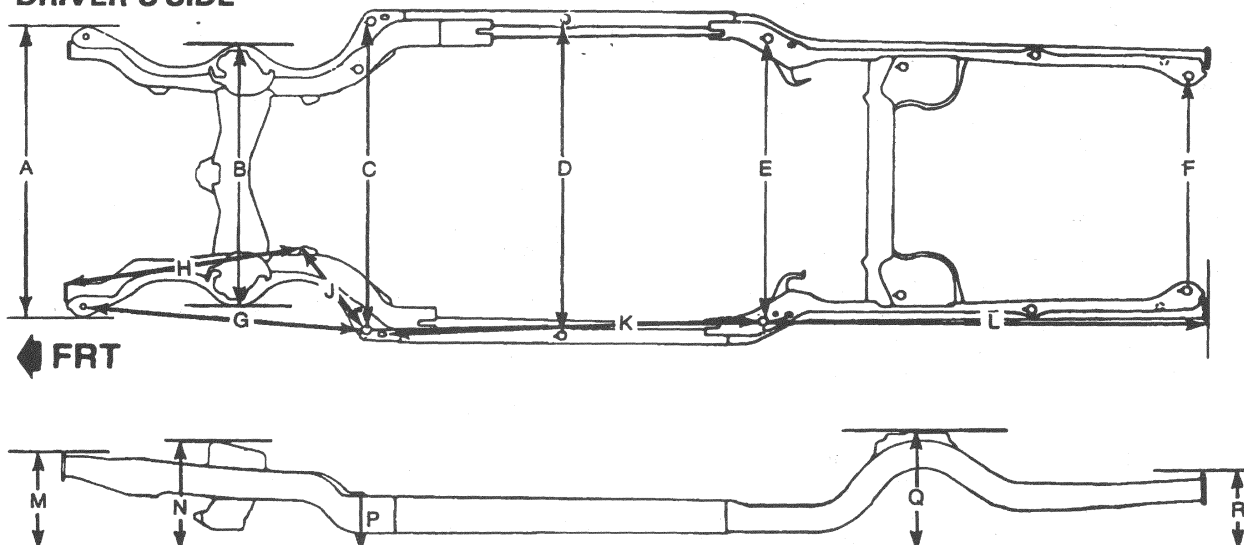


Figure 1-Frame Components

DRIVER'S SIDE



DATUM PLANE

REFERENCE POINT	LOCATION	SEDAN		WAGON	
		mm	INCHES	mm	INCHES
A	OUTERMOST EDGES FRAME HORNS	1276 0	50.24	1276 0	50.24
B	OUTERMOST EDGES FRONT CROSSMEMBER	1150 0	45.28	1150.0	45 28
C	INNER EDGES BODY MOUNT #2 ACCESS HOLES	1304 0	51.34	1304.0	51 34
D	INNER EDGES BODY MOUNT #3 ACCESS HOLES	1366.0	53.78	1366 0	53.78
E	INNER EDGES BODY MOUNT #4 ACCESS HOLES	1218.0	47.95	1218.0	47 95
F	INNER EDGES BODY MOUNT #7 ACCESS HOLES	1010.0	39.76	952.0	37 48
G	BACK EDGE RADIATOR SUPPORT MOUNT TO FRONT EDGE #2 BODY MOUNT ACCESS HOLE	2300 0	90.55	2300.0	90.55
H	OUTERMOST EDGE FRAME HORN TO FRONT EDGE LOWER CONTROL ARM BRACKET	959.0	37.76	959.0	37 76
J	FRONT EDGE LOWER CONTROL ARM BRACKET TO FRONT EDGE #2 BODY MOUNT ACCESS HOLE	377 0	14.84	37.70	14 84
K	BACK EDGE #2 BODY MOUNT ACCESS HOLE TO FRONT EDGE #4 BODY MOUNT ACCESS HOLE	1855.0	73.03	1855 0	73.03
L	BACK EDGE #4 BODY MOUNT ACCESS TO OUTERMOST EDGE FRAME RAIL	1814.0	71.42	1908.0	75.12
M	TOP EDGE FRAME HORN TO DATUM PLANE	409 0	1 61	409.0	1 61
N	TOP FRONT EDGE SPRING POCKET TO DATUM PLANE	454 0	17.87	454.0	17 87
P	TOP FRAME EDGE AT #2 BODY MOUNT TO DATUM PLANE	217.0	8 54	217 0	8 54
Q	TOP FRONT EDGE REAR SPRING POCKET TO DATUM PLANE	502.0	19 76	591.0	23 27
R	TOP EDGE FRAME RAIL END TO DATUM PLANE	291.0	11.46	427 0	16 81

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Figure 2-Frame Gaging Dimensions

10-3-4 BODY DIMENSIONS, FRAME AND UNDERBODY

Use the dimensions in Figure 3 to check the alignment of the frame. Use either the tram gage or plumb bob method to measure the frame. All measurements should be made with the vehicle on level ground. The dimensions between the reference points will show where straightening operations are necessary. Corresponding measurements must be equal within 6 mm (1/4 inch).

TRAM GAGE METHOD

Make crisscross measurements with the tram gage points set at the center of each locating point. To find the center of each point, tape two pieces of tape across the point so they intersect in the middle. With a pen, mark the center point and use it for consistent measurements. Keep the crossbar level to ensure accuracy.

Next, check the vertical dimensions from the datum plane (plane below and parallel to underbody) to the tramming points. The tram bar should be on a parallel plane to the frame. The exception is when one of the reference points used is in the misaligned area.

PLUMB BOB METHOD

If a tram gage is not available, use the plumb bob method for checking. Use a piece of cord attached to a surveyor's plumb bob to measure the distance between two points. Place the free end of the cord on the center of the reference point (as described above). Let the plumb bob hang to the floor. Make a mark on the floor just under the plumb bob. Repeat at all reference points. Measure marks on the floor with a tape measure.

The dimensions between the reference points will show where straightening operations are necessary. Corresponding measurements must be equal within 6 mm (1/4 inch).

- Measure X to check alignment of front portion of frame.
- Measure Y to check alignment of center portion of frame.
- Measure Z to check alignment of rear portion of frame.

TRANSMISSION SUPPORT REPLACEMENT

Figure 4

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Transmission mount nut and washer. Refer to SECTION 7A.
3. Loosen catalytic converter-to-intermediate pipe bolts/screws to allow for pivot.
4. Raise and suitably support automatic transmission.
5. Bolts/screws (6).
6. Transmission support (1).

Install or Connect

NOTICE: Refer to "Notice" on page 10-3-1 of this section.

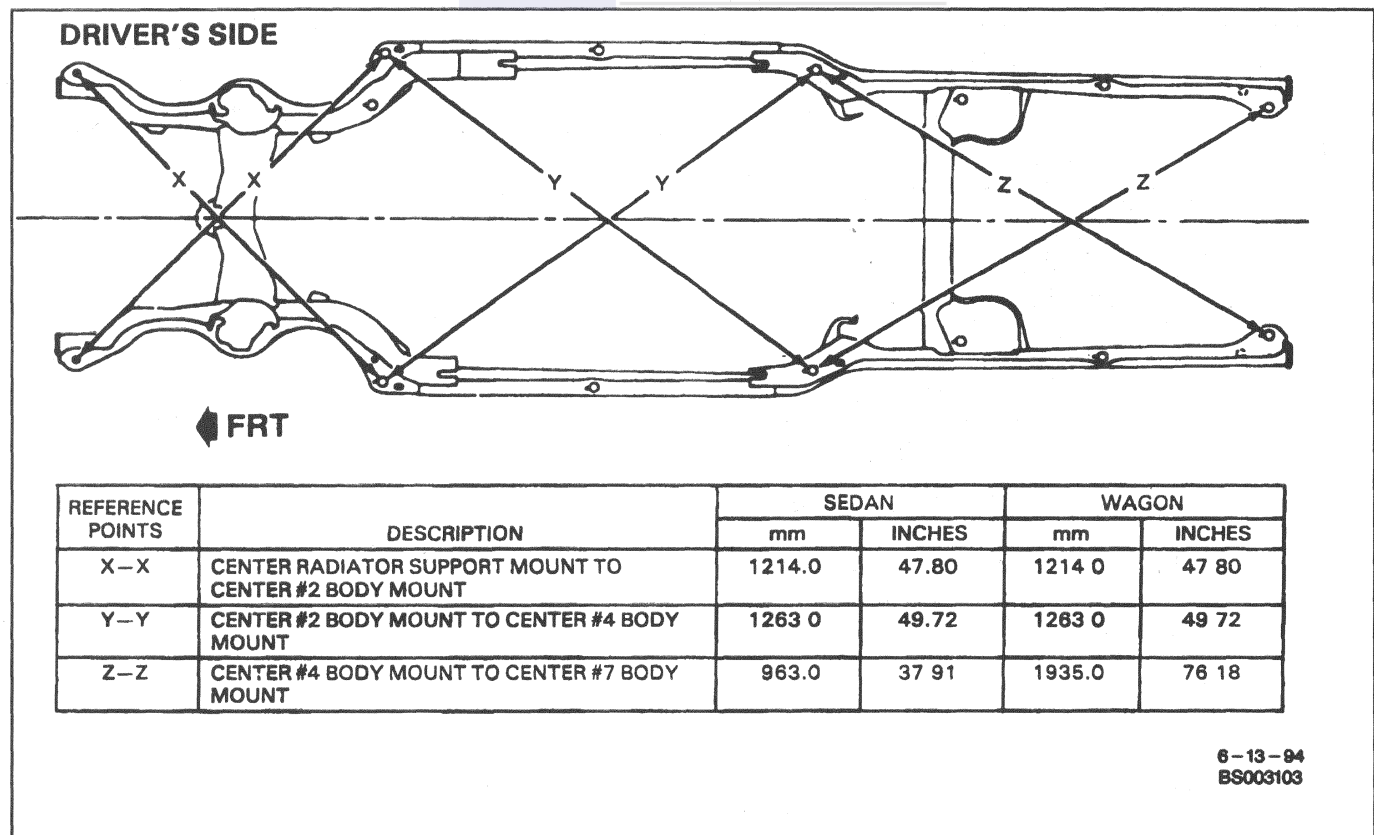


Figure 3-Frame Crosschecking Dimensions

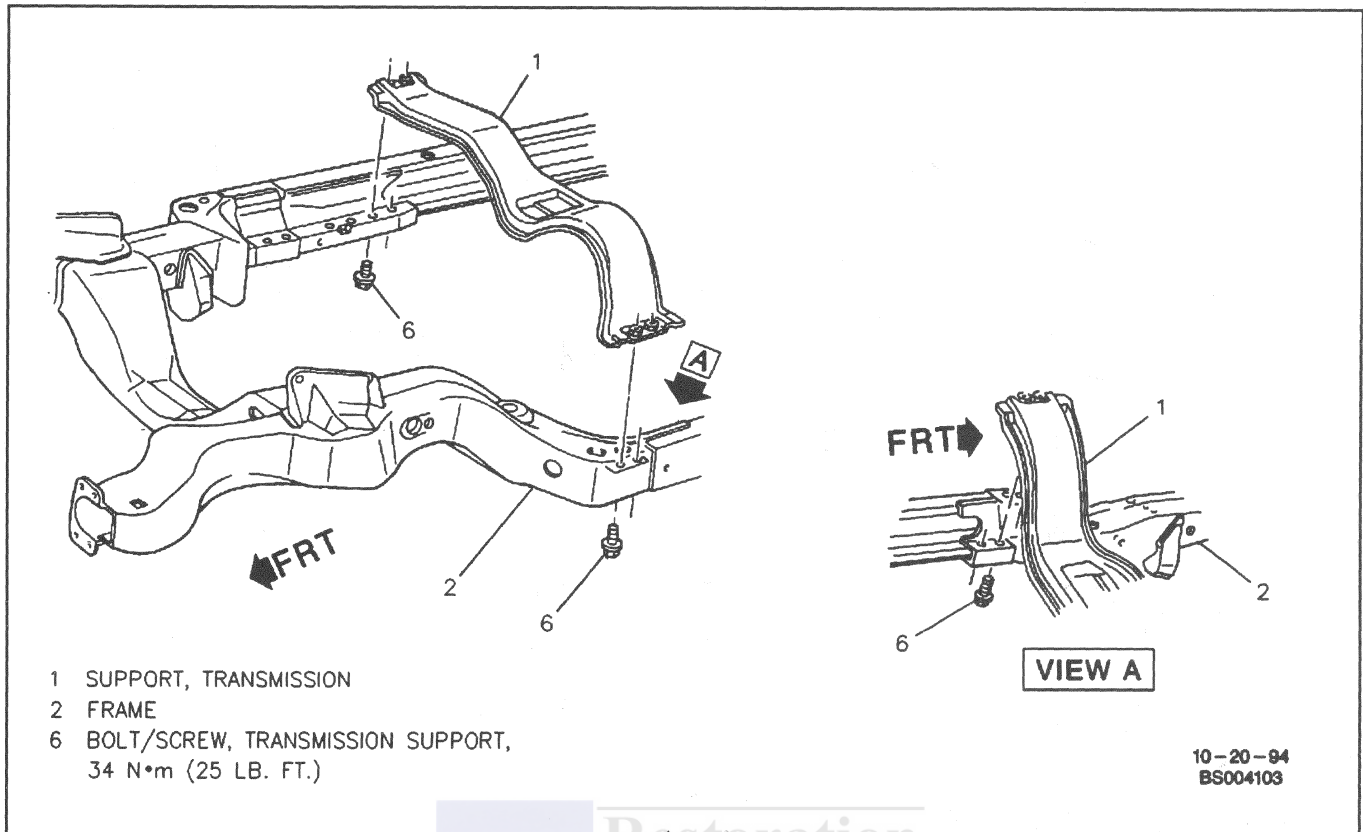


Figure 4-Transmission Support

1. Transmission support (1).
2. Bolts/screws (6).



Tighten

- Bolts/screws (6) to 34 N.m (25 lb. ft.).
3. Lower automatic transmission.



Tighten

- Catalytic converter-to-intermediate pipe bolts/screws to 20 N.m (15 lb. ft.).
4. Transmission mount nut and washer. Refer to SECTION 7A.
 5. Lower vehicle.

BODY MOUNT REPLACEMENT

Figure 5

NOTICE: Perform these procedures exactly as specified regardless of the number of body mounts to be replaced or damage to sheet metal or other components could result.

POSITION NUMBER 1 THROUGH POSITION NUMBER 3



Remove or Disconnect

1. Storage battery and battery tray. Refer to SECTION 6D1.
2. Radiator support nuts, lower washers and bolts/screws. Refer to SECTION 10-5.

3. Raise and suitably support vehicle. Refer to SECTION 0A.

4. Front wheelhouse panel front extension. Refer to SECTION 10-5.

5. Two steering gear bolts/screws securing steering gear to frame. Loosen third steering gear bolt/screw. Refer to SECTION 3B.

6. Loosen intermediate steering shaft bolt/screw. Refer to SECTION 3F.

7. Steering column shift control linkage from frame. Refer to SECTION 7A.

8. Catalytic converter heat shield. Refer to SECTION 6F.

9. Bolts/screws (14), washers (43) and lower cushions (13) at position numbers 1, 2, and 3.

- Store bolts/screws (14 and 15) and lower cushions (13) so they can be identified for reinstallation at same location.

10. Loosen remaining bolts/screws (14) at position numbers 4, 6 and 7.

11. Place jackstands under body side rails near position number 4 and at floor panel reinforcement plates near position number 2.

NOTICE: Do not separate body and frame more than necessary. Damage to sheet metal and other components could result.

12. Lower chassis until separation between body and frame is just enough to slip out upper cushions (11 and 12) at position numbers 1, 2 and 3.

10-3-6 BODY DIMENSIONS, FRAME AND UNDERBODY

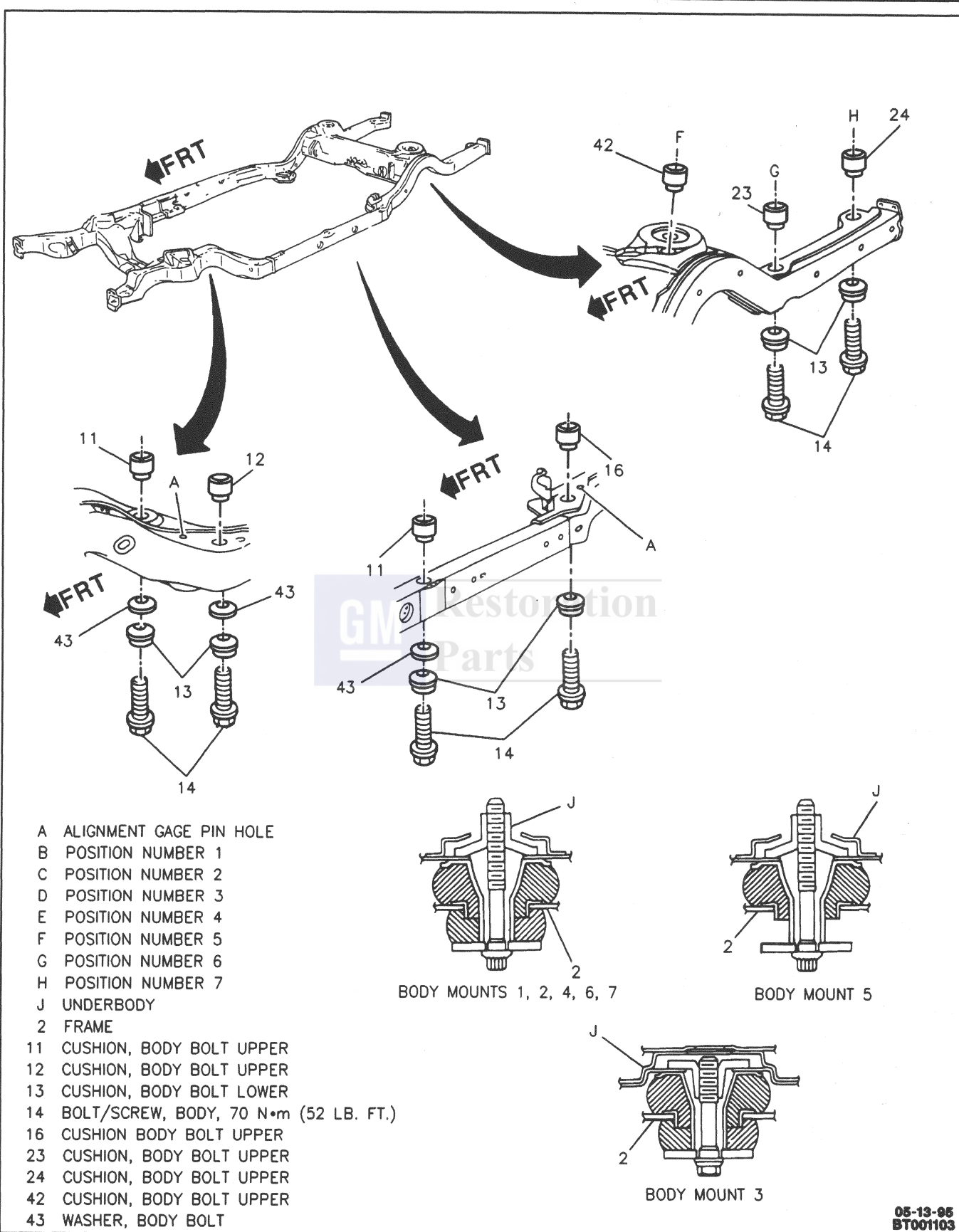


Figure 5-Body Mounts

13. Upper cushions (11 and 12) and shims, if present, at position numbers 1, 2 and 3, as needed.

 Install or Connect

NOTICE: Refer to “Notice” on page 10-3-1 of this section.

1. Upper cushions (11 and 12) as needed.
 - Install shims, if any were found during disassembly, between upper cushions (11 and 12) and frame.
2. Alignment gage pins, 305 mm (12 inches) long and 15.9 mm (5/8 inch) in diameter, through frame and into body at gage pin hole locations near position numbers 1 and 4.
3. Raise chassis until body is supported by frame and lifted from jackstands.
 - Ensure body is aligned with gage pins.
4. Attempt to rotate upper cushions (11 and 12) at position numbers 1, 2 and 3 by hand. If they can be rotated, separate body and frame as before, and install shims as required.

 Tighten

- Bolts/screws (14) at position numbers 4, 6 and 7 to 70 N·m (52 lb. ft.).
5. Remove jackstands.
 6. Bolts/screws (14), washers (43) and lower cushions (13) to positions 1, 2 and 3.

 Tighten

- Bolts/screws (14) at position numbers 1, 2 and 3 to 70 N·m (52 lb. ft.).

 Important

- Ensure torque on all bolts/screws (14) is uniform, or vehicle ride could be affected.
7. Catalytic converter heat shield. Refer to SECTION 6F.
 8. Steering column shift control linkage to frame. Refer to SECTION 7A.
 9. Tighten intermediate steering shaft bolt/screw. Refer to SECTION 3F.
 10. Two steering gear bolts/screws attaching steering gear to frame. Tighten all three bolts/screws. Refer to SECTION 3B.
 11. Front wheelhouse panel front extension. Refer to SECTION 10-5.
 12. Lower vehicle.
 13. Radiator support nuts, lower washers and bolts/screws. Refer to SECTION 10-5.
 14. Storage battery and battery tray. Refer to SECTION 6D1.

POSITION NUMBER 4 THROUGH POSITION NUMBER 7. body

 Remove or Disconnect

1. Storage battery and battery tray. Refer to SECTION 6D1.
2. Radiator support nuts, lower washers and bolts/screws. Refer to SECTION 10-5.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Front wheelhouse panel front extension. Refer to SECTION 10-5.
5. Two steering gear bolts/screws securing steering gear to frame. Loosen third steering gear bolt/screw. Refer to SECTION 3B.
6. Loosen intermediate steering shaft bolt/screw. Refer to SECTION 3F.
7. Steering column shift control linkage from frame. Refer to SECTION 7A.
8. Catalytic converter heat shield. Refer to SECTION 6F.
9. Bolts/screws (14), washers (43) and lower cushions (13) at position numbers 3, 4, 6 and 7.
 - Store bolts/screws (14), washers (43) and lower cushions (13) so they can be identified for reinstallation in the same location.
10. Loosen, but do not remove, bolts/screws (14) at position numbers 1 and 2.
11. Place jackstands under reinforced portion of underbody near position number 4.

NOTICE: Do not separate body and frame more than necessary. Damage to sheet metal and other components could result.

12. Lower chassis until separation between body and frame is just enough to slip out upper cushions (16, 23, 24 and 42) at position numbers 4, 5, 6 and 7.
13. Upper cushions (16, 23, 24 and 42) and shims, if present, at position numbers 4, 5, 6 and 7, as needed.

 Install or Connect

NOTICE: Refer to “Notice” on page 10-3-1 of this section.

1. New upper cushions (16, 23, 24 and 42) to position numbers 4, 5, 6 and 7 as needed.
 - Install shims, if any were found during disassembly, between upper cushions (16) and frame.
2. Alignment gage pins, 305 mm (12 inches) long and 15.9 mm (5/8 inch) in diameter, through frame and into body at gage pin hole locations near position numbers 1 and 4.
3. Raise chassis until body is supported by frame and lifted from jackstands.
 - Ensure body is aligned with gage pins.

10-3-8 BODY DIMENSIONS, FRAME AND UNDERBODY

4. Attempt to rotate upper cushions (16) at position numbers 4, 5, 6 and 7 by hand. If any can be rotated, separate body and frame as before and install shims as required.
5. Remove jackstands.



Tighten

- Bolts/screws (14) at position numbers 1 and 2 to 70 N·m (52 lb. ft.).
6. Washer (43), lower cushions (13) and bolts/screws (14) to position numbers 3, 4, 6 and 7.



Tighten

- Bolts/screws (14) at position numbers 3, 4, 6 and 7 to 70 N·m (52 lb. ft.).



Important

- Ensure torque on all bolts/screws (14 and 15) is uniform or vehicle ride could be affected.
7. Catalytic converter heat shield. Refer to SECTION 6F.
 8. Steering column shift control linkage to frame. Refer to SECTION 7A.
 9. Tighten intermediate steering shaft bolt/screw. Refer to SECTION 3F.
 10. Two steering gear bolts/screws securing steering gear to frame. Tighten all three bolts/screws. Refer to SECTION 3B.
 11. Front wheelhouse panel front extension to frame. Refer to SECTION 10-5.
 12. Lower vehicle.
 13. Radiator support nuts, lower washers and bolts/screws. Refer to SECTION 10-5.
 14. Storage battery and battery tray. Refer to SECTION 6D1.

FRONT AND REAR SIDE DOOR CARPET RETAINER

Figure 6



Remove or Disconnect

1. Bolt/screw (18 or 40).
2. Retainer (20 or 41).
3. Trim plate (19 or 21).

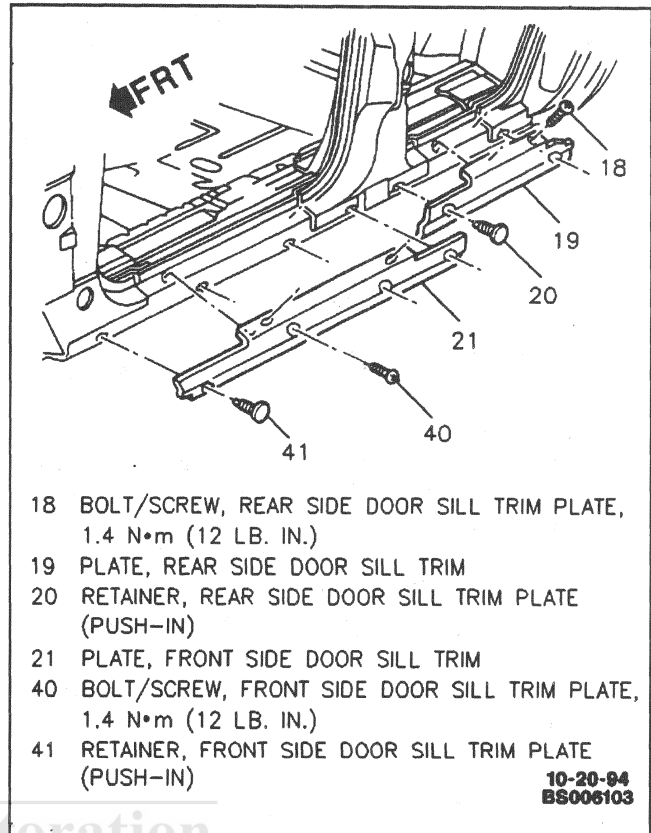


Figure 6-Front and Rear Side Door Sill Trim Plates



Install or Connect

NOTICE: Refer to "Notice" on page 10-3-1 of this section.

1. Trim plate (19 or 21).
2. Retainer (20 or 41).
3. Bolt/screw (18 or 40).



Tighten

- Bolt/screw (18 or 40) to 1.4 N·m (12 lb. in.).

FRAME DIMENSIONS

For frame dimensions, refer to Figures 2 and 3 in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Body Bolt/Screw.....	70 N·m (52 lb. ft.)
Front Crossmember Brace Bolt/Screw.....	100 N·m (74 lb. ft.)
Front Side Door Carpet Bolt/Screw.....	1.4 N·m (12 lb. in.)
Rear Side Door Carpet Retainer Bolt/Screw.....	1.4 N·m (12 lb. in.)
Transmission Support Bolt/Screw	34 N·m (25 lb. ft.)

SECTION 10-4

BUMPERS

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

BUMPERS

For repair of the urethane fascia, refer to SECTION 10-1.

ANTICORROSION PROTECTION

Anticorrosion materials have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels, areas on which this material has been disturbed should be properly recoated with service-type anticorrosion material.

ENERGY ABSORBING UNITS

The Chevrolet and Buick bumper systems are designed to take a collision into a fixed barrier at 8 km/h (5 mph) with limited damage. After absorbing the energy of a collision, these bumper systems restore themselves to their original position. Energy absorbers,

attached to the vehicle frame and to the mounting points at each end of the bumper, collapse on impact. Gases compressed during the impact expand, extending the energy absorbers back to their original length.

DIAGNOSIS

The right and left energy absorbers should be diagnosed separately. The following checks and separate judgments should be made on each energy absorber.

ENERGY ABSORBER LEAK DIAGNOSIS

Some oil wetting may be visible due to the grease packed in the crimp recess. Therefore, a stain or trace of oil on the piston tube near the crimp is normal. However, if oil drips continuously from the crimp or the stud end of the energy absorber, there is a leak and the energy absorber should be replaced.

10-4-2 BUMPERS

ENERGY ABSORBER DAMAGE DIAGNOSIS

CAUTION: Energy absorbers are under constant internal gas pressure. They can cause severe injury if not handled properly.

- To prevent injury to others, relieve gas pressure before throwing away any energy absorber.
- Do not try to repair a damaged energy absorber. Replace it with a new one.
- Do not apply heat to energy absorbers.
- Do not weld near energy absorbers.
- Gas pressure in a collapsed energy absorber can cause it to extend without warning. Keep clear of the line of travel.
- Hold a collapsed bumper in position with chains or cables, and relieve gas pressure before making bumper system repairs.

Look at the bumper bracket, piston tube, frame bracket and cylinder tube for signs of visible distortion. Scuffing of the piston tube will occur when it is stroked and should be considered normal.

If there is obvious damage to the energy absorber, it should be replaced. If a collision is so severe that the bumper does not return to its original position, the energy absorber(s) must be replaced.

TESTING ENERGY ABSORBER OPERATION

1. Remove energy absorber. Refer to "Bumper Energy Absorber Replacement" in this section.
2. Position energy absorber lengthwise in an arbor press.
3. Using suitable measuring device, note original length of energy absorber, then use the arbor press to compress it at least 10 mm (3/8 inch).
4. Release pressure on energy absorber and determine whether it has extended to the original length. If not, discard it. Refer to "Relieving Energy Absorber Gas Pressure" in this section.
5. Install either the original or a new energy absorber as needed. Refer to "Bumper Energy Absorber Replacement" in this section.

ON-VEHICLE SERVICE

BUMPER ENERGY ABSORBER REPLACEMENT

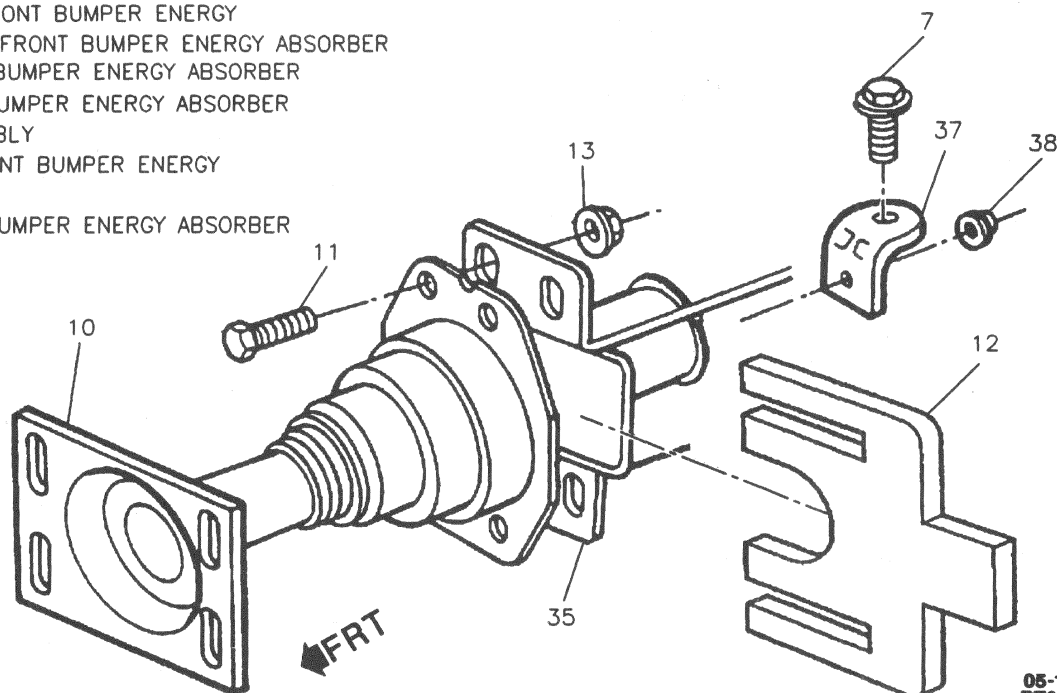
Figures 1 and 2

CAUTION: Refer to Energy Absorber "Caution" above.

 **Remove or Disconnect**

1. Front or rear bumper impact bar. Refer to "Front Bumper Impact Bar," "Rear Bumper Impact Bar (Sedan)" or "Rear Bumper Impact Bar (Wagon)" in this section.

- 7 BOLT/SCREW, FRONT BUMPER ENERGY ABSORBER BRACKET
- 10 ABSORBER, FRONT BUMPER ENERGY
- 11 BOLT/SCREW, FRONT BUMPER ENERGY ABSORBER
- 12 SHIM, FRONT BUMPER ENERGY ABSORBER
- 13 NUT, FRONT BUMPER ENERGY ABSORBER
- 35 FRAME ASSEMBLY
- 37 BRACKET, FRONT BUMPER ENERGY ABSORBER
- 38 NUT, FRONT BUMPER ENERGY ABSORBER BRACKET



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Figure 1 - Front Bumper Energy Absorber

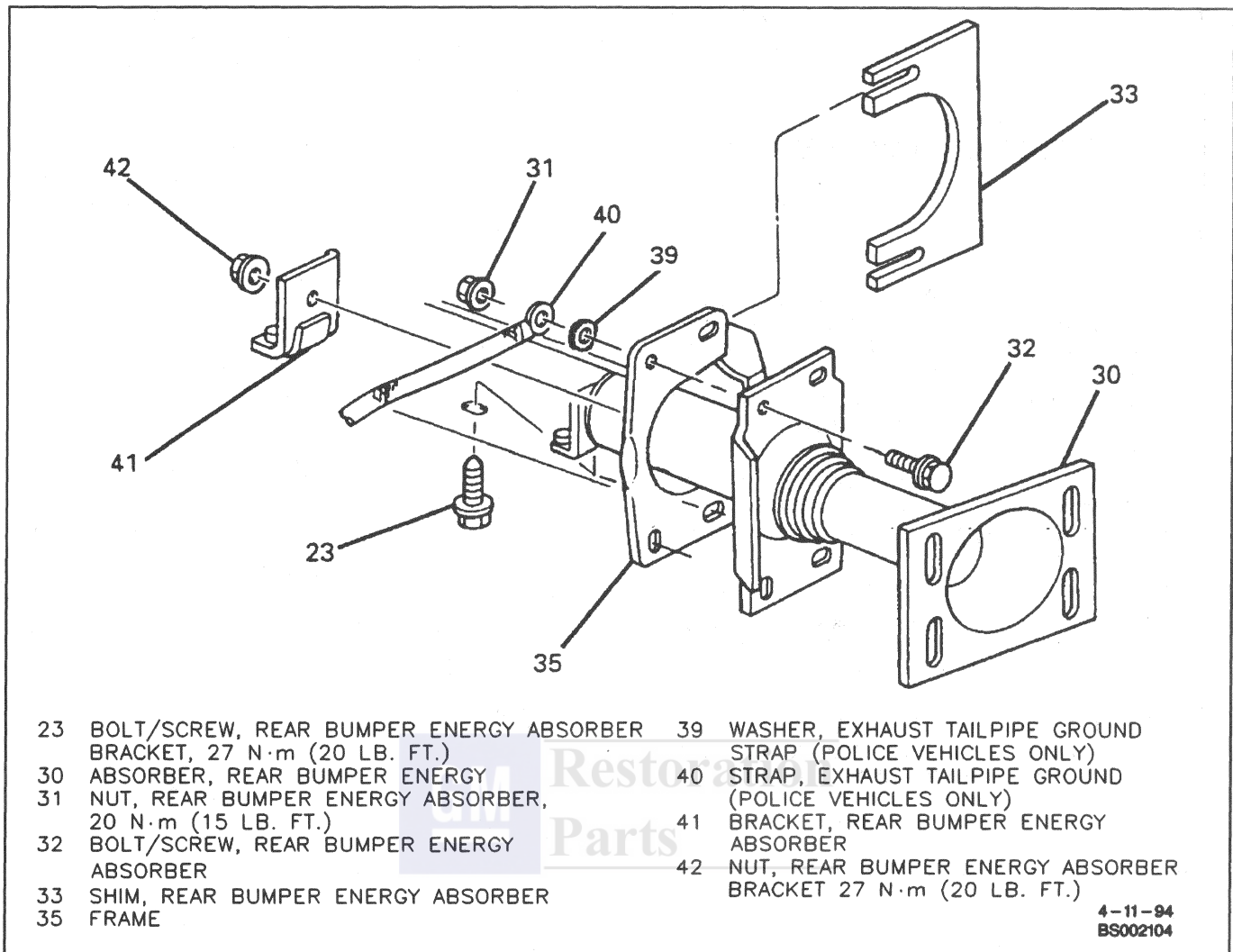


Figure 2 - Rear Bumper Energy Absorber

2. Nuts (13 or 31) and bolts/screws (11 or 32).
3. Washer (39) and ground strap (40) or frame brace (56), on rear bumper energy absorber, if equipped.
4. Shims (12 or 33), if equipped.
5. Note placement and number of shims (12 or 33) so they can be reinstalled in the same location from which they were removed.
6. Bolt/screw (7 or 23).
7. Absorber (10 or 30) with assembled bracket (37 or 41).
8. Nut (38 or 42), if required.
9. Bracket (37 or 41), if required.

Install or Connect

NOTICE: Refer to "Notice " on page 10-4-1 of this section.

1. Bracket (37 or 41) onto absorber (10 or 30), if removed.
 - Bracket (37 or 41) must be positioned so weld nut will line up with bolt/screw hole in frame (35) when absorber (10 or 30) is installed.
2. Nut (38 or 42), if removed.

Tighten

- Nut (38 or 42) to 27 N·m (20 lb. ft.).
3. Absorber (10 or 30) with assembled bracket (37 or 41).
 4. Bolt/screw (7 or 23).

Tighten

- Bolt/screw (7) on absorber (10) to 4.2 N·m (37 lb. ft.).
 - Bolt/screw (23) on absorber (30) to 27 N·m (20 lb. ft.).
5. Shims (12 or 33), if removed, in same location from which they were removed.
 6. Washer (39) and ground strap (40), if equipped.
 7. Bolts/screws (11 or 32) and nuts (13 or 31). May be installed in either direction.

Tighten

- Nuts (13 or 31) to 20 N·m (15 lb. ft.).

10-4-4 BUMPERS

8. Front or rear bumper. Refer to "Front Bumper Impact Bar," "Rear Bumper Impact Bar (Sedan)" or "Rear Bumper Impact Bar (Wagon)" in this section.

RELIEVING ENERGY ABSORBER GAS PRESSURE

Figure 3

CAUTION: Energy absorbers are under constant internal gas pressure. They can cause severe injury if not handled properly.

- To prevent injury to others, relieve gas pressure before throwing away any energy absorber.
- Do not try to repair damaged energy absorber. Replace with a new one.
- Do not apply heat to energy absorbers.
- Do not weld near energy absorbers.
- Gas pressure in a collapsed energy absorber can cause it to extend without warning. Keep clear of the line of travel.
- Hold a collapsed bumper in position with chains or cables, and relieve gas pressure before making bumper system repairs.

Collapsed Energy Absorbers

Figure 3

Collapsed energy absorbers should be relieved of their gas pressure before they are removed from the vehicle. This method must be used on partly or fully collapsed energy absorbers. It may also be used as an alternate method on fully extended energy absorbers.

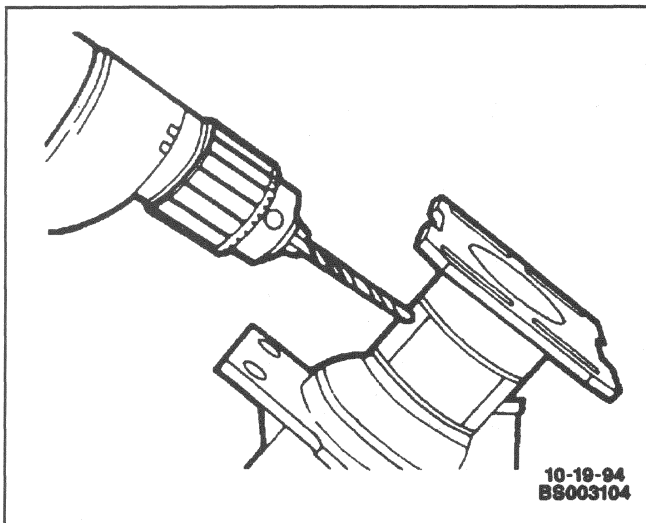


Figure 3 - Relieving Pressure

CAUTION: Energy absorbers are under constant internal gas pressure. They can cause severe injury if not handled properly.

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

1. Hold collapsed bumper in position with chains or cables.
2. Using center punch, make small dent in energy absorber piston tube near bumper bracket.
3. Using 1/8-inch drill bit, drill through piston tube wall to relieve gas pressure.

Fully Extended Energy Absorbers

Fully extended energy absorbers which have been removed from the vehicle may be relieved of their gas pressure before disposal using the following method. Do not try to use this method on partly or fully collapsed energy absorbers. The method shown in "Collapsed Energy Absorbers" in this section may be used as an alternate to this method.

CAUTION: Refer to Energy Absorber "Caution" above.

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

1. Place energy absorber in vise with bumper end up.
2. Using 5/32-inch drift pin punch, drive sealing ball inward to release gas.
 - Sealing ball is located in center of piston tube at bumper end of energy absorber.

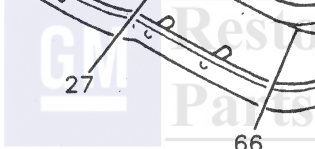
FRONT BUMPER

Front Bumper Fascia

Figures 4, 5 and 6

Remove or Disconnect

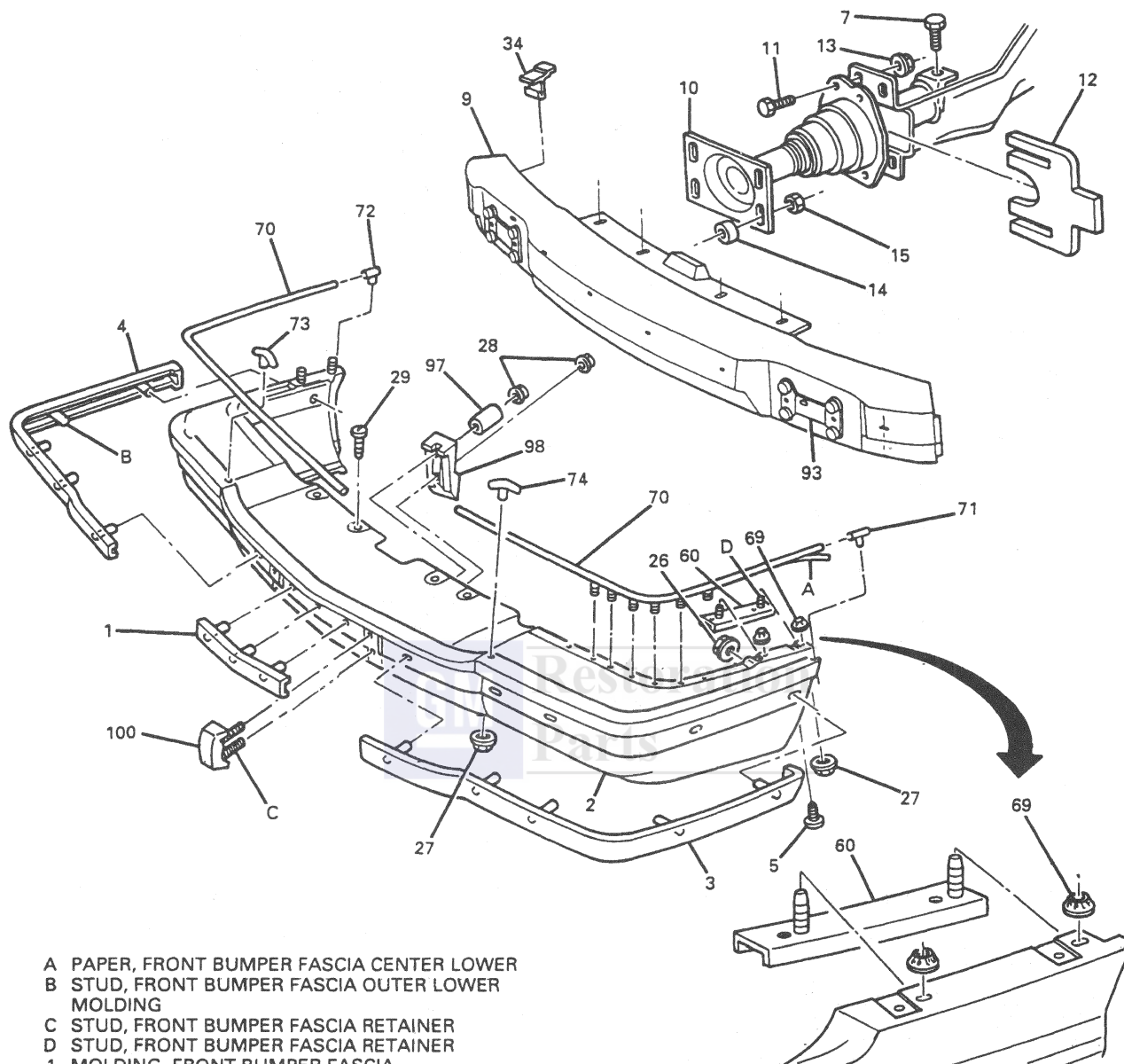
1. Front parking/sidemarkers lamps. Refer to SECTION 8B.
2. Six upper retainers (86) or four upper retainers (29).
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Front fender wheel opening moldings and front wheelhouse panel extension with radiator air side deflectors attached. Refer to SECTION 10-5.
5. Four lower retainers (86 or 29).
6. Four bolts/screws (5).
7. Fascia (66, 2 or 99).



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Figure 4 - Front Bumper - (Buick Sedan)

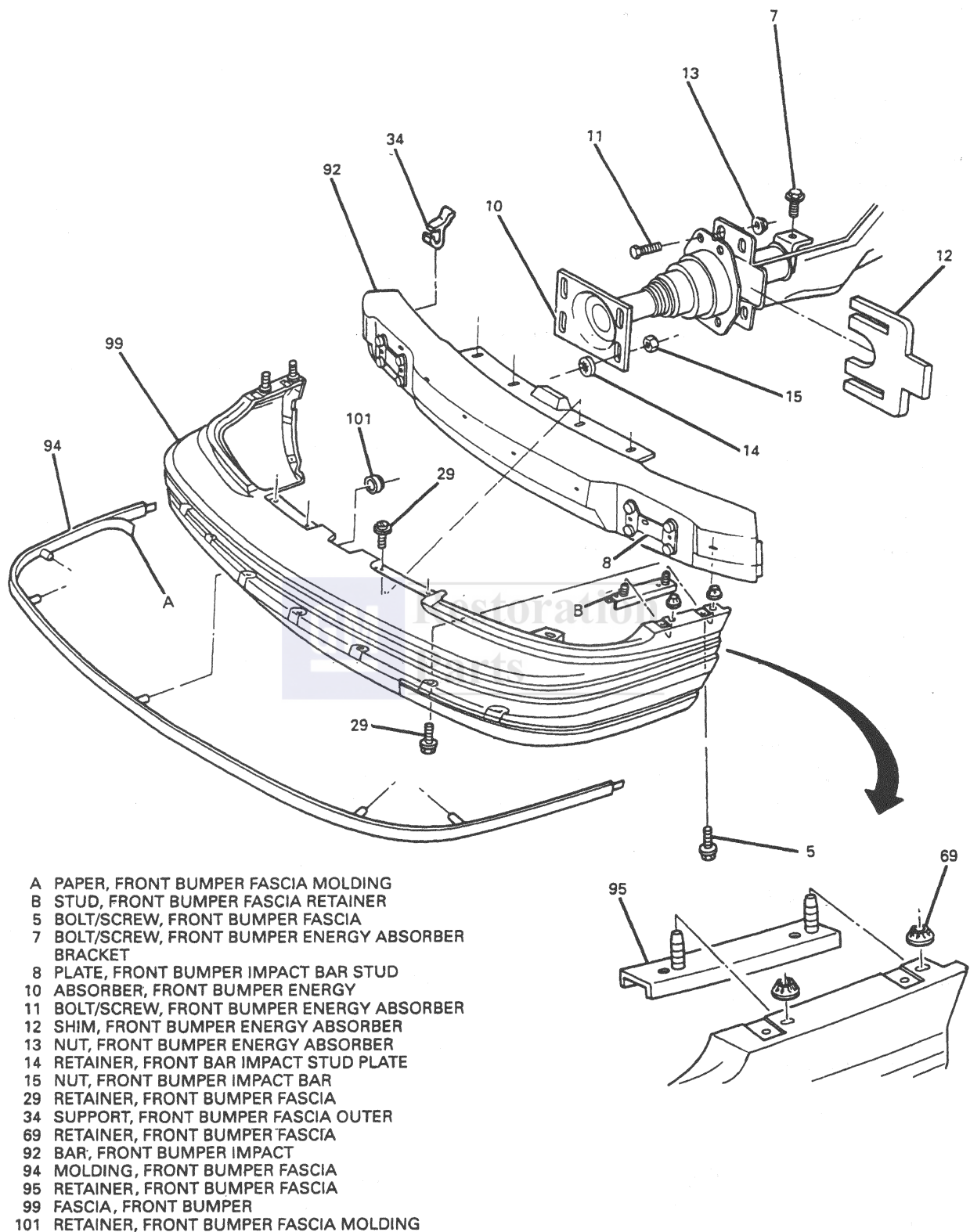
10-4-6 BUMPERS



- | | |
|--|--|
| A PAPER, FRONT BUMPER FASCIA CENTER LOWER | 27 RETAINER, FRONT BUMPER FASCIA MOLDING CAP |
| B STUD, FRONT BUMPER FASCIA OUTER LOWER MOLDING | 28 NUT, FRONT BUMPER GUARD |
| C STUD, FRONT BUMPER FASCIA RETAINER | 29 RETAINER, FRONT BUMPER FASCIA |
| D STUD, FRONT BUMPER FASCIA RETAINER | 34 SUPPORT, FRONT BUMPER FASCIA OUTER |
| 1 MOLDING, FRONT BUMPER FASCIA CENTER LOWER | 60 RETAINER, FRONT BUMPER FASCIA |
| 2 FASCIA, FRONT BUMPER | 69 RETAINER, FRONT BUMPER FASCIA |
| 3 MOLDING, FRONT BUMPER FASCIA OUTER LOWER | 70 MOLDING, FRONT BUMPER FASCIA OUTER UPPER |
| 4 MOLDING, FRONT BUMPER FASCIA OUTER LOWER | 71 CAP, FRONT BUMPER FASCIA OUTER UPPER MOLDING END |
| 5 BOLT/SCREW, FRONT BUMPER FASCIA | 72 CAP, FRONT BUMPER FASCIA OUTER UPPER MOLDING END |
| 6 FILTER, HEADLAMP OPENING | 73 ESCUTCHEON, FRONT BUMPER FASCIA OUTER UPPER MOLDING |
| 7 BOLT/SCREW, FRONT BUMPER ENERGY ABSORBER BRACKET | 93 PLATE, FRONT IMPACT BAR STUD |
| 9 BAR ASSEMBLY, FRONT BUMPER IMPACT | 97 BUSHING, FRONT BUMPER GUARD STUD |
| 10 ABSORBER, FRONT BUMPER ENERGY | 98 PAD, FRONT BUMPER FASCIA BUMPER GUARD |
| 11 BOLT/SCREW, FRONT BUMPER ENERGY ABSORBER | 100 GUARD, FRONT BUMPER |
| 12 SHIM, FRONT BUMPER ENERGY ABSORBER | |
| 13 NUT, FRONT BUMPER ENERGY ABSORBER | |
| 14 RETAINER, FRONT BAR IMPACT STUD PLATE | |
| 15 NUT, FRONT BUMPER IMPACT BAR | |
| 26 NUT, FRONT BUMPER FASCIA MOLDING | |

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Figure 5 - Front Bumper - (Buick Wagon)



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Figure 6 - Front Bumper - (Chevrolet)

10-4-8 BUMPERS

Install or Connect

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Fascia (66, 2 or 99).
2. Four bolts/screws (5).

Tighten

- Bolts/screws (5) to 6 N.m (53 lb. in.).
3. Four lower retainers (86 or 29).
 4. Front fender wheel opening moldings and front wheelhouse panel extensions with radiator air side deflectors attached. Refer to SECTION 10-5.
 5. Lower vehicle.
 6. Six upper retainers (86), or four upper retainers (29).

Adjust

- Front bumper. Refer to "Front Bumper Alignment" in this section.
7. Front parking/sidemarkers lamps. Refer to SECTION 8B.

Front Bumper Fascia Upper Moldings

BUICK

Figures 4 and 5

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Caps (19 and 20 or 71 and 72) and retainers (27).
3. Escutcheons (21 and 22 or 73 and 74) and retainers (27).
4. Moldings (16, 17 and 18 or 70).
 - A. Straighten bend tabs before removing.
 - B. Hold hot air gun 152 mm (6 inches) from molding surfaces.
 - C. Apply heat, using circular motion for about 30 seconds.
 - D. Use flat-bladed tool, being careful not to damage paint, and remove moldings (16, 17 and 18 or 70) from front bumper fascia surface.
 - E. Discard moldings (16, 17 and 18 or 70).

Install or Connect

1. Moldings (16, 17 and 18 or 70).
 - A. Mark position of moldings (16, 17 and 18 or 70) with length of masking tape.

Clean

- Area with soap and water. Wipe dry.
 - Area with oil-free naphtha or alcohol.
- B. If needed, warm fascia (66 or 2) with heat lamp or heat gun to 21° C (70° F).

- C. Peel paper from moldings (16, 17 and 18 or 70).
 - Do not touch adhesive backing.
- D. Press moldings (16, 17 and 18 or 70) to fascia (66 or 2) to secure.
- E. Hand-roll moldings (16, 17 and 18 or 70) to ensure proper adhesion.

Inspect

- Molding ends for bonding. Hand-roll loose ends.
- F. Bend back bend tabs after applying moldings.
2. Escutcheons (21 and 22 or 73 and 74) and retainers (27).
 3. Caps (19 and 20 or 71 and 72) and retainers (27).
 4. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

Front Bumper Fascia Lower Moldings

BUICK

Figures 4 and 5

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Nuts (26) from studs on moldings (65, 67 and 68 or 1, 3 and 4).
3. Moldings (65, 67 and 68 or 1, 3 and 4).

Install or Connect

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Moldings (65, 67 and 68 or 1, 3 and 4).
2. Nuts (26) to studs on moldings (65, 67 and 68 or 1, 3 and 4).

Tighten

- Nuts (26) to 4 N.m (35 lb. in.).
3. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

CHEVROLET

Figure 6

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Retainers (101).
3. Molding (94).
 - A. Hold hot air gun 152 mm (6 inches) away from molding surface.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Use flat-bladed tool, being careful not to damage paint, and remove molding (94) from front bumper fascia surface.
 - D. Discard molding (94).

Install or Connect

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Molding (94).

- A. Mark position of molding (94) with length of masking tape.



Clean

- Area with soap and water. Wipe dry.
- Area with oil-free naphtha or alcohol.

- B. If needed, warm fascia (99) with heat lamp or heat gun to 21° C (70° F).

- C. Peel paper from molding (94).

- Do not touch adhesive backing.

- D. Press molding (94) to fascia (99) to secure.

- E. Hand-roll molding (94) to ensure proper adhesion.



Inspect

- Molding ends for bonding. Hand-roll loose ends.

2. Retainers (101).

3. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

Front Bumper Guards

BUICK

Figures 4 and 5

Remove or Disconnect

1. Open hood.
2. Nuts (28) from studs on guards (24 or 100) behind fascia (66 or 2).
3. Guards (24 or 100), pads (25 or 98) and bushings (90 or 97).

Install or Connect

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Guards (24 or 100), pads (25 or 98) and bushings (90 or 97) to front of fascia (66 or 2).
2. Nuts (28) to studs on guards (24 or 100).



Tighten

- Nuts (28) to 11 N.m (97 lb. ft.).

3. Lower hood.

Front Bumper Impact Bar

Figures 4, 5 and 6

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Radiator air side baffles and radiator air side baffle retainers. Refer to SECTION 10-5.
3. Supports (34), if equipped.
4. Nuts (15).
5. Impact bar (91, 9 or 92).

Install or Connect

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Impact bar (91, 9 or 92).
2. Nuts (15).



Tighten

- Nuts (15) to 27 N.m (20 lb. ft.).
3. Supports (34), if equipped.
 4. Radiator air side baffles and radiator air side baffle retainers. Refer to SECTION 10-5.
 5. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

REAR BUMPER

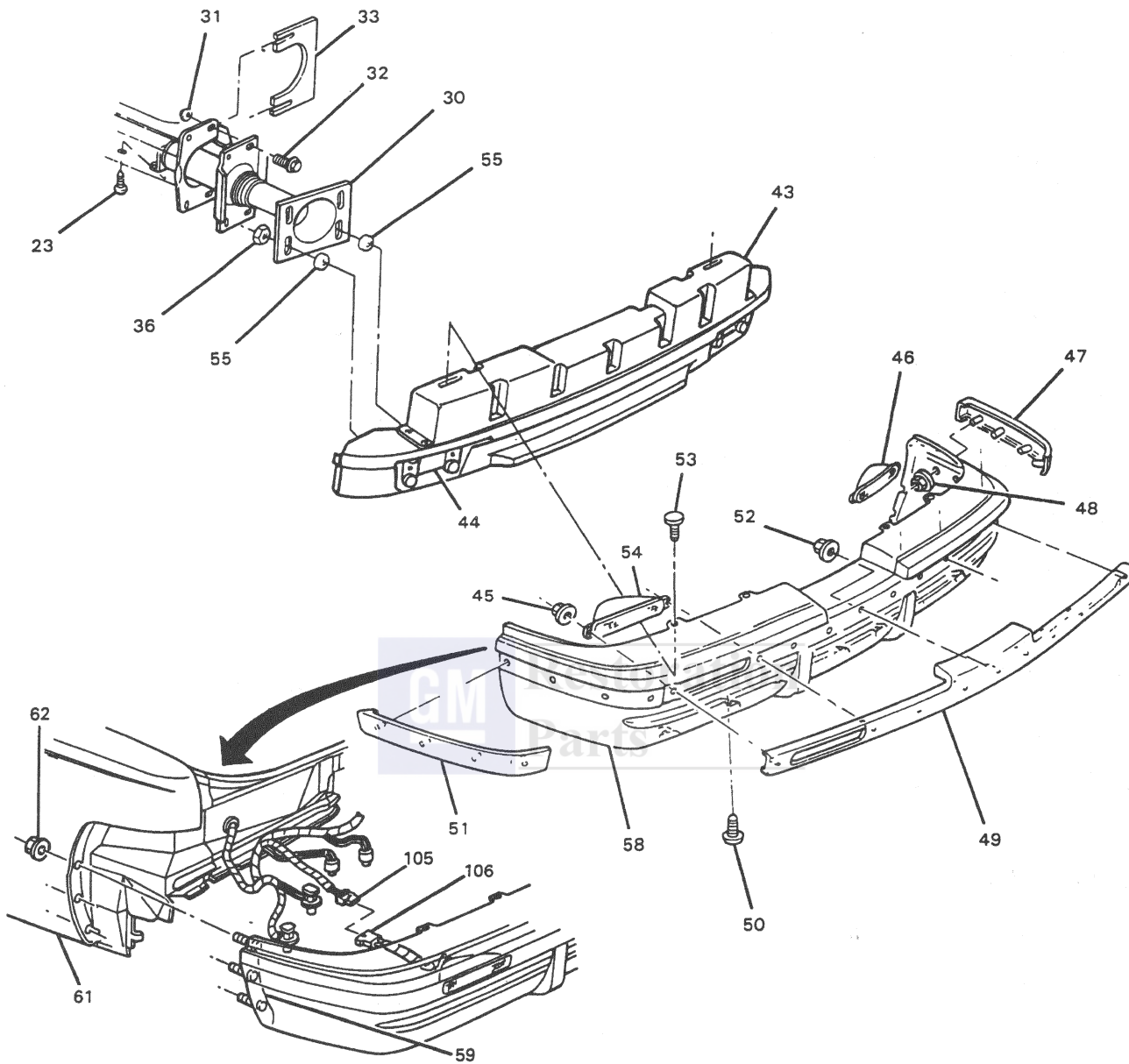
Rear Bumper Fascia (Sedan)

Figures 7 and 8

Remove or Disconnect

1. Open rear compartment lid.
2. Backup lamp connector from backup lamp harness (Buick only). Refer to SECTION 8B.
3. Four upper retainers (53) (Buick) or six upper retainers (108) (Chevrolet).
4. Rear license pocket and fuel tank filler doors (Chevrolet). Refer to SECTION 10-8.
5. Six nuts (62) (Buick) or four upper nuts (62) (Chevrolet) from studs (57).
6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Four lower retainers (50) (Buick) or seven lower retainers (79) (Chevrolet).
8. Four lower nuts (62) (Chevrolet).
9. Lower vehicle.
10. Fascia (58) (Buick) or (112) (Chevrolet).

10-4-10 BUMPERS

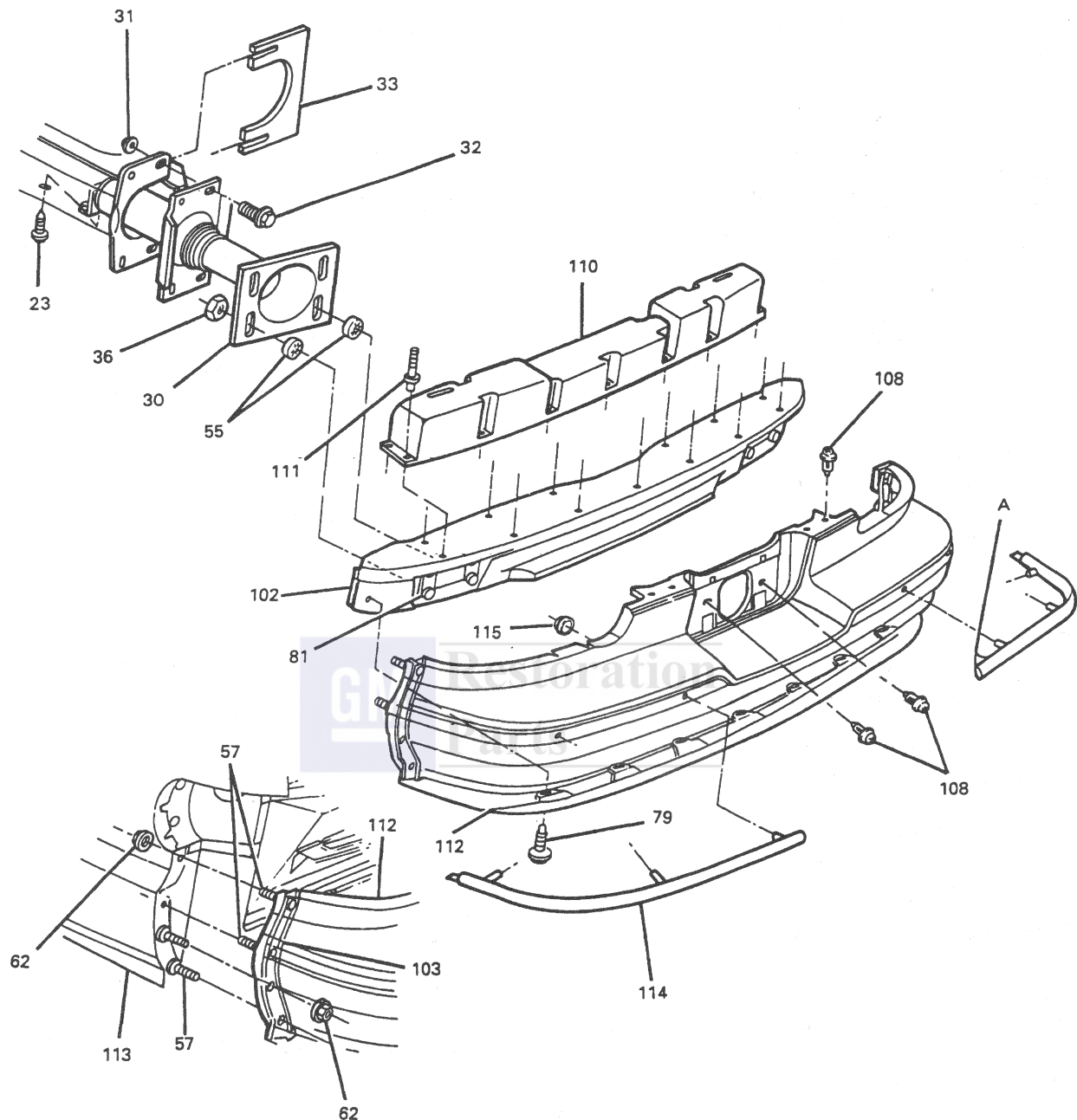


- 23 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER
BRACKET
30 ABSORBER, REAR BUMPER ENERGY
31 NUT, REAR BUMPER ENERGY ABSORBER
32 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER
33 SHIM, REAR BUMPER ENERGY ABSORBER
36 NUT, REAR BUMPER IMPACT BAR
43 BAR, REAR BUMPER IMPACT
44 PLATE, REAR IMPACT BAR STUD
45 NUT, BACKUP LAMP
46 LAMP, BACKUP
47 MOLDING, REAR BUMPER FASCIA OUTER LOWER
48 NUT, REAR BUMPER FASCIA OUTER LOWER MOLDING,
49 MOLDING, REAR BUMPER FASCIA CENTER
LOWER

- 50 RETAINER, REAR BUMPER FASCIA
51 MOLDING, REAR BUMPER FASCIA OUTER
LOWER
52 NUT, REAR BUMPER FASCIA CENTER LOWER MOLDING
53 RETAINER, REAR BUMPER FASCIA
54 LAMP, BACKUP
55 RETAINER, REAR BUMPER IMPACT BAR BOLT
58 FASCIA, REAR BUMPER
59 RETAINER, REAR BUMPER FASCIA
61 PANEL, QUARTER OUTER, BUICK SEDAN
62 NUT, REAR BUMPER FASCIA
105 LAMP CONNECTOR, BACKUP
106 LAMP HARNESS, BACKUP

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Figure 7 - Rear Bumper - (Buick Sedan)



- A PAPER, REAR BUMPER FASCIA MOLDING
- 23 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER BRACKET
- 30 ABSORBER, REAR BUMPER ENERGY
- 31 NUT, REAR BUMPER ENERGY ABSORBER
- 32 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER
- 33 SHIM, REAR BUMPER ENERGY ABSORBER
- 36 NUT, REAR BUMPER IMPACT BAR
- 55 RETAINER, REAR BUMPER IMPACT BAR BOLT
- 57 STUD, REAR BUMPER FASCIA
- 62 NUT, REAR BUMPER FASCIA

- 79 RETAINER, REAR BUMPER FASCIA
- 81 PLATE, REAR BUMPER IMPACT BAR STUD
- 102 BAR, REAR BUMPER IMPACT
- 103 RETAINER, REAR BUMPER FASCIA
- 108 RETAINER, REAR BUMPER FASCIA
- 110 SUPPORT, REAR BUMPER FASCIA
- 111 RIVET, REAR BUMPER IMPACT BAR
- 112 FASCIA, REAR BUMPER
- 113 PANEL, QUARTER OUTER
- 114 MOLDING, REAR BUMPER FASCIA
- 115 RETAINER, REAR BUMPER FASCIA MOLDING

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Figure 8 - Rear Bumper - (Chevrolet Sedan)

10-4-12 BUMPERS

Install or Connect

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

1. Fascia (58) (Buick) or (112) (Chevrolet).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Four lower nuts (62) (Chevrolet).
4. Four lower retainers (50) (Buick) or seven lower retainers (79) (Chevrolet).
5. Lower vehicle.
6. Six nuts (62) (Buick) or four upper nuts (62) (Chevrolet) to studs (57).

Tighten

- Nuts (62) to 6 N.m (53 lb. in.).
7. Rear license pocket and fuel tank filler doors (Chevrolet). Refer to SECTION 10-8.
 8. Four upper retainers (53) (Buick) or six upper retainers (108) (Chevrolet).

Adjust

- Rear bumper. Refer to “Rear Bumper Alignment (Sedan)” in this section.
9. Backup lamp connector from backup lamp harness (Buick only). Refer to SECTION 8B.
 10. Close rear compartment lid.

Rear Bumper Fascia (Wagon)

Figures 9 and 10

Remove or Disconnect

1. Five retainers (87).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Seven lower retainers (79).
4. Rear quarter transfer lower rear finish moldings (Buick) from rear bumper fascia (Buick). Refer to “Rear Quarter Transfer Lower Rear Finish and Bumper Fascia Moldings (Wagon)” in this section.
5. Rear bumper fascia moldings (Chevrolet) from rear bumper fascia (Chevrolet). Refer to “Rear Quarter Transfer Lower Rear Finish and Bumper Fascia Moldings (Wagon)” in this section.
6. Four rivets (85).
 - Drill out.
7. Four nuts (62) from studs (57).
8. Fascia (78).

Install or Connect

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

1. Fascia (78).
2. Four nuts (62) to studs (57).

Tighten

- Nuts (62) and studs (57) to 6 N.m (53 lb. in.).
3. Rivets (85).
 4. Rear quarter transfer lower rear finish moldings (Buick) to rear bumper fascia (Buick). Refer to “Rear Quarter Transfer Lower Rear Finish and Bumper Fascia Moldings (Wagon)” in this section.
 5. Rear bumper fascia moldings (Chevrolet) from rear bumper fascia (Chevrolet). Refer to “Rear Quarter Transfer Lower Rear Finish and Bumper Fascia Moldings (Wagon)” in this section.
 6. Seven lower retainers (79).
 7. Lower vehicle.
 8. Five upper retainers (87).

Rear Bumper Fascia Lower Moldings (Sedan)

Figures 7 and 8

Remove or Disconnect

1. Rear bumper fascia. Refer to “Rear Bumper Fascia (Sedan)” in this section.
2. Nuts (48 and 52) (Buick) or retainers (115) (Chevrolet).
3. Moldings (47, 49 and 51) (Buick) or (114) (Chevrolet).

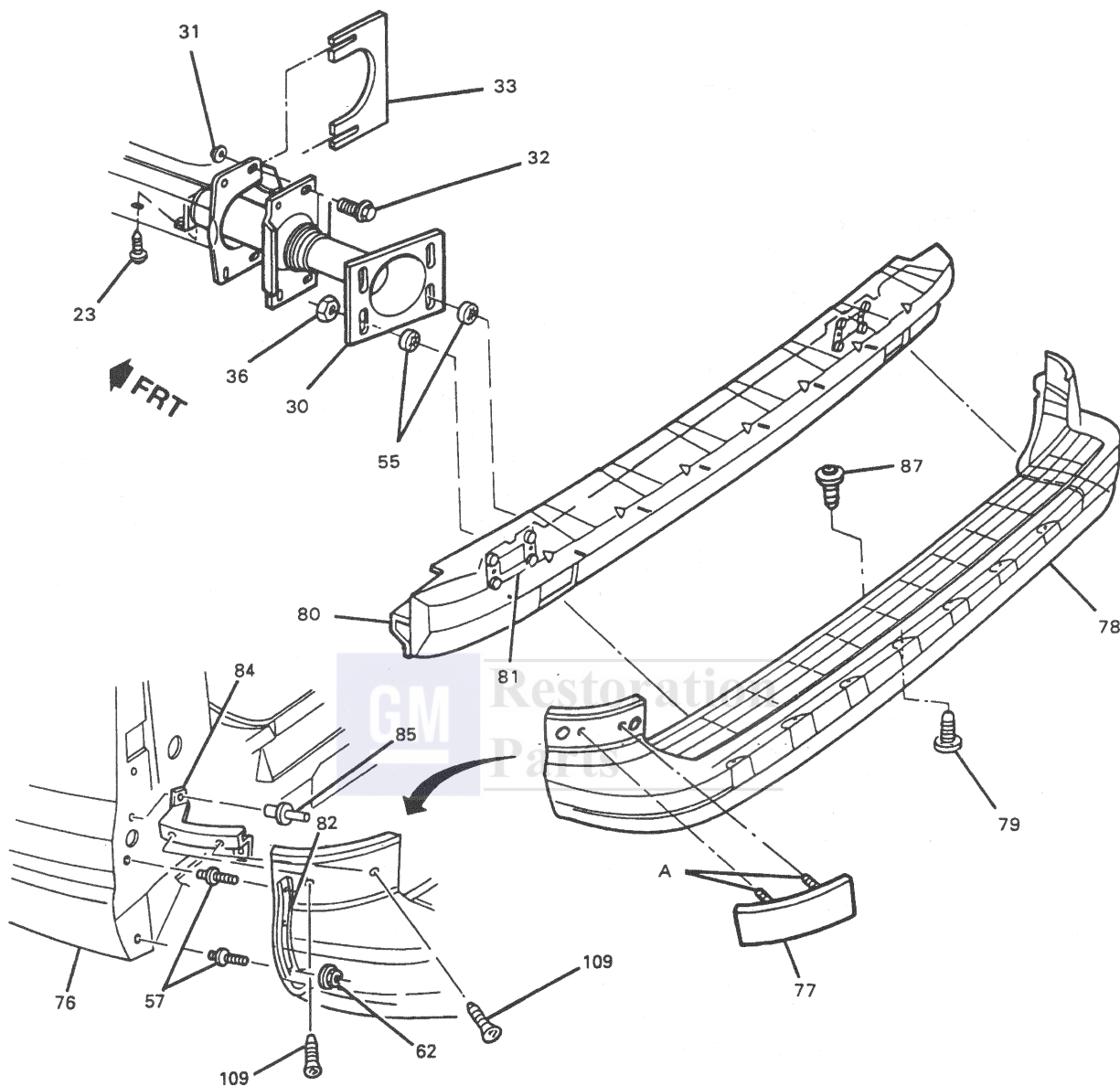
Install or Connect

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

1. Moldings (47, 49 and 51) (Buick) or (114) (Chevrolet).
2. Nuts (48 and 52) (Buick) or retainers (115) (Chevrolet).

Tighten

- Nuts (48 and 52) to 4 N.m (35 lb. in.).
3. Rear bumper fascia. Refer to “Rear Bumper Fascia (Sedan)” in this section.



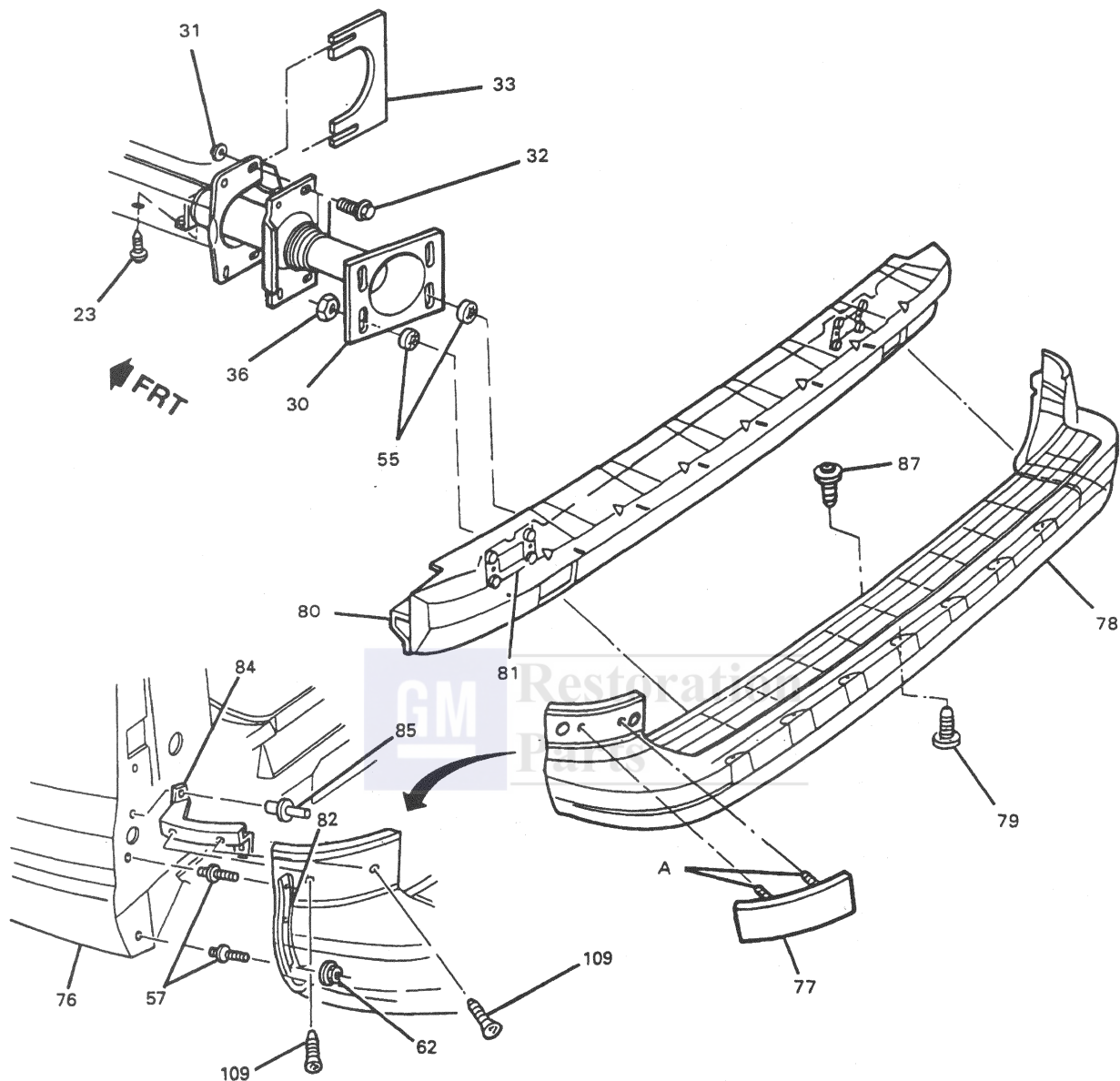
- A RETAINER, REAR QUARTER TRANSFER LOWER REAR FINISH MOLDING
- 23 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER BRACKET
- 30 ABSORBER, REAR BUMPER ENERGY
- 31 NUT, REAR BUMPER ENERGY ABSORBER
- 32 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER
- 33 SHIM, REAR BUMPER ENERGY ABSORBER
- 36 NUT, REAR BUMPER IMPACT BAR
- 55 RETAINER, REAR BUMPER IMPACT BAR BOLT
- 57 STUD, REAR BUMPER FASCIA
- 76 PANEL, QUARTER OUTER

- 77 MOLDING, REAR QUARTER TRANSFER LOWER REAR FINISH
- 78 FASCIA, REAR BUMPER
- 79 RETAINER, REAR BUMPER FASCIA
- 80 BAR, REAR BUMPER IMPACT
- 81 PLATE, REAR BUMPER IMPACT BAR STUD
- 82 RETAINER, REAR BUMPER FASCIA
- 84 BRACKET, REAR BUMPER FASCIA OUTER
- 85 RIVET, REAR BUMPER FASCIA OUTER BRACKET
- 87 RETAINER, REAR BUMPER FASCIA
- 88 NUT, REAR BUMPER FASCIA
- 109 BOLT/SCREW, REAR BUMPER FASCIA

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Figure 9 - Rear Bumper - (Buick Wagon)

10-4-14 BUMPERS



- A RETAINER, REAR QUARTER TRANSFER LOWER REAR FINISH MOLDING
- 23 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER BRACKET
- 30 ABSORBER, REAR BUMPER ENERGY
- 31 NUT, REAR BUMPER ENERGY ABSORBER
- 32 BOLT/SCREW, REAR BUMPER ENERGY ABSORBER
- 33 SHIM, REAR BUMPER ENERGY ABSORBER
- 36 NUT, REAR BUMPER IMPACT BAR
- 55 RETAINER, REAR BUMPER IMPACT BAR BOLT
- 57 STUD, REAR BUMPER FASCIA
- 62 NUT, REAR BUMPER FASCIA
- 76 PANEL, QUARTER OUTER

- 77 MOLDING ASSEMBLY, REAR QUARTER TRANSFER LOWER REAR FINISH
- 78 FASCIA, REAR BUMPER
- 79 RETAINER, REAR BUMPER FASCIA
- 80 BAR ASSEMBLY, REAR BUMPER IMPACT
- 81 PLATE, REAR BUMPER IMPACT BAR STUD
- 82 RETAINER, REAR BUMPER FASCIA
- 84 BRACKET, REAR BUMPER FASCIA OUTER
- 85 RIVET, REAR BUMPER FASCIA OUTER BRACKET
- 87 RETAINER, REAR BUMPER FASCIA
- 88 NUT, REAR BUMPER FASCIA
- 107 MOLDING, REAR BUMPER FASCIA
- 109 BOLT/SCREW, REAR BUMPER FASCIA

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Figure 10 - Rear Bumper - (Chevrolet Wagon)

Rear Quarter Transfer Lower Rear Finish and Bumper Fascia Moldings (Wagon)

Figures 9 and 10

Remove or Disconnect

- Molding (77) with studs (Buick) or molding (107) (Chevrolet).
 - A. Hold hot air gun 152 mm (6 inches) from molding surface.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Use flat-bladed tool, being careful not to damage paint, and remove molding (77 or 107) from rear bumper fascia surface.
 - D. Discard molding (77) with retainers or (107).

Install or Connect

- Molding (77) (Buick) or (107) (Chevrolet).
 - A. Mark position of molding (77 or 107) with length of masking tape.



Clean

- Area with soap and water. Wipe dry.
- Area with oil-free naphtha or alcohol.
- B. If needed, warm fascia (78) with heat lamp or heat gun to 21° C (70° F).
- C. Peel paper from molding (77 or 107).
 - Do not touch adhesive backing.
- D. Press molding (77 or 107) to fascia (78) to secure retainer.
- E. Hand-roll molding (77 or 107) to fascia (78) to ensure proper adhesion.



Inspect

- Molding ends for bonding.
 - Hand-roll loose ends.

Rear Bumper Impact Bar (Sedan)

Figures 7 and 8

Remove or Disconnect

1. Rear bumper fascia. Refer to “Rear Bumper Fascia (Sedan)” in this section.
2. Nuts (36).
3. Impact bar (43) and retainers (55) (Buick) or impact bar (102) from support (110) (Chevrolet).
 - Remove rivets (111) (Chevrolet) using 1/4-inch drill bit.

Install or Connect

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

1. Impact bar (43) and retainers (55) (Buick) or impact bar (102) to support (110) with rivets (111) (Chevrolet).



Adjust

- Impact bar. Refer to “Rear Bumper Alignment (Sedan)” in this section.
- 2. Nuts (36).



Tighten

- Nuts (36) to 27 N.m (20 lb. ft.).
- 3. Rear bumper fascia. Refer to “Rear Bumper Fascia (Sedan)” in this section.

Rear Bumper Impact Bar (Wagon)

Figures 9 and 10

Remove or Disconnect

1. Rear bumper fascia. Refer to “Rear Bumper Fascia (Wagon)” in this section.
2. Nuts (36).
3. Impact bar (80) and retainers (55).



Install or Connect

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

1. Impact bar (80) and retainers (55).



Adjust

- Impact bar. Refer to “Rear Bumper Alignment (Wagon)” in this section.
- 2. Nuts (36).



Tighten

- Nuts (36) to 27 N.m (20 lb. ft.).
- 3. Rear bumper fascia. Refer to “Rear Bumper Fascia (Wagon)” in this section.

FRONT BUMPER ALIGNMENT

Figures 1, 4, 5, 6, 11 and 12

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front wheelhouse panel extensions with radiator air side deflectors attached and radiator air side baffles. Refer to SECTION 10-5.



Adjust

NOTICE: Refer to “Notice” on page 10-4-1 of this section.

- Front bumper.
 - A. Loosen nuts (15).
 - B. Move impact bar (91, 9 or 92) up or down to achieve proper clearance. Front bumper fascia (66, 2 or 99) should be adjusted to specification shown in Figures 11 and 12.

10-4-16 BUMPERS

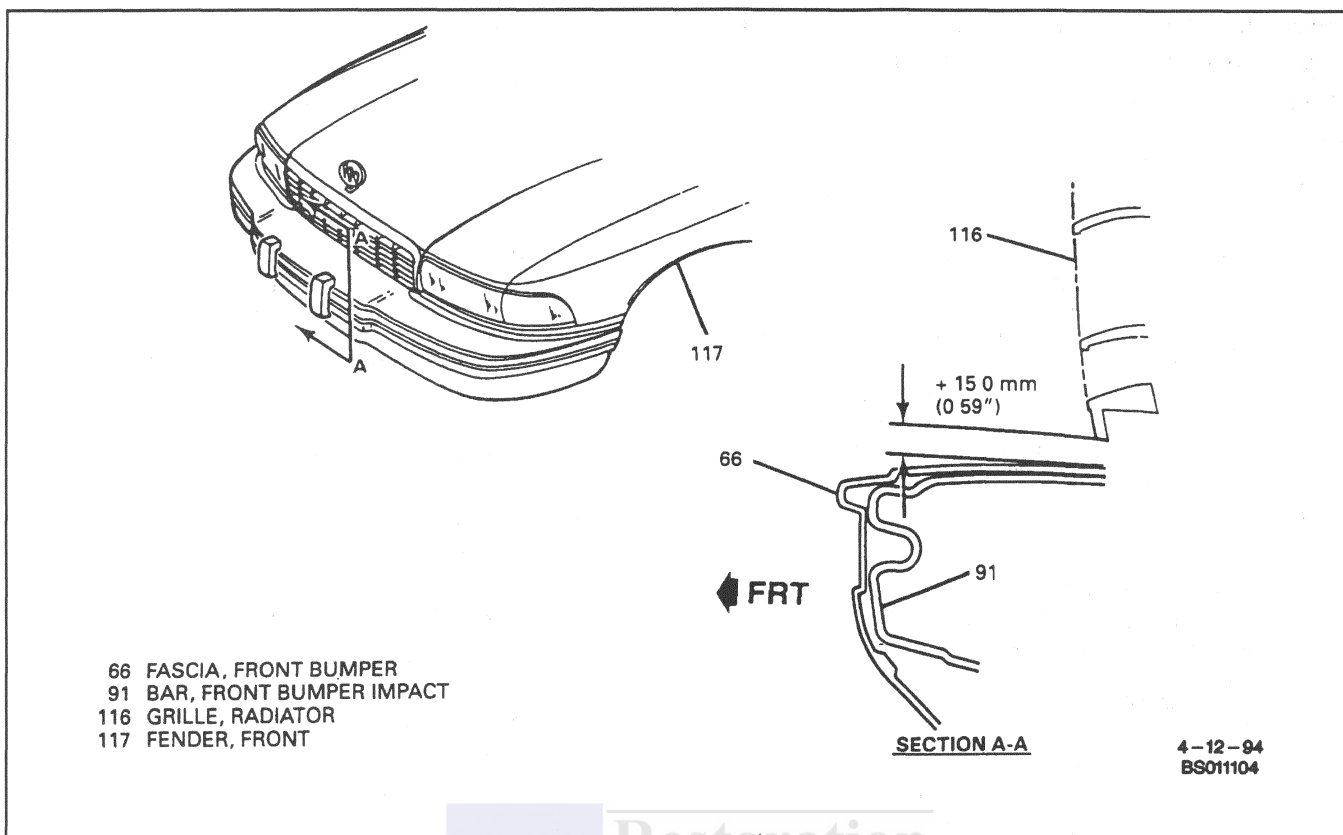


Figure 11 - Front Bumper Alignment - (Buick Sedan)

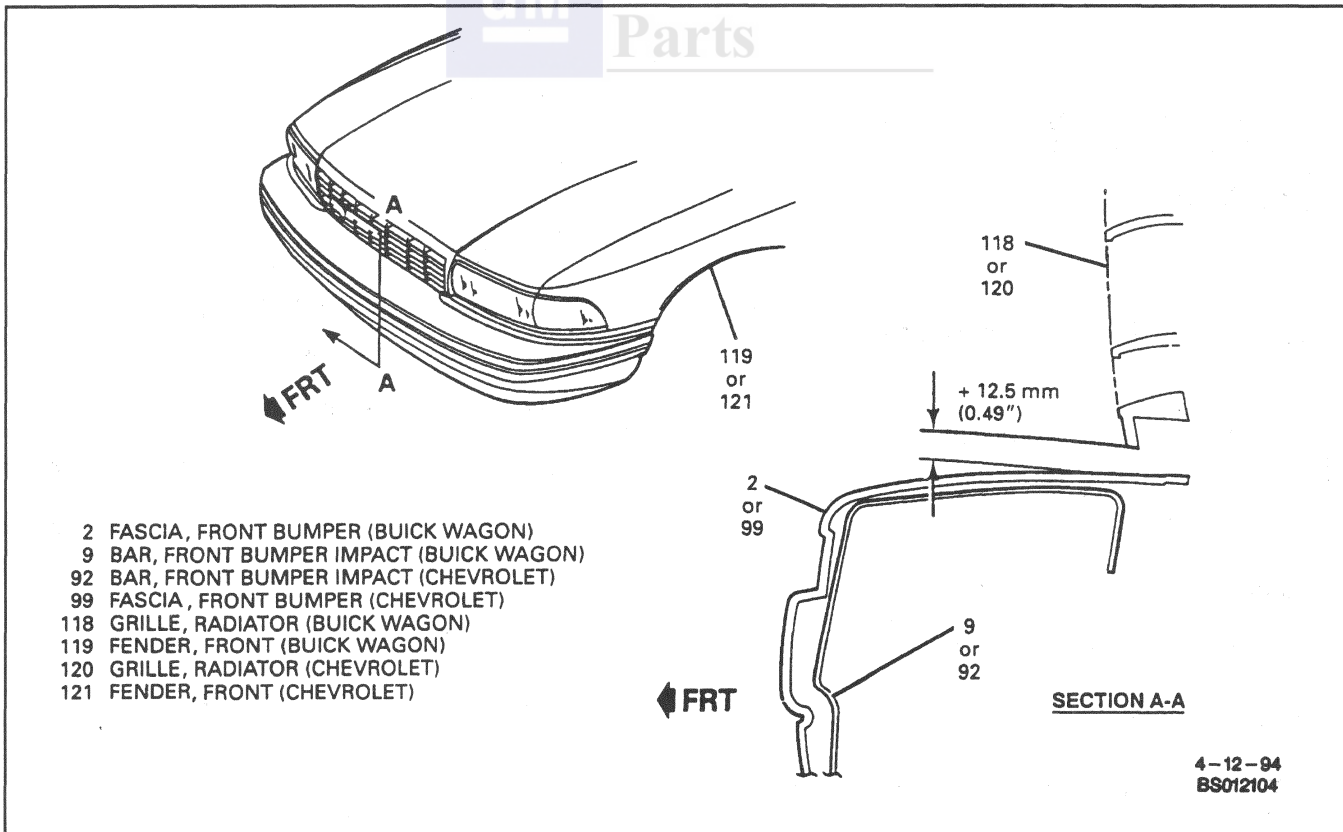


Figure 12 - Front Bumper Alignment - (Chevrolet Sedan, Buick and Chevrolet Wagon)



Tighten

- Nuts (15) to 27 N.m (20 lb. ft.).



Install or Connect

1. Front wheelhouse extension panels with air deflectors attached and radiator air side baffles. Refer to SECTION 10-5.
2. Lower vehicle.

REAR BUMPER ALIGNMENT (SEDAN)

Figures 2, 7, 8 and 13

NOTICE: Proper alignment of rear impact bar flange to impact bar support is critical. If alignment specifications are not followed, the vehicle may not properly absorb the energy of a collision, causing excessive damage.

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Raise and suitably support vehicle. Refer to SECTION 0A.



Adjust

- Rear bumper.
 - A. Loosen nuts (36).
 - B. Move impact bar (43) up or down until fascia (58) just contacts license plate filler pocket (Buick); or move impact bar (102) up or down to achieve proper clearance.



Tighten

- Nuts (36) to 27 N.m (20 lb. ft.).
- 2. Lower vehicle.

REAR BUMPER ALIGNMENT (WAGON)

Figures 2, 9, 10 and 14

NOTICE: Proper alignment of rear impact bar flange to impact bar support is critical. If alignment specifications are not followed, the vehicle may not properly absorb the energy of a collision, causing excessive damage.

NOTICE: Refer to "Notice" on page 10-4-1 of this section.

1. Raise and suitably support vehicle. Refer to SECTION 0A.



Adjust

- Rear bumper.
 - A. Loosen nuts (36).

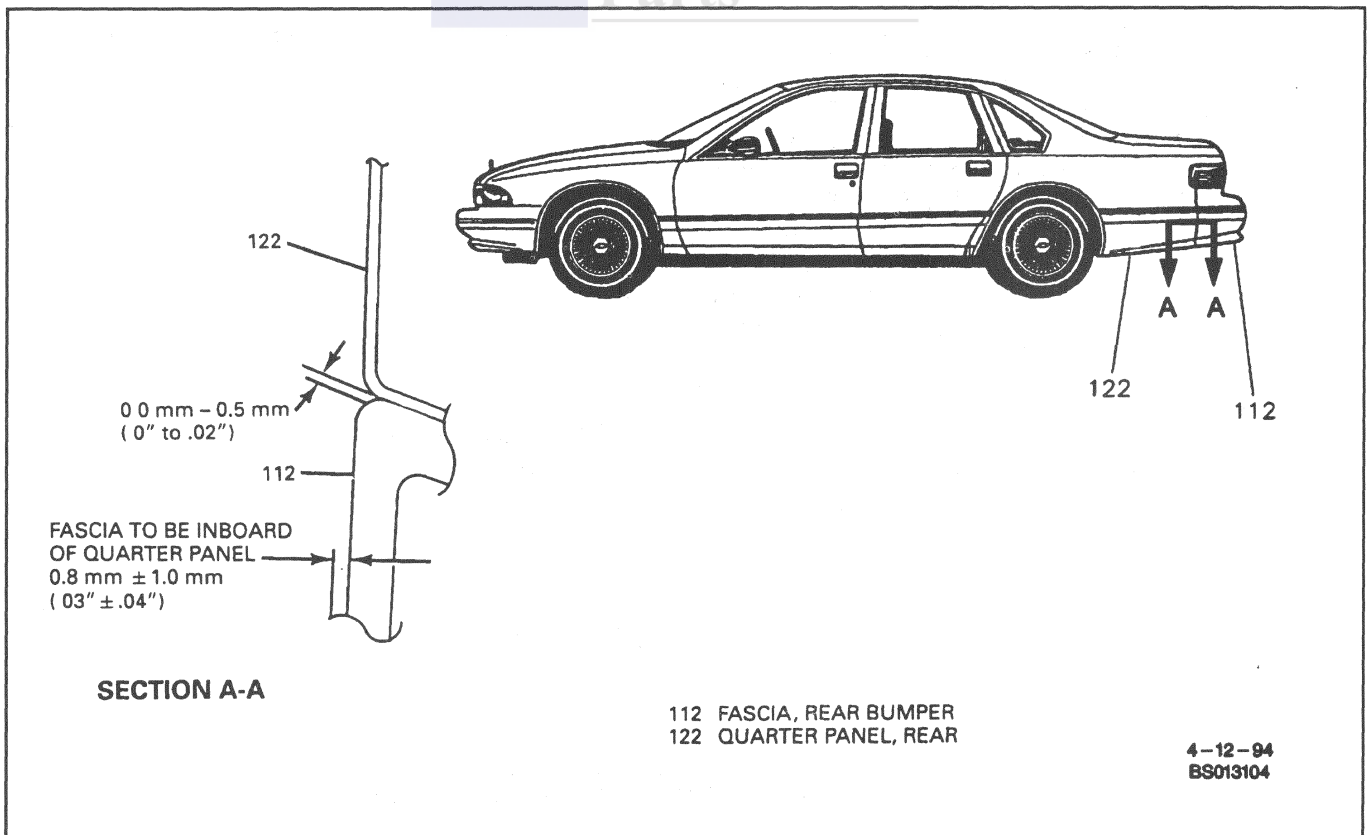


Figure 13 - Rear Bumper Alignment - (Chevrolet Sedan)

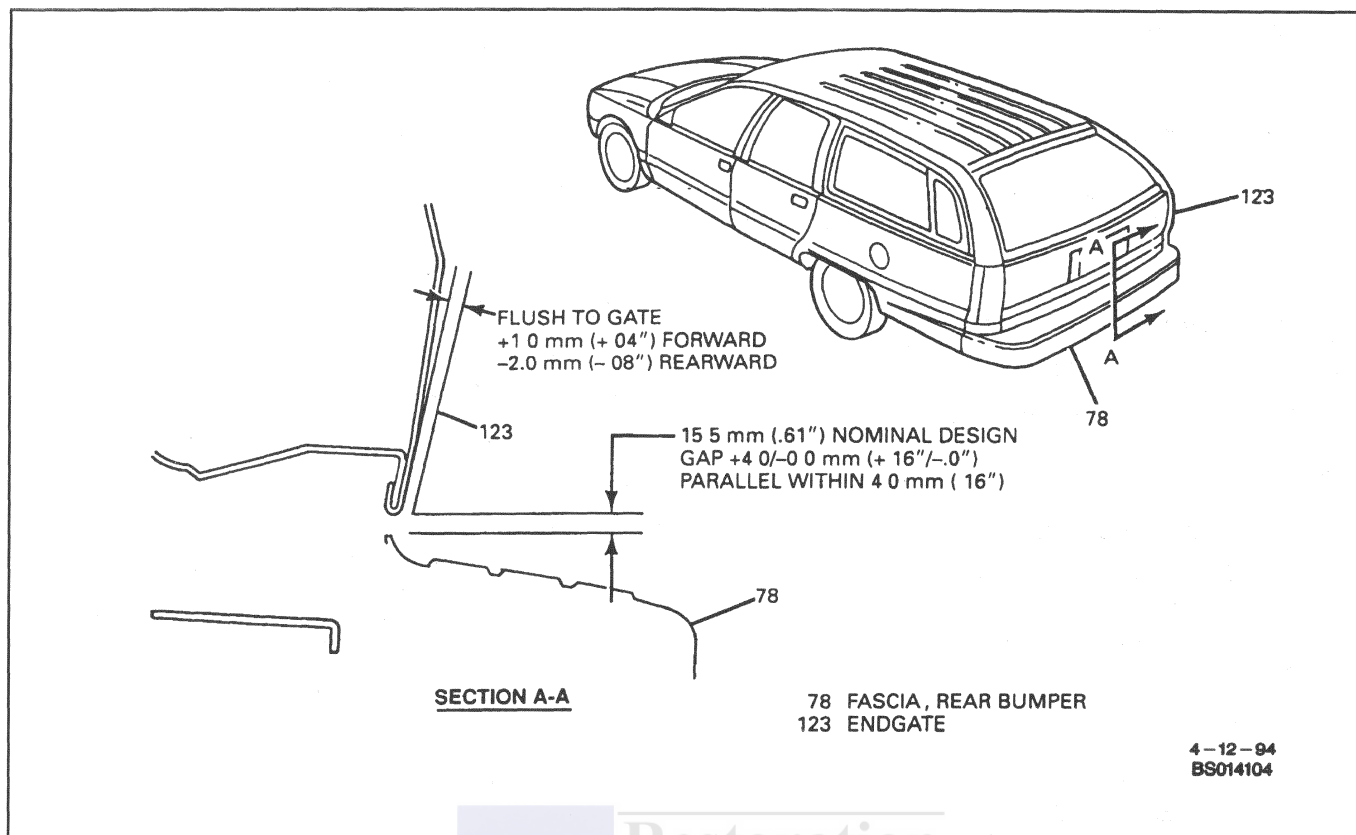


Figure 14 - Rear Bumper Alignment - (Wagon)

B. Move impact bar (80) up or down to achieve proper clearance. Fascia-to-endgate clearance should be adjusted to specifications shown in Figure 14.

The impact bar (80) should be centered on the absorber (30) so the fascia (78), when applied to the impact bar (80), will fit with no interference. The body construction is such that the fascia (78) should fit snugly to the rear end.



Tighten

- Nuts (36) to 27 N.m (20 lb. ft.).

2. Lower vehicle.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Backup Lamp Nut	4 N.m (35 lb. in.)
Front Bumper Energy Absorber Bracket Bolt/Screw.....	4.2 N.m (37 lb. in.)
Front Bumper Energy Absorber Bracket Nut	27 N.m (20 lb. ft.)
Front Bumper Energy Absorber Nut	27 N.m (20 lb. ft.)
Front Bumper Fascia Bolt/Screw.....	6 N.m (53 lb. in.)
Front Bumper Fascia Molding Nut	2.3 N.m (20 lb. in.)
Front Bumper Guard Nut.....	11 N.m (97 lb. in.)
Front Bumper Impact Bar Nut	27 N.m (20 lb. ft.)
Rear Bumper Energy Absorber Bracket Bolt/Screw.....	27 N.m (20 lb. ft.)
Rear Bumper Energy Absorber Bracket Nut	27 N.m (20 lb. ft.)
Rear Bumper Energy Absorber Nut	20 N.m (15 lb. ft.)
Rear Bumper Fascia Center Lower Molding Nut.....	2.3 N.m (20 lb. in.)
Rear Bumper Fascia Nut (Sedan).....	6 N.m (53 lb. in.)
Rear Bumper Fascia Nut (Wagon)	6 N.m (53 lb. in.)
Rear Bumper Fascia Outer Lower Molding Nut	2.3 N.m (20 lb. in.)
Rear Bumper Fascia Stud	5.7 N.m (50 lb. in.)
Rear Bumper Impact Bar Nut.....	27 N.m (20 lb. ft.)
Rear Bumper Fascia Bolt/Screw	2.4 N.m (21 lb. in.)



BLANK



SECTION 10-5

BODY FRONT END

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "On-Vehicle Service" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: The theft deterrent label found on some major sheet metal must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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10-5-2 BODY FRONT END

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GENERAL DESCRIPTION

BODY FRONT END

Figures 1 and 2

The hood (21) is composed of a single outer panel and an inner reinforcement. Further rigidity is obtained by the use of reinforcement braces and brackets located so as not to interfere with adjustments or service repair. The primary latch (35) is attached to the radiator support (31).

Front fenders (25) each consist of an outer panel with a bolt-in reinforcement inner panel.

The fascia, a urethane wrap, attaches to the impact bar and front fenders (25).

LUBRICATION

Figures 1 and 2

The primary latch (35) is a cable released, positive locking latch located on the radiator support (31) which locks the hood-mounted latch bolt. The hood release cable handle (16) is located at the front of the left-hand carpet retainer (52). A "pop-up" spring, attached to the hood (21), provides initial opening of the hood (21) upon release. The secondary latch (30) is used to fully open the hood (21) after the hood release cable handle (16) is pulled.

The secondary latch (30) is attached to the hood (21). To raise the hood (21), once the hood release cable handle (16) has been pulled, the secondary latch (30) attached to the grille lower bracket (50 or 34) must be moved. A rod connects the secondary latch release handle (32) to the secondary latch (30). The assembly should be lubricated periodically with Lubriplate®, GM P/N 1052196.

FASTENERS

NOTICE: When replacing fasteners avoid substituting otherwise similar fasteners in locations which require the use of GM 6174 or GM 6047 type special fasteners for aluminum components. Failing to follow this precaution may result in premature corrosion of the sheet metal in the areas mentioned above.

ANTICORROSION PROTECTION

Anticorrosion materials are part of the coating on most metal panels to provide rust resistance. When servicing these panels, use only GM replacement parts and recoat with specified service primers and paints.

ON-VEHICLE SERVICE

FRONT END PANELS

Radiator Lower Air Deflectors

To replace radiator lower air deflectors, refer to SECTION 6B.

Radiator Air Side Baffles

Figures 3 through 5

Remove or Disconnect

1. Wheelhouse panel extension retainers (84).
2. Baffle retainers (88).
3. Baffle retainers (87).
4. Baffles (85).

Install or Connect

1. Baffles (85).
2. Baffle retainers (87).
3. Baffle retainers (88).
4. Wheelhouse panel extension retainers (84).

Radiator Air Side Deflectors

Figures 3 and 4

The radiator air side deflectors (89) are attached to the bottom of the wheelhouse panel extensions (79) with three bolts/screws. The radiator air side deflectors (121) on police, taxi and public service vehicles are attached with two bolts/screws.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (90).
3. Radiator air side deflector (89 or 121) from wheelhouse panel extension (79).

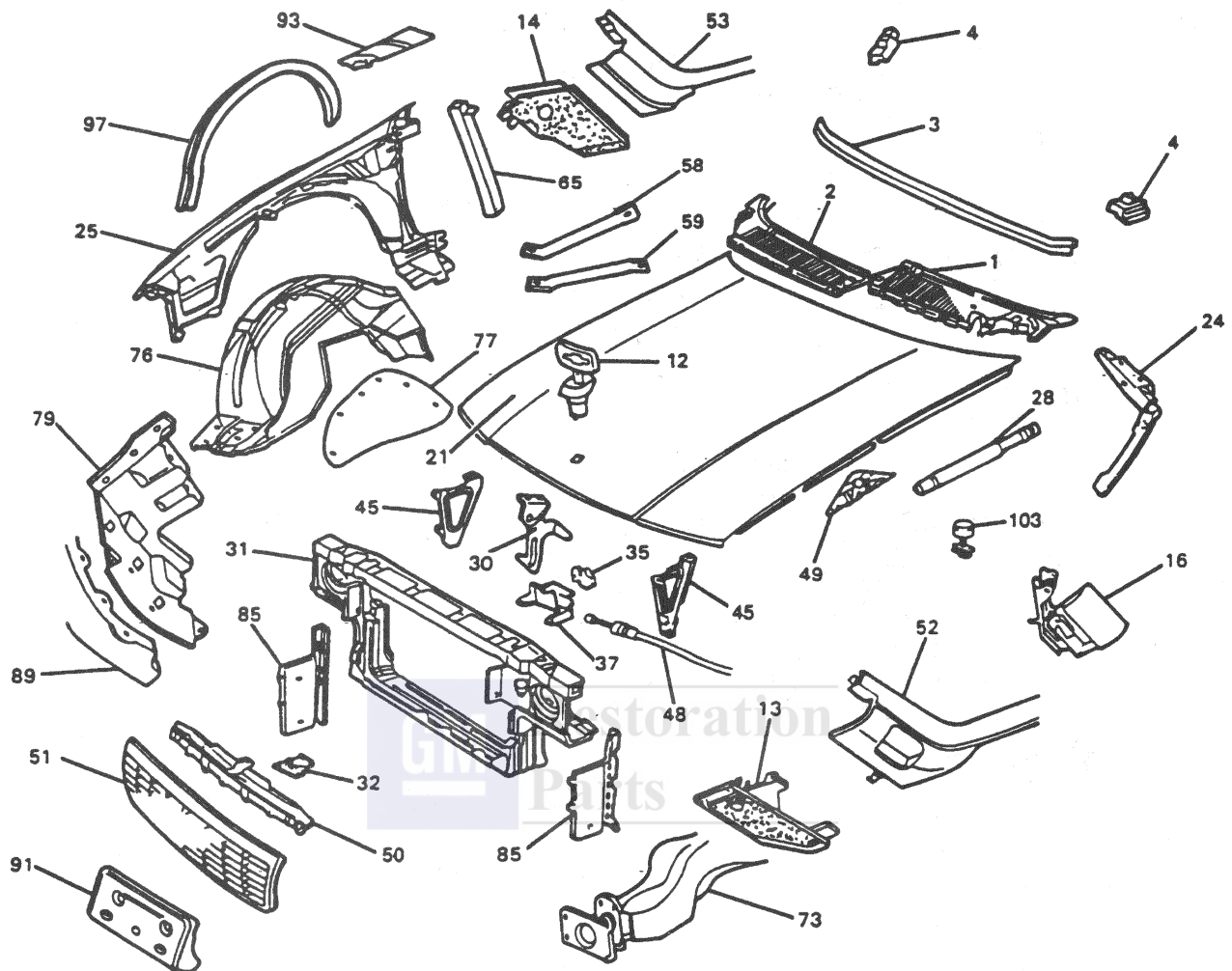
Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Radiator air side deflector (89 or 121) to wheelhouse panel extension (79).
2. Bolts/screws (90).

Tighten

- Bolts/screws (90) to 1.9 N.m (17 lb. in.).
3. Lower vehicle.

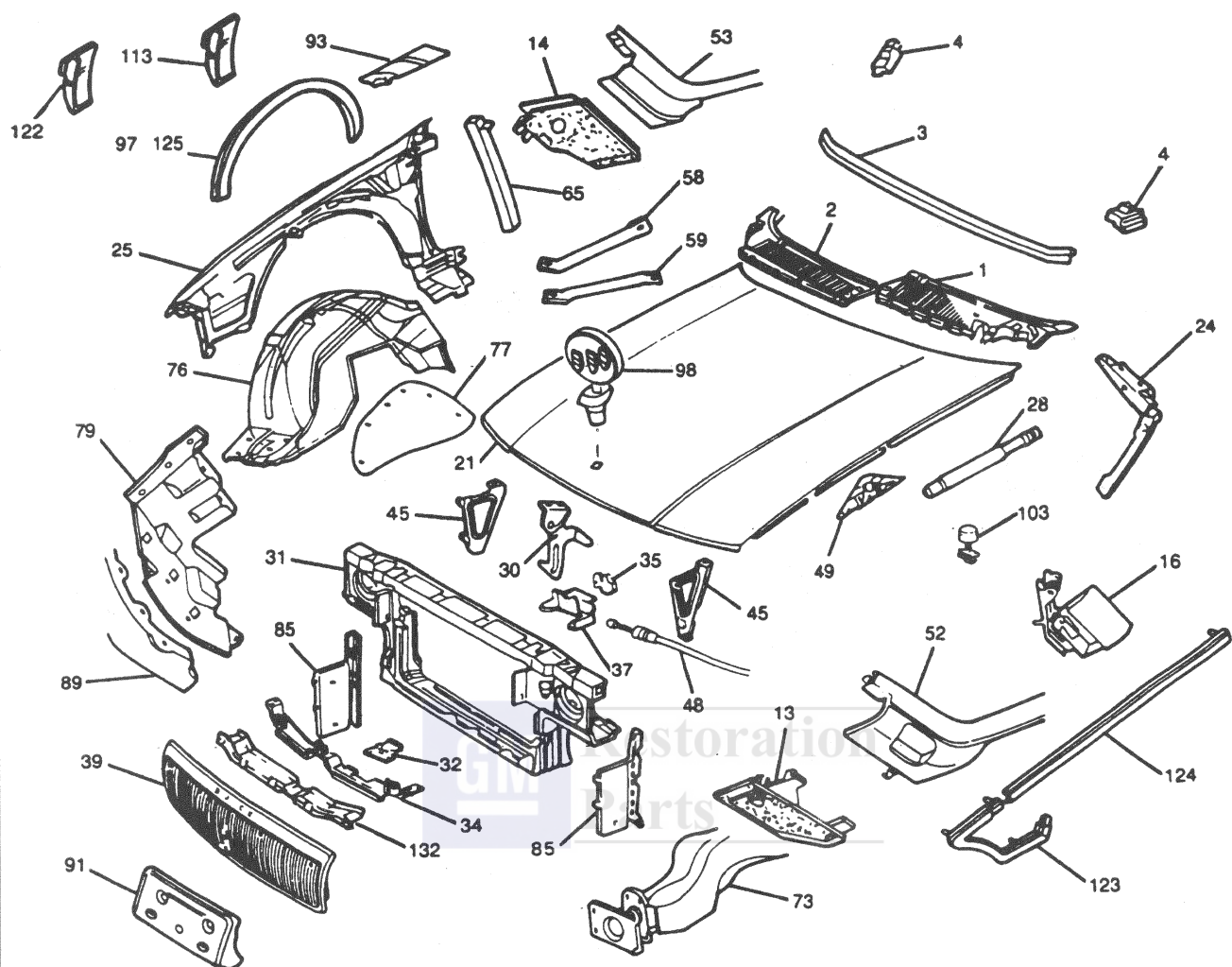


- | | |
|---|--|
| 1 PANEL, AIR INLET GRILLE | 49 BRACKET, HOOD OPEN ASSIST ROD |
| 2 PANEL, AIR INLET GRILLE | 50 BRACKET, RADIATOR GRILLE LOWER |
| 3 SEAL, HOOD | 51 GRILLE, RADIATOR |
| 4 SEAL, HOOD REAR OUTER | 52 RETAINER, FLOOR CARPET (LEFT-HAND) |
| 12 ORNAMENT, HOOD | 53 RETAINER, FLOOR CARPET (RIGHT-HAND) |
| 13 PANEL, BODY HINGE PILLAR TRIM (LEFT-HAND) | 58 BRACE, FRONT FENDER REAR UPPER |
| 14 PANEL, BODY HINGE PILLAR TRIM (RIGHT-HAND) | 59 BRACE, FRONT FENDER REAR LOWER |
| 16 HANDLE, HOOD RELEASE CABLE | 65 INSULATOR, FRONT FENDER |
| 21 HOOD | 73 FRAME |
| 24 HINGE, HOOD | 76 PANEL, FRONT WHEELHOUSE |
| 25 FENDER, FRONT | 77 SHIELD, FRONT WHEELHOUSE PANEL SPLASH |
| 28 ROD, HOOD OPEN ASSIST | 79 EXTENSION, FRONT WHEELHOUSE PANEL |
| 30 LATCH, HOOD SECONDARY | 85 BAFFLE, RADIATOR AIR SIDE |
| 31 RADIATOR SUPPORT | 89 DEFLECTOR, RADIATOR AIR SIDE |
| 32 HANDLE, HOOD SECONDARY LATCH RELEASE | 91 BRACKET, FRONT LICENSE |
| 35 LATCH, HOOD PRIMARY | 93 MOLDING, FRONT FENDER LOWER REAR |
| 37 BRACKET, HOOD PRIMARY LATCH | 97 MOLDING, FRONT FENDER WHEEL OPENING |
| 45 SUPPORT, RADIATOR GRILLE | 103 BUMPER, HOOD ADJUST FRONT |
| 48 CABLE, HOOD PRIMARY LATCH RELEASE | |

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Figure 1 - Body Front End Components-(Chevrolet)

10-5-4 BODY FRONT END



- | | | | |
|----|--|-----|--|
| 1 | PANEL, AIR INLET GRILLE | 65 | INSULATOR, FRONT FENDER |
| 2 | PANEL, AIR INLET GRILLE | 73 | FRAME |
| 3 | SEAL, HOOD | 76 | PANEL, FRONT WHEELHOUSE |
| 4 | SEAL, HOOD REAR OUTER | 77 | SHIELD, FRONT WHEELHOUSE PANEL SPLASH |
| 13 | PANEL, BODY HINGE PILLAR TRIM (LEFT-HAND) | 79 | EXTENSION, FRONT WHEELHOUSE PANEL |
| 14 | PANEL, BODY HINGE PILLAR TRIM (RIGHT-HAND) | 85 | BAFFLE, RADIATOR AIR SIDE |
| 16 | HANDLE, HOOD RELEASE CABLE | 89 | DEFLECTOR, RADIATOR AIR SIDE |
| 21 | HOOD | 91 | BRACKET, FRONT LICENSE |
| 24 | HINGE, HOOD | 93 | MOLDING, FRONT FENDER LOWER REAR |
| 25 | FENDER, FRONT | 97 | MOLDING, FRONT FENDER WHEEL OPENING |
| 28 | ROD, HOOD OPEN ASSIST | 98 | ORNAMENT, HOOD |
| 30 | LATCH, HOOD SECONDARY | 103 | BUMPER, HOOD ADJUST FRONT |
| 31 | RADIATOR SUPPORT | 113 | MOLDING, FRONT FENDER CENTER REAR (SEDAN) |
| 32 | HANDLE, HOOD SECONDARY LATCH RELEASE | 122 | MOLDING, FRONT FENDER TRANSFER LOWER REAR FINISH (WAGON) |
| 34 | BRACKET, RADIATOR GRILLE LOWER (WAGON) | 123 | MOLDING, FRONT FENDER TRANSFER FRONT FINISH |
| 35 | LATCH, HOOD PRIMARY | 124 | MOLDING, FRONT FENDER TRANSFER UPPER FINISH |
| 37 | BRACKET, HOOD PRIMARY LATCH | 125 | MOLDING, FRONT FENDER WHEEL WAGON (WAGON) |
| 39 | GRILLE, RADIATOR | 132 | BRACKET, RADIATOR GRILLE LOWER (SEDAN) |
| 45 | SUPPORT, RADIATOR GRILLE | | |
| 48 | CABLE, HOOD PRIMARY LATCH RELEASE | | |
| 49 | BRACKET, HOOD OPEN ASSIST ROD | | |
| 52 | RETAINER, FLOOR CARPET (LEFT-HAND) | | |
| 53 | RETAINER, FLOOR CARPET (RIGHT-HAND) | | |
| 58 | BRACE, FRONT FENDER REAR UPPER | | |
| 59 | BRACE, FRONT FENDER REAR LOWER | | |

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Figure 2 - Body Front End Components-(Buick)

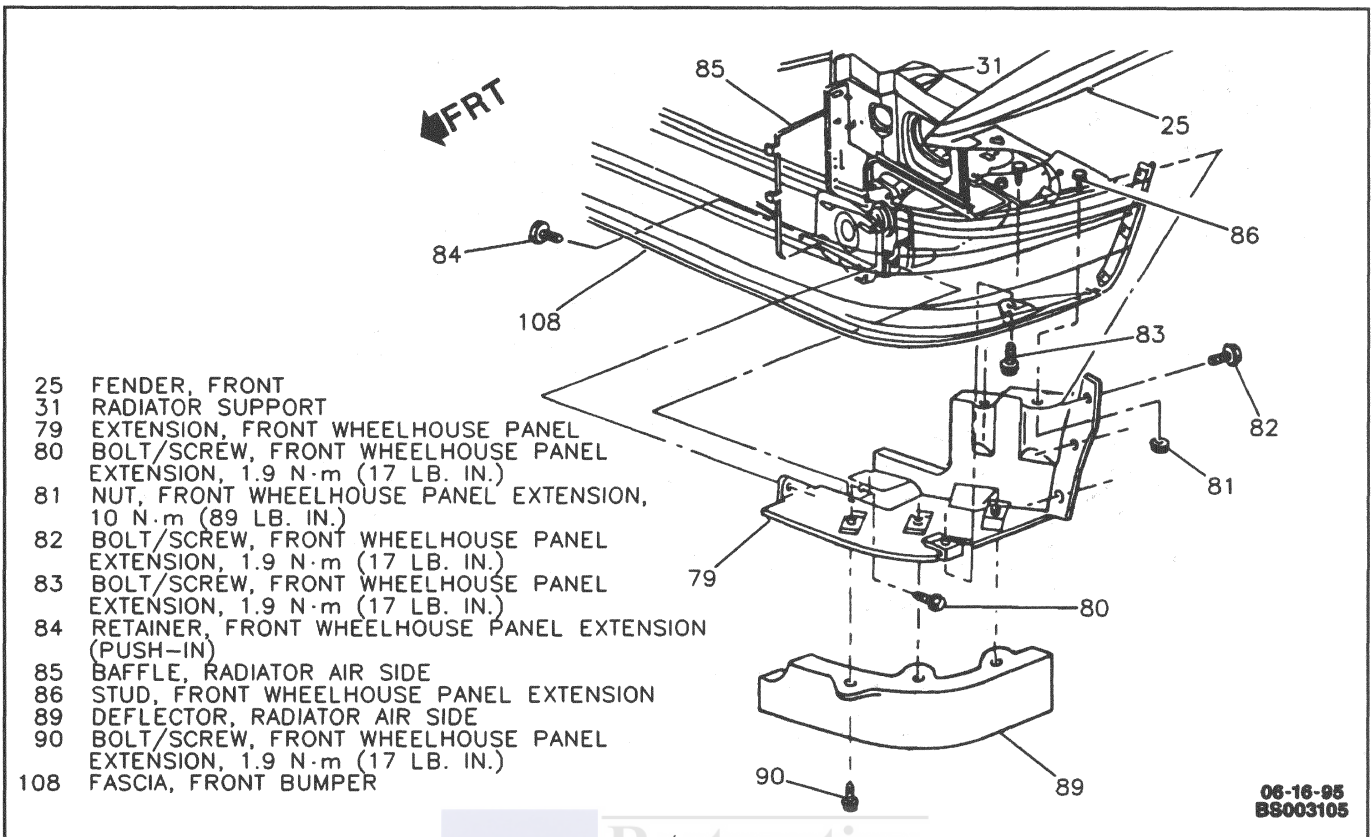


Figure 3 - Front Wheelhouse Panel Extension and Radiator Air Side Deflector

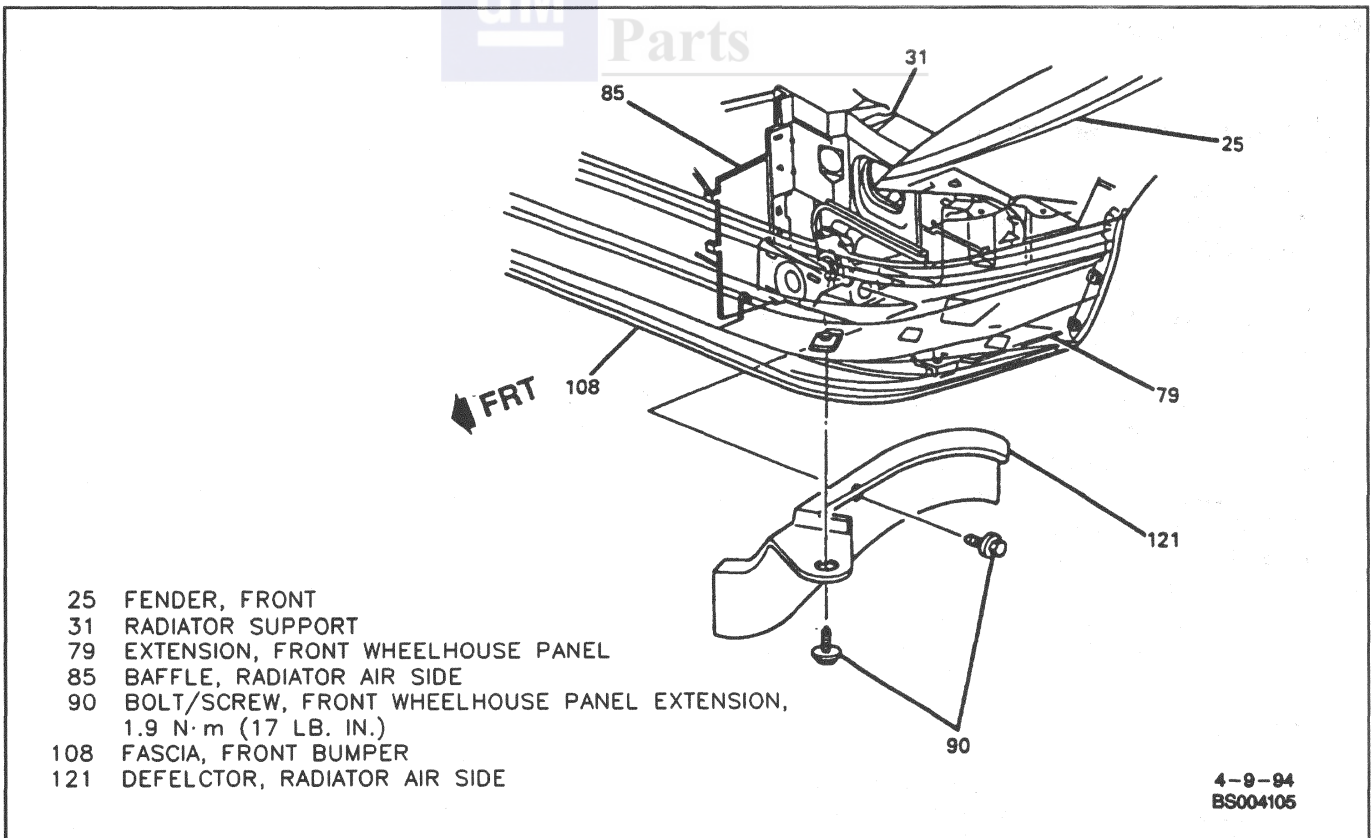


Figure 4 - Radiator Air Side Deflector-(Chevrolet Police and Taxi Vehicles)

10-5-6 BODY FRONT END

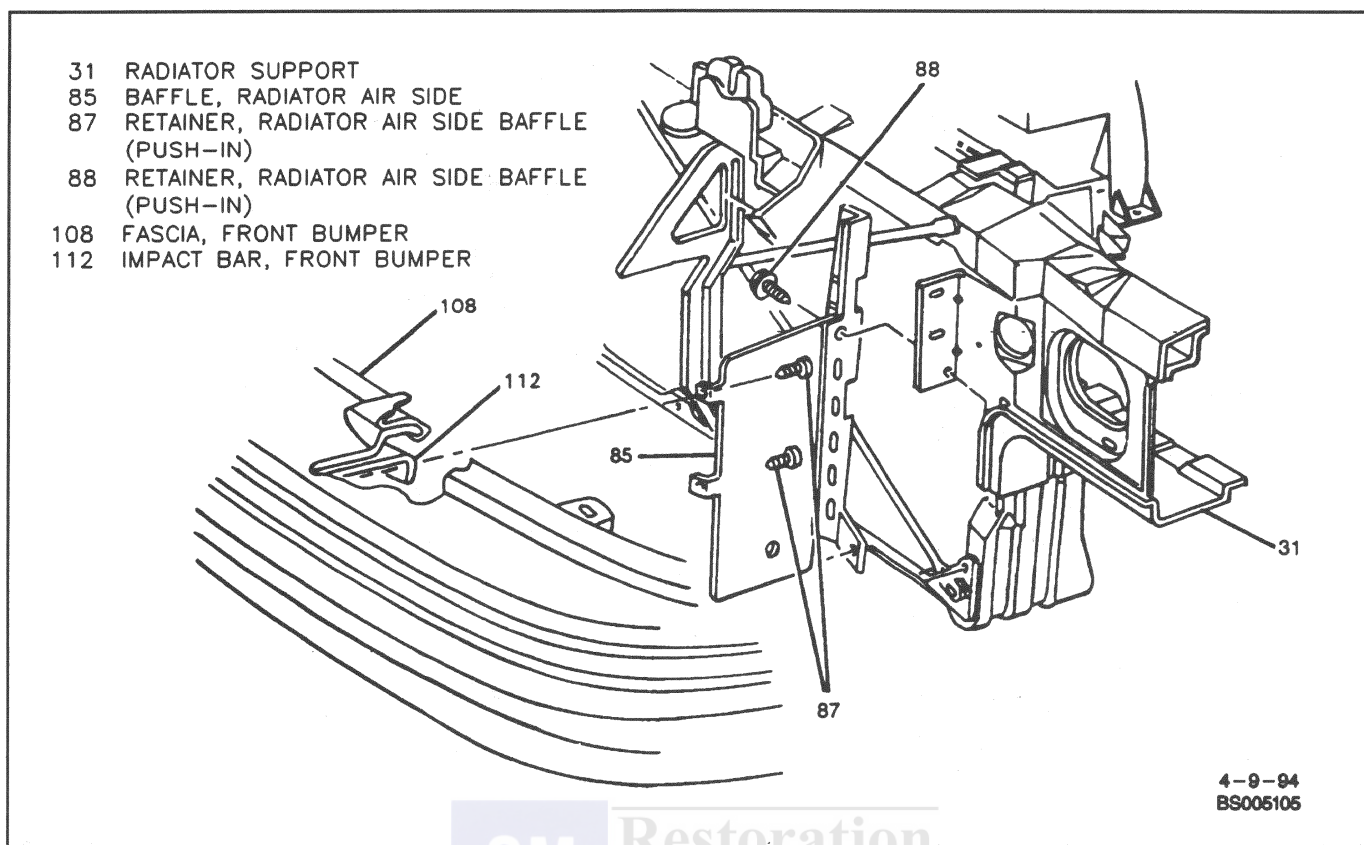


Figure 5 - Radiator Air Side Baffles

Radiator Support

Figures 5 and 6



Remove or Disconnect

1. Disable SIR system. Refer to SECTION 9J.
2. Air intake duct and resonator duct. Refer to SECTION 6E3.
3. Battery tray. Refer to SECTION 6D1.
4. Electrical connectors from inflatable restraint front end sheet metal sensors, outside air temperature sensor, horns and sockets from park and turn signal lamp bulb, front cornering lamp bulb and front sidemarker lamp bulb.
5. Radiator upper mounting panel.
6. Move electrical wiring and connections away from radiator support (31).
7. Headlamp capsule and brace. Refer to SECTION 8B.
8. Cable from primary latch and radiator support. Refer to "Hood Primary Latch Release Cable" in this section.



Important

- Do not remove entire cable. Disconnect from primary latch and radiator support only.
9. Shrouds and radiator from radiator support. Refer to SECTION 6B.
 10. Air conditioning condenser. Refer to SECTION 1B.

11. Wheelhouse panel extension with radiator air side deflector attached. Refer to "Front Wheelhouse Panel Extension" in this section.

12. Wheelhouse panels. Refer to "Front Wheelhouse Panel" in this section.

13. Bolts/screws at radiator support (31).

14. Baffle retainers (88) at radiator support (31).

15. Bolts/screws (66), nuts (74), lower washers (106), upper washers (67), and upper cushions (68).

16. Radiator support (31), lower cushions (69), retainers (70), and shims (71 and 72) from frame (73).



Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Shims (71 and 72), retainers (70), lower cushions (69), and radiator support (31) to frame (73).
2. Upper cushions (68), upper washers (67), bolts/screws (66), lower washers (106) and nuts (74).



Tighten

- Nuts (74) to 50 N.m (37 lb. ft.).
3. Baffle retainers (88) at radiator support (31).
 4. Bolts/screws at radiator support (31).

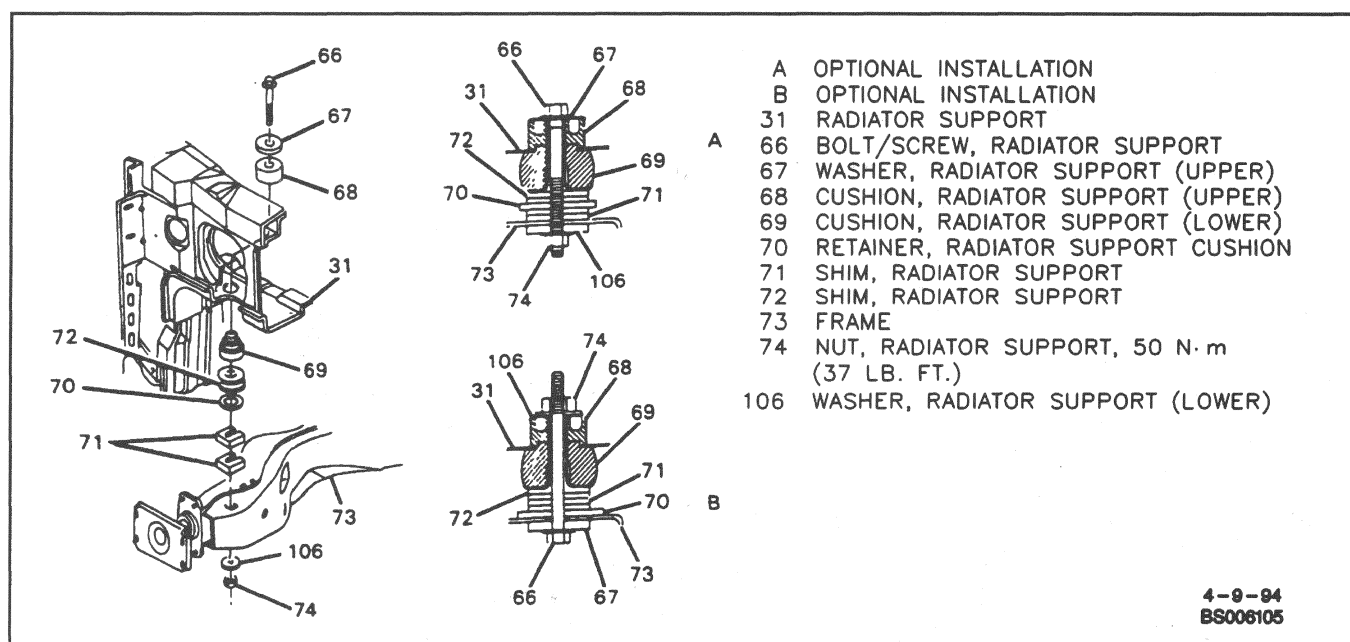


Figure 6 - Radiator Support-(Typical)

5. Wheelhouse panels. Refer to "Front Wheelhouse Panel" in this section.
6. Wheelhouse panel extensions with radiator air side deflector attached. Refer to "Front Wheelhouse Panel Extension" in this section.
7. Air conditioning condenser. Refer to SECTION 1B.
8. Shrouds and radiator to radiator support Refer to SECTION 6B.
9. Cable to primary latch and radiator support. Refer to "Hood Primary Latch Release Cable" in this section.
10. Headlamp capsule and brace. Refer to SECTION 8B.
11. Radiator upper mounting panel.
12. Position wire harness and secure to radiator support (31).
13. Electrical connectors to inflatable restraint front end sheet metal sensors, outside air temperature sensor, horns and sockets to park and turn signal lamp bulb, front cornering lamp bulb and front sidemarker lamp bulb.
14. Battery tray. Refer to SECTION 6D1.
15. Air intake duct and resonator duct. Refer to SECTION 6E3.
16. Enable SIR system. Refer to SECTION 9J.

Grille

Figures 7 through 10

Remove or Disconnect

1. Four bolts/screws (43).
2. Bolt/screw caps (42) and bolts/screws (44).
3. Grille (51 or 39).

- A OPTIONAL INSTALLATION
B OPTIONAL INSTALLATION
31 RADIATOR SUPPORT
66 BOLT/SCREW, RADIATOR SUPPORT
67 WASHER, RADIATOR SUPPORT (UPPER)
68 CUSHION, RADIATOR SUPPORT (UPPER)
69 CUSHION, RADIATOR SUPPORT (LOWER)
70 RETAINER, RADIATOR SUPPORT CUSHION
71 SHIM, RADIATOR SUPPORT
72 SHIM, RADIATOR SUPPORT
73 FRAME
74 NUT, RADIATOR SUPPORT, 50 N·m (37 LB. FT.)
106 WASHER, RADIATOR SUPPORT (LOWER)

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4. Bracket (50, 34 or 132) and supports (45), if necessary.
 - A. Remove clip (116) from rod (33).
 - B. Remove two bolts/screws (104).
 - C. Remove two bolts/screws (105).
 - D. Raise bracket (50, 34 or 132) toward hood assembly (21) until rod (33) disconnects from latch (30).
5. Bracket (50, 34 or 132) from supports (45), if necessary.
 - Remove two bolts/screws (47).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Bracket (50, 34 or 132) to supports (45), if removed.
 - Install two bolts/screws (47).

Tighten

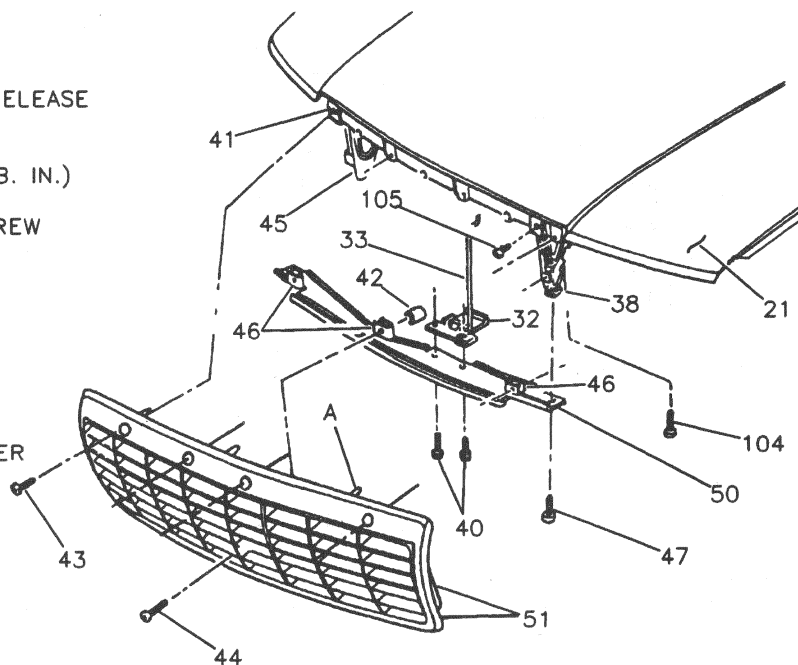
- Bolts/screws (47) to 2.5 N·m (22 lb. in.).
2. Bracket (50, 34 or 132) and supports (45), if removed.
 - A. Install rod (33) to latch (30).
 - B. Install clip (116) to rod (33).
 - C. Install two bolts/screws (105).
 - D. Install two bolts/screws (104).

Tighten

- Bolts/screws (104 and 105) to 2.5 N·m (22 lb. in.).
3. Grille (51 or 39).
 - Align studs to holes in hood (21).
 4. Bolt/screw caps (42) and bolts/screws (44).

10-5-8 BODY FRONT END

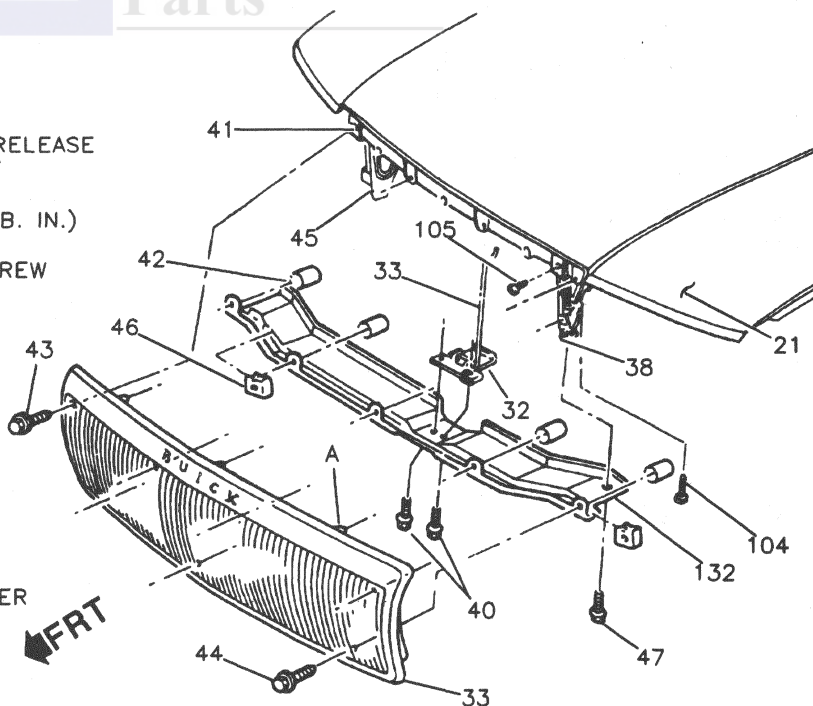
- A STUD
- 21 HOOD
- 32 HANDLE, HOOD SECONDARY LATCH RELEASE
- 33 ROD, HOOD SECONDARY LATCH RELEASE
- 38 NUT, RADIATOR GRILLE SUPPORT
- 40 BOLT/SCREW, HOOD SECONDARY LATCH RELEASE, 2.3 N·m (20 LB. IN.)
- 41 NUT, RADIATOR GRILLE
- 42 CAP, RADIATOR GRILLE BOLT/SCREW
- 43 BOLT/SCREW, RADIATOR GRILLE, 2.4 N·m (21 LB. IN.)
- 44 BOLT/SCREW, RADIATOR GRILLE, 2.4 N·m (21 LB. IN.)
- 45 SUPPORT, RADIATOR GRILLE
- 46 NUT, RADIATOR GRILLE
- 47 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)
- 50 BRACKET, RADIATOR GRILLE LOWER
- 51 GRILLE, RADIATOR
- 104 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)
- 105 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)



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Figure 7 - Grille-(Chevrolet)

- A STUD
- 21 HOOD
- 32 HANDLE, HOOD SECONDARY LATCH RELEASE
- 33 ROD, HOOD SECONDARY LATCH RELEASE
- 38 NUT, RADIATOR GRILLE SUPPORT
- 40 BOLT/SCREW, HOOD SECONDARY LATCH RELEASE, 2.3 N·m (20 LB. IN.)
- 41 NUT, RADIATOR GRILLE
- 42 CAP, RADIATOR GRILLE BOLT/SCREW
- 43 BOLT/SCREW, RADIATOR GRILLE, 2.4 N·m (21 LB. IN.)
- 44 BOLT/SCREW, RADIATOR GRILLE, 2.4 N·m (21 LB. IN.)
- 45 SUPPORT, RADIATOR GRILLE
- 46 NUT, RADIATOR GRILLE
- 47 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)
- 104 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)
- 105 BOLT/SCREW, RADIATOR GRILLE SUPPORT, 2.5 N·m (22 LB. IN.)
- 132 BRACKET, RADIATOR GRILLE LOWER (SEDAN)



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Figure 8 - Grille-(Buick Sedan)

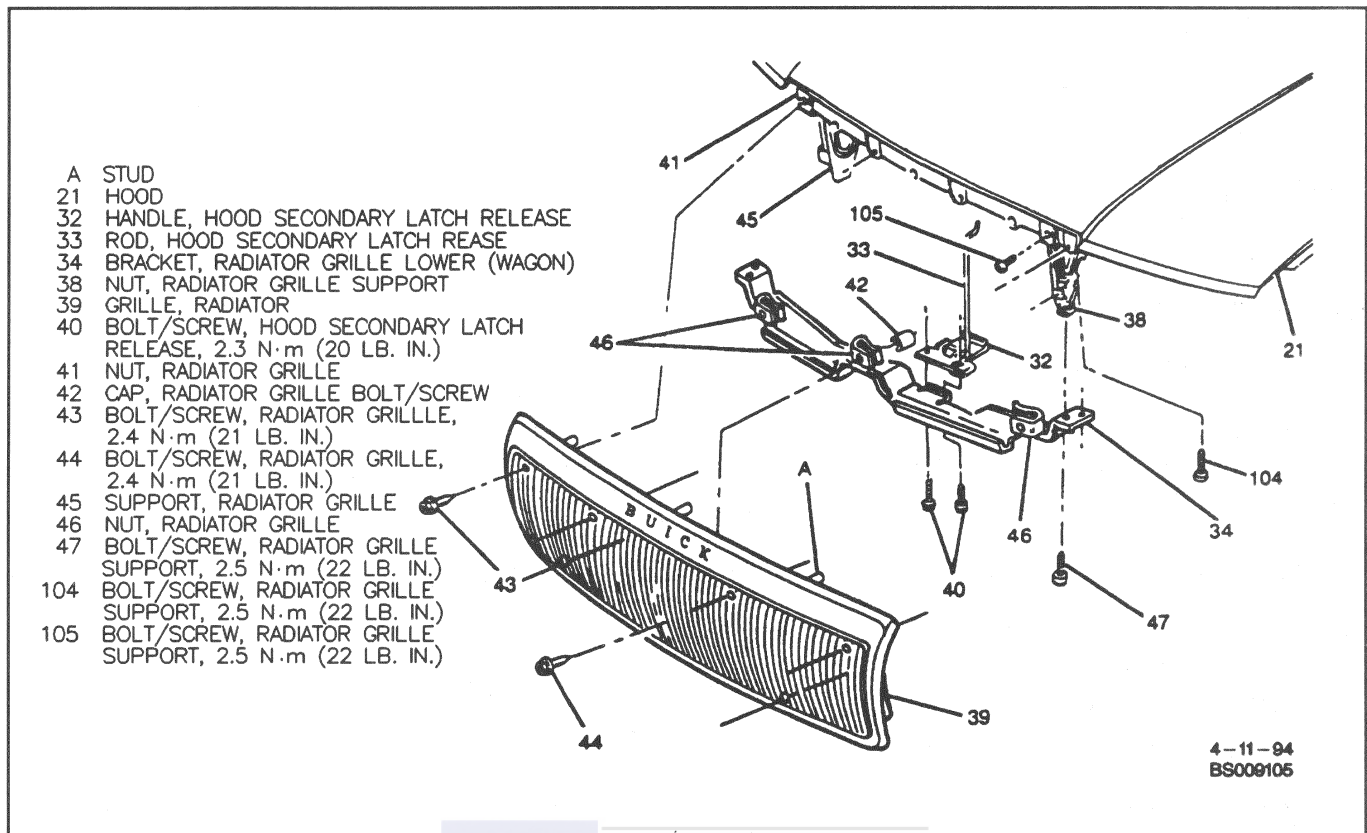


Figure 9 - Grille-(Buick Wagon)

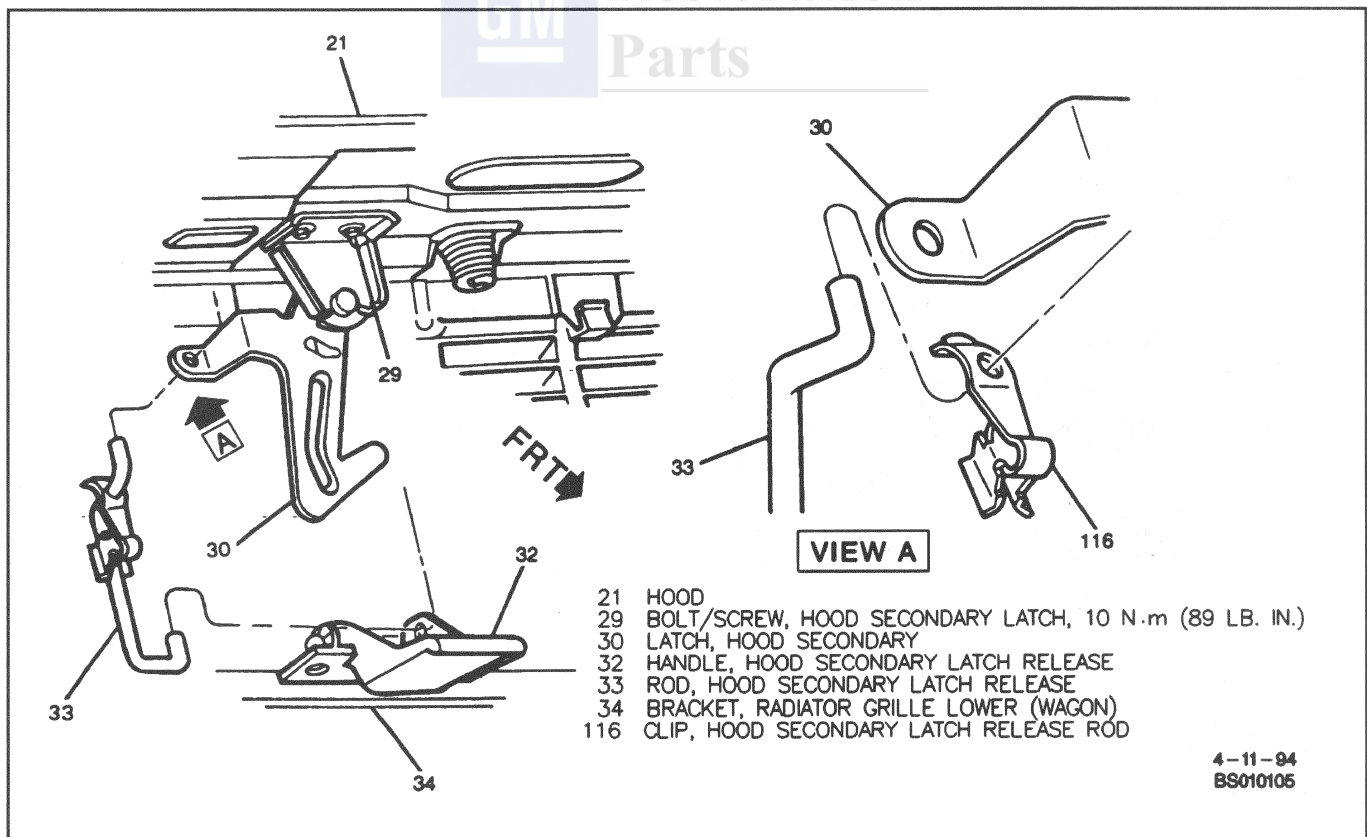


Figure 10 - Hood Secondary Latch-(Typical)



Tighten

- Bolts/screws (44) to 2.4 N.m (21 lb. in.).
5. Four bolts/screws (43).



Tighten

- Bolts/screws (43) to 2.4 N.m (21 lb. in.).

FRONT FENDER

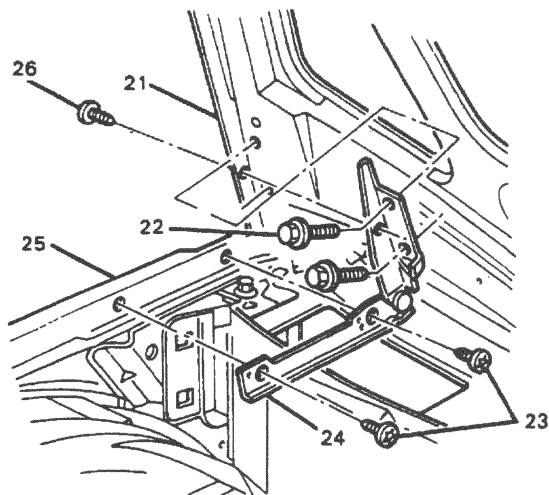
Figures 11 through 16

NOTICE: Tape fender and door edges to prevent vehicle damage during fender removal and installation.



Remove or Disconnect

1. Hood. Refer to "Hood" in this section.
2. Air inlet grille panels. Refer to "Air Inlet Grille Panels" in this section.
3. Headlamp capsule and brace. Refer to SECTION 8B.
4. Front fender lower rear molding, wheel opening molding, and center rear molding, if required. Refer to "Exterior Moldings" in this section.
5. Upper brace bolt/screw (57) from upper brace nut (9).



- 21 HOOD
22 BOLT/SCREW, HOOD HINGE, 25 N.m (18 LB. FT.)
23 BOLT/SCREW, FRONT FENDER INNER PANEL, 25 N.m
(18 LB. IN.)
24 HINGE, HOOD
25 FENDER, FRONT
26 BOLT/SCREW, HOOD HINGE, 8 N.m (71 LB. IN.)

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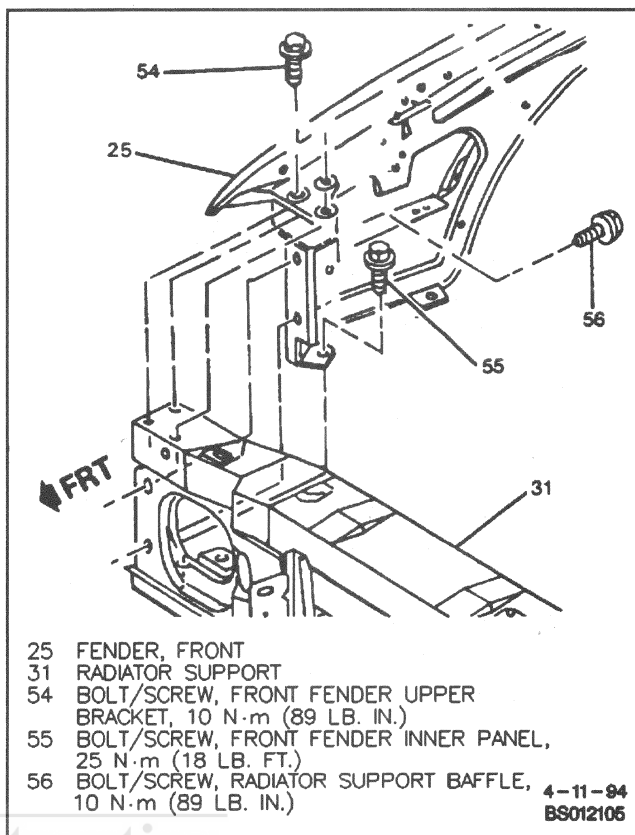


Figure 12 - Front Fender to Radiator Support

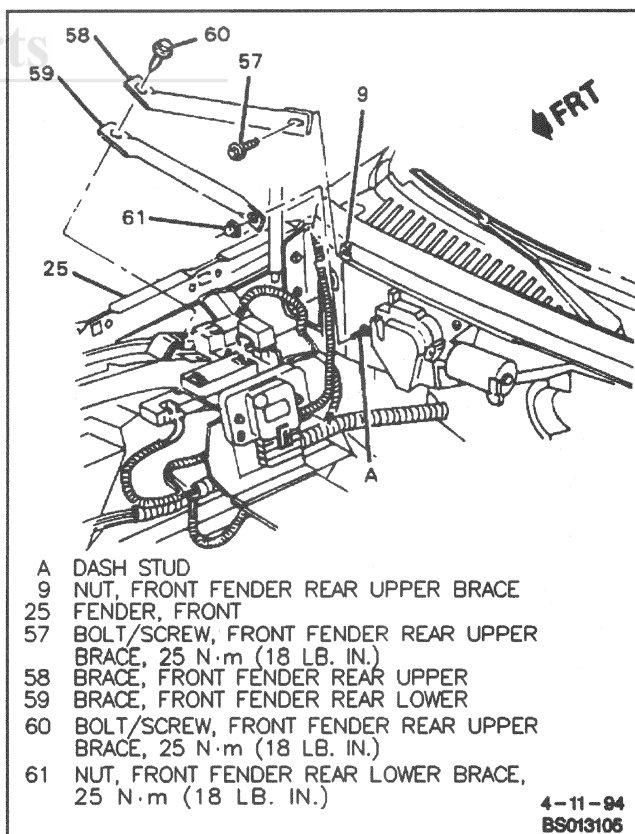


Figure 13 - Front Fender Rear Upper and Lower Braces

Figure 11 - Hood Hinge

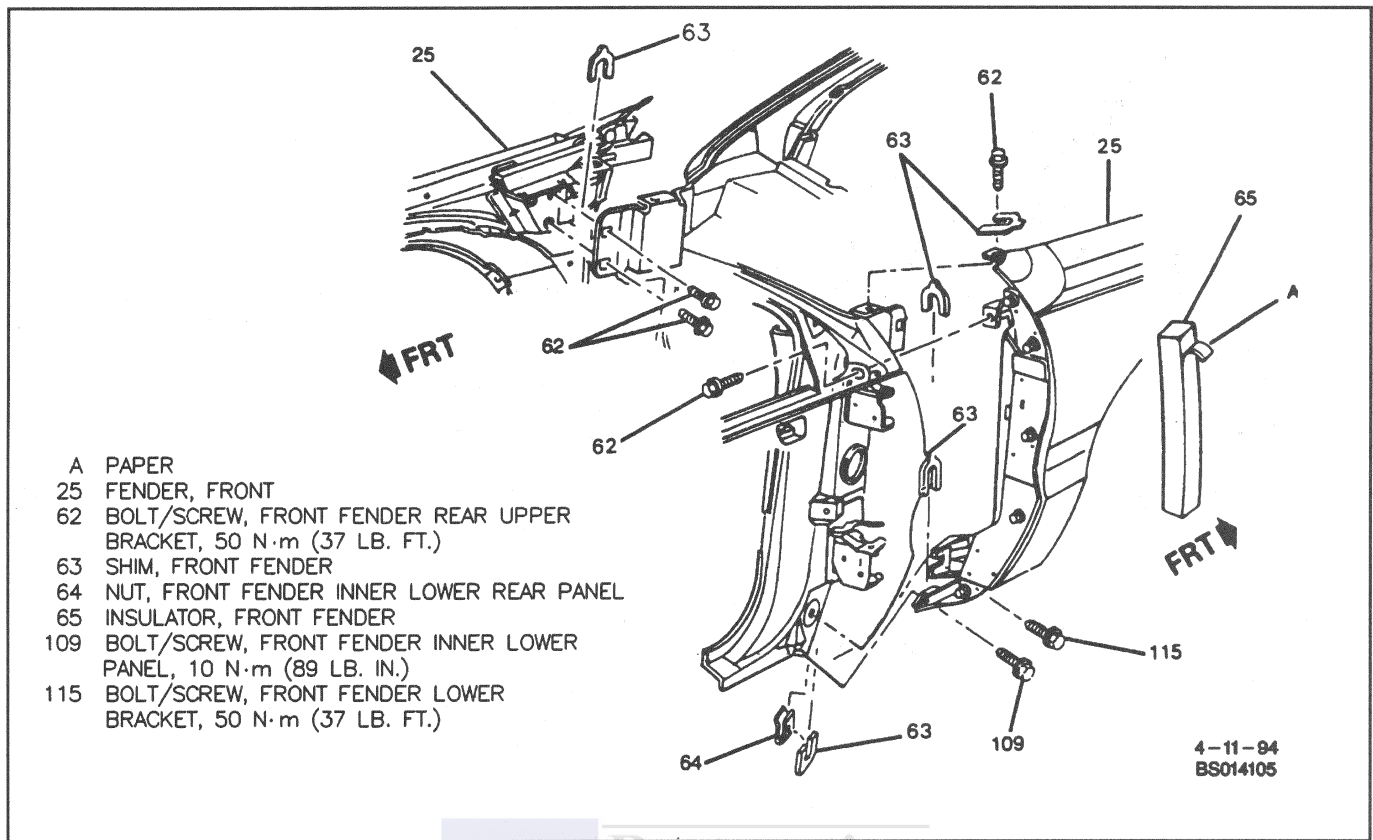


Figure 14 - Front Fender to Dash

6. Upper brace bolt/screw (60) from nut on fender (25).
7. Lower brace nut (61).
8. Upper and lower braces (58 and 59).
9. Horn, if required. Refer to SECTION 8B.
10. Wiring harness clips, if required.
11. Battery tray, if removing right fender. Refer to SECTION 6D1.
12. Upper bracket bolts/screws (54), inner panel bolts/screws (55) and baffle bolts/screws (56).
13. Inner panel bolts/screws (23).
14. Wheelhouse panel bolts/screws (75).
15. Raise and suitably support vehicle. Refer to SECTION 0A.
16. Wheelhouse panel bolts/screws (111).
17. Wheelhouse panel extension with radiator air side deflectors attached. Refer to "Front Wheelhouse Panel Extension" in this section.
18. Bolts/screws attaching fascia to fender. Refer to SECTION 10-4.
19. Lower vehicle.
20. Upper bracket bolts/screws (62).
21. Shims (63).

- Note placement and number of shims (63) so they can be reinstalled in same location from which they were removed.

22. Lower panel bolt/screw (109).
23. Lower bracket bolt/screw (115).
24. Fender (25).

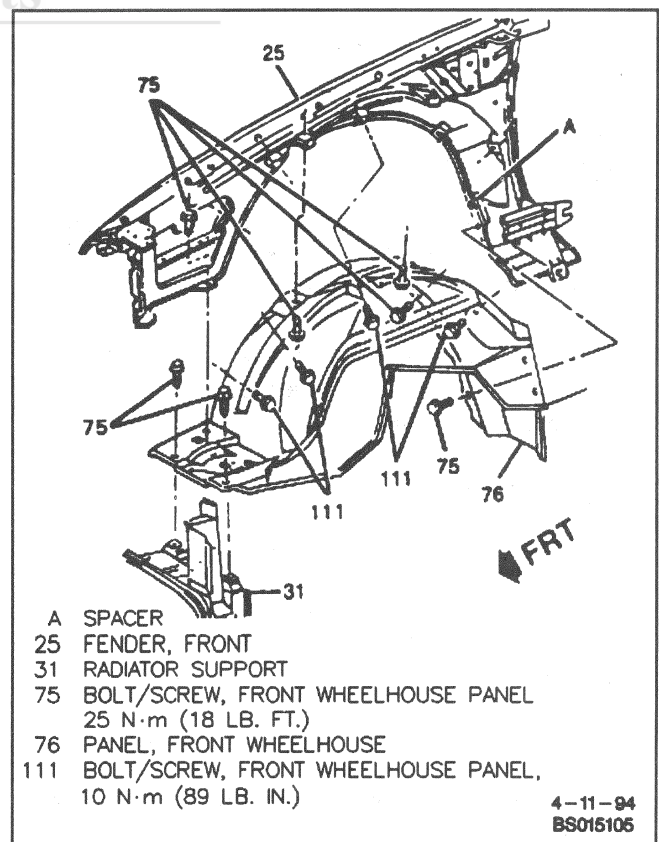


Figure 15 - Front Wheelhouse Panel

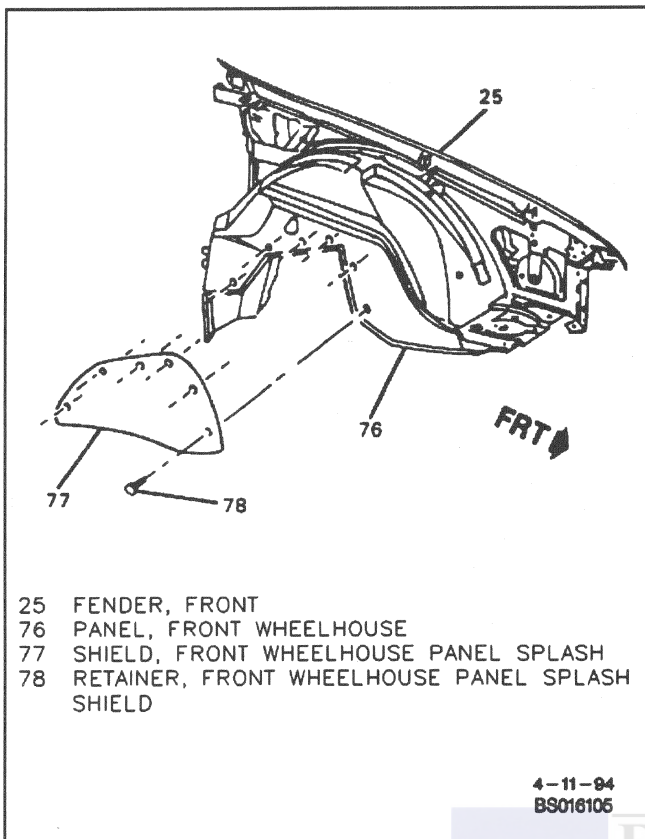


Figure 16 - Front Wheelhouse Panel-(Splash Shield)

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

Important

- When fender is removed from vehicle, a special insulator must be installed in replacement procedure.

1. Fender (25) and insulator (65).

- Peel paper off insulator (65) and press insulator (65) onto fender (25).

2. Lower bracket bolt/screw (115).

Tighten

- Lower bracket bolt/screw (115) to 50 N.m (37 lb. ft.).

3. Lower panel bolt/screw (109).

Tighten

- Lower panel bolt/screw (109) to 10 N.m (89 lb. in.).

4. Shims (63) in same location from which they were removed.

5. Upper bracket bolts/screws (62).

Tighten

- Upper bracket bolts/screws (62) to 50 N.m (37 lb. ft.).

6. Raise and suitably support vehicle. Refer to SECTION 0A.

7. Bolts/screws attaching fascia to fender. Refer to SECTION 10-4.

8. Wheelhouse panel extension with radiator air side deflectors attached. Refer to "Front Wheelhouse Panel Extension" in this section, but do not lower vehicle at this time.

9. Wheelhouse panel bolts/screws (111).

Tighten

- Wheelhouse panel bolts/screws (111) to 10 N.m (89 lb. in.).

10. Lower vehicle.

11. Wheelhouse panel bolts/screws (75).

Tighten

- Wheelhouse Panel bolts/screws (75) to 25 N.m (18 lb. ft.).

12. Inner panel bolts/screws (23).

Tighten

- Inner panel bolts/screws (23) to 25 N.m (18 lb. ft.).

13. Upper bracket bolts/screws (54), inner panel bolts/screws (55) and baffle bolts/screws (56).

Tighten

- Upper bracket bolts/screws (54) to 10 N.m (89 lb. in.).

- Inner panel bolts/screws (55) to 25 N.m (18 lb. ft.).

- Baffle bolts/screws (56) to 10 N.m (89 lb. in.).

14. Battery tray, if removed. Refer to SECTION 6D1.

15. Wiring harness clips, if removed.

16. Horn. Refer to SECTION 8B.

17. Upper and lower braces (58 and 59).

18. Lower brace nut (61).

Tighten

- Lower brace nut (61) to 25 N.m (18 lb. ft.).

19. Upper brace bolt/screw (60) to nut on fender (25).

20. Upper brace bolt/screw (57) to upper brace nut (9).

Tighten

- Upper brace bolts/screws (57 and 60) to 25 N.m (18 lb. ft.).

21. Front fender lower rear molding, wheel opening molding, and center rear moldings, if removed. Refer to "Exterior Moldings" in this section.

22. Headlamp capsule and brace. Refer to SECTION 8B.
23. Air inlet grille panels. Refer to "Air Inlet Grille Panels" in this section.
24. Hood. Refer to "Hood" in this section.

Front Wheelhouse Panel

Figure 15

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Battery tray, if removing right wheelhouse panel. Refer to SECTION 6D1.
3. Move electrical wiring and connections away from wheelhouse panel (76).
4. Coolant recovery reservoir, if removing right wheelhouse panel. Refer to SECTION 6B.
5. Fuel vapor canister and air intake duct, if removing left wheelhouse panel. Refer to SECTION 6E3.
6. Windshield washer solvent container, if removing left wheelhouse panel. Refer to SECTION 8E.
7. Wiring harness clips at wheelhouse panel (76).
8. Bolts/screws attaching cruise control module to left wheelhouse panel (76), if removing left wheelhouse panel (76).
9. Nuts from studs attaching multi-purpose relay bracket and air conditioning accumulator bracket to right wheelhouse panel (76), if removing right wheelhouse panel (76).
10. Battery cable junction block, if removing right wheelhouse panel. Refer to SECTION 6D1.
11. Wheelhouse panel extension with radiator air side deflector attached. Refer to "Front Wheelhouse Panel Extension" in this section.
12. Tire and wheel. Refer to SECTION 3E.
13. Wheelhouse panel bolts/screws (75 and 111).
14. Wheelhouse panel (76).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Wheelhouse panel (76).
2. Wheelhouse panel bolts/screws (75 and 111).

Tighten

- Wheelhouse panel bolts/screws (75) to 25 N·m (18 lb. ft.).
 - Wheelhouse panel bolts/screws (111) to 10 N·m (89 lb. in.).
3. Tire and wheel. Refer to SECTION 3E.

4. Wheelhouse panel extension with radiator air side deflector attached. Refer to "Front Wheelhouse Panel Extension" in this section.
5. Battery cable junction block, if right wheelhouse panel was removed. Refer to SECTION 6D1.
6. Nuts onto studs attaching air conditioning accumulator bracket and multi-purpose relay bracket to right wheelhouse panel (76), if right wheelhouse panel (76) was removed.
7. Bolts/screws attaching cruise control module to left wheelhouse panel (76), if left wheelhouse panel (76) was removed.
8. Wiring harness clips at wheelhouse panel (76).
9. Windshield washer solvent container, if left wheelhouse panel was removed. Refer to SECTION 8E.
10. Fuel vapor canister and air intake duct, if left wheelhouse panel was removed. Refer to SECTION 6E3.
11. Coolant recovery reservoir, if right wheelhouse panel was removed. Refer to SECTION 6B.
12. Battery tray, if right wheelhouse panel was removed. Refer to SECTION 6D1.
13. Battery negative cable.

Front Wheelhouse Panel Splash Shield

Figure 16

Remove or Disconnect

1. Resonator duct, if removing left wheelhouse panel splash shield. Refer to SECTION 6E3.
2. Six splash shield retainers (78).
3. Wheelhouse panel splash shield (77).

Install or Connect

1. Wheelhouse panel splash shield (77).
2. Six splash shield retainers (78).
3. Resonator duct, if removed. Refer to SECTION 6E3.

Front Wheelhouse Panel Extension

Figure 3

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Wheelhouse panel extension retainers (84).
3. Wheelhouse panel extension bolts/screws (82).
4. Wheelhouse panel extension bolts/screws (83).
5. Wheelhouse panel extension nuts (81) from studs (86).
6. Wheelhouse panel extension bolt/screw (80).
7. Wheelhouse panel extension bolts/screws (90).
8. Radiator air side deflector (89).
9. Wheelhouse panel extension (79).

10-5-14 BODY FRONT END

Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Wheelhouse panel extension (79).
2. Radiator air side deflector (89).
3. Wheelhouse panel extension bolts/screws (90).

Tighten

- Wheelhouse panel extension bolts/screws (90) to 1.9 N·m (17 lb. in.).
4. Wheelhouse panel extension bolt/screw (80).

Tighten

- Wheelhouse panel extension bolt/screw (80) to 1.9 N·m (17 lb. in.).
5. Wheelhouse panel extension nuts (81) to studs (86).

Tighten

- Wheelhouse panel extension nuts (81) to 10 N·m (89 lb. in.).
6. Wheelhouse panel extension bolts/screws (83).

Tighten

- Wheelhouse panel extension bolts/screws (83) to 1.9 N·m (17 lb. in.).
7. Wheelhouse panel extension bolts/screws (82).

Tighten

- Wheelhouse panel extension bolts/screws (82) to 1.9 N·m (17 lb. in.).
8. Wheelhouse panel extension retainers (84).
 9. Lower vehicle.

HOOD

Figures 11 and 17

NOTICE: Raise hood and install protective coverings over fender areas to prevent damage to paint and moldings when removing or installing the hood.

Remove or Disconnect

1. Underhood lamp wire.
2. Mark positions of hood hinges (24) on hood (21) to allow alignment during installation.
3. With aid of a helper, support hood (21).
4. Hood open assist rod (28) from ball stud (27).
5. Hood hinge bolts/screws (22 and 26).
6. Hood (21).

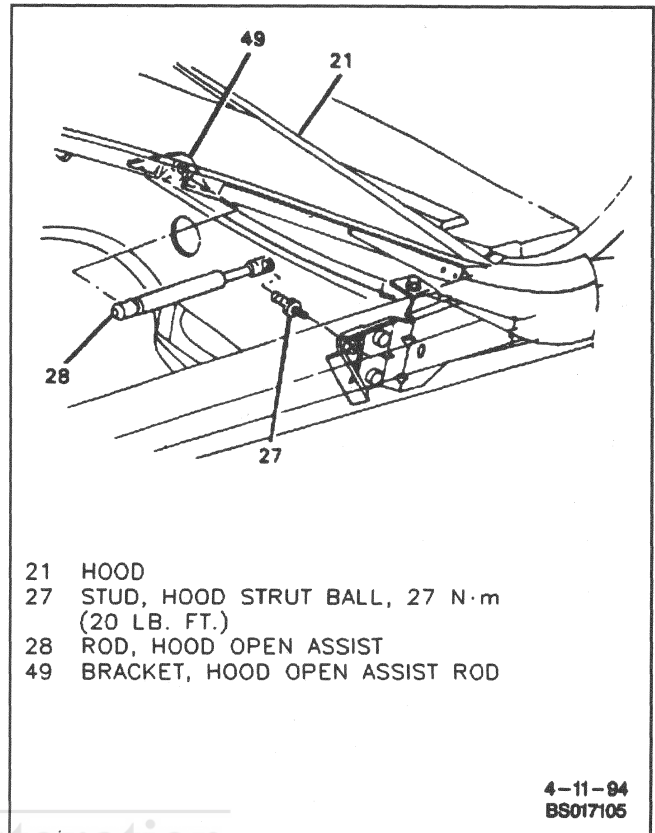


Figure 17 - Hood Open Assist Rod

Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Hood (21), with aid of a helper so that alignment marks made during removal line up with hood hinges (24).
2. Hood hinge bolts/screws (22 and 26).

Tighten

- Hood hinge bolts/screws (22) to 25 N·m (18 lb. ft.).
 - Hood hinge bolt/screw (26) to 8 N·m (71 lb. in.).
3. Hood open assist rod (28) to ball stud (27).

Inspect

NOTICE: Failure to align hood hinge properly may result in damage to the hood seal.

- A. Close hood (21) slowly, checking clearance between hood (21) and front fenders (25).
- B. With hood (21) closed, check alignment of hood (21). For hood alignment specifications, refer to “Body Panel Adjustment and Alignment” in this section.

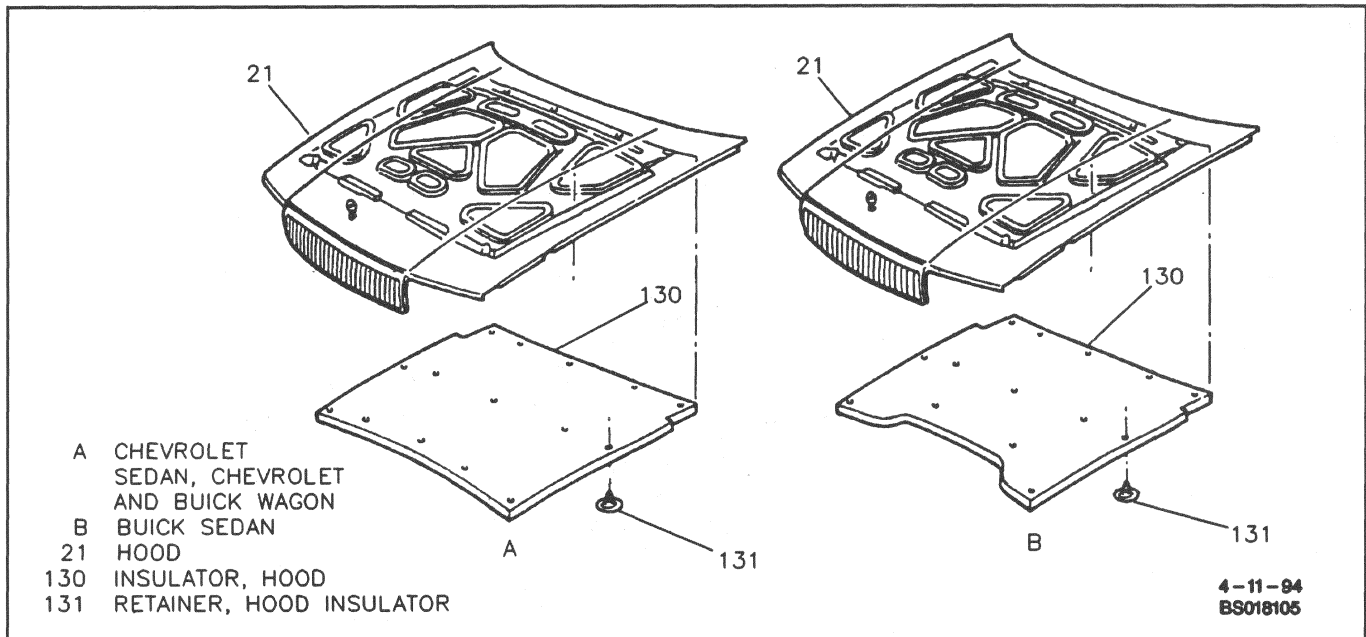


Figure 18 - Hood Insulator



Adjust

- Hood, if necessary. Refer to “Hood Adjustment” in this section.

4. Underhood lamp wire.

Hood Insulator

Figure 18



Remove or Disconnect

1. Retainers (131) from hood (21).
2. Hood insulator (130).



Install or Connect

1. Hood insulator (130).
2. Retainers (131) to hood (21).

Hood Hinge

Figures 11, 17 and 19

NOTICE: Raise hood and install protective coverings over the fender areas to prevent damage to paint and moldings when removing or installing hood hinges.



Remove or Disconnect

1. Mark position of hood hinge (24) on hood (21) to allow alignment during installation.
2. Safely support hood (21).
3. Block hood (21) on side where hood hinge (24) is to be removed.
4. Outer seals (4).
5. Hood open assist rod (28) from ball stud (27).

6. Hood hinge bolts/screws (22 and 26).
7. Inner panel bolts/screws (23).
8. Hood hinge (24).



Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Hood hinge (24) so that it lines up with marks made on hood (21) during removal.
2. Inner panel bolts/screws (23).
3. Hood hinge bolts/screws (22 and 26).



Tighten

- Hood hinge bolts/screws (22) and inner panel bolts/screws (23) to 25 N.m (18 lb. ft.).
 - Hood hinge bolt/screw (26) to 8 N.m (71 lb. in.).
4. Hood open assist rod (28) to ball stud (27).
 5. Outer seals (4).
 6. Remove block and close hood (21).

NOTICE: Failure to align hood hinge properly may result in damage to the hood seal.



Inspect

- A. Close hood (21) slowly, checking clearance between hood (21) and front fenders (25).
- B. With hood (21) closed, check alignment of hood (21). For hood alignment specifications, refer to “Body Panel Adjustment and Alignment” in this section.

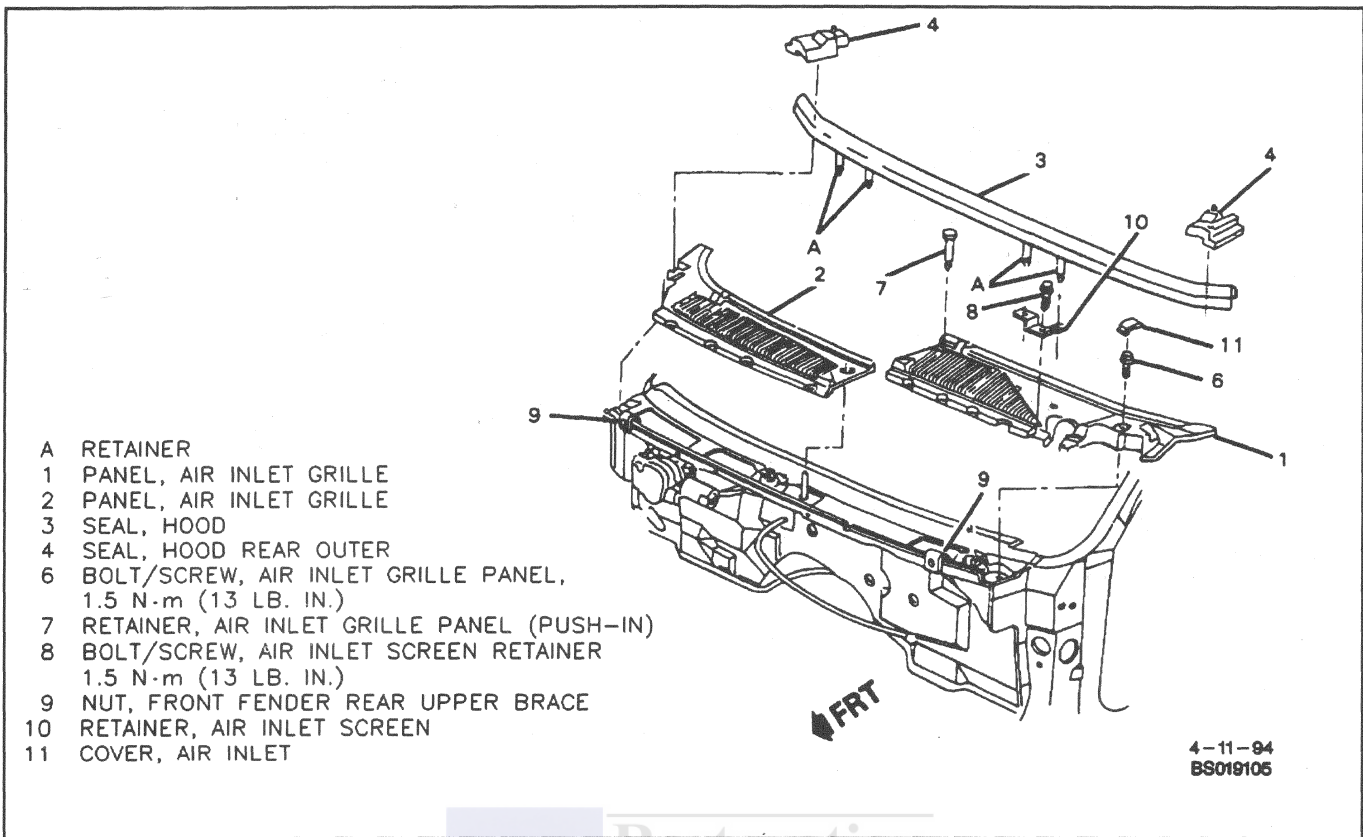


Figure 19 - Air Inlet Grille Panel



Adjust

- Hood, if necessary. Refer to “Hood Adjustment” in this section.

Hood Primary Latch

Figure 20



Remove or Disconnect

1. Primary latch release cable from primary latch. Refer to “Hood Primary Latch Release Cable” in this section.
2. Mark position of primary latch (35).
3. Bracket bolts/screws (36) and primary latch (35).



Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Primary latch (35) and bracket bolts/screws (36).
 - Align primary latch (35) with marks made during removal.



Tighten

- Bracket bolts/screws (36) to 25 N·m (18 lb. ft.).

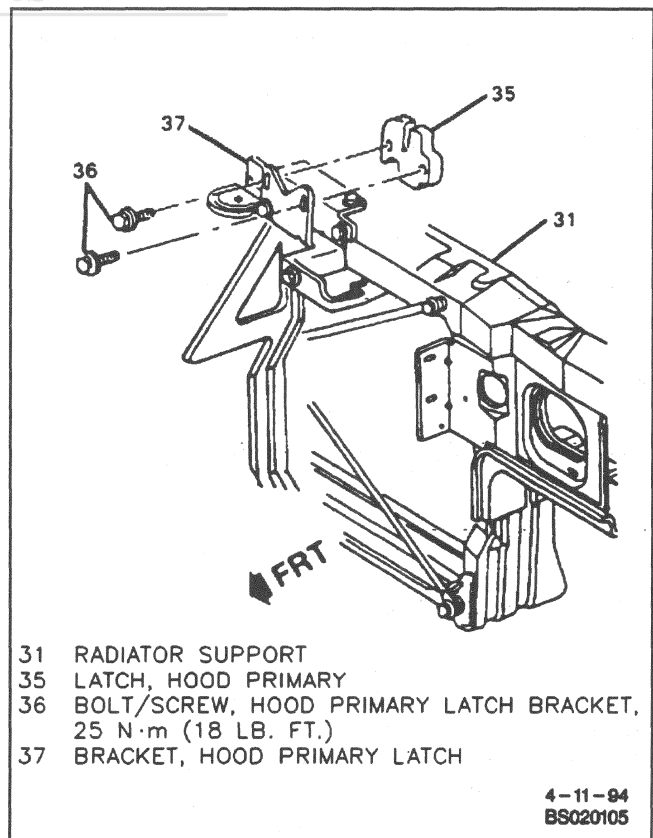


Figure 20 - Hood Primary Latch

2. Primary latch release cable to primary latch. Refer to "Hood Primary Latch Release Cable" in this section.
3. Check operation of primary latch release cable.



Adjust

- Primary latch (35), if necessary.

Hood Secondary Latch

Figure 10



Remove or Disconnect

1. Secondary latch bolts/screws (29).
2. Secondary latch (30).
3. Clip (116) from rod (33).
4. Rod (33) from secondary latch (30) and handle (32).



Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Rod (33) to secondary latch (30) and handle (32).
2. Clip (116) to rod (33).
3. Secondary latch (30).
4. Secondary latch bolts/screws (29).



Tighten

- Secondary latch bolts/screws (29) to 10 N.m (89 lb. in.).

Hood Secondary Latch Release Handle

Figures 7 through 10



Remove or Disconnect

1. Secondary latch release bolts/screws (40).
2. Handle (32).
3. Clip (116) from rod (33).
4. Rod (33) from handle (32) and secondary latch (30).



Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Rod (33) to handle (32) and secondary latch (30).
2. Clip (116) to rod (33).
3. Handle (32).
4. Secondary latch bolts/screws (40).



Tighten

- Secondary latch bolts/screws (40) to 2.3 N.m (20 lb. in.).

Hood Primary Latch Release Cable

Figures 20 through 22



Remove or Disconnect

1. Cable (48) from primary latch (35) and radiator support (31).
 - A. Disconnect cable (48) by prying cable (48) from primary latch (35).
 - B. Pry cable grommet from primary latch (35).
 - C. Pull cable (48) out through hole in radiator support (31).
2. Windshield washer solvent container. Refer to SECTION 8E.
3. Four carpet retainer bolts/screws (15) from left side carpet retainer (52) ahead of center pillar.
4. Left side body hinge pillar trim panel (13).
 - Slide left side body hinge pillar trim panel (13) out from beneath left side carpet retainer (52).
5. Primary latch release cable bolts/screws (5) and hood release cable handle (16).
6. Cowl grommet.
7. Cable (48).
 - Note where cable (48) is routed before removing so it can be installed correctly.



Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Cable (48) through cowl.
 - Route cable (48) where previously noted.
2. Cowl grommet.
3. Hood release cable handle (16) and primary latch release cable bolts/screws (5).



Tighten

- Primary latch release cable bolts/screws (5) to 1.9 N.m (17 lb. in.).
4. Left side trim panel (13).
 - Slide left side trim panel (13) under left side carpet retainer (52).
 5. Four carpet retainer bolts/screws (15) to left side carpet retainer (52) ahead of center pillar.



Tighten

- Carpet retainer bolts/screws (15) to 1.3 N.m (12 lb. in.).
6. Windshield washer solvent container. Refer to SECTION 8E.
 7. Cable (48) to primary latch (35).
 - A. Route cable (48) through hole in radiator support (31).
 - B. Insert end of cable (48) into latch clip and attach cable grommet.

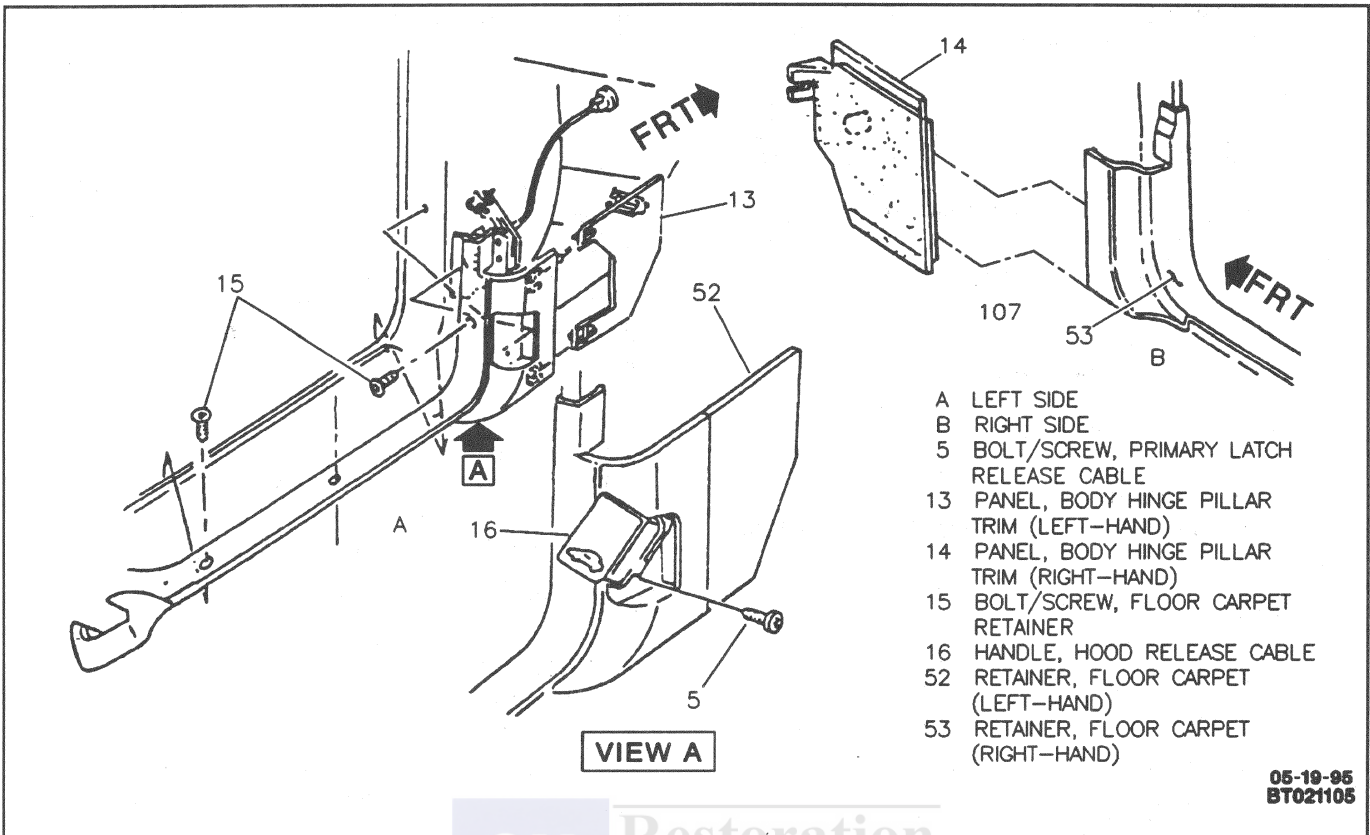


Figure 21 - Body Hinge Pillar Trim Panel

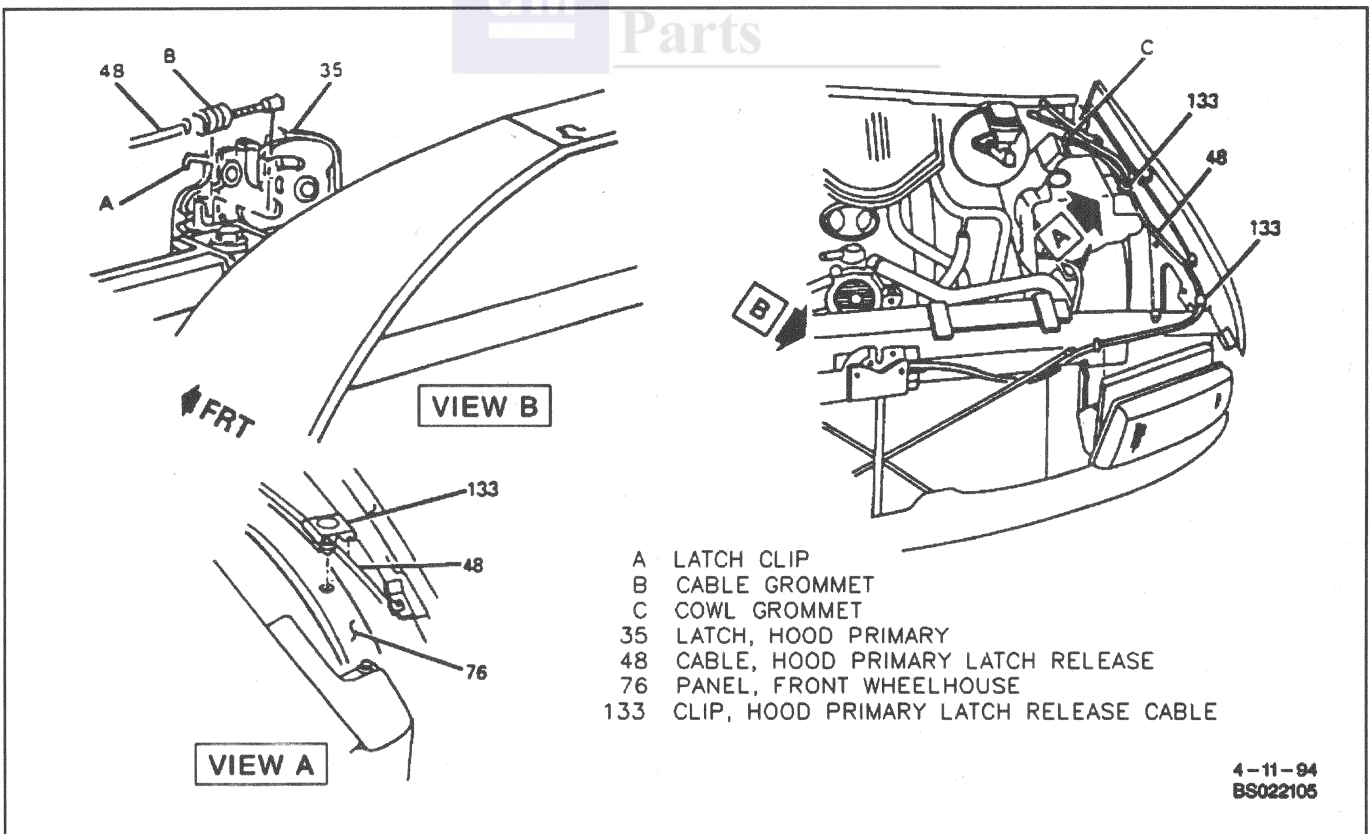


Figure 22 - Hood Primary Latch Release Cable

Hood Open Assist Rod

Figure 17

CAUTION: Hood open assist rods hold the hood in the up position. Ensure the hood is safely supported when hood open assist rods are removed or installed to avoid the possibility of damage to the vehicle or personal injury.

Remove or Disconnect

1. Raise hood (21) to full open position.
2. Safely support hood (21).
3. Hood open assist rod (28) from ball stud on bracket (49).
4. Hood open assist rod (28) from front fender ball stud (27).
5. Front fender ball stud (27), if required.

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Front fender ball stud (27), if removed.

Tighten

- Front fender ball stud (27) to 27 N.m (20 lb. ft.).
2. Hood open assist rod (28) to front fender ball stud (27).
 3. Hood open assist rod (28) to ball stud (27) on bracket (49).

Hood Adjust Front Bumpers

Figure 23

Remove or Disconnect

- Bumper (103) from radiator support (31) by turning 1/8 turn counterclockwise and pulling up.

Install or Connect

- Bumper (103) to radiator support (31) by turning 1/8 turn clockwise.

Adjust

- Bumper (103). Refer to "Body Panel Adjustment and Alignment" in this section.

Air Inlet Grille Panels

Figure 19

Tool Required:
J 21104-B Universal Weatherstrip Remover

Remove or Disconnect

1. Hood seal (3) from left and right air inlet grille panels (1 and 2).
 - Remove 15 retainers using J 21104-B.
2. Wiper arms. Refer to SECTION 8E.
3. Outer seals (4).
4. Two covers (11) and eight grille panel bolts/screws (6) from left and right air inlet grille panels (1 and 2).
5. Screen retainer bolt/screw (8) and retainer (10).
6. Retainers (7).

NOTICE: When removing left and right air inlet grille panels, always remove the left first, then the right, to avoid windshield breakage.

7. Left and right air inlet grille panels (1 and 2).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

NOTICE: When installing left and right air inlet grille panels, the right must be installed first, then the left, to avoid windshield breakage.

1. Right and left air inlet grille panels (1 and 2).
2. Retainers (7).
3. Screen retainer bolt/screw (8) and retainer (10).
4. Two covers (11) and eight grille panel bolts/screws (6).

Tighten

- Grille panel bolts/screws (6) to 1.5 N.m (13 lb. in.).
 - Screen retainer bolt/screw (8) to 1.5 N.m (13 lb. in.).
5. Outer seals (4).

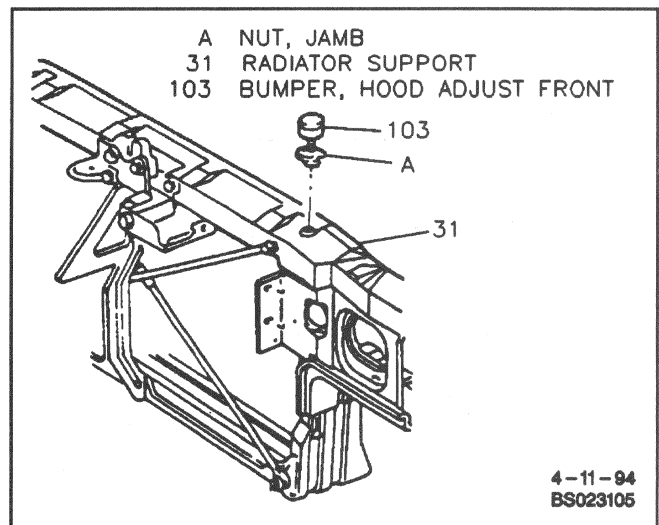


Figure 23 - Hood Adjust Front Bumper

10-5-20 BODY FRONT END

6. Wiper arms. Refer to SECTION 8E.
7. Hood seal (3) to left and right air inlet grille panels (1 and 2).
 - Install 15 retainers firmly.

FRONT END SEALING

All potential water leak locations are sealed in production with high quality durable sealers. To reseal specific areas, a high quality medium-bodied sealer that will remain flexible after curing and can be painted should be used. Refer to SECTION 10-1.

BODY HINGE PILLAR TRIM PANELS

Figure 21

The left trim panel (13) attaches under the left side carpet retainer (52) which contains the hood release cable handle (16) for the cable. The right trim panel (14) attaches under the right side carpet retainer (53). This trim panel (14) covers the Daytime Running Lamp (DRL) module or twilight sentinel module.

Remove or Disconnect

1. Four carpet retainer bolts/screws (15) from left or right side carpet retainer (52 or 53), just ahead of center pillar.
2. Left or right trim panel (13 or 14).
 - Slide left or right trim panel (13 or 14) out from beneath left or right side carpet retainer (52 or 53).

Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Left or right trim panel (13 or 14) under left or right side carpet retainer (52 or 53).
2. Four carpet retainer bolts/screws (15) to left or right side carpet retainer (52 or 53), just ahead of center pillar.

Tighten

- Carpet retainer bolts/screws (15) to 1.3 N.m (12 lb. in.).

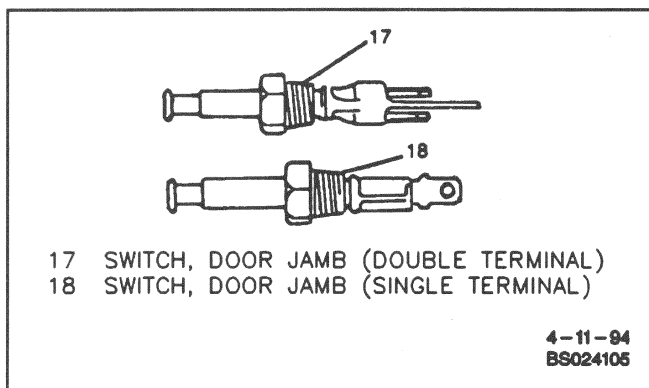


Figure 24 - Door Jamb Switch

AUDIO SPEAKERS

NOTICE: All Delco® audio systems have ungrounded speakers. Installing add-on tape players, CB radios or other units which use the vehicle speakers may damage your Delco® audio system. Please consult your dealer in advance if you are considering additions. Refer to SECTION 9A for speaker information.

FRONT DOOR JAMB SWITCHES

Figures 24 and 25

Door jamb switches (17 or 18) consist of a plunger, plunger collar, threaded retainer and terminals. They are installed in the door hinge pillars. When the door of the vehicle is closed, the plunger is depressed which creates an open in the ground circuit. When the door is opened, the plunger is released and completes the circuit to ground.

When a new door jamb switch (17 or 18) is installed and the door is closed the first time, the plunger is forced into the sleeve and automatically adjusts the door jamb switch (17 or 18) for that particular door. If a door jamb switch (17 or 18) fails, it should not be readjusted by hand. A new door jamb switch (17 or 18) should be installed.

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Double or single terminal door jamb switch (17 or 18).
3. Electrical connector(s) (20) and seal (19).

Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Seal (19) and electrical connector(s) (20).
2. Double or single terminal door jamb switch (17 or 18).

Tighten

- Door jamb switch (17 or 18) to 8 N.m (71 lb. in.).
- 3. Battery negative cable.

FRONT LICENSE BRACKET

Figure 26

Remove or Disconnect

1. Bolts/screws (92).

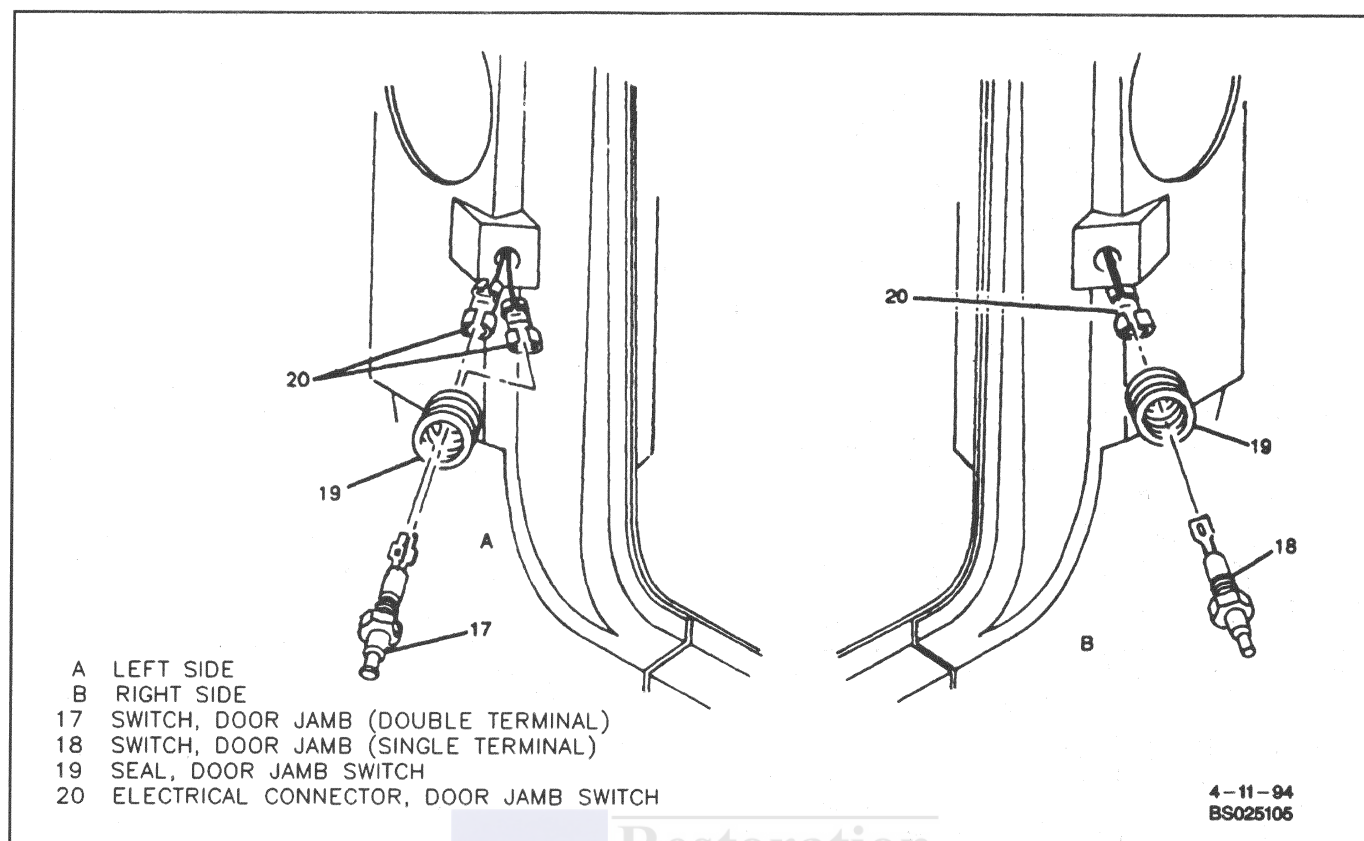


Figure 25 - Door Jamb Switch Installation

2. Bracket (91).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Bolt/screw (92) to bottom hole in bracket (91) so that only screw tip is protruding.
2. Align bracket (91) to fascia (108), placing screw tip on dimple or in lower hole in fascia (108).
3. Bolt/screw (92) to fascia (108).
4. If upper holes are not present in fascia (108), drill two holes in fascia (108) where two upper holes in bracket (91) are located.
5. Remaining two bolts/screws (92).

Tighten

- Bolts/screws (92) to 5.5 N·m (49 lb. in.).

EXTERIOR MOLDINGS

Figures 27 through 30

NOTICE: Failure to place a protective shield over nearby trim and paint may cause damage to the vehicle.

Adhesive Body Stripe (Wagon)

Refer to SECTION 10-1 for removal and installation of adhesive body stripe on vehicles without woodgrain.

Woodgrain Transfers (Wagon)

For removal and installation of woodgrain transfers, refer to SECTION 10-1.

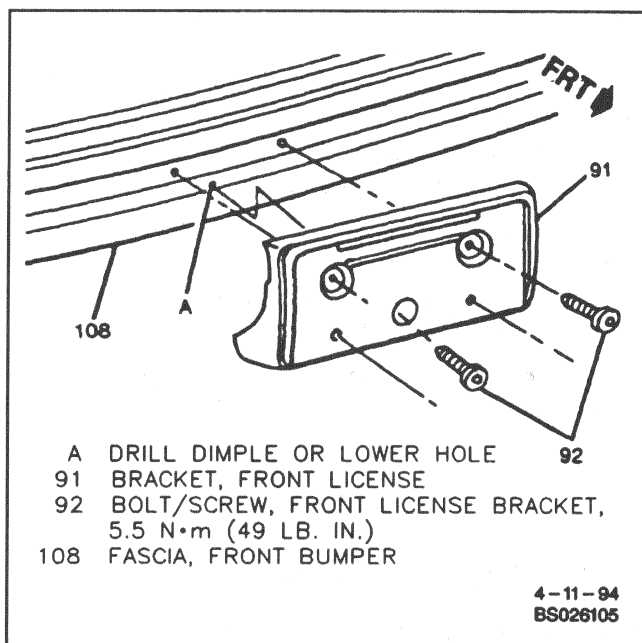


Figure 26 - Front License Bracket

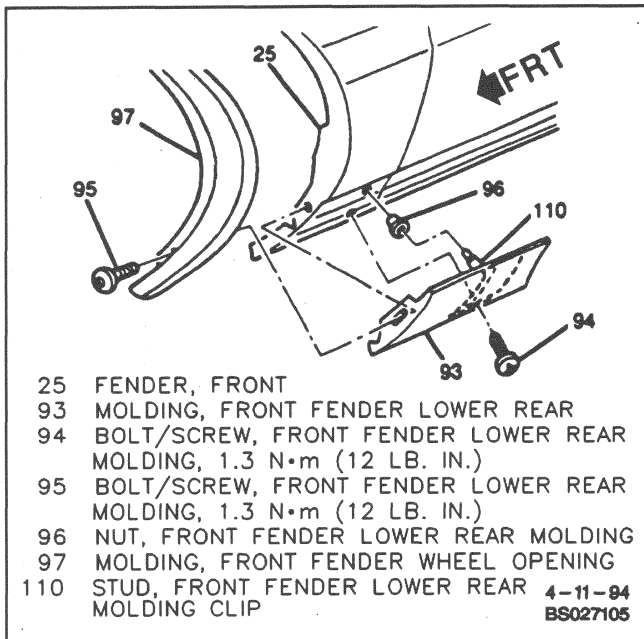


Figure 27 - Front Fender Lower Rear Molding-(Chevrolet Sedan and Wagon, Buick Sedan)

Weld Stud Replacement

If a weld stud on an outer panel becomes damaged or broken off, a replacement weld stud must be installed. For weld stud replacement, refer to SECTION 10-1.

Front Fender Lower Rear Molding

Figures 27 and 28

 Remove or Disconnect

1. Lower rear molding bolts/screws (94 or 95).
2. Lower rear molding (93).

 Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Lower rear molding (93).
2. Lower rear molding (94 or 95).

Tighten

- Lower rear molding bolts/screws (94 or 95) to 1.3 N.m (12 lb. in.).

Front Fender Transfer Upper Finish Moldings

WAGON

Figure 30

 Remove or Disconnect

1. Finish molding bolt/screw (128).
2. Finish moldings (123 and 124) together.

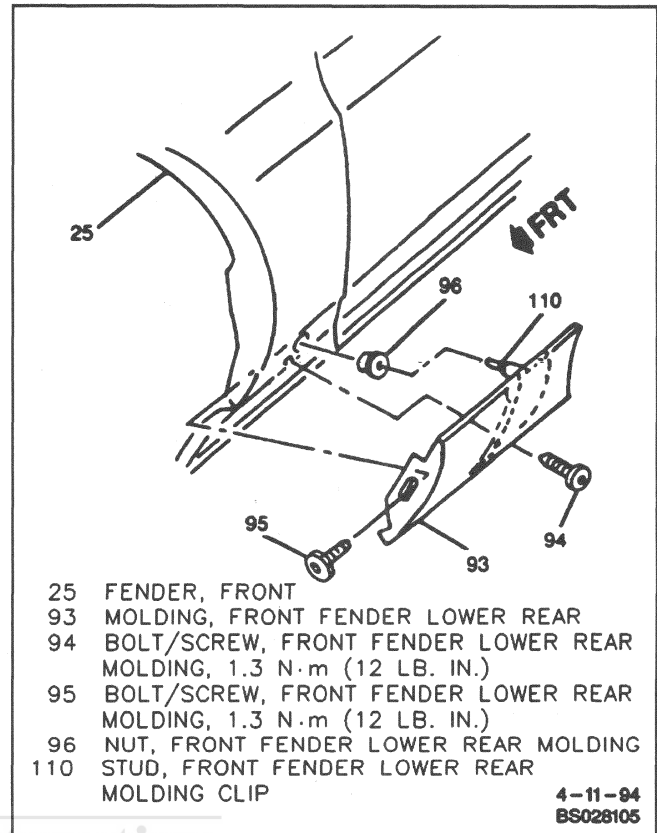


Figure 28 - Front Fender Lower Rear Molding

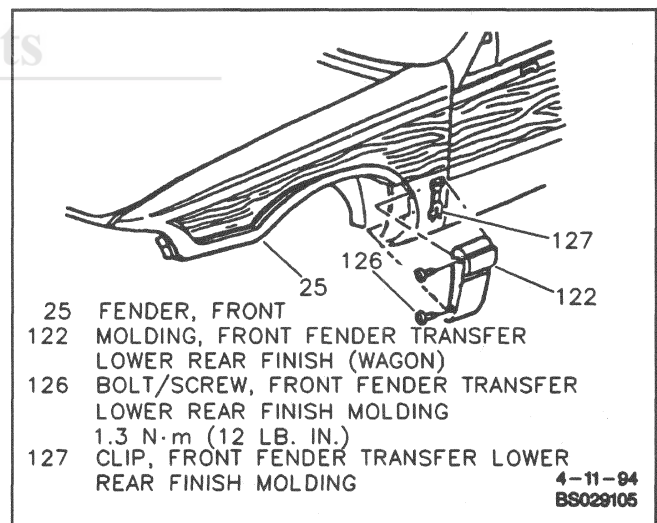


Figure 29 - Front Fender Transfer Lower Rear Finish Molding-(Buick Wagon)

3. Disengage upper edge of finish molding (124) and (123) separate.

 Install or Connect

NOTICE: Refer to “Notice” on page 10-5-1 of this section.

1. Finish molding (123) to clips on fender (25).
2. Finish molding (124) to clips on fender (25).

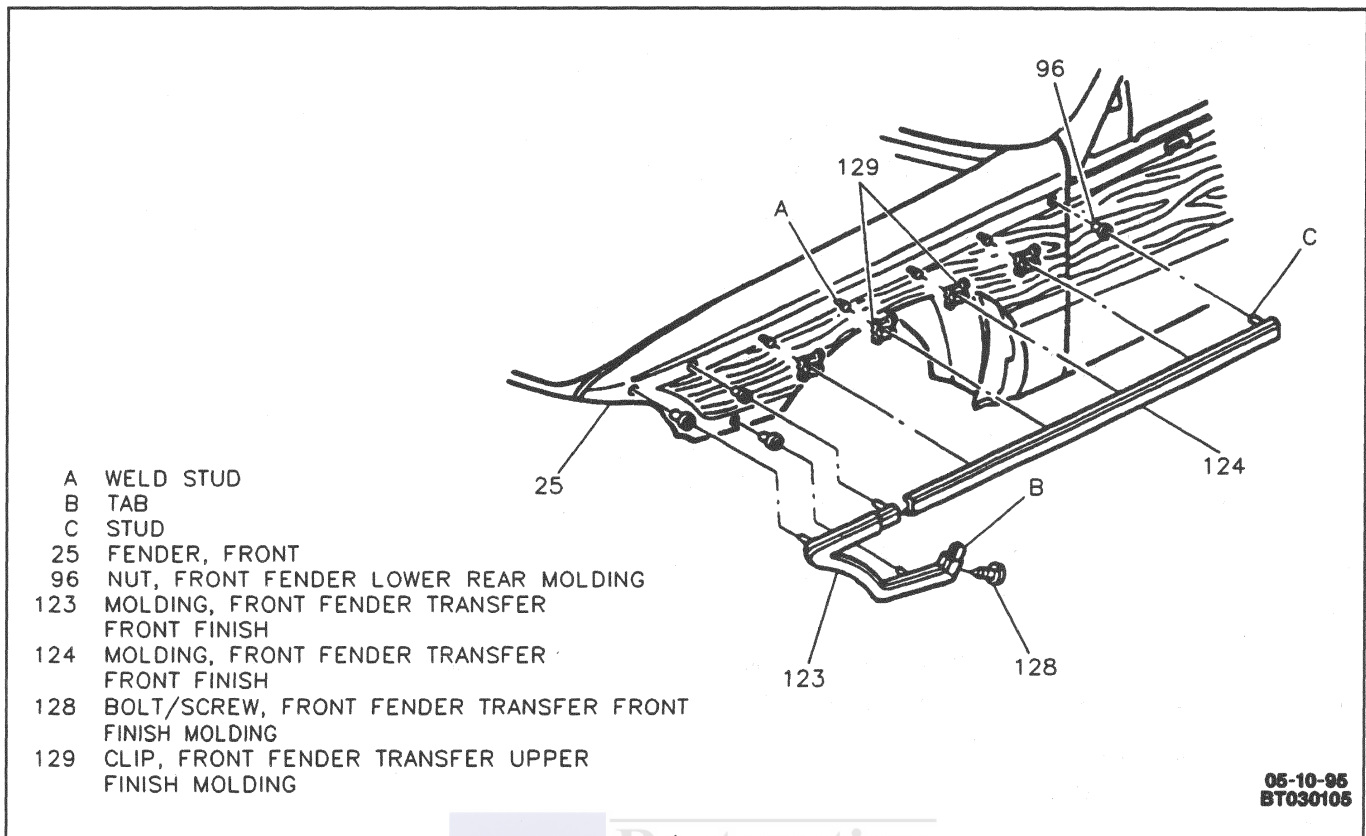


Figure 30 - Front Fender Transfer Upper Finish Molding-(Wagon)

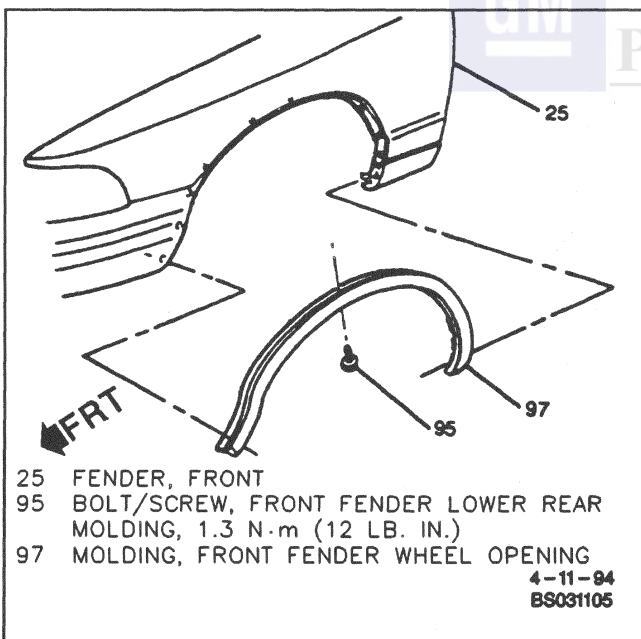


Figure 31 - Front Fender Wheel Opening Molding-(Chevrolet)



Tighten

- Finish molding nuts (128) to 1.3 N·m (12 lb. in.).
- Disengage studs from nuts (96) and finish molding (124) from (129) by pulling gently.

Front Fender Transfer Lower Rear Finish Molding

BUICK WAGON

Figure 29



Remove or Disconnect

1. Finish molding bolt/screw (126).
2. Finish molding (122) from clip (127) on fender (25).

- Lift up on finish molding (122) and pull top of finish molding (122) out gently.



Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Finish molding (122) to clip (127) on fender (25).
 - A. Engage bottom edge of finish molding (122) to bottom of clip (127).

3. Finish molding (128) nuts (96).
 - A. Engage bottom edge of finish moldings (123 and 124 to bottom of clips (129).
 - B. Push up on bottom of finish molding (124) until top engage with top of clip (129).
4. Finish molding Bolt/screw (128).

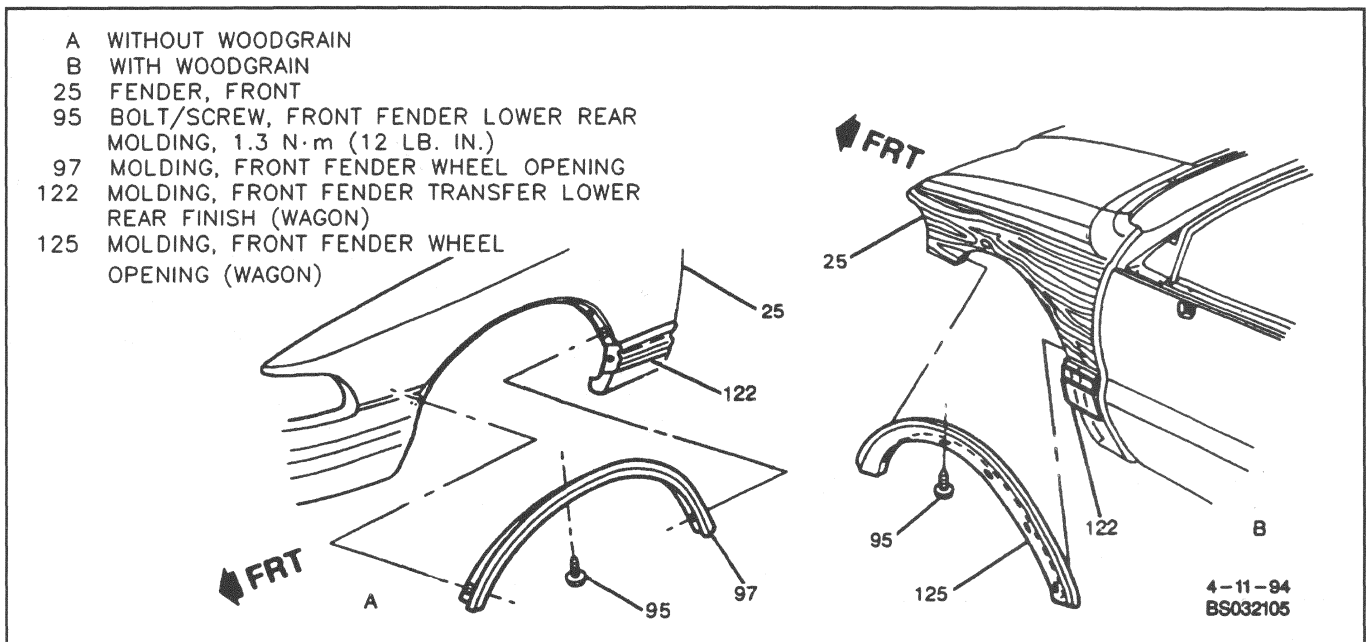


Figure 32 - Front Fender Wheel Opening Molding-(Buick Wagon)

- B. Push up on bottom of finish molding (122) until top of finish molding (122) engages with top of clip (127).

2. Finish molding bolt/screw (126).

Tighten

- Finish molding bolt/screw (126) to 1.3 N·m (12 lb. in.).

3. Disengage studs from nuts (96) and finish molding (124) from clips (129) by pulling gently.

Install or Connect

1. Finish moldings (123 and 124) together.
 - A. Push studs into nuts (96).
 - B. Engage finish molding (124) to clips (129). Push gently to secure.
2. Finish molding bolt/screw (128).

Tighten

- Finish molding bolt/screw (128) to 1.3 N·m (12 lb. in.).

Front Fender Wheel Opening Moldings

Figures 31 through 33

Remove or Disconnect

1. Lower rear molding bolts/screws (95).
2. Wheel opening molding (97), or woodgrain wheel opening molding (125), if Buick wagon.

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Wheel opening molding (97), or woodgrain wheel opening molding (125), if Buick wagon.
2. Lower rear molding bolts/screws (95).

Tighten

- Lower rear molding bolts/screws (95) to 1.3 N·m (12 lb. in.).

Front Fender Center Rear Molding

BUICK SEDAN

Figure 33

Remove or Disconnect

1. Lower rear molding bolt/screw (95) from wheel opening molding (97).
2. Center rear molding (113).

- Push down on top of center rear molding (113) while pulling bottom away from fender (25). Push bottom upward to disengage top of molding from clip.

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Center rear molding (113).
 - A. Place bottom of center rear molding (113) behind bottom of clip.
 - B. Push bottom of center rear molding (113) up and snap top of center rear molding (113) into place.
2. Lower rear molding bolt/screw (95) to wheel opening molding (97).

**Tighten**

- Lower rear molding bolt/screw (95) to 1.3 N.m (12 lb. in.).

Front Fender Center Rear Molding (Adhesive Type)

BUICK SEDAN

Figure 33

NOTICE: To avoid damaging to underlying paints finish, do not use pointed or sharp instrument for removal of molding from quarter panel.

**Remove or Disconnect**

1. Molding by starting at one edge and peeling molding from front fender.
 - Application of heat to molding at point of removal aids removal operation.
2. All trace of adhesive residue from painter surface with silicone, wax and grease remover.

**Install or Connect**

NOTICE: Always refer to manufacturer's packaged instructions to avoid damage.

1. Prepare surface.

**Clean**

- A. Painted surface with silicone, wax and grease remover.
- B. Area where molding will be applied with a 50-50 mixture of isopropyl alcohol and water.
- C. Remove backing material of molding as necessary.

2. Molding to front fender.

- For up/down location, refer to (Figure 1) for set up dimensions.

**Important**

- Roll the molding with approximately 25 lb. force over each adhesive contact point.
- Be certain that adhesive contact points make full contact on surface or molding will not adhere.

Headlamp Opening Molding

BUICK SEDAN

Figure 34

**Remove or Disconnect**

1. Raise hood (21) to full open position.
2. Headlamp opening molding bolts/screws (118).

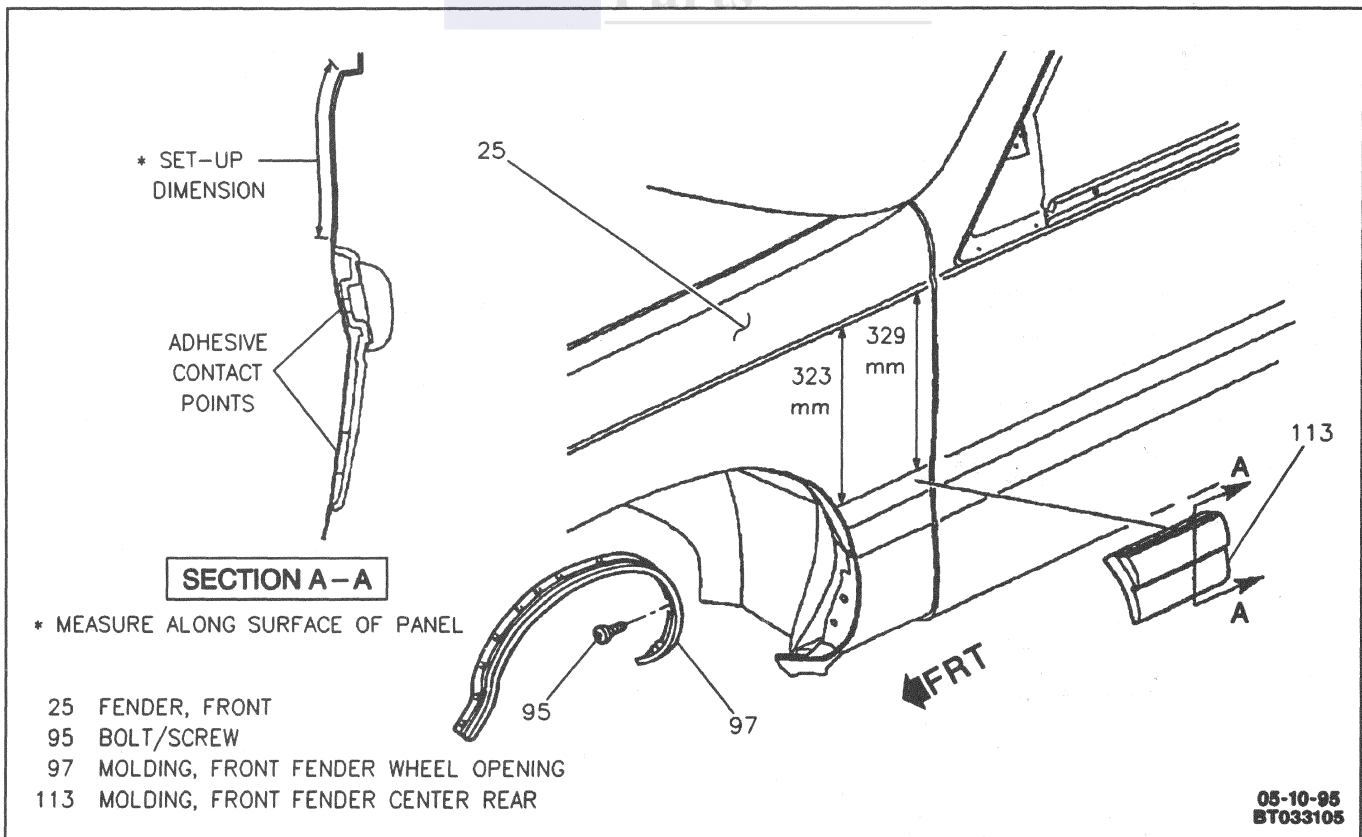


Figure 33 - Front Fender Center Rear Molding-(Buick Sedan)

10-5-26 BODY FRONT END

3. Headlamp opening molding (117).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Headlamp opening molding (117).
2. Headlamp opening molding bolts/screws (118).

Tighten

- Headlamp opening molding bolts/screws (118) to 1.3 N.m (12 lb. in.).
3. Close hood (21).

Front Fender Park Lamp Upper Molding

BUICK SEDAN

Figure 34

Remove or Disconnect

1. Front cornering/turn signal lamp. Refer to SECTION 8B.
2. Park lamp upper bolts/screws (120).
3. Park lamp upper molding (119).

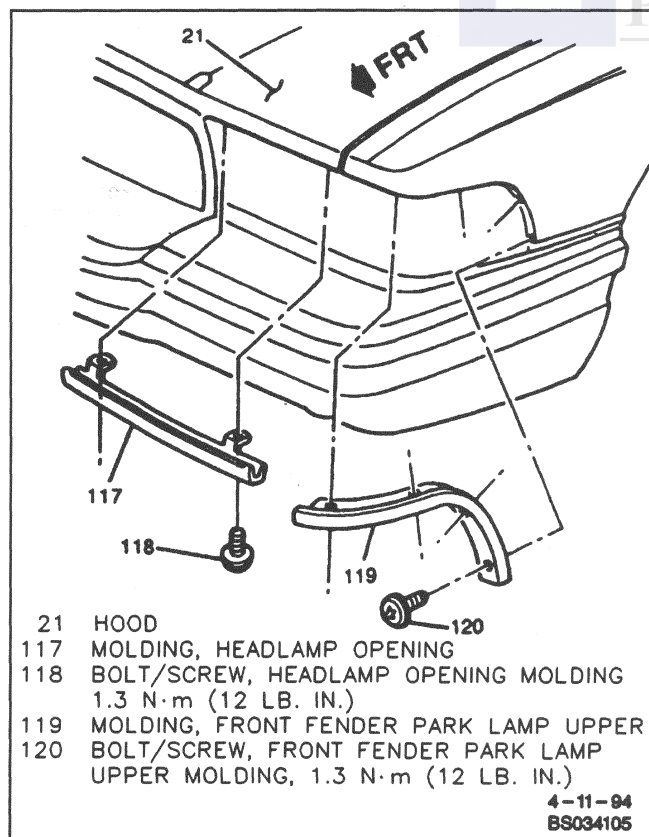


Figure 34 - Front Fender Park Lamp Upper Molding-(Buick Sedan)

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Park lamp upper molding (119).
2. Park lamp upper bolts/screws (120).

Tighten

- Park lamp upper bolts/screws (120) to 1.3 N.m (12 lb. in.).
3. Front cornering/turn signal lamp. Refer to SECTION 8B.

HOOD ORNAMENT

Figure 35

Remove or Disconnect

1. Raise hood (21).
2. Nut (101), washer (100) and spacer (99) from underside of hood (21).
3. Hood ornament (12 or 98).

Install or Connect

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

1. Hood ornament (12 or 98).
2. Spacer (99), washer (100) and nut (101) to underside of hood (21).

Tighten

- Hood ornament nut (101) to 6.5 N.m (58 lb. in.).
3. Close hood (21).

BODY PANEL ADJUSTMENT AND ALIGNMENT

Figures 36 through 38

NOTICE: Failure to align hood hinge properly could result in damage to the hood seal.

For proper fit, appearance, and operation of doors (102) and hood (21), front end body panels should be adjusted to the specifications shown in Figures 36 through 38.

Hood Adjustment

Slotted holes are provided at all hood hinge attaching points for proper adjustment both vertically and forward and rearward. Vertical adjustment at the front may be made by adjusting rubber bumpers up and down. For best results, make one adjustment at a time.

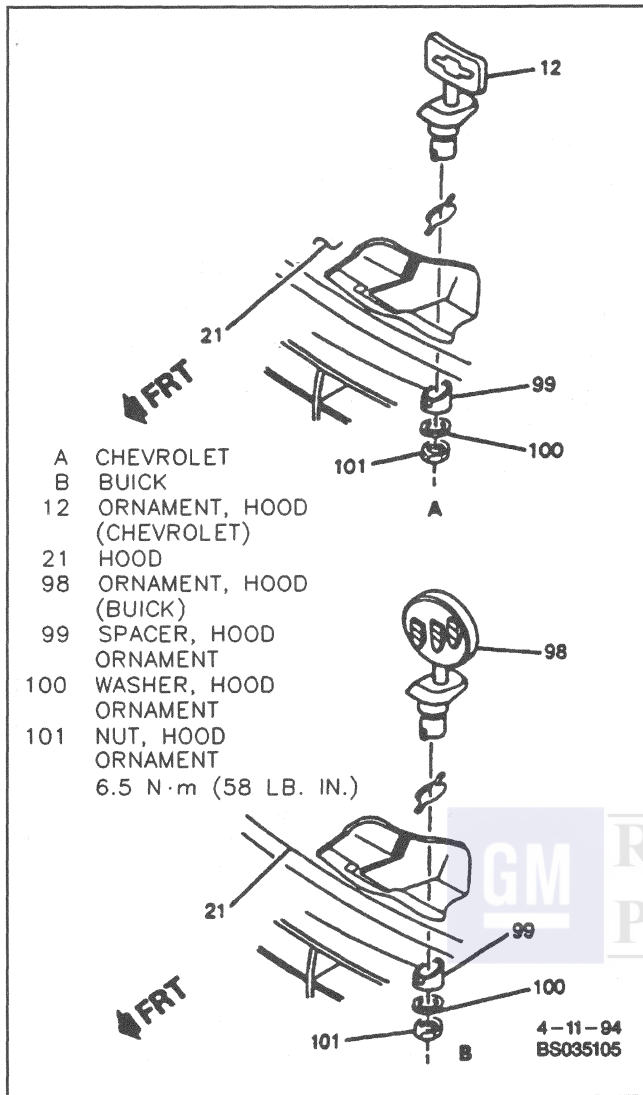


Figure 35 - Hood Ornament

Raise or Lower Rear Corners of Hood

Figures 11, 19, 20, 36, 37 and 38

Remove or Disconnect

- Right or left outer seal (4).

NOTICE: Failure to align hood hinge properly could result in damage to the hood seal.

Adjust

- Hood hinge (24).
 - Loosen inner panel bolts/screws (23).
 - Move hood hinge (24) up or down, as needed. For hood alignment specifications refer to Figures 36 through 38.

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

Tighten

- Inner panel bolts/screws (23) to 25 N·m (18 lb. ft.).

Install or Connect

- Right or left outer seal (4).
- Repeat above steps for opposite side of hood (21), if necessary.

Raise or Lower Front Corners of Hood

Figures 20, 36, 37 and 38

Adjust

- Bumpers (103).
 - Close hood (21) firmly.
 - Determine amount of adjustment needed. For hood alignment specifications refer to Figures 36 through 38.
 - Raise hood (21) to full open position.
 - Change height by loosening jam nuts, and turning bumpers (103) up or down, and tightening jam nuts.
 - Repeat above steps until hood (21) is properly aligned.

Forward and Rearward Hood Adjustment

Figures 11, 36, 37 and 38

NOTICE: Failure to align hood hinge properly could result in damage to the hood seal.

Adjust

- Hood (21).
 - Loosen hood hinge bolts/screws (22 and 26).
 - Move hood (21) forward or rearward. For hood alignment specifications refer to Figures 36 through 38.

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

Tighten

- Hood hinge bolts/screws (22) to 25 N·m (18 lb. ft.).
- Hood hinge bolt/screw (26) to 8 N·m (71 lb. in.).

- Repeat above steps for opposite side of hood (21), if necessary.

Front Fender Adjustment

Figures 12 through 14, 36, 37 and 38

Adjust

- Front fender (25).
 - Loosen bolts/screws at locations where adjustment is to be made.

10-5-28 BODY FRONT END

- 21 HOOD
- 25 FENDER, FRONT
- 97 MOLDING, FRONT FENDER WHEEL OPENING
- 102 DOOR, FRONT SIDE
- 103 BUMPER, HOOD ADJUST FRONT

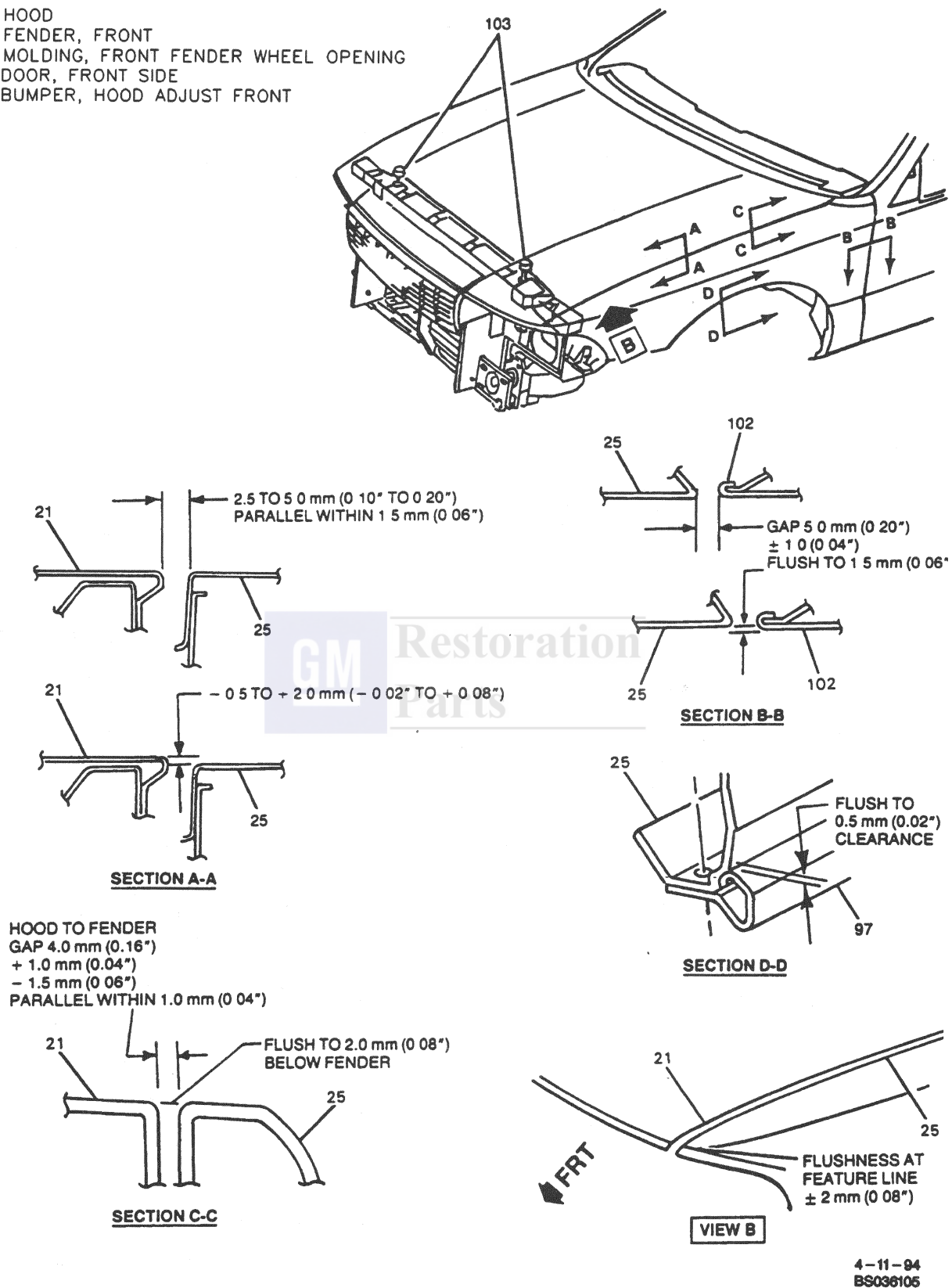
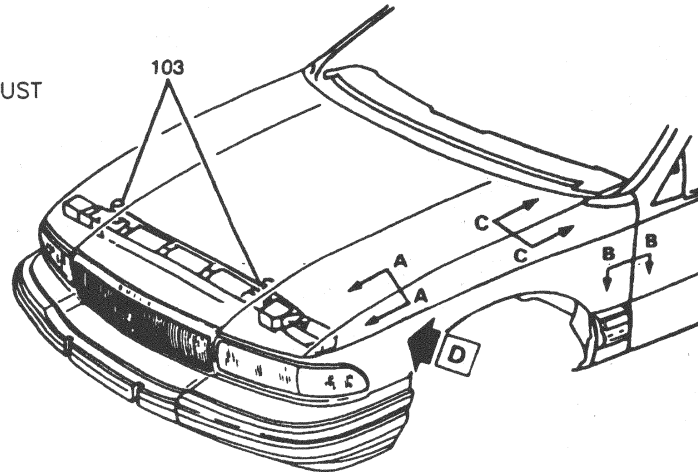
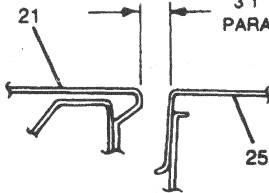


Figure 36 - Front End Body Panel Alignment-(Chevrolet)

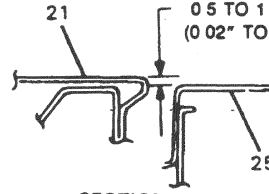
- 21 HOOD
- 25 FENDER, FRONT
- 102 DOOR, FRONT SIDE
- 103 BUMPER, HOOD ADJUST FRONT



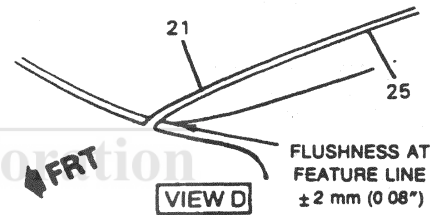
3.1 TO 5.6 mm (0.12" TO 0.22")
PARALLEL WITHIN 1.5 mm (0.06")



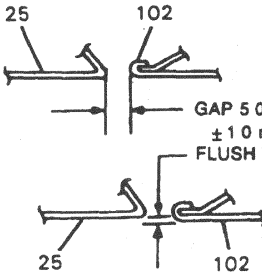
0.5 TO 1.5 mm
(0.02" TO 0.06")



SECTION A-A



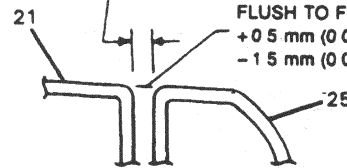
GAP 5.0 mm (0.20")
± 1.0 mm (0.04")
FLUSH TO 1.5 mm (0.06")



SECTION B-B

HOOD ASSEMBLY TO FENDER ASSEMBLY
GAP 4.6 mm (0.18")
+1.0 mm (0.04")
-1.5 mm (0.06")
PARALLEL WITHIN 2.0 mm (0.08")

FLUSH TO FENDER ASSEMBLY
+0.5 mm (0.02")
-1.5 mm (0.06")



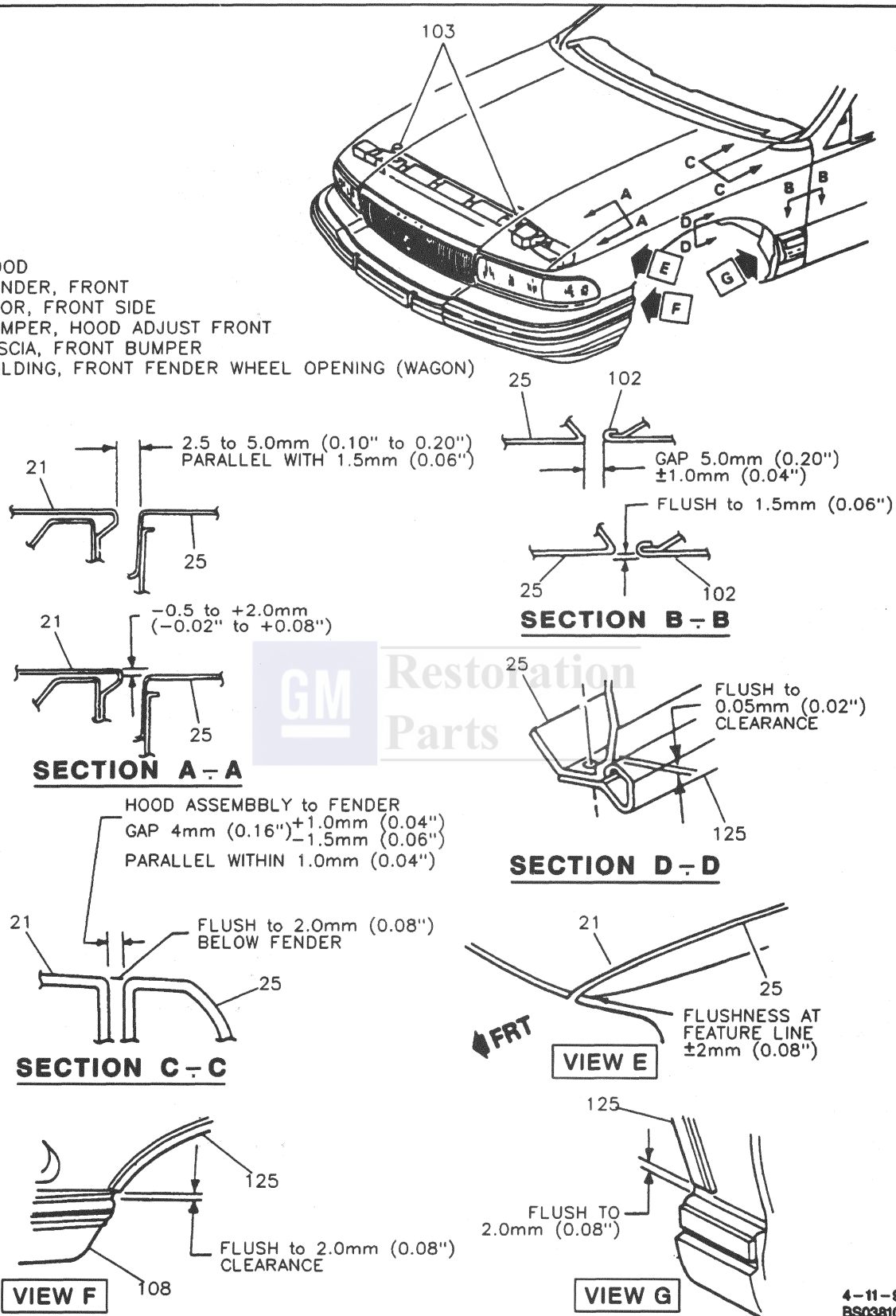
SECTION C-C

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BS037105

Figure 37 - Front End Body Panel Alignment-(Buick Sedan)

10-5-30 BODY FRONT END

- 21 HOOD
- 25 FENDER, FRONT
- 102 DOOR, FRONT SIDE
- 103 BUMPER, HOOD ADJUST FRONT
- 108 FASCIA, FRONT BUMPER
- 125 MOLDING, FRONT FENDER WHEEL OPENING (WAGON)



4-11-94
BS038105

Figure 38 - Front End Body Panel Alignment-(Buick Wagon)

NOTICE: Be careful when prying on body panels to avoid damage.



Tighten

- Pry shift panels to allow clearance for removal or installation of shims (63).

- All bolts/screws that were loosened to proper torque. Refer to "Specifications" in this section.

2. Remove or install shims (63) as needed.

3. Primary latch (35), if necessary.

NOTICE: Refer to "Notice" on page 10-5-1 of this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Air Inlet Grille Panel Bolt/Screw	1.5 N.m (13 lb. in.)
Air Inlet Screen Retainer Bolt/Screw	1.5 N.m (13 lb. in.)
Door Jamb Switch	8 N.m (71 lb. in.)
Floor Carpet Retainer Bolt/Screw	1.3 N.m (12 lb. in.)
Front Fender Front Upper Bracket Bolt/Screw	10 N.m (89 lb. in.)
Front Fender Inner Lower Panel Bolt/Screw	10 N.m (89 lb. in.)
Front Fender Inner Panel Bolt/Screw	25 N.m (18 lb. ft.)
Front Fender Inner Panel Bolt/Screw (Hood Hinge)	25 N.m (18 lb. ft.)
Front Fender Lower Rear Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Fender Park Lamp Upper Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Fender Rear Lower Brace Nut	25 N.m (18 lb. ft.)
Front Fender Rear Lower Bracket Bolt/Screw	50 N.m (37 lb. ft.)
Front Fender Rear Upper Brace Bolt/Screw	25 N.m (18 lb. ft.)
Front Fender Rear Upper Bracket Bolt/Screw	50 N.m (37 lb. ft.)
Front Fender Transfer Front Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Fender Transfer Lower Rear Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front License Bracket Bolt/Screw	5.5 N.m (49 lb. in.)
Front Wheelhouse Panel Bolt/Screw (Inner)	25 N.m (18 lb. ft.)
Front Wheelhouse Panel Bolt/Screw (Outer)	10 N.m (89 lb. in.)
Front Wheelhouse Panel Extension Bolt/Screw	1.9 N.m (17 lb. in.)
Front Wheelhouse Panel Extension Bolt/Screw (To Baffle)	1.9 N.m (17 lb. in.)
Front Wheelhouse Panel Extension Nut	10 N.m (89 lb. in.)
Headlamp Opening Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Hood Hinge Bolt/Screw (Hinge-to-Hood)	25 N.m (18 lb. ft.)
Hood Hinge Bolt/Screw (Hood-to-Hinge)	8 N.m (71 lb. in.)
Hood Ornament Nut	6.5 N.m (58 lb. in.)
Hood Primary Latch Bracket Bolt/Screw	25 N.m (18 lb. ft.)
Hood Secondary Latch Bolt/Screw	10 N.m (89 lb. in.)
Hood Secondary Latch Release Bolt/Screw	2.3 N.m (20 lb. in.)
Hood Strut Ball Stud	27 N.m (20 lb. ft.)
Primary Latch Release Cable Bolt/Screw	1.9 N.m (17 lb. in.)
Radiator Grille Bolt/Screw	2.4 N.m (21 lb. in.)
Radiator Grille Support Bolt/Screw	2.5 N.m (22 lb. in.)
Radiator Support Baffle Bolt/Screw	10 N.m (89 lb. in.)
Radiator Support Nut	50 N.m (37 lb. ft.)

SPECIAL TOOLS

J 21104-B



1 UNIVERSAL WEATHERSTRIP REMOVER

4-11-94
BS039105



SECTION 10-6

DOORS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "On-Vehicle Service" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Make sure to disconnect the front side door window switch when working inside the driver's door. When operated, the Express Down feature allows the front side door window to drop very quickly which could cause personal injury.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: The theft deterrent label found on some major sheet metal must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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10-6-2 DOORS

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GENERAL DESCRIPTION

This section contains the service operations necessary for the removal, installation, adjustment, and sealing of doors, hardware, and trim (Figures 1 through 17).

THREAD LOCKING FASTENERS

All factory installed door hardware attaching bolts/screws contain an epoxy thread-locking compound to ensure the torque setting will be maintained.

Service replacement bolts/screws may not contain a thread-locking compound. Such bolts/screws must be treated with No. 1052279, Loctite® 75, or equivalent. The adhesive is placed on the fastener prior to installation. After the fastener is installed and tightened, the adhesive will cure, preventing the fastener from becoming loose.

WATER DEFLECTOR

A waterproof plastic deflector is used to seal the door inner panel and prevent entry of water into the body. The deflector is secured to the door inner panel with pressure sensitive adhesive located on the outboard surface of the deflector. This allows the deflector to be peeled back as needed to service door components.

LOCK STRIKERS

The lock strikers consist of a dual pin striker plate attached to a floating anchor plate in the body. This design is also known as the "mini-wedge" type lock striker. The door is secured in the closed position when the door lock fork snaps over and engages the first striker pin.

DOOR LOCKING SYSTEM MODULE

The door locking system module contains the door lock and door lock actuators, inside handle and rods. The module receives its rigidity from the door structure and should not be checked for proper operation without first mounting to the door.

OUTSIDE HANDLES

Outside handles actuate front and rear side door locks through connecting rods. The right front and left rear are identical and the left front and right rear are identical.

REAR WINDOW LOCKOUT FEATURE

The rear window lockout feature consists of a "lockout" switch located on the driver side front power window switch. The "lockout" switch allows the driver to prevent rear seat occupants from operating power windows. When in lockout mode, the driver may still control rear window operation.

REAR DOOR SECURITY LOCK

The rear door security lock (lock-out switch) is an integral part of the door lock. No attempt should be made to repair the rear door security lock of the lock itself.

EXPRESS DOWN

Express down fully lowers the driver's front side door window when the front side door window switch is fully pressed and then released. The express down module is an integral part of the window switch.

DOOR HINGES

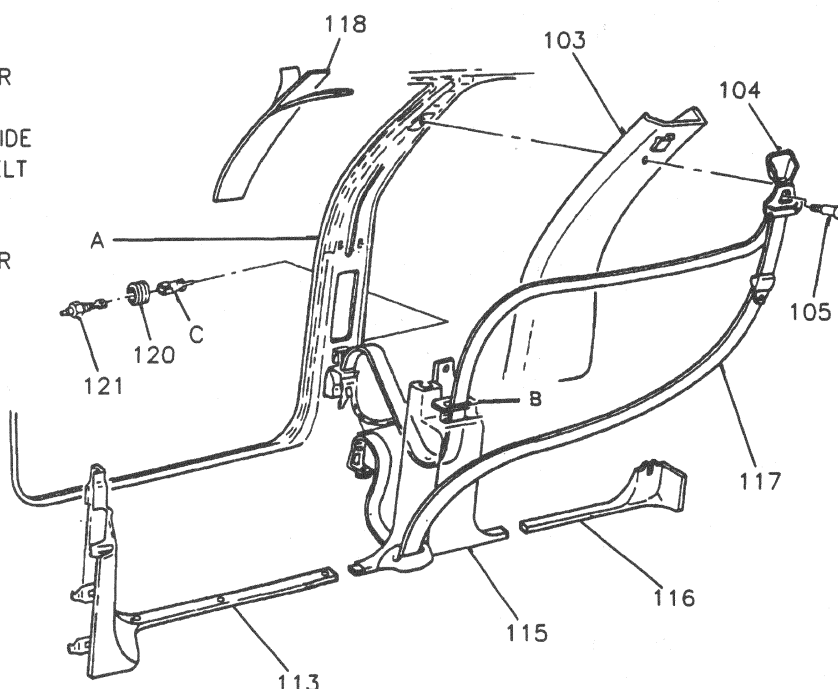
All but the front side door lower hinge are directly accessible. The front side door lower hinge requires partial removal of the front fender for replacement, or J 39927 Door Hinge Adjustment Wrench for adjustment.

OUTSIDE REARVIEW MIRRORS

The outside rearview mirrors are remote control electric and/or remote control. Electric mirrors have a heated face.



- A PILLAR, CENTER
- B ESCUTCHEON
- C CONNECTOR, ELECTRICAL
- 103 PANEL, CENTER PILLAR UPPER TRIM FINISH
- 104 CONER, FRONT SEAT BELT GUIDE
- 105 BOLT/SCREW, FRONT SEAT BELT 42 N•m (31 LB. FT.)
- 113 RETAINER, REAR CARPET
- 115 PANEL, CENTER PILLAR LOWER TRIM FINISH
- 116 RETAINER, FORWARD CARPET
- 117 BELT, FRONT SEAT
- 118 APPLIQUE, CENTER PILLAR (BUICK SEDAN)
- 120 SEAL, DOOR JAMB SWITCH
- 121 SWITCH, DOOR JAMB, 8 N•m (71 LB. IN.)



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Figure 1 - Center Pillar Components

10-6-4 DOORS

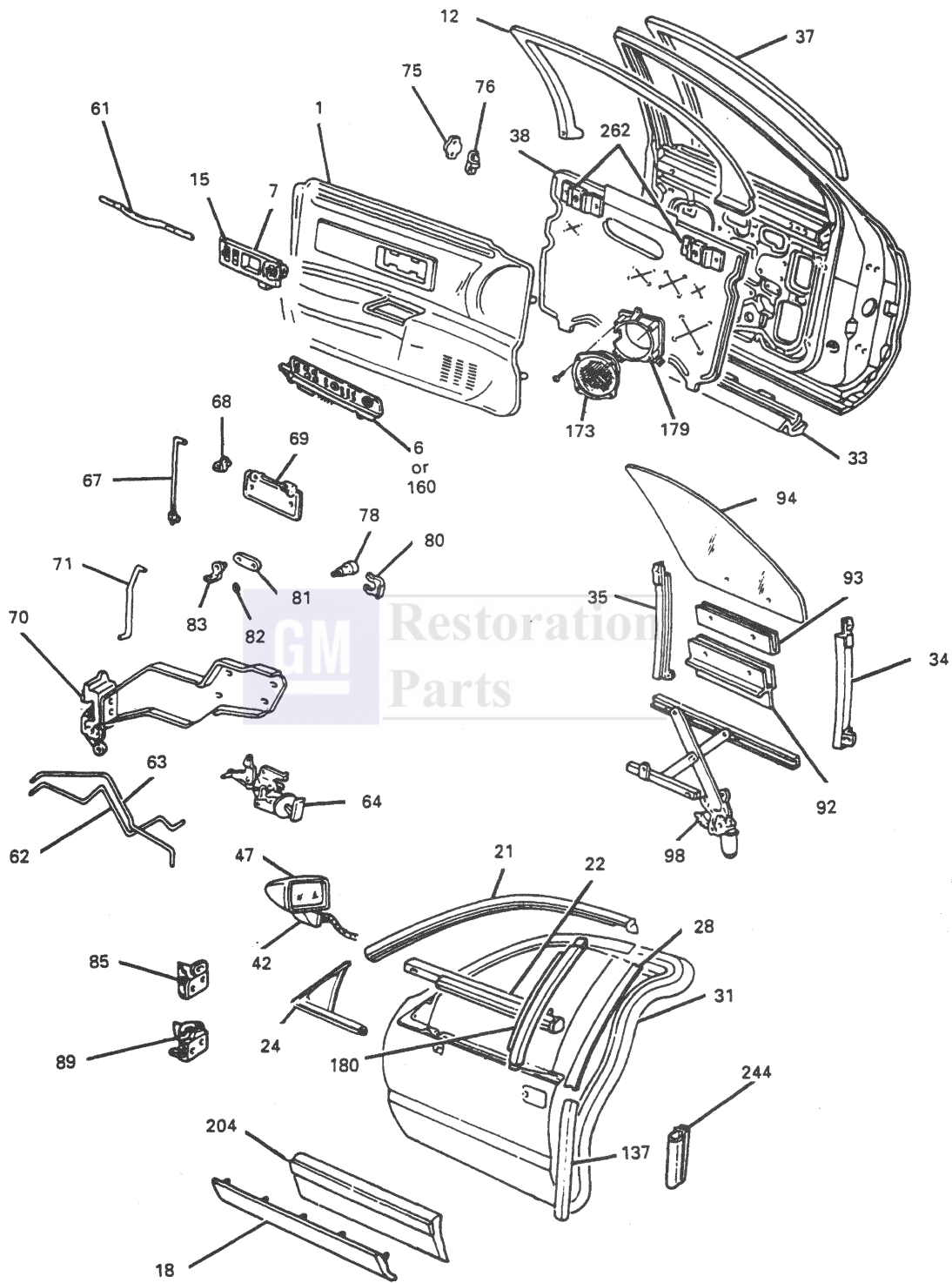
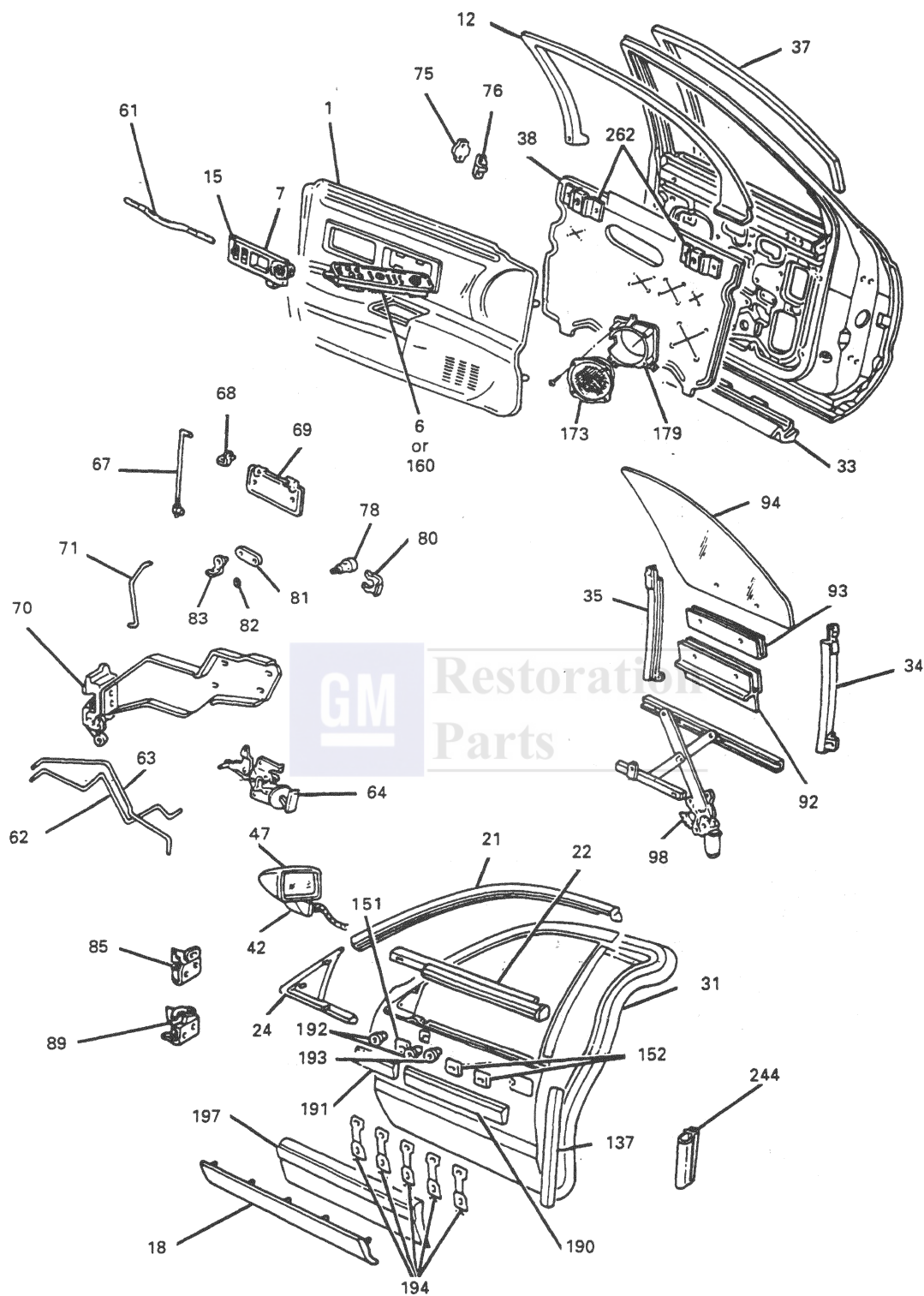


Figure 2 - Front Side Door Components-(Buick Sedan)

- 1 TRIM ASSEMBLY, FRONT SIDE DOOR
- 6 PLATE ASSEMBLY, FRONT SIDE DOOR ARMREST SWITCH MOUNT
- 7 BEZEL ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
- 12 MOLDING ASSEMBLY, BODY SIDE FRONT WINDOW GARNISH
- 15 LEVER ASSEMBLY, FRONT SIDE DOOR LOCK ROD
- 18 MOLDING ASSEMBLY, FRONT SIDE DOOR LOWER
- 21 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW UPPER REVEAL
- 22 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW REVEAL
- 24 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT REVEAL
- 28 APPLIQUE, FRONT SIDE DOOR WINDOW FRAME REAR
- 31 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR
- 33 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR BOTTOM AUXILIARY
- 34 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT
- 35 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR
- 37 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR WINDOW
- 38 DEFLECTOR, FRONT SIDE DOOR WATER
- 42 INSULATOR, OUTSIDE REARVIEW MIRROR
- 47 MIRROR ASSEMBLY, OUTSIDE REARVIEW
- 61 HANDLE ASSEMBLY, FRONT SIDE DOOR PULL
- 62 ROD, FRONT SIDE DOOR LOCKING
- 63 ROD, FRONT SIDE DOOR INSIDE HANDLE
- 64 LEVER ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
- 67 ROD ASSEMBLY, FRONT SIDE DOOR OUTSIDE HANDLE
- 68 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
- 69 HANDLE ASSEMBLY, FRONT SIDE DOOR OUTSIDE
- 70 MODULE ASSEMBLY, FRONT SIDE DOOR LOCKING SYSTEM
- 71 ROD ASSEMBLY, FRONT SIDE DOOR LOCK CYLINDER
- 75 SPACER, FRONT SIDE DOOR LOCK STRIKER
- 76 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
- 78 CYLINDER ASSEMBLY, FRONT SIDE DOOR LOCK
- 80 RETAINER, FRONT SIDE DOOR LOCK CYLINDER
- 81 PAWL, FRONT SIDE DOOR LOCK CYLINDER
- 82 CLIP, FRONT SIDE DOOR LOCK CYLINDER PAWL
- 83 CLIP, FRONT SIDE DOOR LOCK CYLINDER
- 85 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
- 89 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
- 92 SASH, FRONT SIDE DOOR WINDOW
- 93 FILLER FRONT SIDE DOOR WINDOW SASH
- 94 WINDOW, FRONT SIDE DOOR
- 98 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
- 137 MOLDING, FRONT SIDE DOOR EDGE GUARD
- 160 PLATE ASSEMBLY, FRONT SIDE DOOR ARMREST SWITCH/KNOB MOUNT
- 173 SPEAKER ASSEMBLY, RADIO FRONT SIDE DOOR
- 179 HOUSING ASSEMBLY, RADIO FRONT SIDE DOOR SPEAKER
- 180 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW REAR REVEAL
- 204 MOLDING ASSEMBLY, FRONT SIDE DOOR CENTER
- 244 EDGE PROTECTOR, FRONT SIDE DOOR OUTER PANEL
- 262 BRACKET ASSEMBLY, FRONT SIDE DOOR PULL HANDLE

Figure 3 - Front Side Door Components-(Buick Sedan)-Legend

10-6-6 DOORS



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Figure 4 - Front Side Door Components-(Buick Wagon)

- 1 TRIM ASSEMBLY, FRONT SIDE DOOR
- 6 PLATE ASSEMBLY FRONT SIDE DOOR ARMREST SWITCH MOUNT
- 7 BEZEL ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
- 12 MOLDING ASSEMBLY, BODY SIDE FRONT WINDOW GARNISH
- 15 LEVER ASSEMBLY, FRONT SIDE DOOR LOCK ROD
- 18 MOLDING ASSEMBLY, FRONT SIDE DOOR LOWER
- 21 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW UPPER REVEAL
- 22 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW REVEAL
- 24 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT REVEAL
- 31 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR
- 33 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR BOTTOM AUXILIARY
- 34 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT
- 35 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR
- 37 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR WINDOW
- 38 DEFLECTOR, FRONT SIDE DOOR WATER
- 40 INSULATOR, OUTSIDE REARVIEW MIRROR
- 47 MIRROR ASSEMBLY, OUTSIDE REARVIEW
- 61 HANDLE ASSEMBLY, FRONT SIDE DOOR PULL
- 62 ROD, FRONT SIDE DOOR LOCKING
- 63 ROD, FRONT SIDE DOOR INSIDE HANDLE
- 64 LEVER ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
- 67 ROD ASSEMBLY, FRONT SIDE DOOR OUTSIDE HANDLE
- 68 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
- 69 HANDLE ASSEMBLY, FRONT SIDE DOOR OUTSIDE
- 70 MODULE ASSEMBLY, FRONT SIDE DOOR LOCKING SYSTEM
- 71 ROD ASSEMBLY, FRONT SIDE DOOR LOCK CYLINDER
- 75 SPACER, FRONT SIDE DOOR LOCK STRIKER
- 76 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
- 78 CYLINDER ASSEMBLY, FRONT SIDE DOOR LOCK
- 80 RETAINER, FRONT SIDE DOOR LOCK CYLINDER
- 81 PAWL, FRONT SIDE DOOR LOCK CYLINDER
- 82 CLIP, FRONT SIDE DOOR LOCK CYLINDER PAWL
- 83 CLIP, FRONT SIDE DOOR LOCK CYLINDER
- 85 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
- 89 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
- 92 SASH FRONT SIDE DOOR WINDOW
- 93 FILLER, FRONT SIDE DOOR WINDOW SASH
- 94 WINDOW, FRONT SIDE DOOR
- 98 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
- 137 MOLDING, FRONT SIDE DOOR EDGE GUARD
- 151 CLIP, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH MOLDING
- 152 CLIP, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH MOLDING
- 160 PLATE ASSEMBLY, FRONT SIDE DOOR ARMREST SWITCH//KNOB MOUNT
- 173 SPEAKER ASSEMBLY, RADIO FRONT SIDE DOOR
- 179 HOUSING ASSEMBLY, RADIO FRONT SIDE DOOR SPEAKER
- 190 MOLDING ASSEMBLY, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH
- 191 MOLDING ASSEMBLY, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH
- 192 NUT, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH MOLDING
- 193 NUT, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH MOLDING
- 194 CLIP, FRONT SIDE DOOR TRANSFER LOWER FINISH MOLDING
- 197 MOLDING ASSEMBLY, FRONT SIDE DOOR TRANSFER LOWER FINISH
- 244 EDGE PROTECTOR, FRONT SIDE DOOR OUTER PANEL
- 262 BRACKET ASSEMBLY, FRONT SIDE DOOR PULL HANDLE

Figure 5 - Front Side Door Components-(Buick Wagon)-Legend

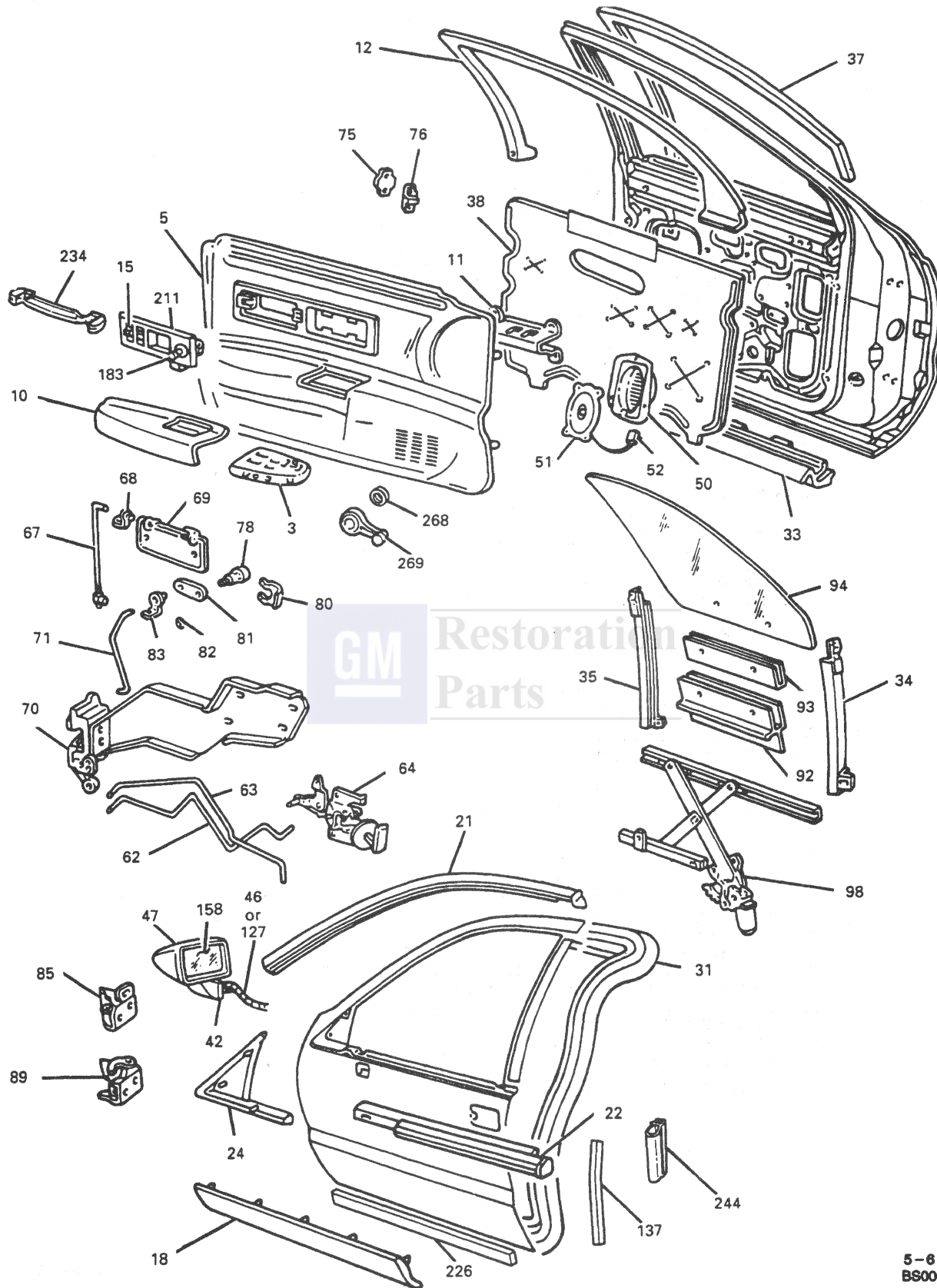


Figure 6 - Front Side Door Components-(Chevrolet Sedan)

3 PANEL ASSEMBLY, ACCESSORY SWITCH
 5 TRIM ASSEMBLY, FRONT SIDE DOOR
 10 ARMREST ASSEMBLY, FRONT SIDE DOOR
 11 PLATE, FRONT SIDE DOOR ARMREST HANGER
 12 MOLDING ASSEMBLY, BODY SIDE FRONT WINDOW GARNISH
 15 LEVER ASSEMBLY, FRONT SIDE DOOR LOCK ROD
 18 MOLDING ASSEMBLY, FRONT SIDE DOOR LOWER
 21 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW UPPER REVEAL
 22 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW REVEAL
 24 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT REVEAL
 31 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR
 33 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR BOTTOM AUXILIARY
 34 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT
 35 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR
 37 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR WINDOW
 38 DEFLECTOR, FRONT SIDE DOOR WATER
 42 INSULATOR OUTSIDE REARVIEW MIRROR
 46 WIRING HARNESS, BODY CROSS CAR
 47 MIRROR ASSEMBLY, OUTSIDE REARVIEW
 50 HOUSING ASSEMBLY, RADIO FRONT SIDE DOOR SPEAKER
 51 SPEAKER ASSEMBLY, RADIO FRONT SIDE DOOR
 52 CONNECTOR, RADIO FRONT SIDE DOOR SPEAKER
 62 ROD, FRONT SIDE DOOR LOCKING
 63 ROD, FRONT SIDE DOOR INSIDE HANDLE
 64 LEVER ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
 67 ROD ASSEMBLY, FRONT SIDE DOOR OUTSIDE HANDLE
 68 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
 69 HANDLE ASSEMBLY, FRONT SIDE DOOR OUTSIDE
 70 MODULE ASSEMBLY, FRONT SIDE DOOR LOCKING SYSTEM
 71 ROD ASSEMBLY, FRONT SIDE DOOR LOCK CYLINDER
 75 SPACER, FRONT SIDE DOOR LOCK STRIKER
 76 STRIKER ASSEMBLY FRONT SIDE DOOR LOCK
 78 CYLINDER ASSEMBLY, FRONT SIDE DOOR LOCK
 80 RETAINER, FRONT SIDE DOOR LOCK CYLINDER
 81 PAWL, FRONT SIDE DOOR LOCK CYLINDER
 82 CLIP, FRONT SIDE DOOR LOCK CYLINDER PAWL
 83 CLIP, FRONT SIDE DOOR LOCK CYLINDER
 85 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
 89 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
 92 SASH, FRONT SIDE DOOR WINDOW
 93 FILLER, FRONT SIDE DOOR WINDOW SASH
 94 WINDOW, FRONT SIDE DOOR
 98 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
 127 CABLE, OUTSIDE REARVIEW MIRROR
 137 MOLDING, FRONT SIDE DOOR EDGE GUARD
 158 FACE, OUTSIDE REARVIEW MIRROR
 183 KNOB, OUTSIDE REARVIEW MIRROR CONTROL
 211 BEZEL ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
 226 MOLDING ASSEMBLY, FRONT SIDE DOOR CENTER
 234 HANDLE ASSEMBLY, FRONT SIDE DOOR PULL
 244 EDGE PROTECTOR, FRONT SIDE DOOR OUTER PANEL
 268 PLATE, FRONT SIDE DOOR WINDOW REGULATOR HANDLE BEARING
 269 HANDLE ASSEMBLY FRONT SIDE DOOR WINDOW REGULATOR

Figure 7 - Front Side Door Components-(Chevrolet Sedan)-Legend

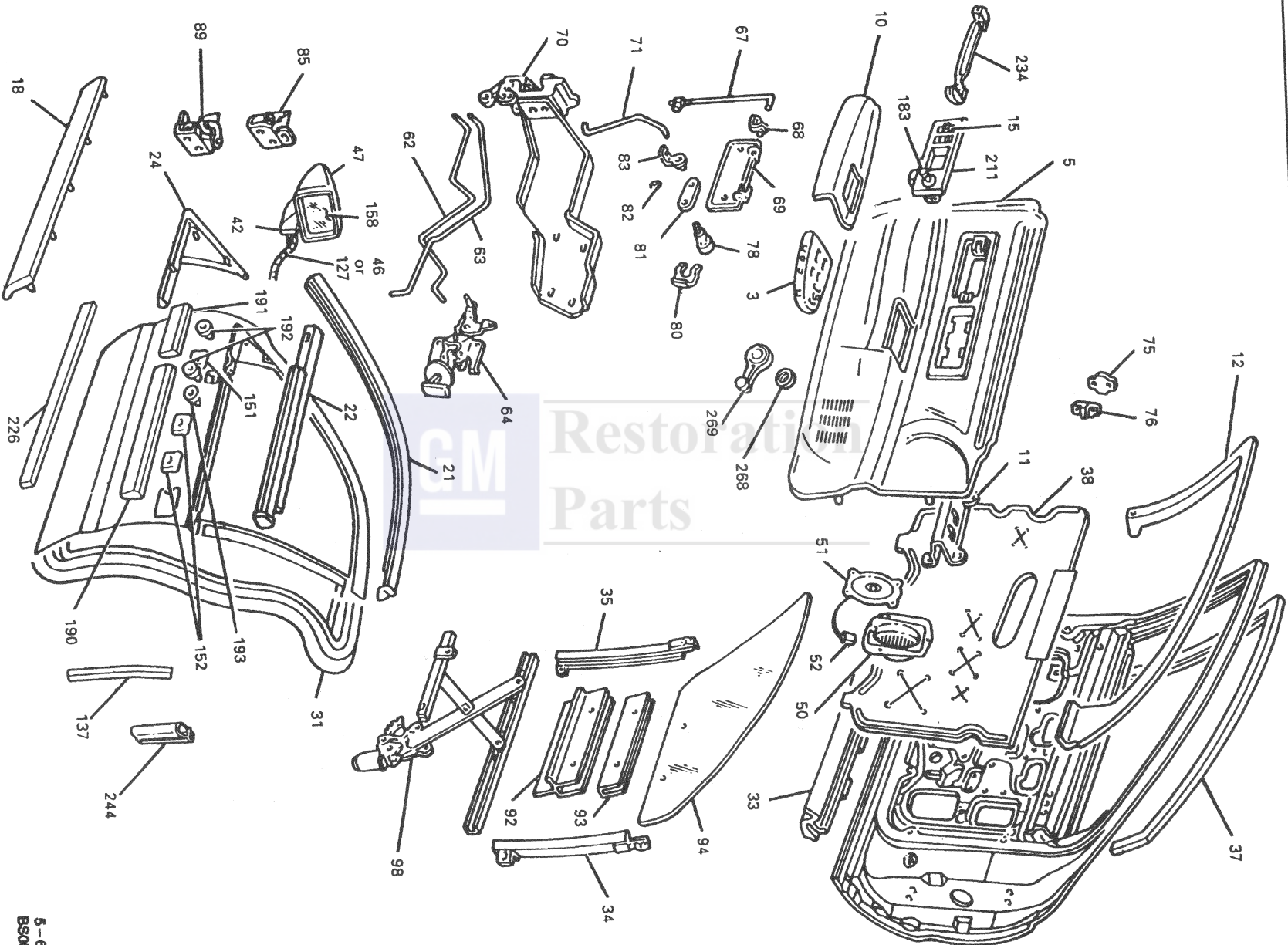
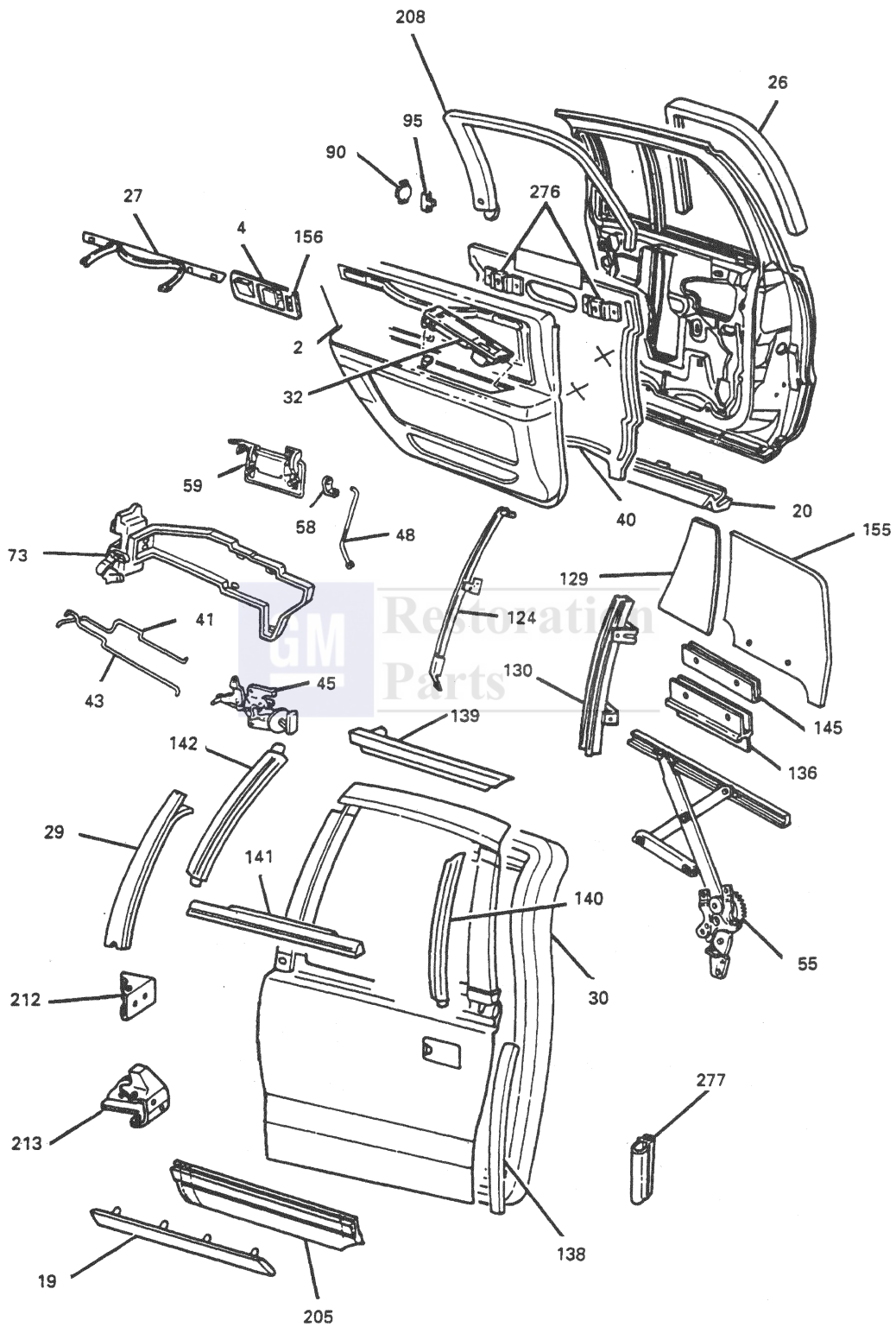


Figure 8 - Front Side Door Components-(Chevrolet Wagon)

3 PANEL ASSEMBLY, ACCESSORY SWITCH
 5 TRIM ASSEMBLY, FRONT SIDE DOOR RIGHT/LEFT
 10 ARMREST ASSEMBLY, FRONT SIDE DOOR
 11 PLATE, FRONT SIDE DOOR ARMREST HANGER
 12 MOLDING ASSEMBLY, BODY SIDE FRONT WINDOW GARNISH
 15 LEVER ASSEMBLY, FRONT SIDE DOOR LOCK ROD
 18 MOLDING ASSEMBLY, FRONT SIDE DOOR LOWER
 21 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW UPPER REVEAL
 22 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW REVEAL
 24 MOLDING ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT REVEAL
 31 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR
 33 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR BOTTOM AUXILIARY
 34 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT
 35 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR
 37 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR WINDOW
 38 DEFLECTOR, FRONT SIDE DOOR WATER
 42 INSULATOR, OUTSIDE REARVIEW MIRROR
 46 WIRING, HARNESS, BODY CROSS CAR
 47 MIRROR ASSEMBLY, OUTSIDE REARVIEW
 50 HOUSING ASSEMBLY, RADIO FRONT SIDE DOOR SPEAKER
 51 SPEAKER ASSEMBLY, RADIO FRONT SIDE DOOR
 52 CONNECTOR, RADIO FRONT SIDE DOOR SPEAKER
 62 ROD, FRONT SIDE DOOR LOCKING
 63 ROD, FRONT SIDE DOOR INSIDE HANDLE
 64 LEVER ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
 67 ROD ASSEMBLY, FRONT SIDE DOOR OUTSIDE HANDLE
 68 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
 69 HANDLE ASSEMBLY, FRONT SIDE DOOR OUTSIDE
 70 MODULE ASSEMBLY, FRONT SIDE DOOR LOCKING SYSTEM
 71 ROD ASSEMBLY, FRONT SIDE DOOR LOCK CYLINDER
 75 SPACER, FRONT SIDE DOOR LOCK STRIKER
 76 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
 78 CYLINDER ASSEMBLY, FRONT SIDE DOOR LOCK
 80 RETAINER, FRONT SIDE DOOR LOCK CYLINDER
 81 PAWL, FRONT SIDE DOOR LOCK CYLINDER
 82 CLIP, FRONT SIDE DOOR LOCK CYLINDER PAWL
 83 CLIP, FRONT SIDE DOOR LOCK CYLINDER
 85 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
 89 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
 92 SASH, FRONT SIDE DOOR WINDOW
 93 FILLER, FRONT SIDE DOOR WINDOW SASH
 94 WINDOW, FRONT SIDE DOOR
 98 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
 127 CABLE, OUTSIDE REARVIEW MIRROR
 137 MOLDING, FRONT SIDE DOOR EDGE GUARD
 151 CLIP, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH MOLDING
 152 CLIP, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH MOLDING
 158 FACE, OUTSIDE REARVIEW MIRROR
 183 KNOB, OUTSIDE REARVIEW MIRROR CONTROL
 190 MOLDING ASSEMBLY, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH
 191 MOLDING ASSEMBLY, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH
 192 NUT, FRONT SIDE DOOR TRANSFER UPPER FRONT FINISH MOLDING
 193 NUT, FRONT SIDE DOOR TRANSFER UPPER REAR FINISH MOLDING
 211 BEZEL ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
 226 MOLDING ASSEMBLY, FRONT SIDE DOOR CENTER
 234 HANDLE ASSEMBLY, FRONT SIDE DOOR PULL
 244 EDGE PROTECTOR, FRONT SIDE DOOR OUTER PANEL
 268 PLATE, FRONT SIDE DOOR WINDOW REGULATOR HANDLE BEARING
 269 HANDLE ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR

Figure 9 - Front Side Door Components-(Chevrolet Wagon)-Legend

10-6-12 DOORS



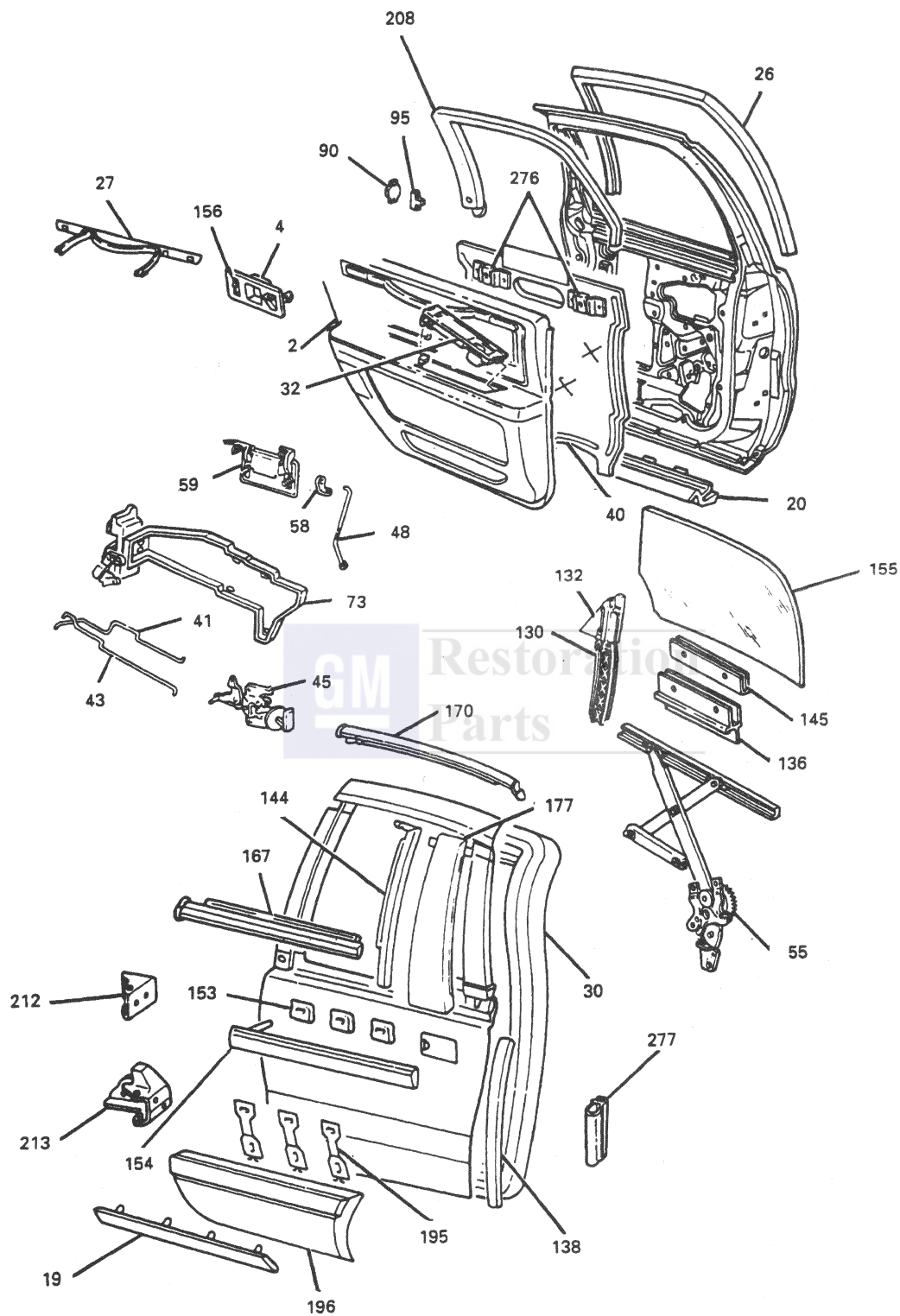
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Figure 10 - Rear Side Door Components-(Buick Sedan)

- 2 TRIM ASSEMBLY, REAR SIDE DOOR RIGHT/LEFT
- 4 BEZEL ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 19 MOLDING ASSEMBLY, REAR SIDE DOOR LOWER
- 20 SEALING STRIP ASSEMBLY, REAR SIDE DOOR BOTTOM AUXILIARY
- 26 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR WINDOW
- 27 HANDLE ASSEMBLY, REAR SIDE DOOR PULL
- 29 APPLIQUE, REAR SIDE DOOR WINDOW FRAME FRONT
- 30 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR
- 32 PLATE ASSEMBLY, REAR SIDE DOOR ARMREST SWITCH MOUNT
- 40 DEFLECTOR, REAR SIDE DOOR WATER
- 41 ROD, REAR SIDE DOOR LOCKING
- 43 ROD, REAR SIDE DOOR INSIDE HANDLE
- 45 LEVER ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 48 ROD ASSEMBLY, REAR SIDE DOOR OUTSIDE HANDLE
- 55 REGULATOR ASSEMBLY, REAR SIDE DOOR WINDOW
- 58 CLIP, REAR SIDE DOOR OUTSIDE HANDLE
- 59 HANDLE ASSEMBLY, REAR SIDE DOOR OUTSIDE
- 73 MODULE ASSEMBLY, REAR SIDE DOOR LOCKING SYSTEM
- 90 SPACER, REAR SIDE DOOR LOCK STRIKER
- 95 STRIKER ASSEMBLY, REAR SIDE DOOR LOCK
- 124 CHANNEL ASSEMBLY, REAR SIDE DOOR STATIONARY WINDOW DIVISION
- 129 WINDOW, REAR SIDE DOOR VENT
- 130 CHANNEL ASSEMBLY, REAR SIDE DOOR WINDOW FRONT
- 136 SASH, REAR SIDE DOOR WINDOW
- 138 MOLDING, REAR SIDE DOOR EDGE GUARD
- 139 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW UPPER REVEAL
- 140 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW REAR REVEAL
- 141 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW BELT REVEAL
- 142 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW FRONT REVEAL
- 145 FILLER, REAR SIDE DOOR WINDOW SASH
- 155 WINDOW, REAR SIDE DOOR
- 156 LEVER ASSEMBLY, REAR SIDE DOOR LOCK ROD
- 205 MOLDING ASSEMBLY, REAR SIDE DOOR CENTER
- 208 MOLDING ASSEMBLY, BODY SIDE REAR WINDOW GARNISH
- 212 HINGE ASSEMBLY, REAR SIDE DOOR UPPER
- 213 HINGE ASSEMBLY, REAR SIDE DOOR LOWER
- 276 BRACKET ASSEMBLY, REAR SIDE DOOR INNER PANEL
- 277 EDGE PROTECTOR, REAR SIDE DOOR OUTER PANEL

Figure 11 - Rear Side Door Components-(Buick Sedan)-Legend

10-6-14 DOORS



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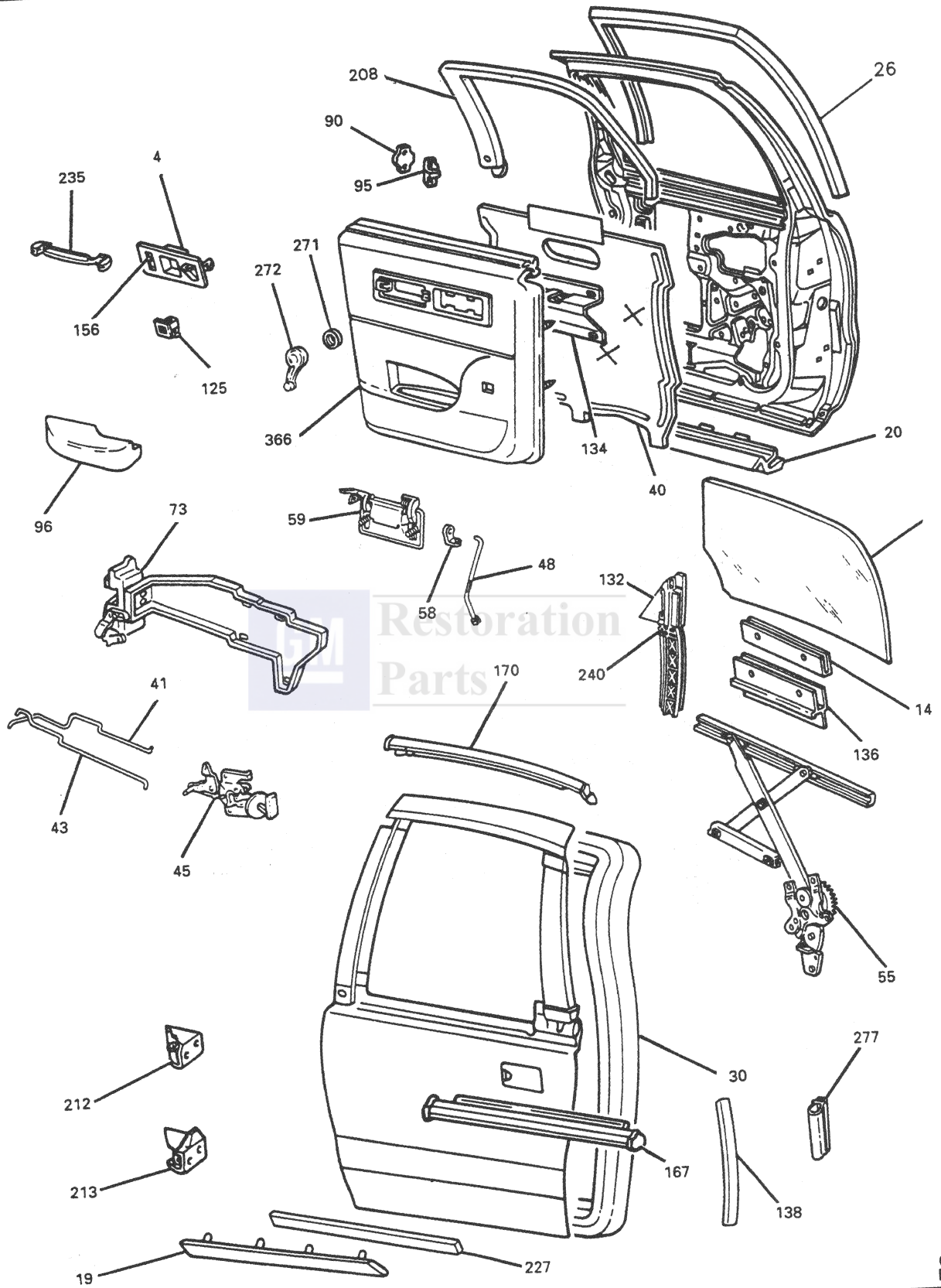
Figure 12 - Rear Side Door Components-(Buick Wagon)

- 2 TRIM ASSEMBLY, REAR SIDE DOOR RIGHT/LEFT
- 4 BEZEL ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 19 MOLDING ASSEMBLY, REAR SIDE DOOR LOWER
- 20 SEALING STRIP ASSEMBLY, REAR SIDE DOOR BOTTOM AUXILIARY
- 26 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR WINDOW
- 27 HANDLE ASSEMBLY, REAR SIDE DOOR PULL
- 30 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR
- 32 PLATE ASSEMBLY, REAR SIDE DOOR ARMREST SWITCH MOUNT
- 40 DEFLECTOR, REAR SIDE DOOR WATER
- 41 ROD, REAR SIDE DOOR LOCKING
- 43 ROD, REAR SIDE DOOR INSIDE HANDLE
- 45 LEVER ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 48 ROD ASSEMBLY, REAR SIDE DOOR OUTSIDE HANDLE
- 55 REGULATOR ASSEMBLY, REAR SIDE DOOR WINDOW
- 58 CLIP, REAR SIDE DOOR OUTSIDE HANDLE
- 59 HANDLE ASSEMBLY, REAR SIDE DOOR OUTSIDE
- 73 MODULE ASSEMBLY, REAR SIDE DOOR LOCKING SYSTEM
- 90 SPACER, REAR SIDE DOOR LOCK STRIKER
- 95 STRIKER ASSEMBLY, REAR SIDE DOOR LOCK
- 130 CHANNEL ASSEMBLY, REAR SIDE DOOR WINDOW FRONT
- 132 INSULATOR, REAR SIDE DOOR WINDOW REAR CHANNEL
- 136 SASH, REAR SIDE DOOR WINDOW
- 138 MOLDING, REAR SIDE DOOR EDGE GUARD
- 144 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW REAR REVEAL
- 145 FILLER, REAR SIDE DOOR WINDOW SASH
- 153 CLIP, REAR SIDE DOOR TRANSFER UPPER FINISH MOLDING
- 154 MOLDING ASSEMBLY, REAR SIDE DOOR TRANSFER UPPER FINISH
- 155 WINDOW, REAR SIDE DOOR
- 156 LEVER ASSEMBLY, REAR SIDE DOOR LOCK ROD
- 167 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW REVEAL
- 170 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW UPPER REVEAL
- 177 APPLIQUE ASSEMBLY, REAR SIDE DOOR WINDOW FRAME REAR
- 195 CLIP, REAR SIDE DOOR TRANSFER LOWER FINISH MOLDING
- 196 MOLDING ASSEMBLY, REAR SIDE DOOR TRANSFER LOWER FINISH
- 208 MOLDING ASSEMBLY, BODY SIDE REAR WINDOW GARNISH
- 212 HINGE ASSEMBLY, REAR SIDE DOOR UPPER
- 213 HINGE ASSEMBLY, REAR SIDE DOOR LOWER
- 276 BRACKET ASSEMBLY, REAR SIDE DOOR INNER PANEL
- 277 EDGE PROTECTOR, REAR SIDE DOOR OUTER PANEL

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Figure 13 - Rear Side Door Components-(Buick Wagon)-Legend

10-6-16 DOORS



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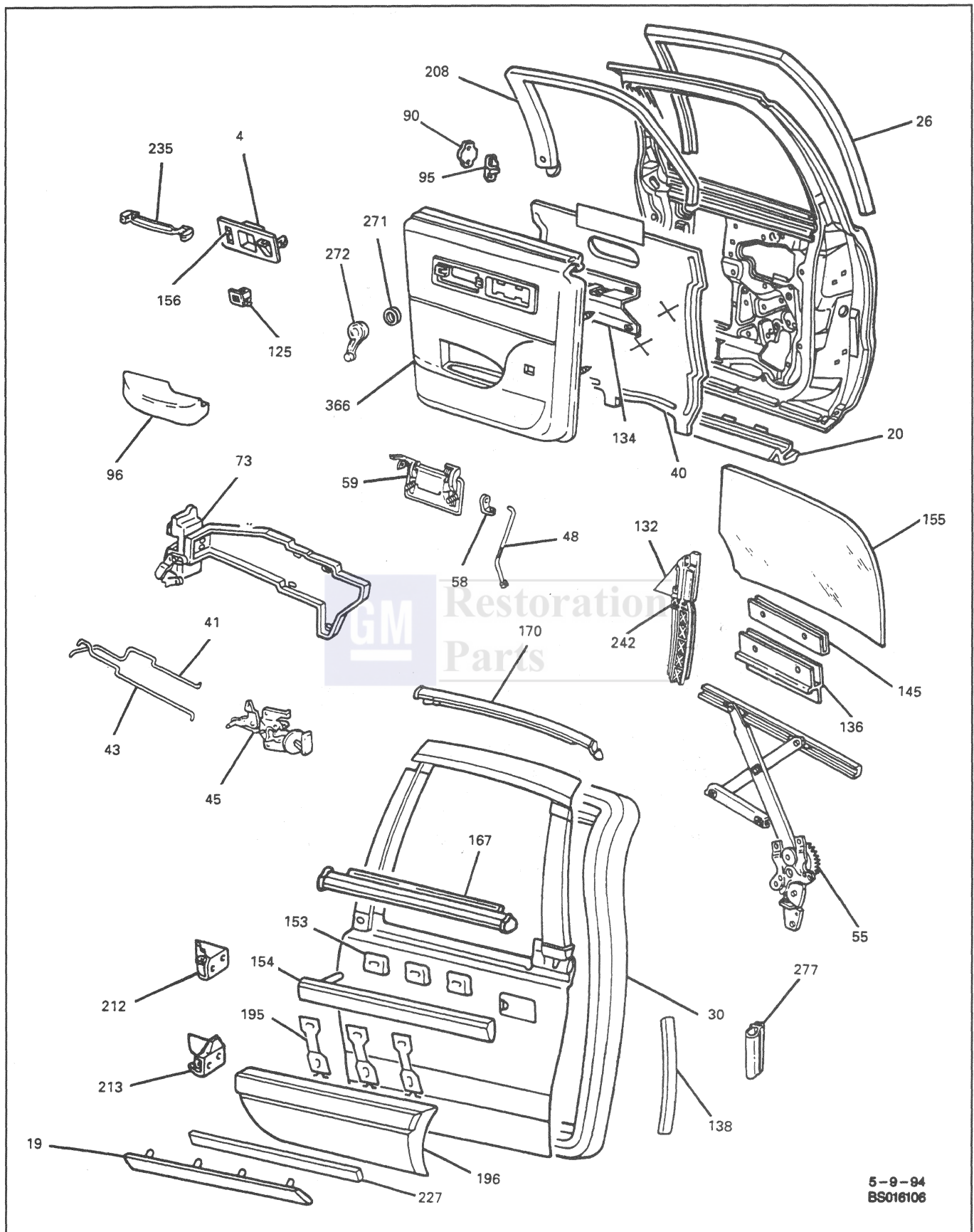
Figure 14 - Rear Side Door Components-(Chevrolet Sedan)

4 BEZEL ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
19 MOLDING ASSEMBLY, REAR SIDE DOOR LOWER
20 SEALING STRIP ASSEMBLY, REAR SIDE DOOR BOTTOM AUXILIARY
26 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR WINDOW
30 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR
40 DEFLECTOR, REAR SIDE DOOR WATER
41 ROD, REAR SIDE DOOR LOCKING
43 ROD, REAR SIDE DOOR INSIDE HANDLE
45 LEVER ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
48 ROD ASSEMBLY, REAR SIDE DOOR OUTSIDE HANDLE
55 REGULATOR ASSEMBLY, REAR SIDE DOOR WINDOW
58 CLIP, REAR SIDE DOOR OUTSIDE HANDLE
59 HANDLE ASSEMBLY, REAR SIDE DOOR OUTSIDE
73 MODULE ASSEMBLY, REAR SIDE DOOR LOCKING SYSTEM
90 SPACER, REAR SIDE DOOR LOCK STRIKER
95 STRIKER ASSEMBLY, REAR SIDE DOOR LOCK
96 ARMREST ASSEMBLY, REAR SIDE DOOR
125 SWITCH, REAR SIDE DOOR WINDOW
132 INSULATOR, REAR SIDE DOOR WINDOW REAR CHANNEL
134 PLATE, REAR SIDE DOOR ARMREST HANGER
136 SASH, REAR SIDE DOOR WINDOW
138 MOLDING, REAR SIDE DOOR EDGE GUARD
145 FILLER, REAR SIDE DOOR WINDOW SASH
155 WINDOW, REAR SIDE DOOR
156 LEVER ASSEMBLY, REAR SIDE DOOR LOCK ROD
167 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW REVEAL
170 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW UPPER REVEAL
208 MOLDING ASSEMBLY, BODY SIDE REAR WINDOW GARNISH
212 HINGE ASSEMBLY, REAR SIDE DOOR UPPER
213 HINGE ASSEMBLY, REAR SIDE DOOR LOWER
227 MOLDING ASSEMBLY, REAR SIDE DOOR CENTER
235 HANDLE ASSEMBLY, REAR SIDE DOOR PULL
240 CHANNEL ASSEMBLY, REAR SIDE DOOR WINDOW FRONT
271 PLATE, REAR SIDE DOOR WINDOW REGULATOR HANDLE BEARING
272 HANDLE ASSEMBLY, REAR SIDE DOOR WINDOW REGULATOR
277 EDGE PROTECTOR, REAR SIDE DOOR OUTER PANEL
366 TRIM ASSEMBLY, REAR SIDE DOOR RIGHT/LEFT

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Figure 15 - Rear Side Door Components-(Chevrolet Sedan)-Legend

10-6-18 DOORS



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Figure 16 - Rear Side Door Components-(Chevrolet Wagon)

- 4 BEZEL ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 19 MOLDING ASSEMBLY, REAR SIDE DOOR LOWER
- 20 SEALING STRIP ASSEMBLY, REAR SIDE DOOR BOTTOM AUXILIARY
- 26 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR WINDOW
- 30 WEATHERSTRIP ASSEMBLY, REAR SIDE DOOR
- 40 DEFLECTOR, REAR SIDE DOOR WATER
- 41 ROD, REAR SIDE DOOR LOCKING
- 43 ROD, REAR SIDE DOOR INSIDE HANDLE
- 45 LEVER ASSEMBLY, REAR SIDE DOOR INSIDE HANDLE
- 48 ROD ASSEMBLY, REAR SIDE DOOR OUTSIDE HANDLE
- 55 REGULATOR ASSEMBLY, REAR SIDE DOOR WINDOW
- 58 CLIP, REAR SIDE DOOR OUTSIDE HANDLE
- 59 HANDLE ASSEMBLY, REAR SIDE DOOR OUTSIDE
- 73 MODULE ASSEMBLY, REAR SIDE DOOR LOCKING SYSTEM
- 90 SPACER, REAR SIDE DOOR LOCK STRIKER
- 95 STRIKER ASSEMBLY, REAR SIDE DOOR LOCK
- 96 ARMREST ASSEMBLY, REAR SIDE DOOR
- 125 SWITCH, REAR SIDE DOOR WINDOW
- 132 INSULATOR, REAR SIDE DOOR WINDOW REAR CHANNEL
- 134 PLATE, REAR SIDE DOOR ARMREST HANGER
- 136 SASH, REAR SIDE DOOR WINDOW
- 138 MOLDING, REAR SIDE DOOR EDGE GUARD
- 145 FILLER, REAR SIDE DOOR WINDOW SASH
- 153 CLIP, REAR SIDE DOOR TRANSFER UPPER FINISH MOLDING
- 154 MOLDING ASSEMBLY, REAR SIDE DOOR TRANSFER UPPER FINISH
- 155 WINDOW, REAR SIDE DOOR
- 156 LEVER ASSEMBLY, REAR SIDE DOOR LOCK ROD
- 167 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW REVEAL
- 170 MOLDING ASSEMBLY, REAR SIDE DOOR WINDOW UPPER REVEAL
- 195 CLIP, REAR SIDE DOOR TRANSFER LOWER FINISH MOLDING
- 196 MOLDING ASSEMBLY, REAR SIDE DOOR TRANSFER LOWER FINISH
- 208 MOLDING ASSEMBLY, BODY SIDE REAR WINDOW GARNISH
- 212 HINGE ASSEMBLY, REAR SIDE DOOR UPPER
- 213 HINGE ASSEMBLY, REAR SIDE DOOR LOWER
- 227 MOLDING ASSEMBLY, REAR SIDE DOOR CENTER
- 235 HANDLE ASSEMBLY, REAR SIDE DOOR PULL
- 242 CHANNEL ASSEMBLY, REAR SIDE DOOR WINDOW FRONT
- 271 PLATE, REAR SIDE DOOR WINDOW REGULATOR HANDLE BEARING
- 272 HANDLE ASSEMBLY, REAR SIDE DOOR WINDOW REGULATOR
- 277 EDGE PROTECTOR, REAR SIDE DOOR OUTER PANEL
- 366 TRIM ASSEMBLY, REAR SIDE DOOR RIGHT/LEFT

Figure 17 - Rear Side Door Components-(Chevrolet Wagon)-Legend

ON-VEHICLE SERVICE

FRONT SIDE DOOR INTERIOR TRIM

Front Side Door Trim

Figures 18 through 23

The front and rear side door trim is serviced the same way. Use the following procedure for both. Replace the spring clip (GM P/N 10221260) whenever the switch mount plate (6 or 160) is removed from the door trim.

Tool Required:

J 24595-C Door Trim Pad and Garnish Clip Remover

 Remove or Disconnect

CAUTION: Refer to "CAUTION" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.

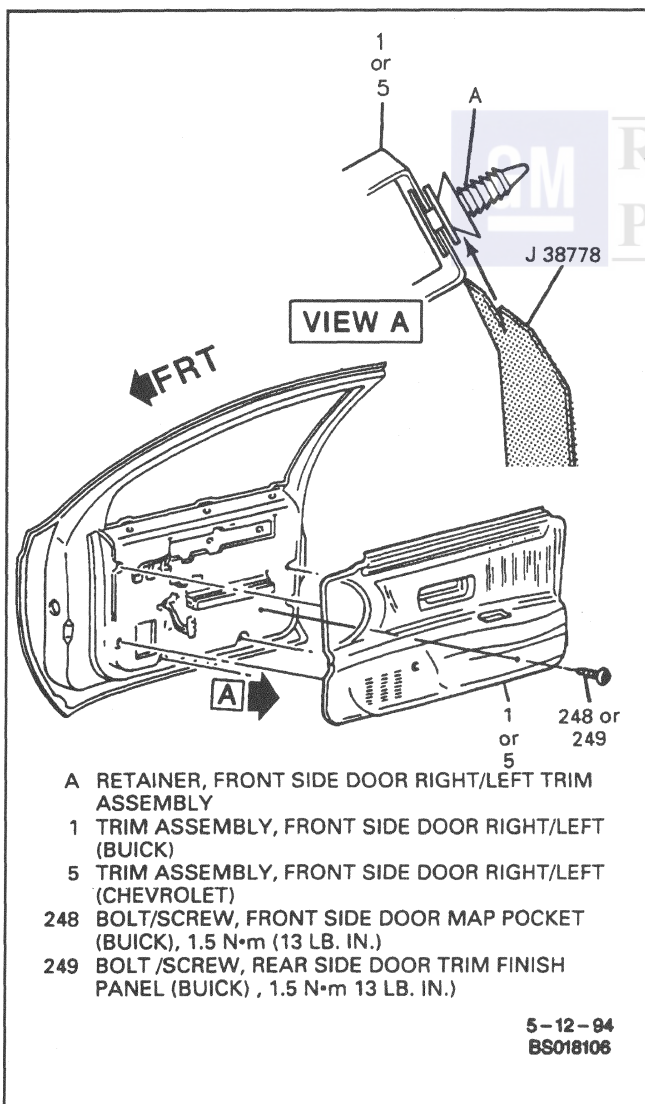


Figure 18 - Removing Front Side Door Right/Left Trim

2. Bezel bolt/screw.
3. Bezel (7 or 211).
4. Electrical connectors from bezel (7 or 211).
5. Switch mount plate (6 or 160) or switch panel (3).
 - A. Insert screwdriver under forward edge of switch (6 or 160) to disengage spring clip.
 - B. Slide forward and up to remove.
 - C. Insert screwdriver in outward slots to disengage tabs and remove switch panel (3) (Chevrolet).
6. Front side door window switch floodlamp, if equipped.
 - Twist 90 degrees to remove.
7. Loosen setscrew (257) connecting knob (183) from switch mount plate.
8. Knob (183), if equipped.
9. Outside rearview mirror knob (183) to bezel (211), if equipped.
10. Front side door ashtray, if equipped. Refer to "Front Side Door Ashtray" in this section.
11. Front side door window regulator handle, if equipped. Refer to "Front Side Door Window Regulator Handle" in this section.
12. Electrical connectors from switch (6 or 160).
13. Pull handle bolts/screws.
14. Front side door armrest, if necessary. Refer to "Front Side Door Armrest" in this section.

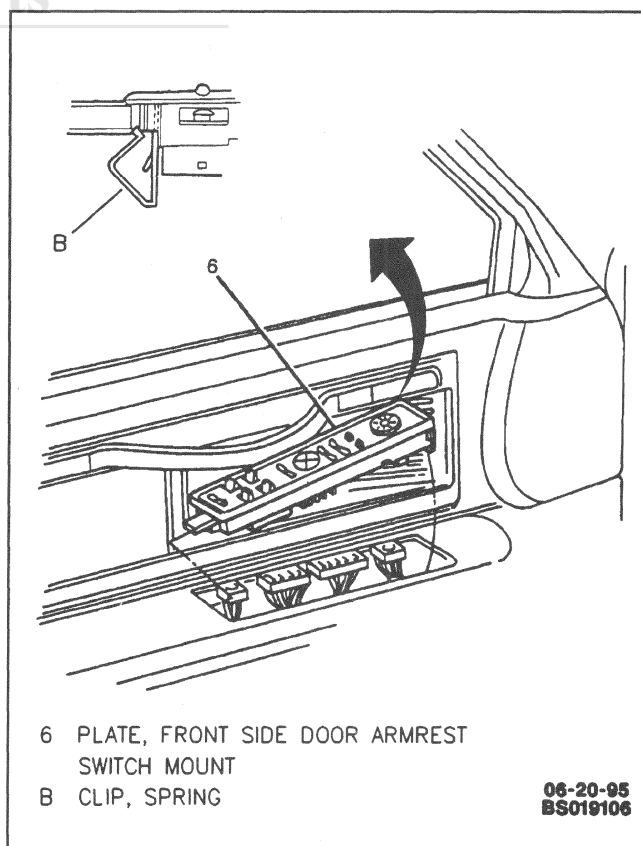


Figure 19 - Removing Front Side Door Armrest Switch Mount Plate-(Buick)

15. Front side door map pocket bolt/screw (248), located in lower edge of door in carpeted area.
 - If rear side door, remove rear side door trim finish panel bolt/screw (249), located above edge of rear side door carpet strip.
16. Courtesy lamp connector from body crosscar wiring harness.
17. Trim (1, 2, 5 or 366) using J 38778.
18. Electrical connectors from front side door courtesy lamp.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Replace any damaged retainers on trim pad (1).
2. Pull electrical connectors through their respective cutouts in trim (2).
3. Front side door courtesy lamp electrical connectors.
4. Trim (2), using a clean, rubber mallet to seat retainers (1).
5. Front side door map pocket bolt/screw (248), located in lower edge of door in carpeted area (Buick).
 - If rear side door, install rear side door trim finish panel bolt/screw (249), located above edge of rear side door carpet strip.

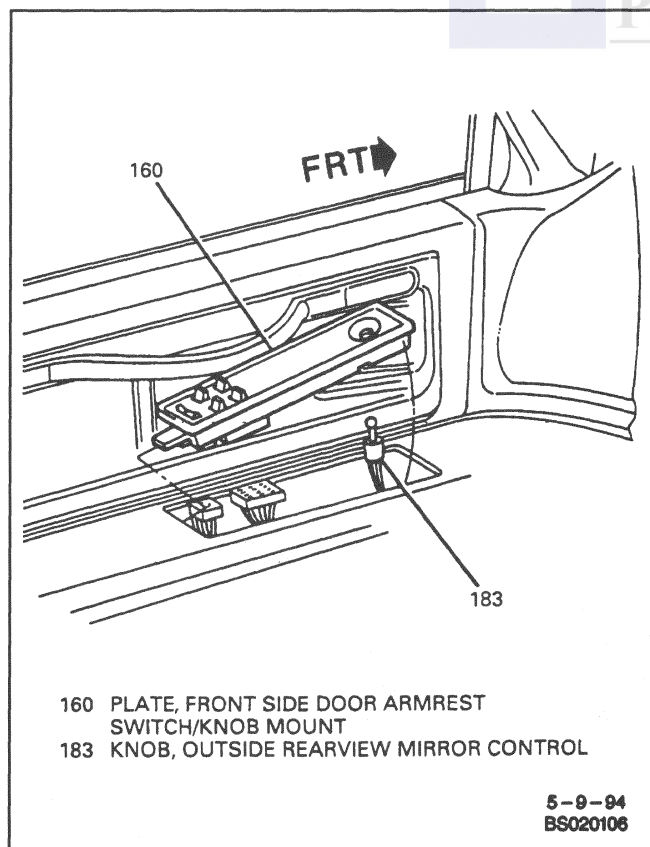


Figure 20 - Removing Front Side Door Armrest Switch/Knob Mount Plate-(Buick)

Tighten

- Front side door map pocket bolt/screw (248) or rear side door trim finish panel bolt/screw (249) to 1.5 N.m (13 lb. in.).
6. Front side door armrest. Refer to "Front Side Door Armrest" in this section.
 7. Pull handle bolts/screw (253) and (254).

Tighten

- Pull handle bolts/screws (253) and (254) to 6 N.m (53 lb. in.).
8. Switch electrical connectors.
 9. Knob (183).
 10. Tighten setscrew (257) connecting knob (183) to bezel (211).

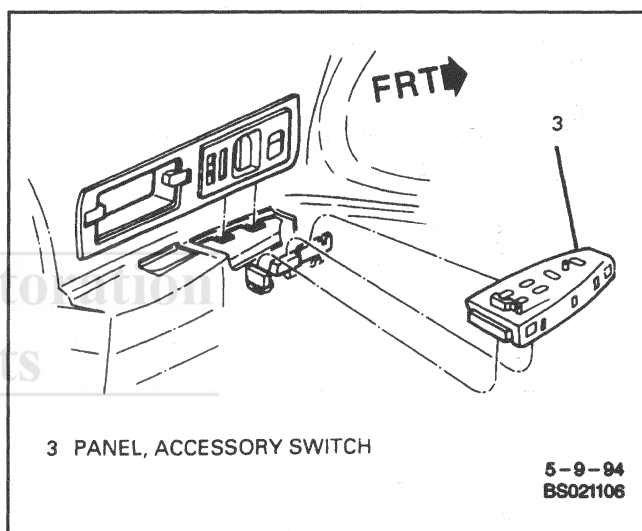


Figure 21 - Removing Accessory Switch Panel-(Chevrolet)

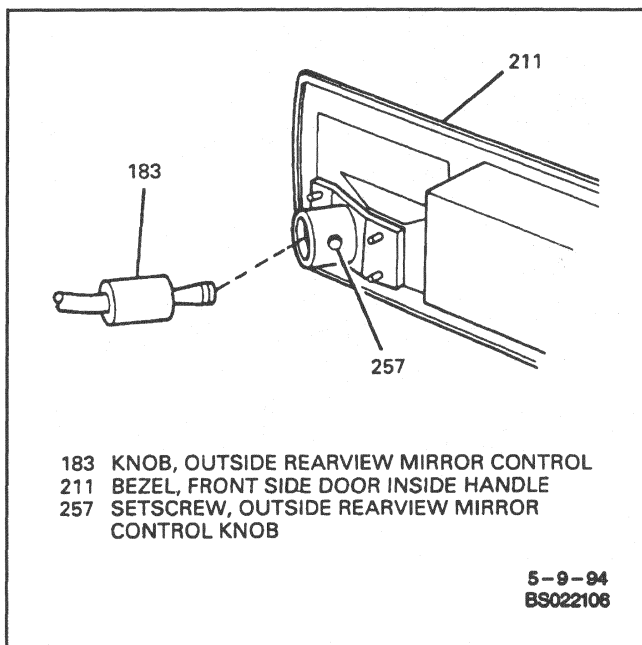


Figure 22 - Outside Rearview Control Knob-(Chevrolet)

10-6-22 DOORS

11. Front side door window switch floodlamp, if equipped.
 - Twist 90 degrees to secure.
12. Snap bezel (7 or 211) into trim (1 or 5).
13. Bolt/screw (8) to 3.25 N·m (30 lb. in.).

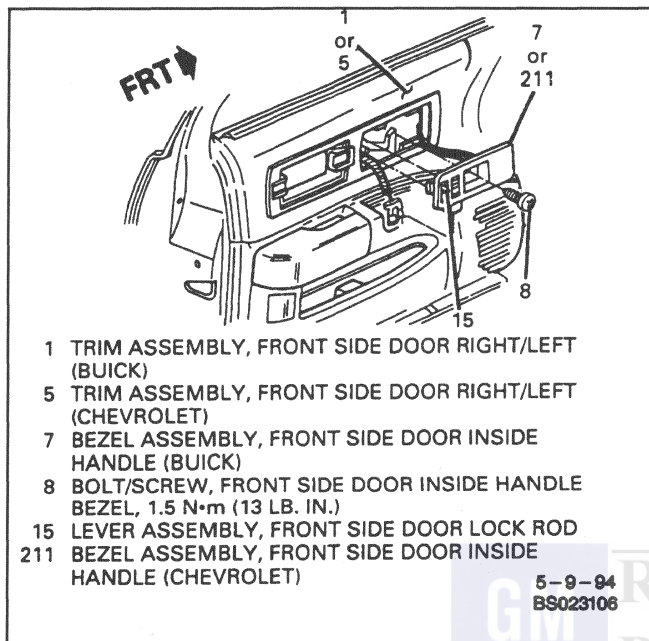


Figure 23 - Removing Front Side Door Inside Handle Bezel



Tighten

- Bolt/screw (8) to 1.5 N·m (13 lb. in.).
14. New spring clip to switch mount plate (6 or 160).
 - Slide clip into groove on bezel until fully seated.
 15. Front side door ashtray, if equipped. Refer to "Front Side Door Ashtray" in this section.
 16. Front side door window regulator handle, if equipped. Refer to "Front Side Door Window Regulator Handle" in this section.
 17. Electrical connectors to switch mount plate (6 or 160) or switch panel (3).
 18. Switch mount plate (6 or 160) or switch panel (3).
 - Snap in to secure.
 19. Battery negative cable.

Front Side Door Armrest

CHEVROLET

Figure 24

The front and rear door armrests are serviced the same way. Use the following procedure for both.



Remove or Disconnect

1. Bolts/screws (9).
2. Armrest (10) from hanger plate (11).
 - Pull armrest (10) away from door to disengage clips.

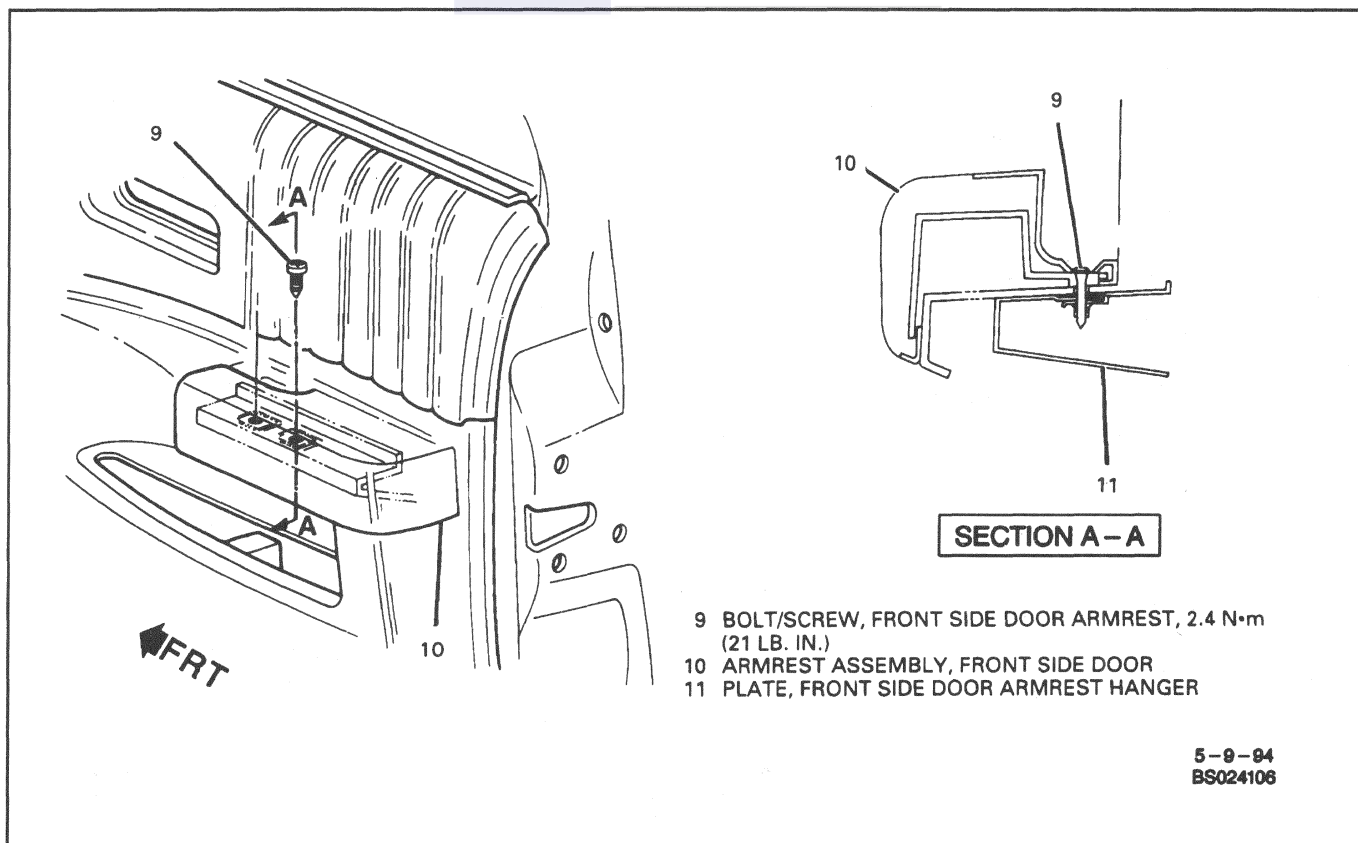


Figure 24 - Removing Front Side Door Armrest-(Chevrolet)

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Armrest (10) to hanger plate (11).
 - Push armrest (10) toward door to engage clips.
- 2 Bolts/screws (9).

⌚ Tighten

- Bolts/screws (9) to 2.4 N.m (21 lb. in.).

Body Side Front Window Garnish Molding

Figure 25

↔ Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Bolt/screw (13).
3. Fastener (14) from door inner panel.
4. Garnishing molding (12).
 - Disengage clips.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Molding (12).
 - Engage clips.

2. Fastener (14) to hole in door inner panel.
3. Bolt/screw (13).

⌚ Tighten

- Bolt/screw (13) to 1.3 N.m (12 lb. in.).
4. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR EXTERIOR TRIM

Front Side Door Moldings

NOTICE: When removing or installing any outside molding, cover adjacent finishes with masking tape to prevent damage to the finish. Use proper tools and care to prevent damage to the molding. Seal all holes for bolts/screws or clips in body panels with body caulking compound or presealed bolts/screws, nuts, or clips to prevent water entry into the body interior.

FRONT SIDE DOOR TRANSFER UPPER FINISH MOLDING

The rear side door transfer upper finish molding is serviced the same way as the front side door transfer upper finish molding. Use the following procedure for both.

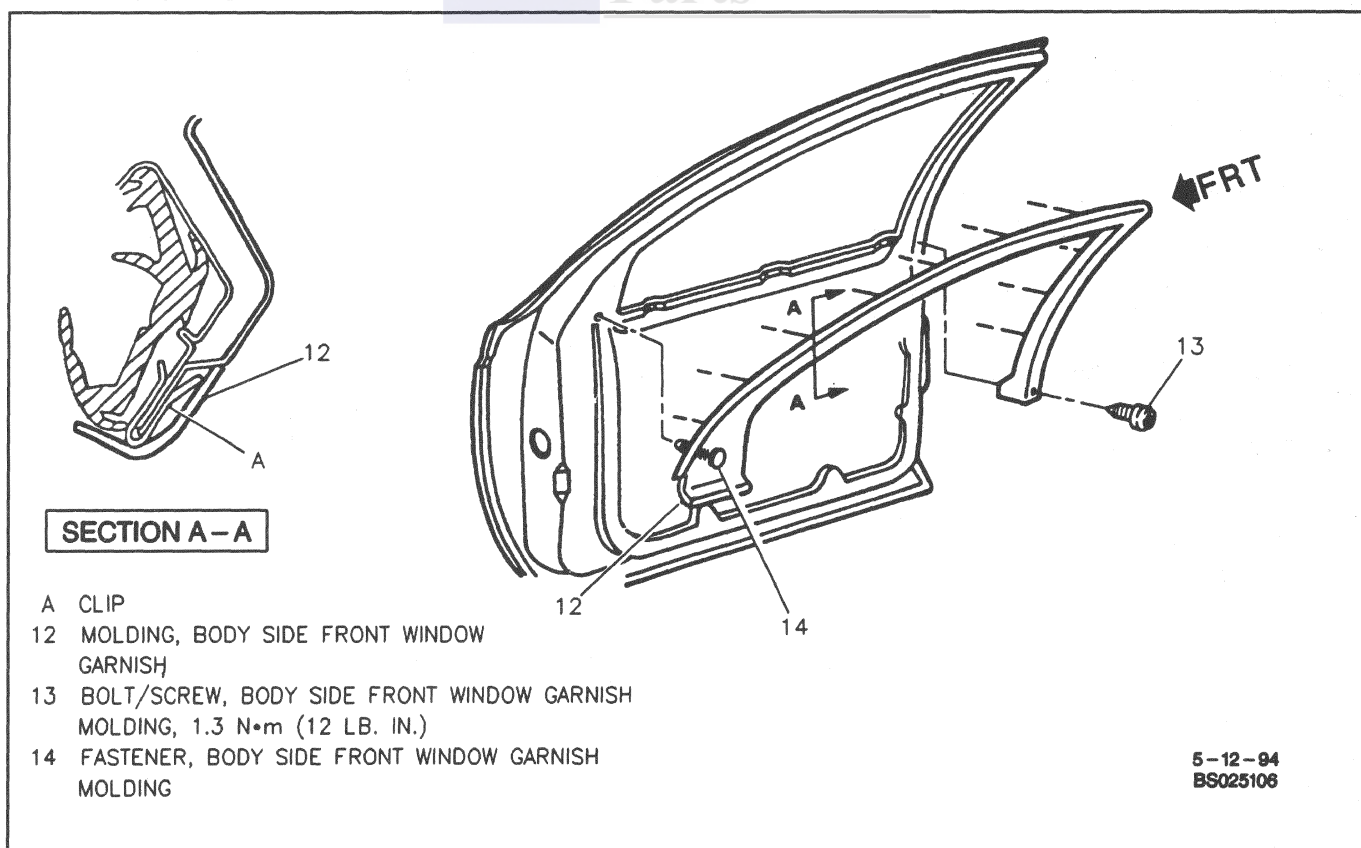


Figure 25 - Removing Body Side Front Window Garnish Molding

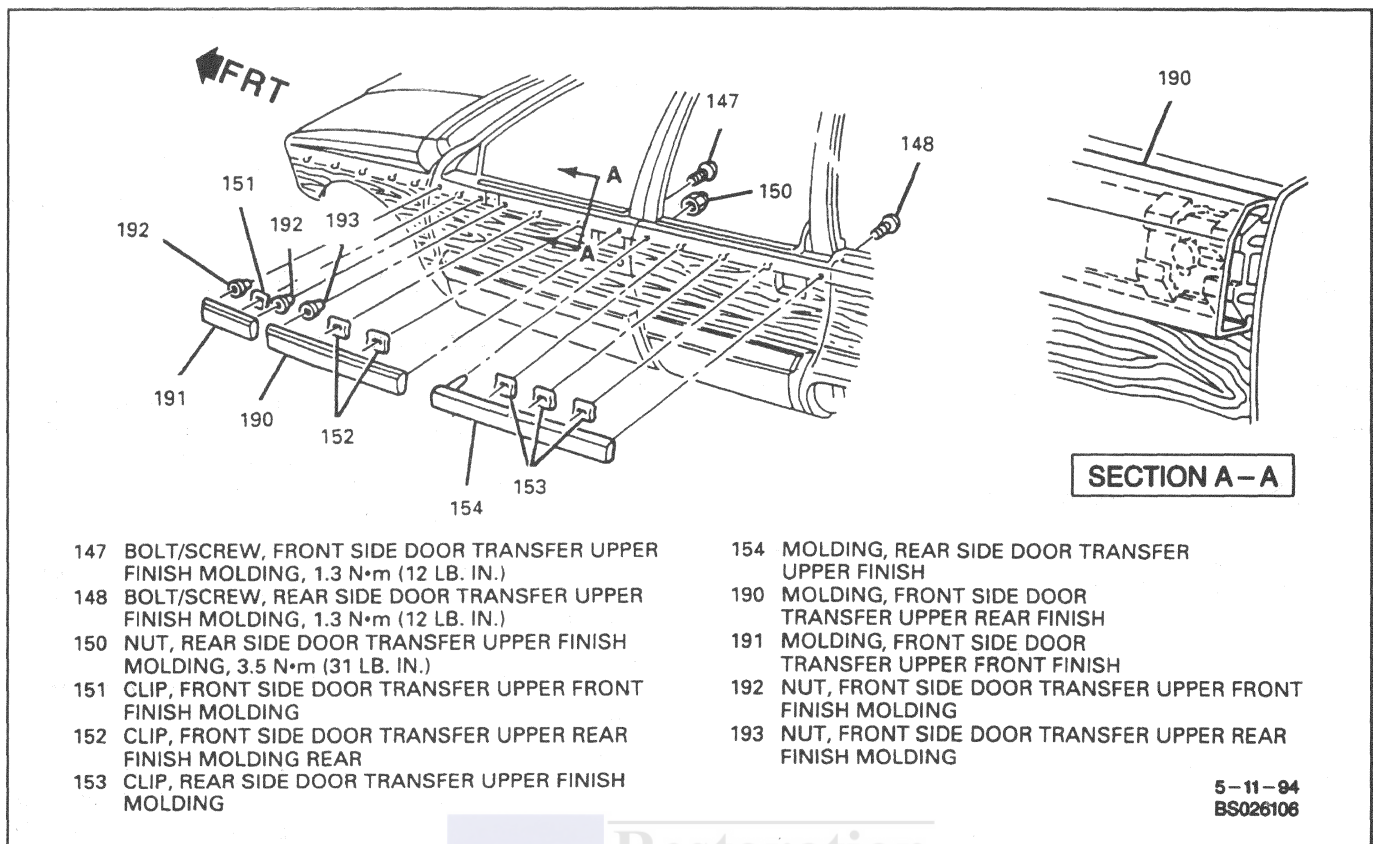


Figure 26 - Wood Grain Side Door Transfer Upper Finish Molding-(Wagon)

WAGON

Figure 26

Remove or Disconnect

1. Bolt/screw (147), if necessary.
2. Molding (190 or 191).
 - Carefully pry molding (190 or 191) off with flat-bladed tool such as a putty knife.
3. Clips (151 or 152), if necessary.
 - Slide forward to disconnect.
4. Nuts (192 or 193), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Nuts (192 or 193), if removed.
2. Clips (151 or 152), if removed.
 - Slide rearward to engage.
3. Molding (190 or 191).
 - Align studs to nuts (192 or 193) and snap onto clips (151 or 152).
4. Bolt/screw (147), if necessary.

Tighten

- Bolt/screw (147) to 1.3 N·m (12 lb. in.).

FRONT SIDE DOOR TRANSFER LOWER FINISH MOLDING

The rear side door transfer lower finish molding is serviced the same way as the front side door transfer lower finish molding. Use the following procedure for both.

BUICK SEDAN

Figure 27

Remove or Disconnect

1. Nut (149).
2. Molding (197).
 - Push up on bottom of molding (197) and remove from tops of clips (194).
3. Clips (194), if necessary.
 - Slide rearward and then downward to disconnect.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Clips (194), if removed.
 - A. Place over bottom studs.
 - B. Slide upward.
 - C. Align upper holes in clips (194) to upper studs.

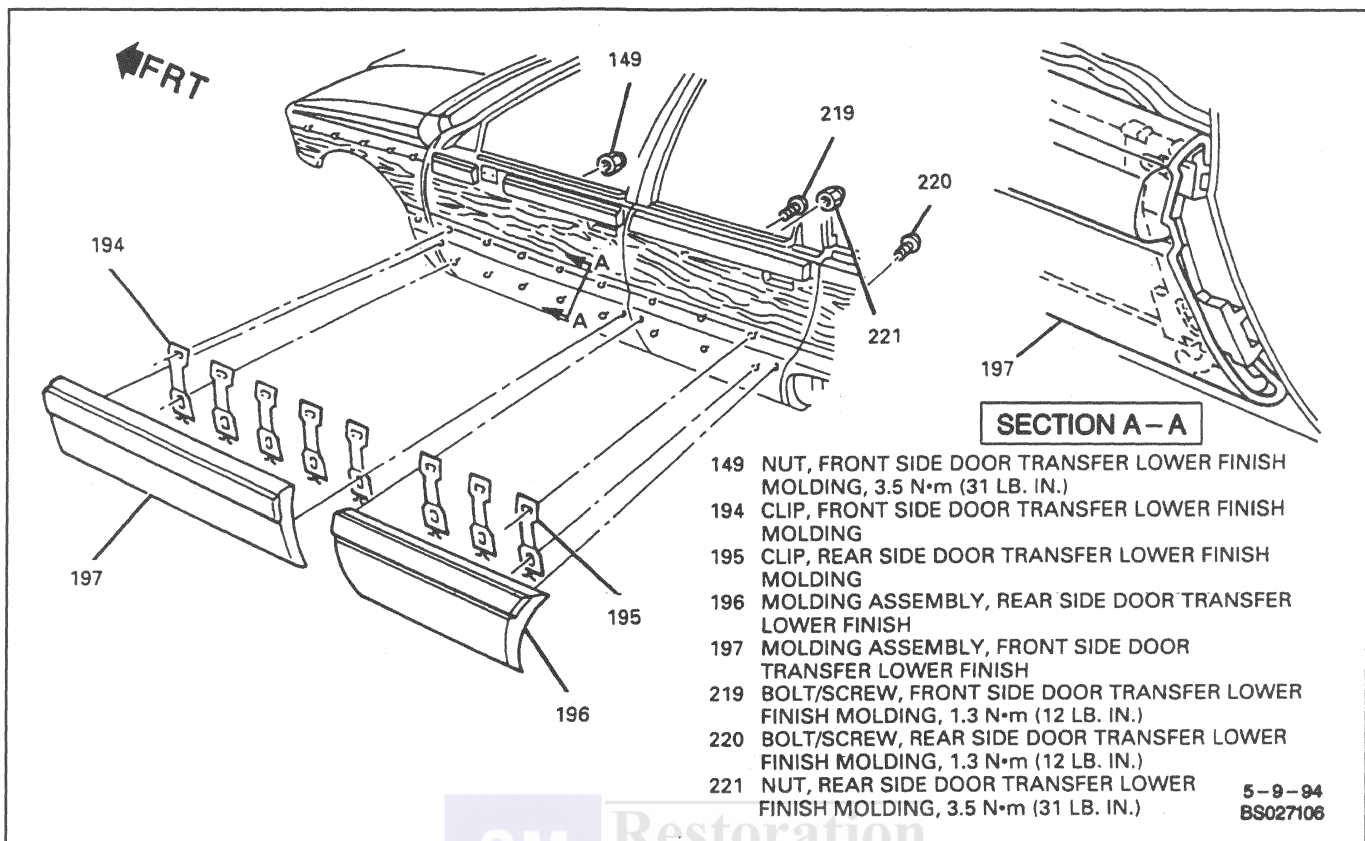


Figure 27 - Wood Grain Side Door Transfer Lower Finish Molding-(Buick Wagon)

- D. Slide upper parts of clips (194) forward.
2. Molding (197).
 - A. Engage bottom edge to bottoms of clips (194).
 - B. Push up on bottom of molding (197) until top engages with tops of clips (194).
3. Nut (149).

**Tighten**

- Nut (149) to 3.5 N·m (31 lb. in.).

FRONT SIDE DOOR CENTER MOLDING

The rear side door center molding is serviced the same way as the front side door center molding. Use the following procedures for both.

BUICK SEDAN**Figure 28 and 29****Remove or Disconnect**

1. Molding by starting at one edge and peeling molding from rear door.
 - Application of heat to molding at point of removal aids removal operation.
2. All traces of adhesive residue from painted surfaces with a silicone, wax, and grease remover.

**Install or Connect**

1. Prepare surface.

**Clean**

- A. Painted surface with silicone, wax, and grease remover.
- B. Area where molding will be applied with a 50-50 mixture of isopropyl alcohol and water.
 - Wipe panel surface with a clean cloth while solvent is still wet and allow to dry.
2. Remove backing material of molding as necessary.
3. Molding to door.
 - For up/down location, Refer to (Figures 2 and 3) for set-up dimensions.
 - For fore/aft location, place exterior center molding to trailing edge of outer door panel to provide the most door swing clearance at leading edge.

**Important**

- Roll the molding with approximately 25 lb. of force over each adhesive contact point.
- Be certain that adhesive contact points make full contact on surface or molding will not adhere.

CHEVROLET SEDAN**Remove or Disconnect**

1. Molding (226).
 - A. Hold hot air gun 152 mm (6 inches) away from molding surface.
 - B. Apply heat, using circular motion for about 30 seconds.

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- C. Use flat-bladed tool, being careful not to damage paint, and remove molding (226) from door.
- D. Discard molding (226).



Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Molding (226).
 - A. Caprice molding should be placed 5mm below door feature line. Impala SS molding should be placed 19 mm below door feature line.
 - B. Mark position of molding (226) with length of masking tape.



Clean

- a. Area with soap and water. Wipe dry.
- b. Area with oil-free naphtha or alcohol.
- C. If needed, warm door surface with heat lamp or heat gun to 21° C (70° F).
- D. Peel paper from molding (226).
 - Do not touch adhesive backing.
- E. Press molding (226) to door to secure.
- F. Hand-roll molding (226) to ensure proper adhesion.



Inspect

- Molding ends for bonding. Hand-roll loose ends.

FRONT SIDE DOOR LOWER MOLDING

The rear side door lower molding is serviced the same way as the front side door lower molding. Use the following procedure for both.

Figure 30



Remove or Disconnect

1. Nuts (16).
2. Molding (18) from door.
3. Nuts (206).



Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Nuts (206).
 - Press into holes to secure.
2. Molding (18) by pressing studs (174) to nuts (206).
3. Nuts (16).



Tighten

- Nuts (16) to 3.5 N.m (31 lb. in.).

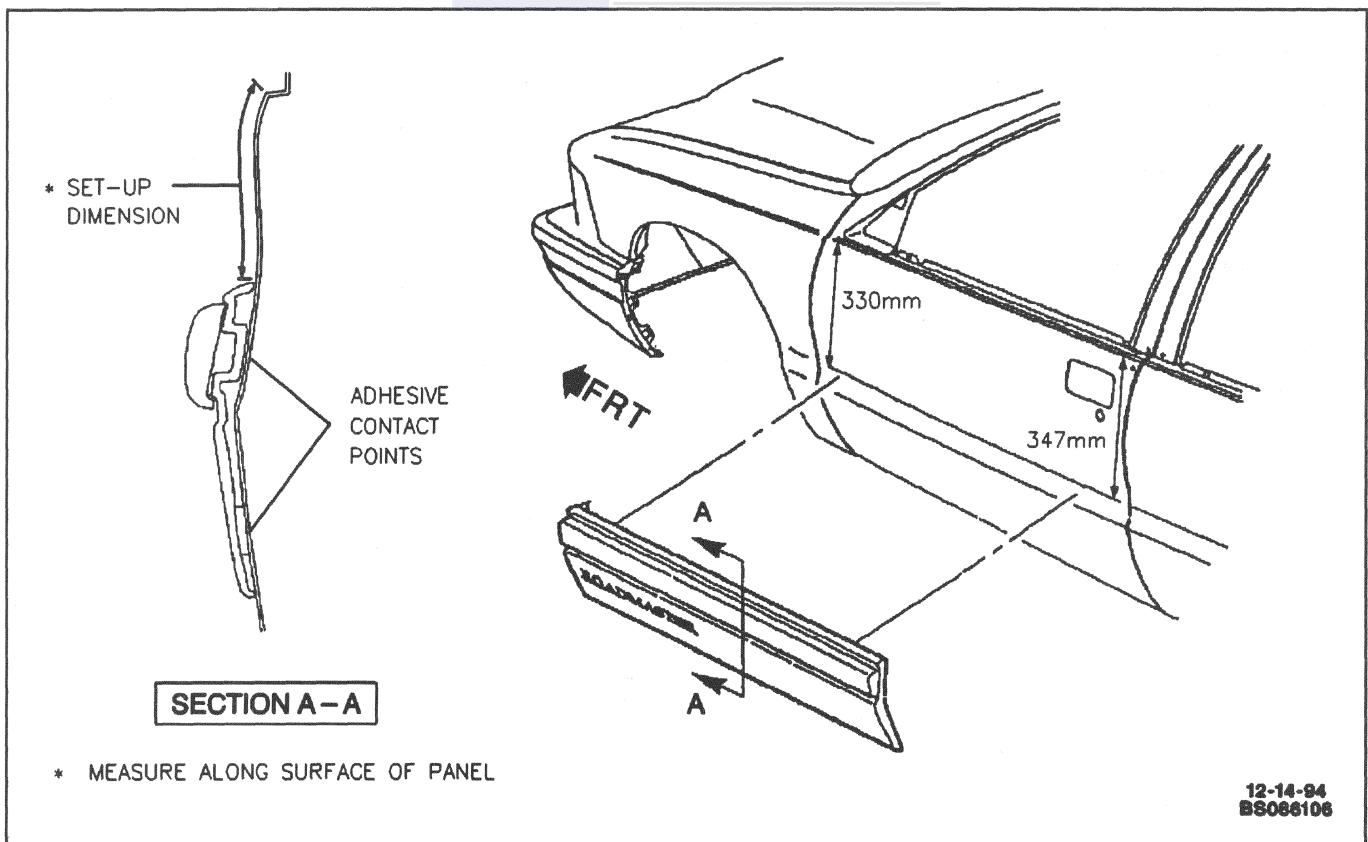


Figure 28 - Front Side Door Center Molding-(Buick Sedan)

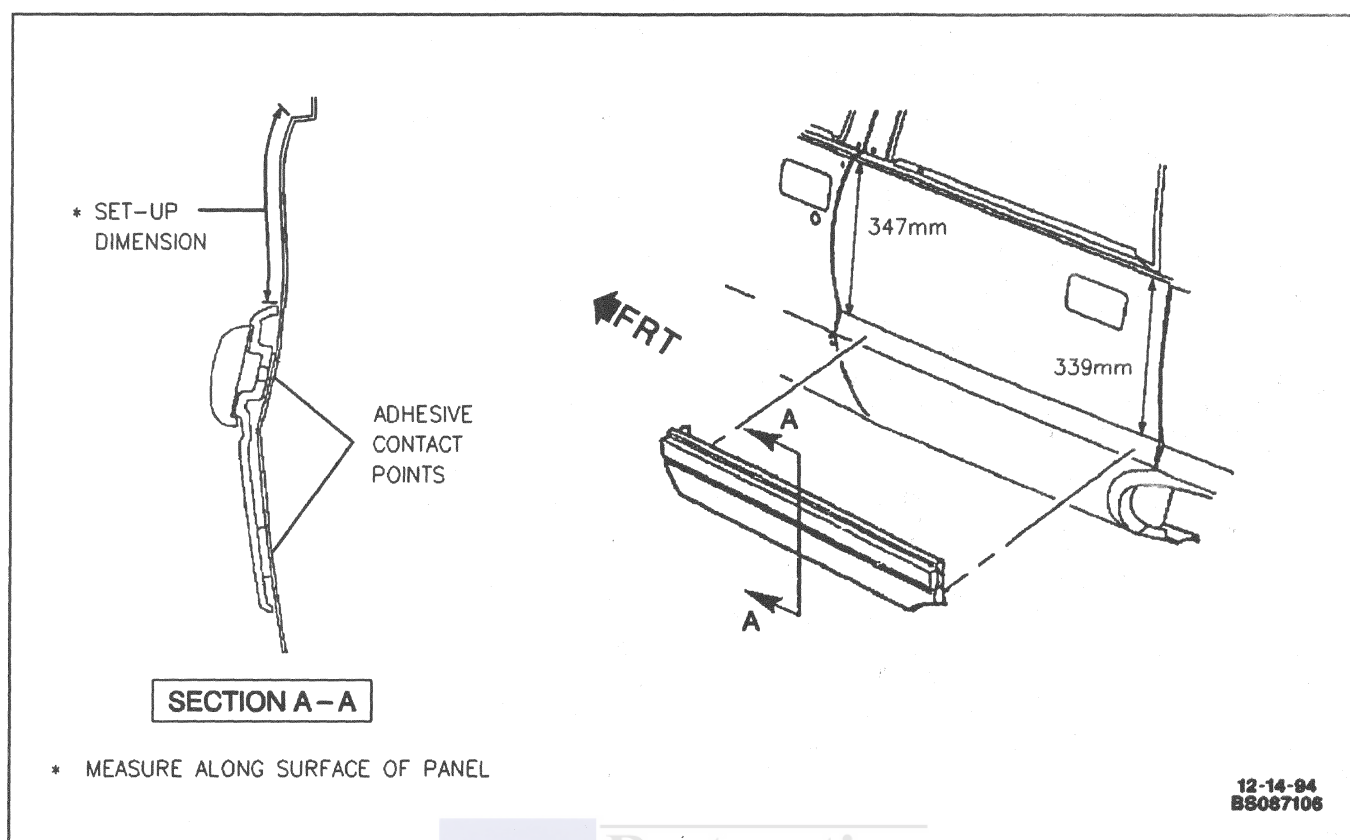


Figure 29 - Rear Side Door Center Molding-(Buick Sedan)

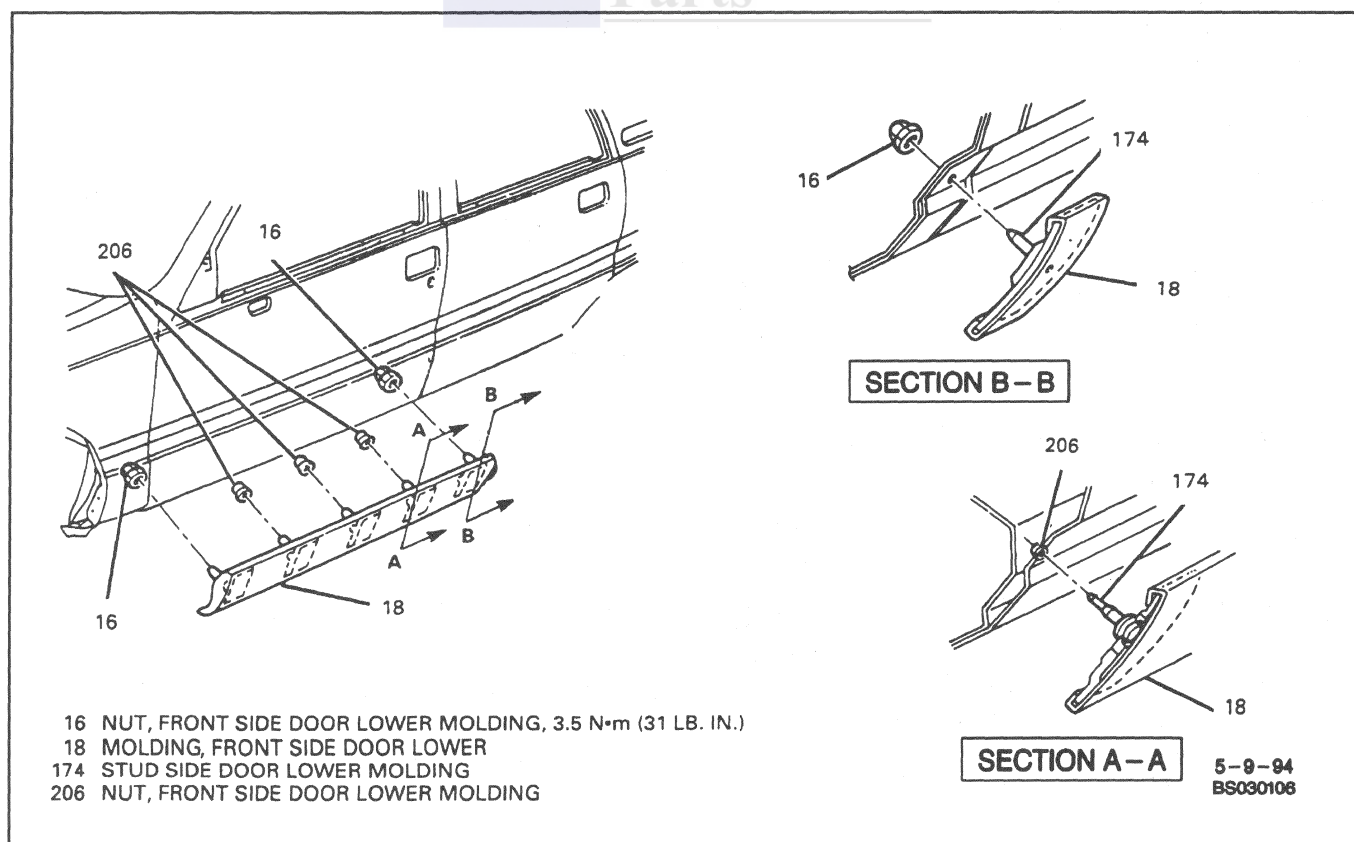


Figure 30 - Removing Front Side Door Lower Molding-(Typical)

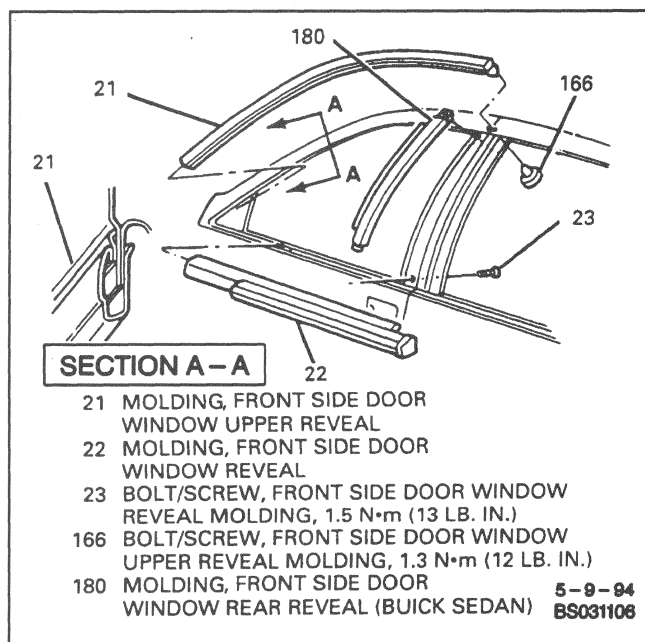


Figure 31 - Removing Front Side Door Window Reveal Moldings

FRONT SIDE DOOR WINDOW UPPER REVEAL MOLDING

Figure 31

Remove or Disconnect

1. Fully lower front side door window.
2. Peel back rubber edge of front side door window weatherstrip.
3. Bolt/screw (166).
4. Molding (21).

Install or Connect

1. Molding (21).
 - Align T-nut to pierced hole at rear upper corner of front side door.
2. Bolt/screw (166).

Tighten

- Bolt/screw (166) to 1.3 N·m (12 lb. in.).

FRONT SIDE DOOR REVEAL MOLDING

Figure 31

Remove or Disconnect

1. Outside rearview mirror. Refer to "Outside Rearview Mirror" in this section.
2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Bolt/screw (23).
4. Reveal molding (22).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Reveal molding (22).
 - Place over pinch-weld flange.
2. Bolt/screw (23).

Tighten

- Bolt/screw (23) to 1.5 N·m (13 lb. in.).
3. Front side door trim. Refer to "Front Side Door Trim" in this section.
 4. Outside rearview mirror. Refer to "Outside Rearview Mirror" in this section.

FRONT SIDE WINDOW UPPER REVEAL MOLDING

BUICK SEDAN

Figure 31

Remove or Disconnect

1. Front side door window upper reveal molding. Refer to "Front Side Door Window Upper Reveal Molding" under "Front Side Door Moldings" in this section.
2. Reveal molding (180).
 - Pull from flange.

Install or Connect

1. Reveal molding (180).
 - Align to flange and press to secure.
2. Front side door window upper reveal molding. Refer to "Front Side door Window Upper Reveal Molding" under "Front Side Door Moldings" in this section.

FRONT SIDE DOOR WINDOW FRONT REVEAL MOLDING

Figure 31 and 32

Tool Required:
J 24595-C Door Trim Pad and Garnish Clip Remover

Remove or Disconnect

1. Outside rearview mirrors Refer to "Outside Rearview Mirror" in this section.
2. Bolt/screw (26).

NOTICE: Tape door to prevent vehicle damage during removal and installation of front side door window reveal molding.

3. Fastener.
 - A. Pull forward edge of molding (24) away from door.

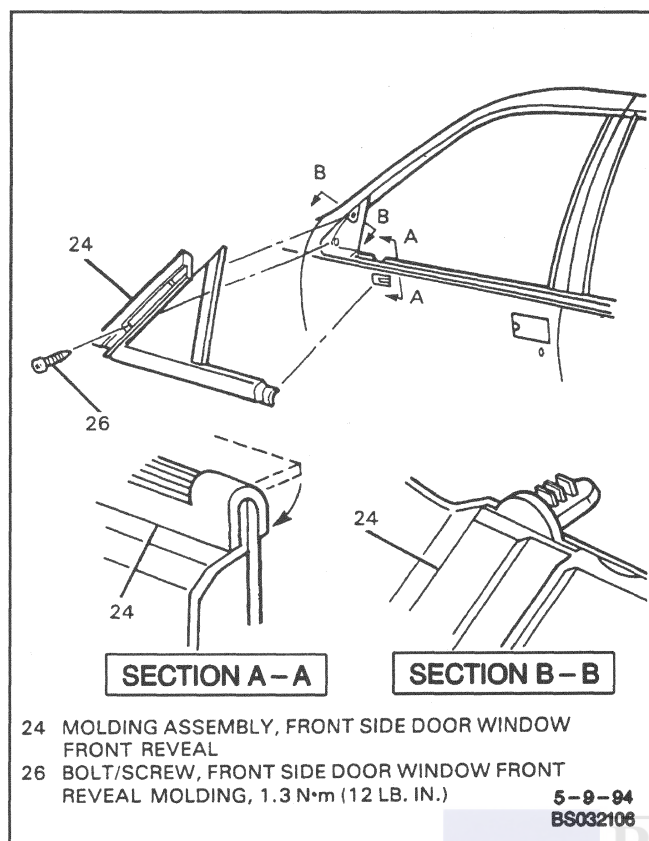


Figure 32 - Removing Front Side Door Window Front Reveal Molding

B. Using J 24595-C, pry fastener from door.

4. Molding (24).

- Slide molding (24) toward front of vehicle to disengage it from front side door window upper reveal molding and front side door window reveal molding.

→→ Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Molding (24).

- A. Place under front side door window reveal molding, then under front side door upper reveal molding.

B. Slide molding (24) toward rear of vehicle.

2. Fastener.

3. Remove tape from door.

4. Bolt/screw (26).

⌚ Tighten

- Bolt/screw (157) to 1.3 N·m (12 lb. in.).

5. Outside rearview mirror. Refer to "Outside Rearview mirror" in this section.

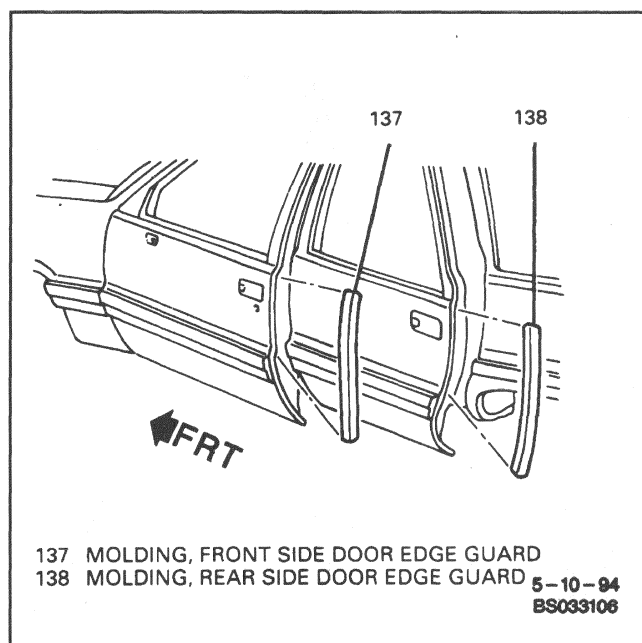


Figure 33 - Front and Rear Side Door Edge Guard Moldings

FRONT SIDE DOOR EDGE GUARD MOLDING

Figure 33

↔ Remove or Disconnect

- Molding (137).
— Pull from edge of door.

→→ Install or Connect

- Molding (137).
A. Match to shape of door edge.
B. Press along entire length to secure.

FRONT SIDE DOOR OUTER PANEL EDGE PROTECTOR

Figure 34

↔ Remove or Disconnect

- Door outer panel edge protector (244).

→→ Install or Connect

- Door outer panel edge protector (244).
— Position to rear edge of front door and press forward to secure.

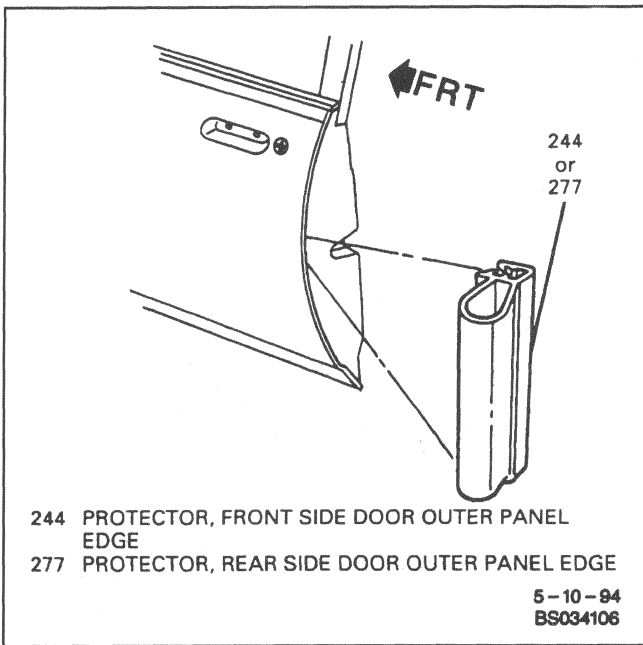


Figure 34 - Removing Front and Rear Side Door Outer Panel Edge Protector

Front Side Door Window Frame Applique

BUICK SEDAN

Figure 35

Remove or Disconnect

1. Front side door window reveal moldings. Refer to "Front Side Door Window Upper Reveal Molding," "Front Side Door Window Reveal Molding" or "Front Side Door Window Rear Reveal Molding" under "Front Side Door Moldings" in this section.
2. Applique (28).
 - Use heat gun to soften adhesive.



Clean

- Surface with 50/50 alcohol and water solution.



Install or Connect

1. Applique (28).
 - A. Surface temperature must be between 15° C and 32° C (60° F and 90° F). If necessary, adjust surface temperature by using a heat gun or allowing surface to cool.
 - B. Peel back paper on applique (28).
 - C. Align top notch in applique (28) to top pierced hole on window frame.
 - D. Working downward, remove paper backing and align applique to bottom pierced hole on window frame, using squeegee to smooth applique (28).
 - E. Fold remaining edge of applique (28) over window frame flange.
2. Front side door window reveal moldings. Refer to "Front Side Door Window Upper Reveal Molding," "Front Side Door Window Reveal Molding" or "Front Side Door Window Rear Reveal Moldings" under "Front Side Door Moldings" in this section.

FRONT SIDE DOOR WEATHERSTRIP

Figure 36

Remove or Disconnect

1. Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.
2. Floor carpet retainer. Refer to "Floor Carpet Retainer" in this section.
3. Windshield garnish molding. Refer to SECTION 10-9.
4. Weatherstrip (31).
 - Pull from pinch-weld flange.

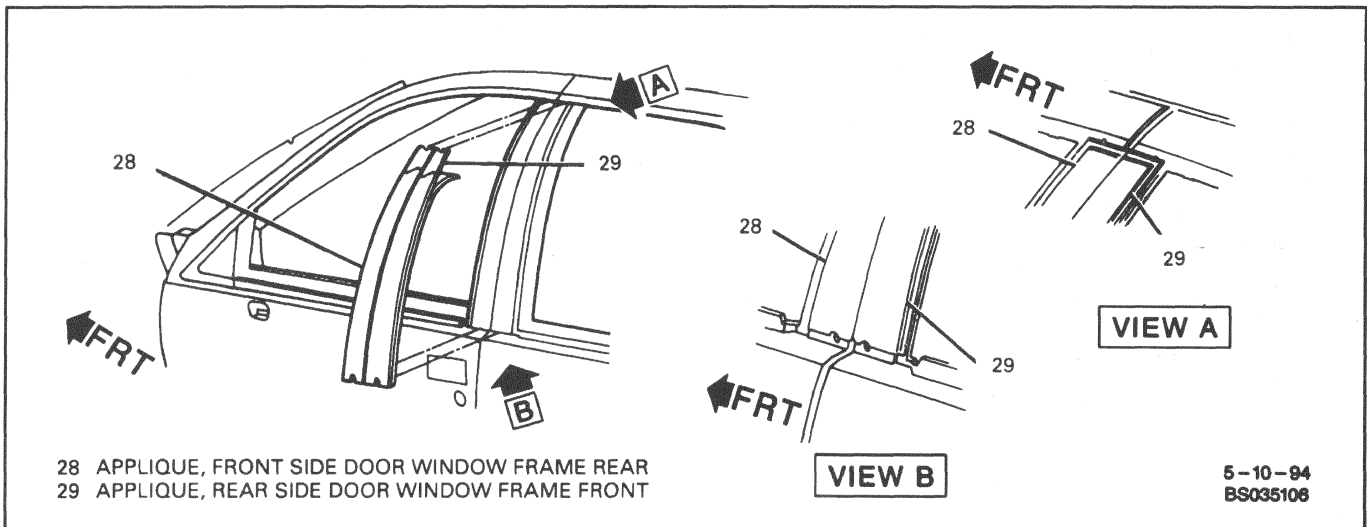


Figure 35 - Applying Side Door Window Frame Appliques-(Buick Sedan)

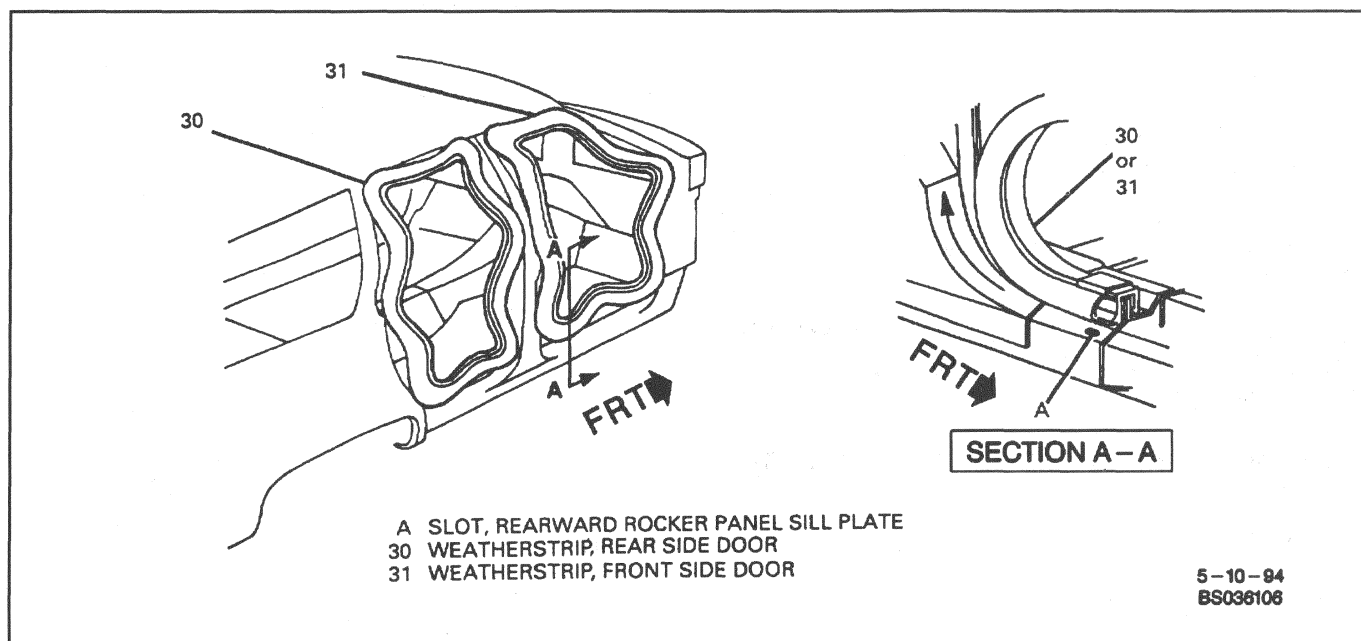


Figure 36 - Front and Rear Side Door Weatherstrips-(Typical)

Install or Connect

- Weatherstrip (31).
 - Position to body by locating weatherstrip to slot and engage onto pinch-weld flange.
 - Roll the weatherstrip onto the pinch-weld flange. Make sure weatherstrip is fully seated in corner areas.
 - Install the last 300 mm (11.8 inches) by fitting ends together and evenly compressing onto pinch-weld flange.
- Windshield garnish molding. Refer to SECTION 10-9.
- Floor carpet retainer. Refer to "Floor Carpet Retainer" in this section.
- Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.

FRONT SIDE DOOR SEALING STRIPS

FRONT SIDE DOOR WINDOW BELT OUTER SEALING STRIP

The front side door window belt outer sealing strip is part of the front side door window belt reveal molding. Refer to "Front Side Door Window Belt Reveal Molding" under "Front Side Door Moldings" in this section.

FRONT SIDE DOOR WINDOW BELT INNER SEALING STRIP

The front side door window belt inner sealing strip is not serviceable. If the sealing strip requires service, the door trim must be replaced.

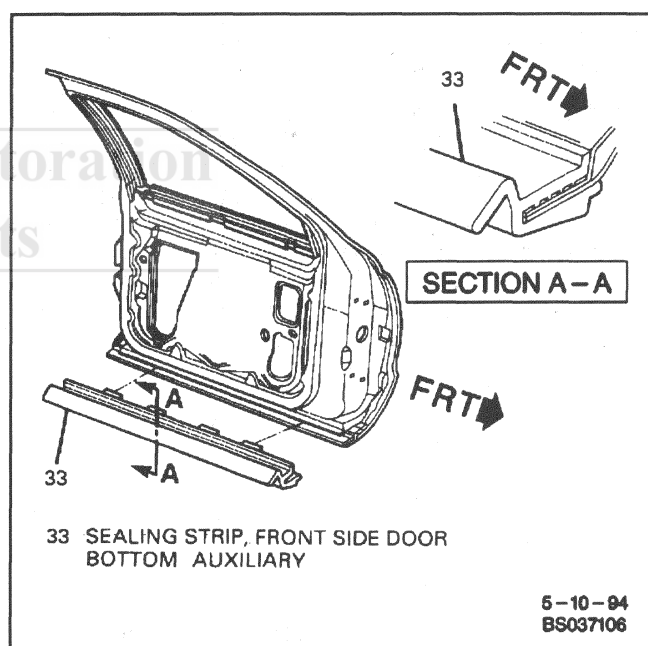


Figure 37 - Removing Front Side Door Bottom Auxiliary Sealing Strip

Front Side Door Bottom Auxiliary Sealing Strip

Figure 37

Remove or Disconnect

- Front side door lower molding. Refer to "Front Side Door Lower Molding" or "Front Side Door Transfer Lower Finish Molding" (Buick Wagon) under "Front Side Door Moldings" in this section.
- Sealing strip (33) from lower door flange.

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↔ Install or Connect

1. Sealing strip (33) to lower door flange.
 - Tap with rubber mallet, making sure to hit square to flange.
2. Front side door lower molding. Refer to "Front Side Door Lower Molding" or "Front Side Door Transfer Lower Finish Molding" (Buick Wagon) under "Front Side Door Moldings" in this section.

FRONT SIDE DOOR WINDOW CHANNELS AND FRONT SIDE DOOR WINDOW WEATHERSTRIP

Front Side Door Window Front And Rear Channels

Figure 38

↔ Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.

CAUTION: When activated, the window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

3. Fully raise front side door window.
4. Bolt/screw (39).
5. Channel (35).
 - Disengage tabs on upper edge of channel (35) from tabs on door inner panel.
6. Bolt/screw (36).
7. Channel (34).
 - Disengage tabs on upper edge of channel (34) from tabs on door inner panel.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Channel (34).
 - Engage tabs on upper edge of channel (34) and push upward to secure.
2. Bolt/screw (36).
 - Align hole on lower end of channel (34) to hole in door inner panel.

⌚ Tighten

- Bolt/screw (36) to 11 N.m (97 lb. in.).

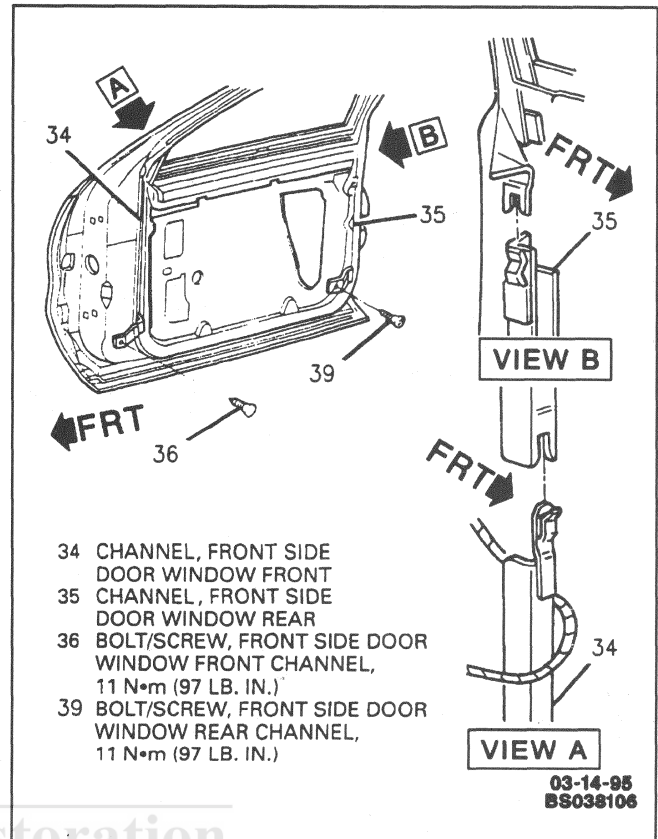


Figure 38 - Removing Front and Rear Side Window Channels

3. Channel (35).
 - Engage tabs on upper edge of channel (35) and push upward to secure.
4. Bolt/screw (39) to channel (35).
 - Align hole on lower end of channel (35) to hole in door inner panel.

⌚ Tighten

- Bolt/screw (39) to 11 N.m (97 lb. in.).
5. Make sure mirror cable is looped around outside of channel (34).
 6. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
 7. Front side door trim. Refer to "Front Side Door Trim" in this section.

Front Side Door Window Weatherstrip

Figure 39

↔ Remove or Disconnect

1. Front side door window. Refer to "Front Side Door Window" in this section.
2. Weatherstrip (37).
 - Using finger pressure, squeeze weatherstrip (37) together and pull weatherstrip (37) from window frame.

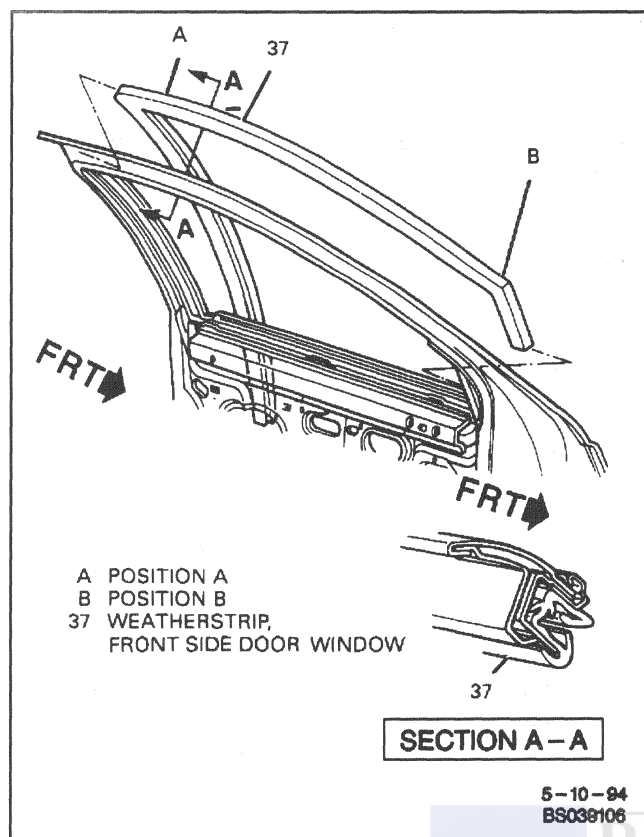


Figure 39 - Removing Front Side Door Window Weatherstrip

Install or Connect

- Weatherstrip (37).
 - Squeeze together.
 - Working from position A forward along upper header toward position B, seat weatherstrip (37) into window frame.
- Front side door window. Refer to "Front Side Door Window" in this section.
- Seat weatherstrip (37) into front side door front and rear window channels.

FRONT SIDE DOOR SWITCHES

Front Side Door Lock Switch

Figure 23

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

- Battery negative cable.
- Bolt/screw (8).
- Bezel (7 or 211).
- Switch from bezel (7 or 211).
 - Unsnap switch from bezel (7 or 211).
- Wiring harness connector from switch.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

- Switch to wiring harness connector.
- Switch to bezel (7 or 211).
 - Snap switch into bezel (7 or 211).
- Bezel (7 or 211).
- Bolt/screw (8).

Tighten

- Bolt/screw (8) to 1.5 N.m (13 lb. in.).
- Battery negative cable.

Front Side Door Window Switch

Figures 19 through 21

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

- Battery negative cable.
- Switch panel (3) or switch plate (6 or 160).
 - Insert screwdriver under center of forward edge of switch panel (3) or switch plate (6 or 160) to compress spring clip.
 - Slide up and forward to remove switch panel or plate.
- Wiring harness connector from switch.
- Switch from switch panel (3) or switch plate (6 or 160).
 - Insert screwdriver at two forward and two rearward corners of switch. Push in and pry up (Buick).
 - Remove bolts/screws, if driver's side of vehicle (Chevrolet).
 - Unsnap, if passenger side of vehicle (Chevrolet).

Install or Connect

- Switch to switch panel (3) or switch plate (6 or 160).
 - Snap into place (Buick).
 - Install bolts/screws, if driver's side of vehicle (Chevrolet).
 - Snap to secure, if passenger side of vehicle (Chevrolet).
- Wiring harness connector to switch.
- Switch panel (3) or switch plate (6 or 160).
 - Slide rearward and snap in to secure.
- Battery negative cable.

Front Side Door Power Seat Switch

Figures 19 through 21

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the battery negative cable” in SECTION 0A.

1. Battery negative cable.
2. Switch panel (3) or switch mount plate (6).
 - A. Insert screwdriver under center of forward edge of switch panel (3) or switch plate (6 or 160) to compress spring clip.
 - B. Slide up and forward to remove switch panel or plate.
3. Wiring harness connector from power seat switch.
4. Bolts/screws from switch.
5. Switch.

Install or Connect

1. Switch.
2. Bolts/screws to switch.
3. Wiring harness connector to switch.
4. Switch panel (3) or switch mount plate (6).
 - Slide rearward and snap into place.
5. Battery negative cable.

Front Side Door Outside Rearview Mirror Electrical Remote Switch/ Remote Control Knob

BUICK

Figures 19 and 20

Remove or Disconnect

CAUTION: Refer to “Caution” under “Disconnecting the Battery Negative Cable” in SECTION 0A.

1. Battery negative cable.
2. Switch plate (6 or 160).
 - A. Insert screwdriver under center of forward edge of switch panel (3) or switch plate (6 or 160) to compress spring clip.
 - B. Slide up and forward to remove switch panel or plate.
3. Wiring harness connector from switch, if electrical remote mirror.
4. Switch or knob (183) from switch plate (6 or 160).
 - A. Insert screwdriver at forward and rearward sides of switch, if equipped. Push in and pry up.
 - B. Unsnap remote control knob, if equipped, from switch plate (6 or 160).

Install or Connect

1. Switch or knob (183) to switch plate (6 or 160).
 - Snap switch or knob (183) in place.
2. Wiring harness connector to switch, if removed.
3. Switch plate (6 or 160).
4. Battery negative cable.

FRONT SIDE DOOR WATER DEFLECTOR

Figures 2, 3, 24 and 40

Remove or Disconnect

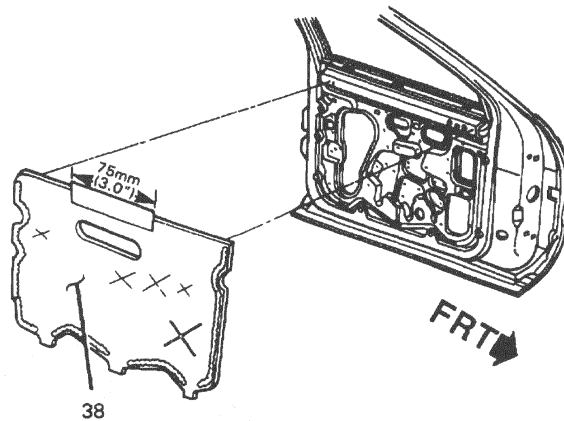
1. Front side door trim. Refer to “Front Side Door Trim” in this section.
2. Radio front side door speaker. Refer to “Radio Front Side Door Speaker” in this section.
3. Brackets (262) (Buick) or hanger plate (11) (Chevrolet).
 - Remove rivets with drill and 1/4-inch bit.
4. Deflector (38).
 - A. Pull away from door to break sealer bond.
 - B. Pull bottom edge of water deflector (38) from retaining slots.
 - C. Do not allow dirt or lubricants to contact sealer.

Inspect

- For tears or holes. Repair tears or holes using waterproof body tape on both sides of deflector (38).

Install or Connect

1. Deflector (38).
 - A. If installing new deflector (38), use old deflector (38) as template.
 - B. Pull electrical connectors through their respective holes and slots in deflector (38).
 - C. Apply string sealer in a continuous bead that will guide water to drain slots.
 - D. Insert bottom edge of deflector (38) into retaining slots.
 - E. Press deflector (38) into inner panel to ensure good bond.
 - F. Apply 75 mm (3.0-inch) strip of tape to secure top of deflector (38) to door inner panel.
2. Brackets (262) (Buick) or hanger plate (11) (Chevrolet), if removed.
3. Radio front side door speaker. Refer to “Radio Front Side Door Speaker” in this section.
4. Front side door trim. Refer to “Front Side Door Trim” in this section.



38 DEFLECTOR, FRONT SIDE DOOR WATER

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Figure 40 - Removing Front Side Door Water Deflector

OUTSIDE REARVIEW MIRROR**Mirror Face (Non-Heated Type)****Figure 41****↔ Remove or Disconnect**

CAUTION: To minimize the chance of personal injury, gloves and safety glasses should be worn when removing broken glass.

NOTICE: When breaking the outside rearview mirror face, cover the front side door in the area of the mirror to avoid damage to the paint.

- Face (158) from mirror frame.
 - A. Place tape over face (158).
 - B. Break face (158) and remove broken pieces.

→ Install or Connect

- Face (158).
 - A. Remove paper backing to expose adhesive.
 - B. Press face (158) firmly onto center of mirror frame.

Standard and Remote Control Outside Rearview Mirror**Figure 41****↔ Remove or Disconnect**

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Peel back upper edge of front side door water deflector to access nuts (44) and mirror cable, if equipped.

3. Remote control knob of mirror cable (127) from pierced hole in door inner panel.
4. Nuts (44).
5. Mirror (47).

→ Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Mirror (47).
2. Nuts (44).

⌚ Tighten

- Nuts (44) to 5 N.m (44 lb. in.).
3. Remote control end of mirror cable (127) into pierced hole in door inner panel.
 4. Upper edge of front side door water deflector.
 5. Front side door trim. Refer to "Front Side Door Trim" in this section.

Power Remote Heated Outside Rearview Mirror**Figure 41**

Heated outside rearview mirrors are included if the vehicle is equipped with electric mirrors. The mirror's heating elements are not functional unless the vehicle is also equipped with an electric rear window defogger.

↔ Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.

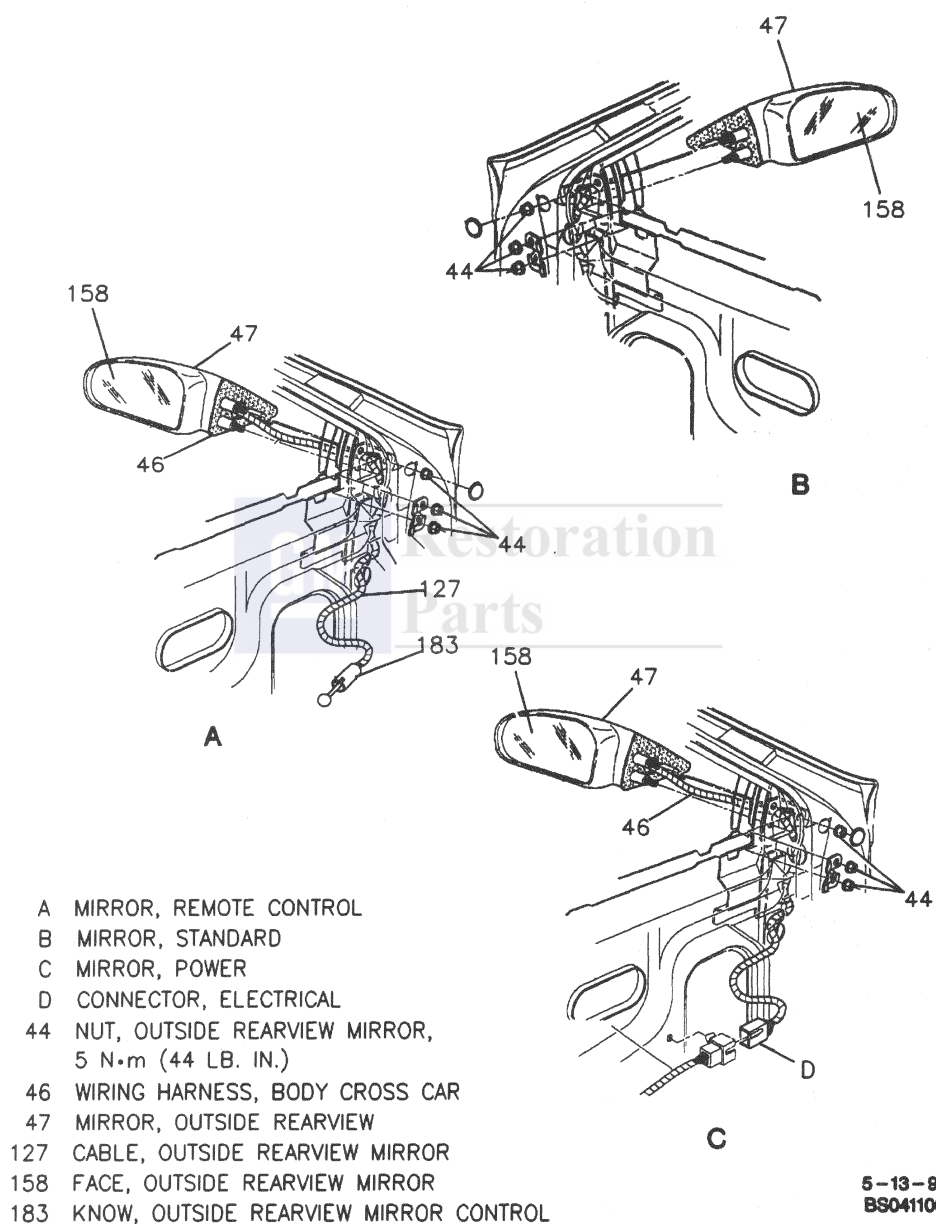


Figure 41 - Removing Outside Rearview Mirror

2. Peel back upper edge of front side door water deflector to access wiring harness (46) and electrical connector.
3. Wiring harness (46) from reinforcement.
4. Electrical connector.
5. Wiring harness (46) from door.
6. Nuts (44).
7. Mirror (47) and wiring harness (46).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Mirror (47) and wiring harness (46).
 - Insert studs in mirror base through holes, in window front reveal molding.
2. Nuts (44).

Tighten

- Nuts (44) to 5 N.m (44 lb. in.).
3. Wiring harness (46) through door.
 - Make sure wiring harness (46) is looped around outside of lower portion of window front channel.
 4. Electrical connector.
 5. Wiring harness (46) to reinforcement.
 6. Reposition upper edge of water deflector.
 7. Front side door trim. Refer to "Front Side Door Trim" in this section.

Outside Rearview Mirror Motor

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Outside rearview mirror and case.
 - Unsnap mirror and case from outside rearview mirror shell.
3. Note position of outside rearview mirror motor.
4. Outside rearview mirror motor bolts/screws.
5. Outside rearview mirror motor.
 - A. Label wiring harness wires 1 through 4 beginning with bottom wire.
 - B. Cut wires from motor as close to motor as possible.

Install or Connect

1. Outside rearview mirror motor.
 - Splice motor wires to wiring harness wires in proper order.
2. Outside rearview mirror motor bolts/screws.
3. Tuck wires and connectors into shell.

4. Outside rearview mirror and case.
 - Snap mirror and case into outside rearview mirror shell.
5. Battery negative cable.

RADIO FRONT SIDE DOOR SPEAKER

Figures 42 and 43

The front side door tweeter is serviced as part of the front side door inside handle bezel. For service information, refer to "Front Side Door Trim" in this section. The following procedure is for the midrange speaker mounted to the door inner panel.

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Rosebud clip on speaker connector (52), if equipped, from deflector (38) and front door inner panel.
3. Wiring harness connector (53) from speaker (173) (Buick) or speaker connector (52) (Chevrolet).
4. Bolts/screws (54) connecting speaker (173 or 51) to housing (179 or 50).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Bolts/screws (49) connecting housing (179 or 50) to door inner panel.

Tighten

- Bolts/screws (49) to 1.9 N.m (17 lb. in.).
2. Bolts/screws (54) connecting speaker (173 or 51) to housing (179 or 50).

Tighten

- Bolts/screws (54) to 1.5 N.m (13 lb. in.).
3. Wiring harness connector (53) to speaker (173) or speaker connector (52).
 4. Rosebud clip on speaker connector (52), if equipped, through deflector (38) to front door inner panel.
 5. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR ASHTRAY

CHEVROLET

POLICE AND TAXI VEHICLES

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.

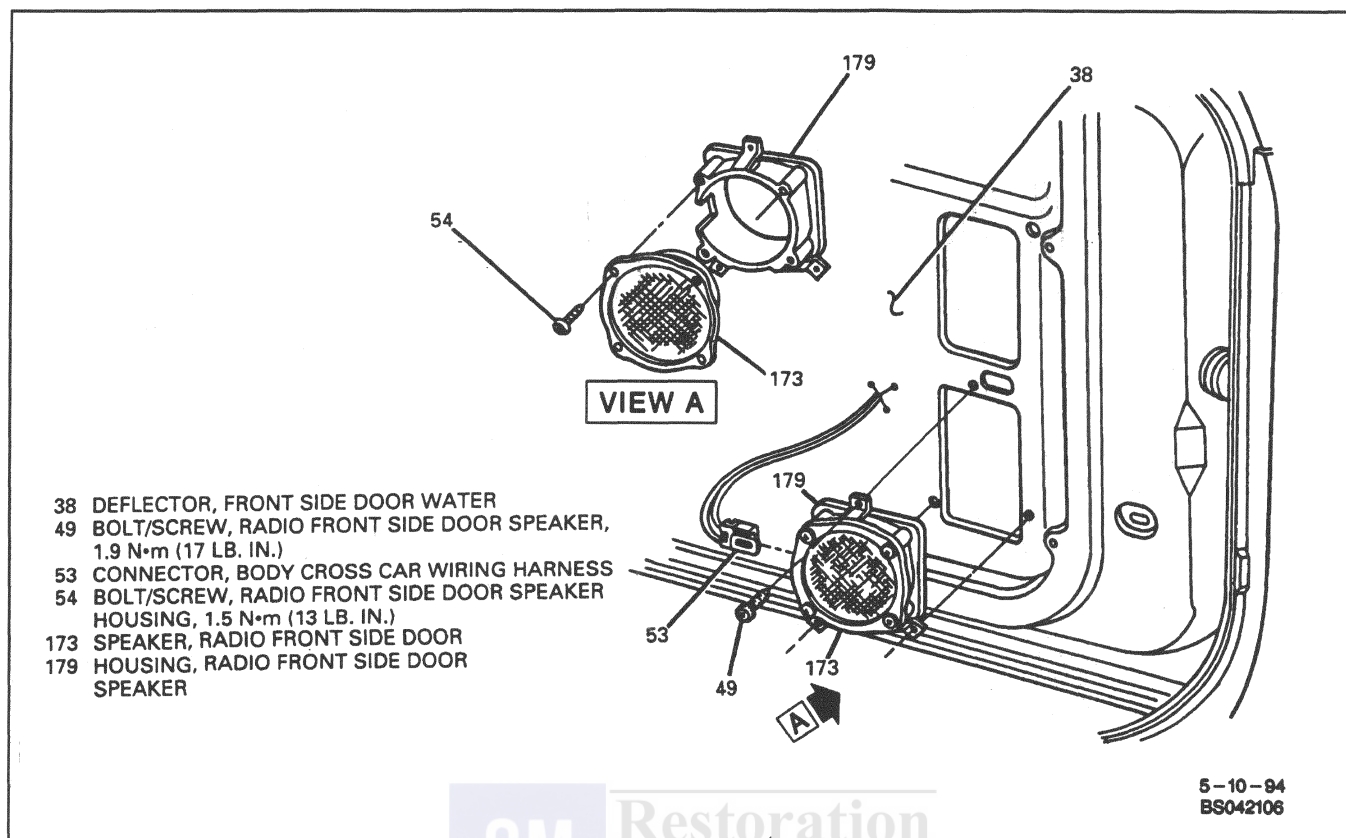


Figure 42 - Removing Radio Front Side Door Speaker-(Buick)

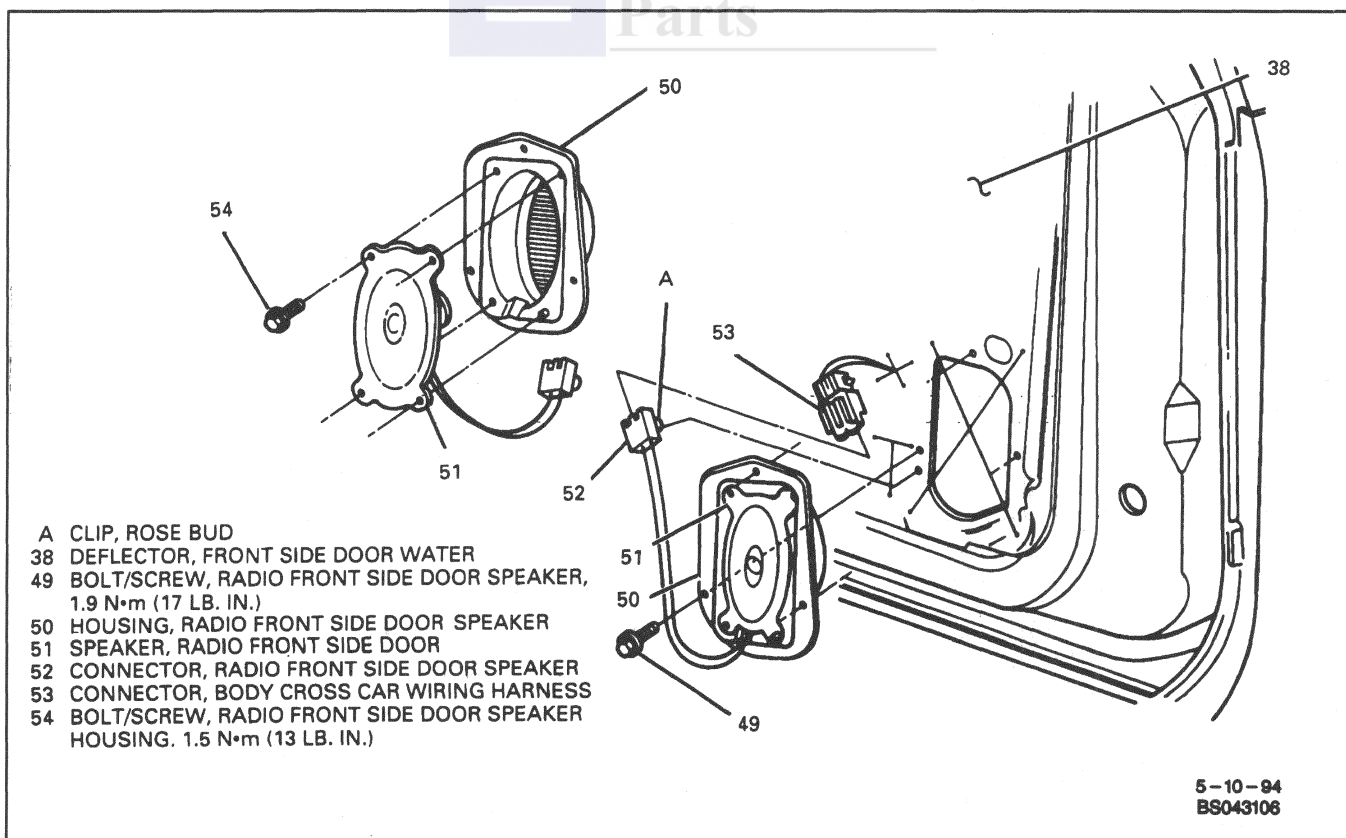


Figure 43 - Removing Radio Front Side Door Speaker-(Chevrolet)

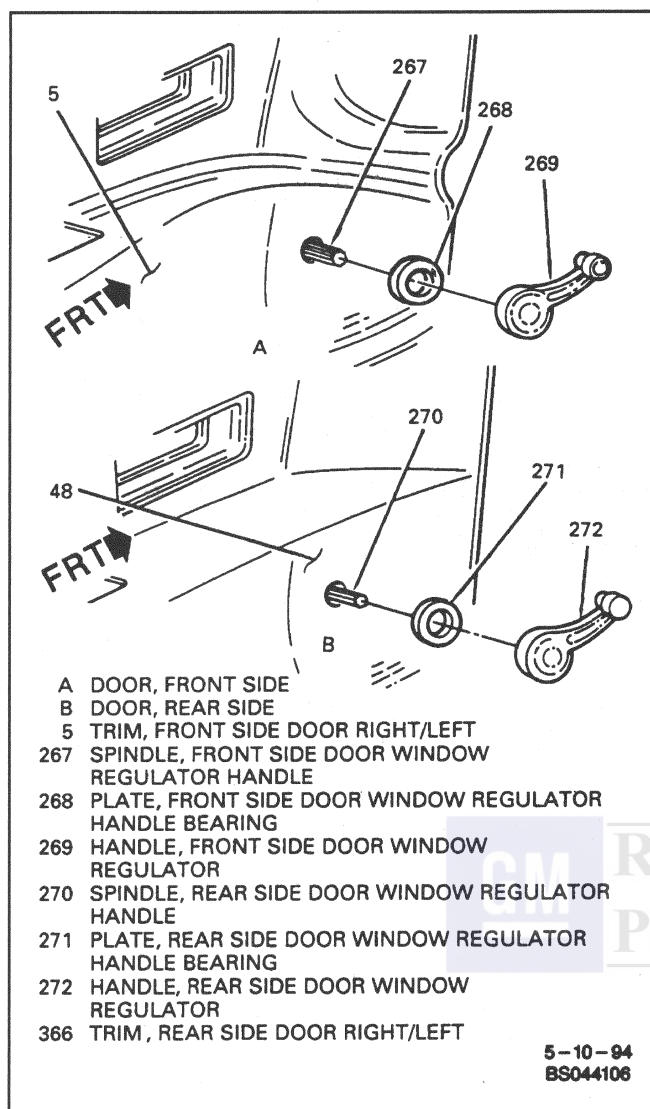


Figure 44 - Front and Rear Side Door Window Regulator Handle-(Chevrolet)

2. Ashtray.
3. Backing plate bolts/screws.
4. Backing plate.



Clean

- Ashtray in solution of warm water and soap, if necessary.



Install or Connect

1. Backing plate.
2. Backing plate bolts/screws.
3. Ashtray.
4. Front side door trim. Refer to "Front Side Door Trim" in this section.
5. Bolts/screws (49) connecting housing (179 or 50) to door inner panel.

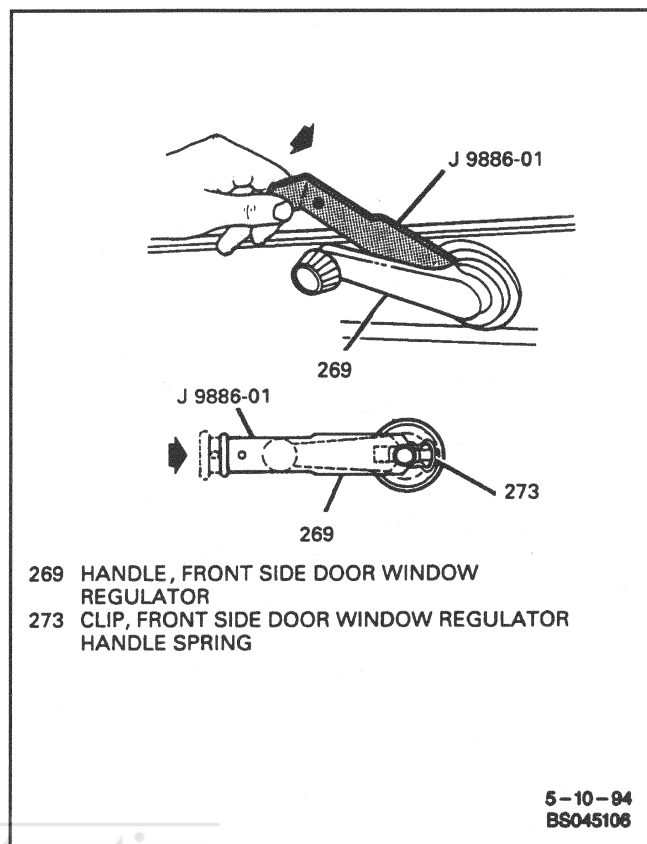


Figure 45 - Removing Front Side Door Window Regulator Handle-(Chevrolet)

FRONT SIDE DOOR HANDLES

Front Side Door Window Regulator Handle CHEVROLET

Figures 44 and 45

Tool Required:

J 9886-01 Door Handle Clip Remover



Remove or Disconnect

1. Close front side door window.
2. Clip (273), by pushing J 9886-01 between handle (269) and trim (5) or plate (268).
3. Handle (269) from spindle (267).



Install or Connect

1. Clip (273) to handle (269).
2. Plate (268) to handle (269).
3. Position handle (269) on horizontal plane pointing forward, if front door. If rear door, position on vertical plane pointing upward.
4. Use mallet as required on handle to secure.

Front Side Door Pull Handle

BUICK

Figures 2, 3 and 46

Remove or Disconnect

1. Front side door trim (1). Refer to "Front Side Door Trim" in this section.
2. Pull handle (61) from trim (1).
 - A. Unsnap front and rear ends of pull handle from retainer to expose bolts/screws (253).
 - B. Bolts/screws (253) and nuts (254).

Install or Connect

1. Pull handle (61) to trim (1).
 - A. Bolts/screws (253) and nuts (254).

Tighten

- Bolts/screws (253) to 6 N.m (53 lb. in.).
 - B. Snap front and rear ends of pull strap in place on retainer.
2. Front side door trim (1). Refer to "Front Side Door Trim" in this section.

CHEVROLET

Figure 47

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Handle (234).
 - A. Unlock and remove hinge spring from back of trim (5).
 - B. Remove pins (60) from back of trim (5).

Install or Connect

1. Handle (234).
2. Pins (60) to back of trim (5).
3. Hinge spring to back of trim (5).
 - Hook hinge spring over tab.
4. Front side door rim. Refer to "Front Side Door Trim" in this section.
 - A. Move adjusting nut until it aligns with clip (68) on outside door handle lock lever.
 - B. Insert adjusting nut into clip (68) and press to secure.
5. Reposition front side door water deflector.
6. Front side door trim. Refer to "Front Side Door Trim" in this section.

SPRING CLIPS

Spring clips are used to secure various rods and levers of the door hardware. Discard spring clips after removal and use new spring clips for installation.

Front Side Door Inside Handle Lever

Figure 48

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

2. Fully raise front side door window.
3. Move front side door water deflector out of the way to access inside handle lever (64).
4. Rivets (65), using 1/4-inch drill bit.
5. Inside handle rod (63) from inside handle lever (64).
6. Locking rod (62) from bellcrank (186).
7. Inside handle lever (64).

Install or Connect

1. Inside handle lever (64).
2. Locking rod (62) to bellcrank (186).
3. Inside handle rod (63) to inside handle lever (64).
4. Rivets (65).
5. Reposition front side door water deflector.
6. Front side door trim. Refer to "Front Side Door Trim" in this section.

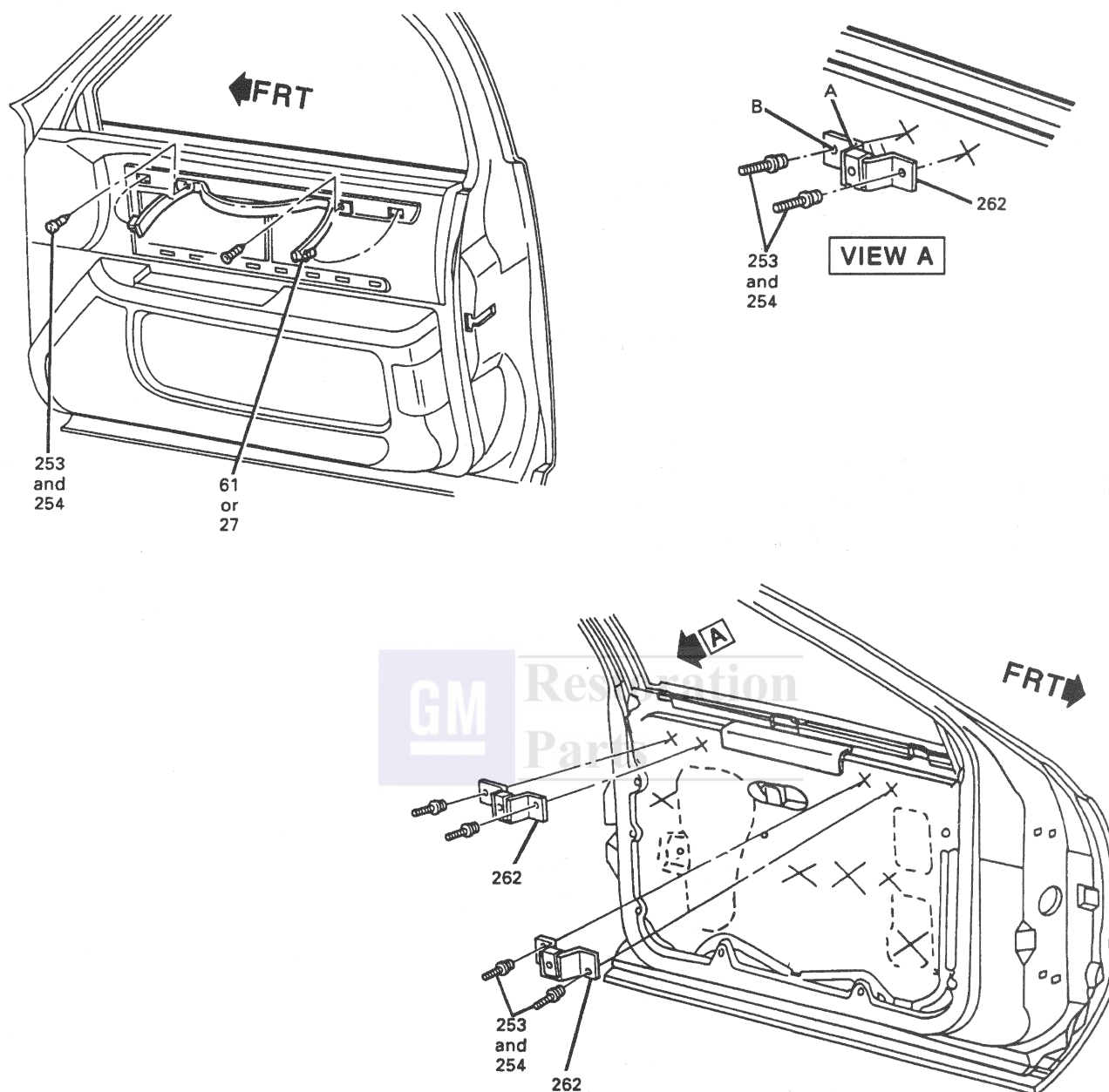
Front Side Door Outside Handle

Figures 49 and 50

Remove or Disconnect

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

1. Fully raise front side door window.
2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Upper edge of front side door water deflector.
4. Rod (67) from module (70).



- A SLOT ON BRACKET USED FOR WAGON
- B SLOT ON BRACKET USED FOR SEDAN
- 27 PULL HANDLE, REAR SIDE DOOR
- 61 PULL HANDLE, FRONT SIDE DOOR
- 253 BOLT/SCREW, FRONT SIDE DOOR PULL HANDLE
3.5 N m (31 LB. IN.)
- 254 NUT, FRONT SIDE DOOR PULL HANDLE
- 262 BRACKET, FRONT SIDE DOOR PULL HANDLE

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Figure 46 - Removing Front Side Door Pull Handle (Front Side Door Shown, Rear Side Door Similar)-(Buick)

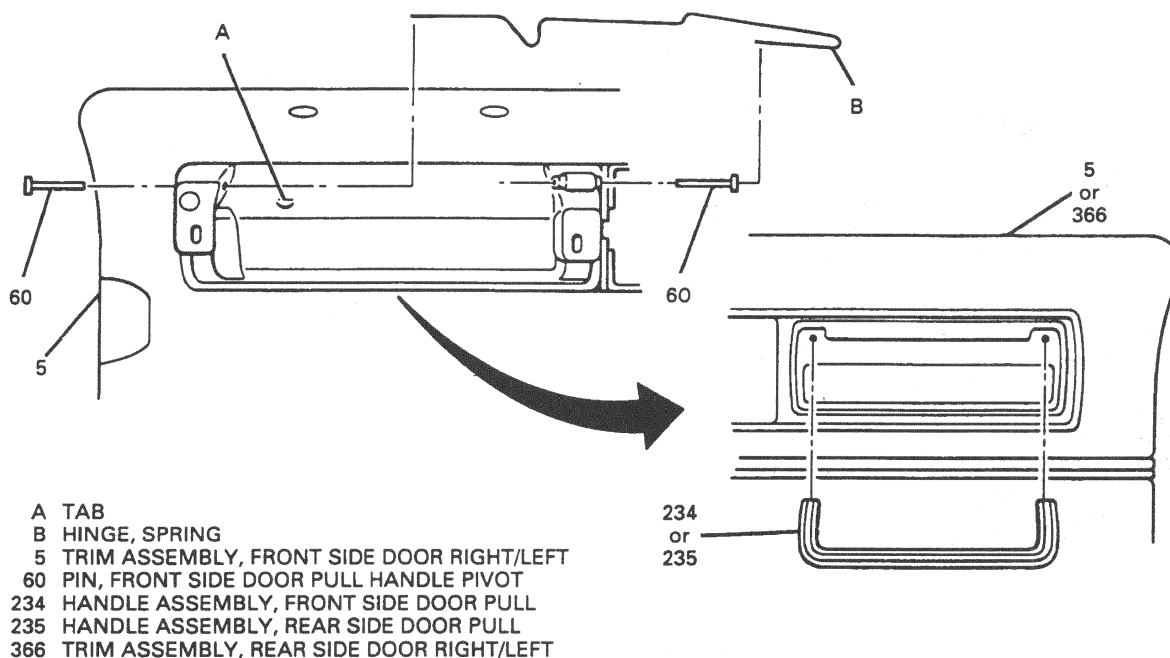
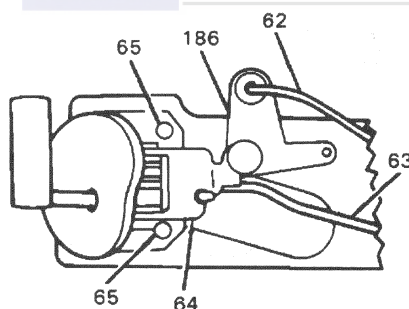

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Figure 47 - Front and Rear Side Door Pull Handle-(Chevrolet)



- 62 ROD, FRONT SIDE DOOR LOCKING
63 ROD, FRONT SIDE DOOR INSIDE HANDLE
64 LEVER ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
65 RIVET, FRONT SIDE DOOR LOCK ACTUATOR BELLCRANK
186 BELLCRANK ASSEMBLY, FRONT SIDE DOOR LOCKING ROD

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Figure 48 - Front Side Door Inside Handle Lever

5. Nuts (66).
6. Handle (69), rod (67) and clip (68).
7. Rod (67) and clip (68) from handle (69).



Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Rod (67) and new clip (68) to handle (69).
2. Snap new clip (68) into place.
3. Hold handle (69) in open position.
4. Insert handle (69) through hole in door outer panel.
5. Nuts (66) to handle (69) through access holes.

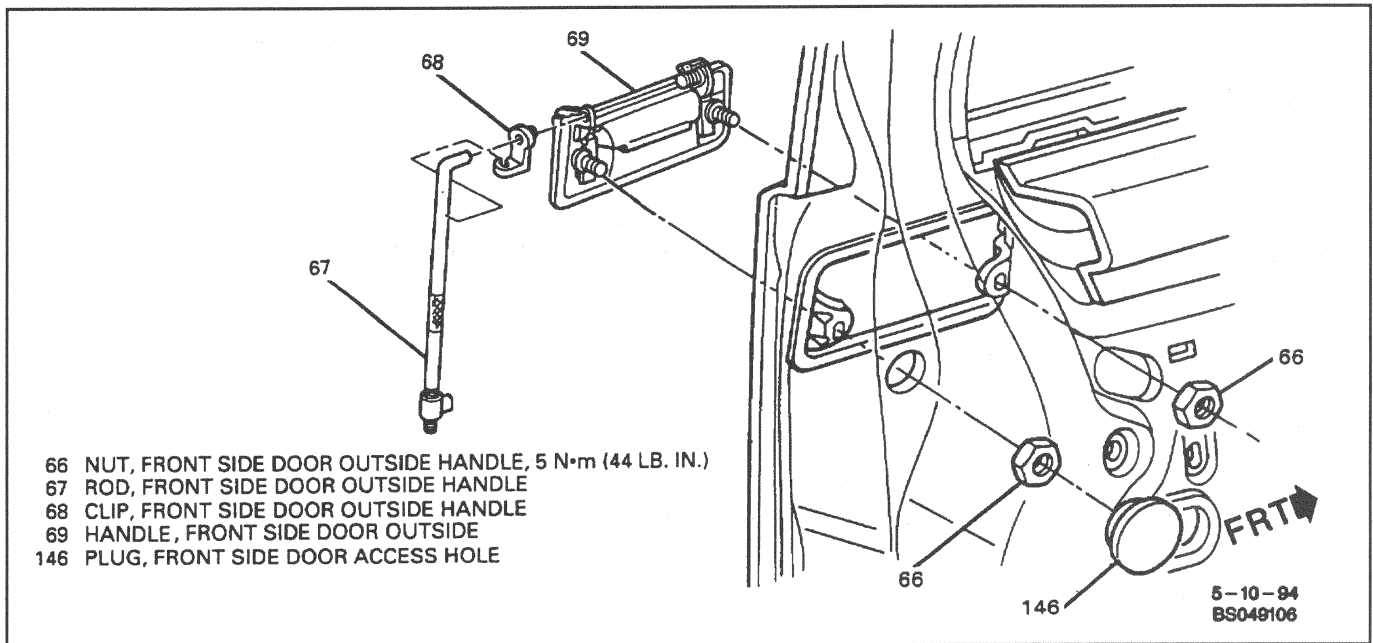


Figure 49 - Removing Front Side Door Outside Handle

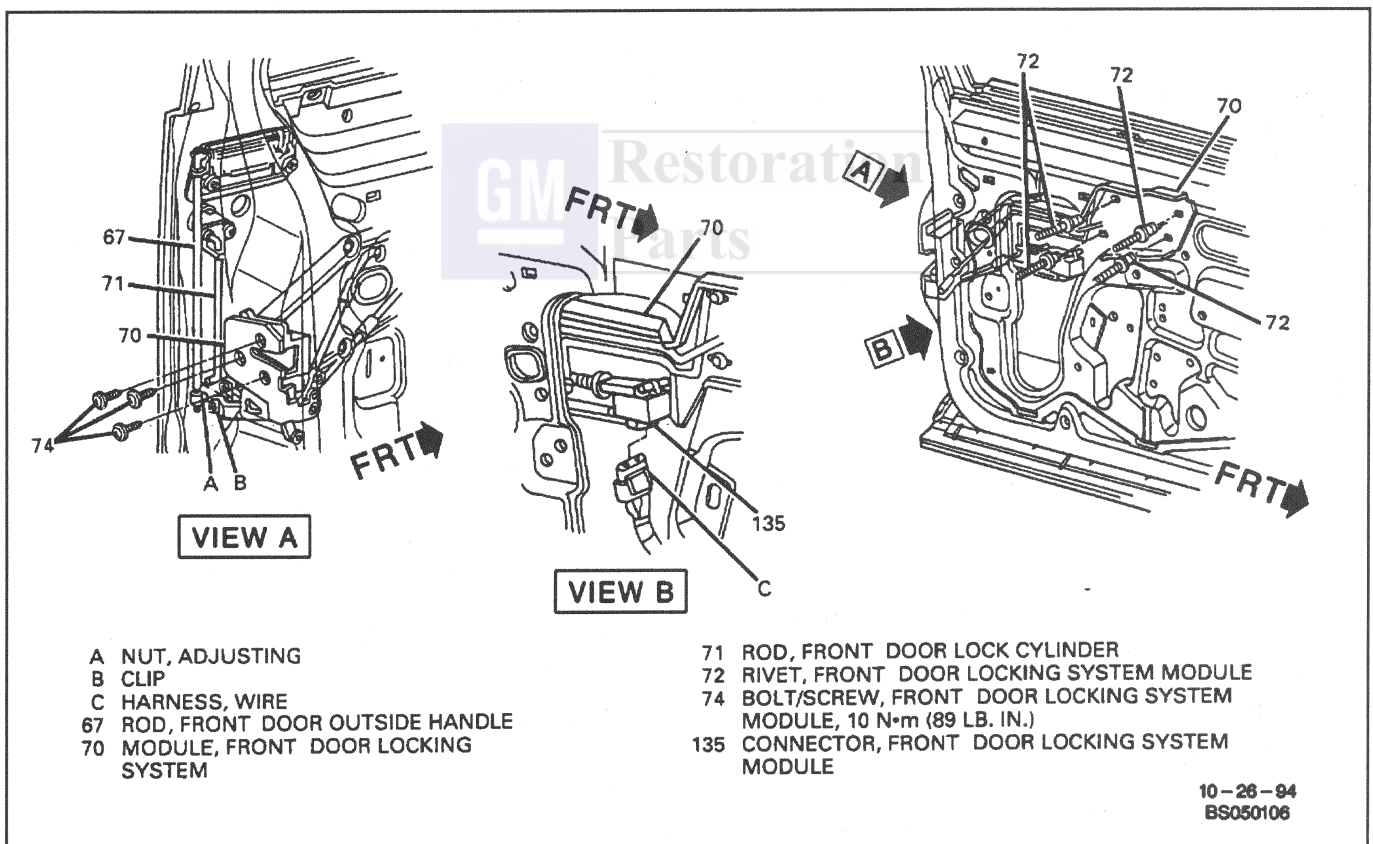


Figure 50 - Front Side Door Locking System Module

**Tighten**

- Nuts (66) to 5 N·m (44 lb. in.).
6. Rod (67) to module (70).

**Adjust**

- Handle (69), if necessary.

**Remove or Disconnect**

1. Spring clip.
 - Use scratch awl, pick or similar tool to push spring clip tang away from rod.

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2. Rod from spring clip and lever.
3. Spring clip from lever.

Install or Connect

1. Push new spring clip over lever and snap into place.
2. Rod to spring clip and lever.
3. Spring clip.
 - Snap spring clip tang over rod.

FRONT SIDE DOOR LOCKING SYSTEM MODULE

Figure 50

The rear side door locking system module is serviced the same way as the front side door locking system module. Use the following procedure for both.

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Move upper half of front side door water deflector to access module (70).
3. Front side door window rear channel. Refer to "Front Side Door Window Front and Rear Channels" in this section.
4. Rivets (72), using a 1/4-inch drill bit.
5. Bolts/screws (74).
6. Rod (67) from module (70).
7. Lock cylinder rod (71) from module (70).
8. Wire harness from lock module connector (135).
9. Module (70).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Module (70).
2. Wire harness to lock module connector (135).
3. Lock cylinder rod (71) to module (70).
4. Rod (67) to module (70).
5. Bolts/screws (74).

Tighten

- Bolts/screws (74) to 10 N·m (89 lb. in.).

Important

- A. Module (70) must be held tight against door facing while driving all attaching bolts/screws (74).
 - B. All bolts/screws (74) must be driven at a 90-degree angle to door facing.
6. Rivets (72).
 - Attach uppermost forward rivet (72) first.

7. Front side door window rear channel. Refer to "Front Side Door Window Front and Rear Channels" in this section.
8. Reposition front side door water deflector.
9. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR LATCH AND FRONT SIDE DOOR LOCK STRIKER

The illuminated entry and theft deterrent switches are not serviced separately from the latch. If either switch must be replaced, the entire latch must be replaced.

The rear side door latch and lock strikers are serviced the same way as the front side door latch and lock strikers. Use the following procedures.

Front Side Door Latch

Figure 51

CAUTION: Do not attempt to repair a broken latch. A latch malfunction may result in serious bodily injury. A broken latch must be replaced.

Remove or Disconnect

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

1. Fully raise front side door window.
2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Move front side door water deflector to access door latch.
4. Front side door locking system module. Refer to "Front Side Door Locking System Module" in this section.
5. Handle rod (63) from module (70).
6. Locking rod (62) from module (70).
7. Bolts/screws connecting door latch to module (70).
8. Door latch.

Install or Connect

1. Door latch.
 - Hand tighten.
2. Bolts/screws connecting door latch to module (70).
3. Locking rod (62) to module (70).
4. Handle rod (63) to module (70).

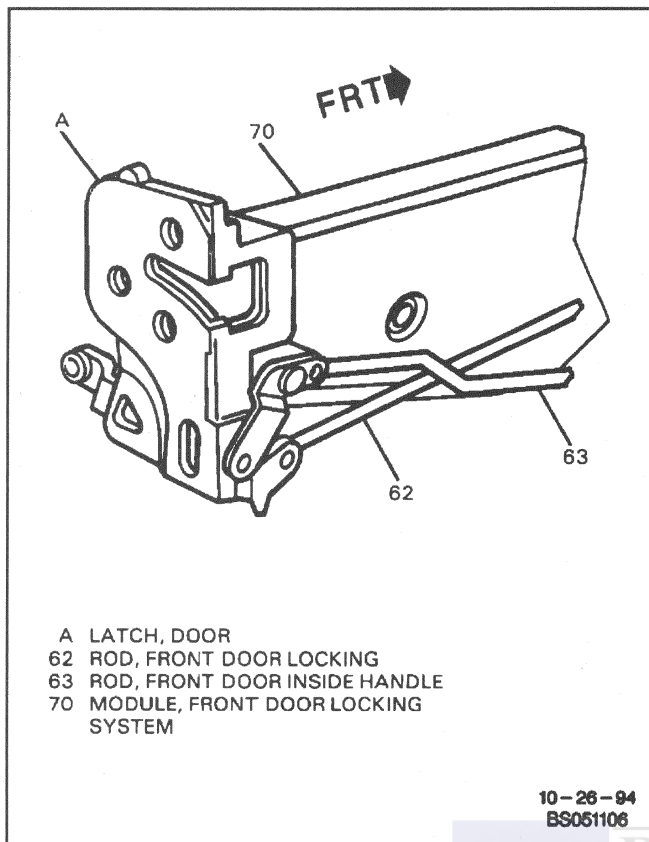


Figure 51 - Front Side Door Latch

5. Front side door locking system module. Refer to "Front Side Door Locking System Module" in this section.
6. Reposition front water deflector.
7. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR ADJUSTMENT

Figure 52 and 54

Tool Required
J 39927 Door Hinge Adjustment Wrench

↔ Remove or Disconnect

- Front door lock striker bolts/screws (77) and striker (76).
— Leave one bolt/screw (77) in door lock striker anchor at all times.

🔑 Adjust

- Front side door inward or outward.
A. Loosen door upper and lower door side hinge nuts (201).
B. Position door as necessary.

🔧 Tighten

- Door upper and lower door side hinge nuts (201) to 32 N.m (24 lb. ft.).

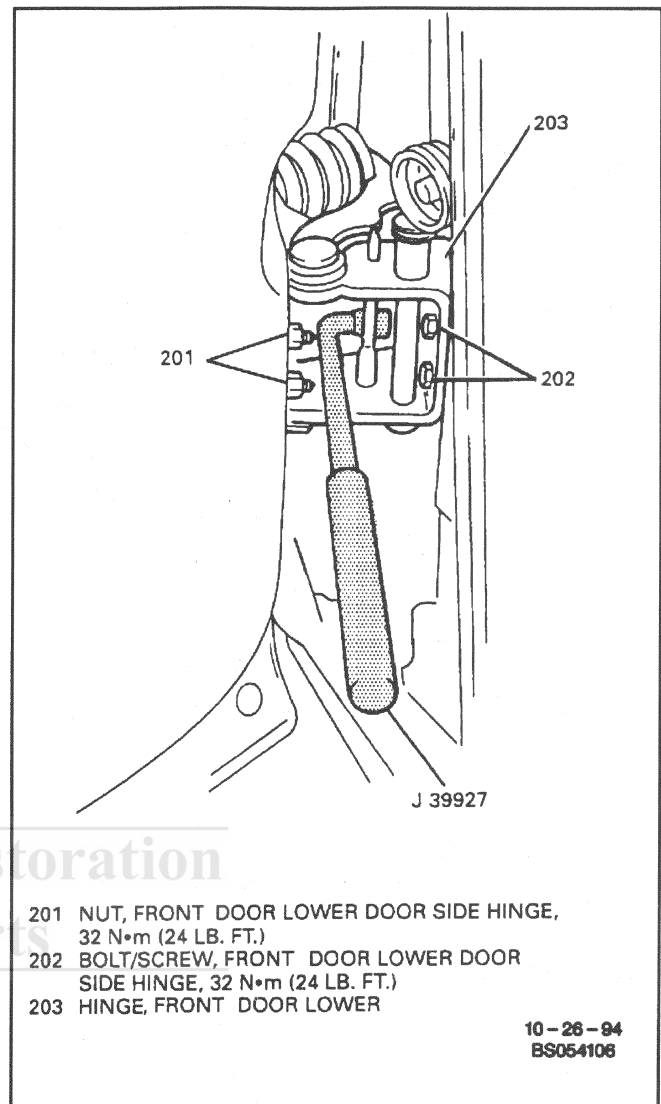


Figure 52 - Front Side Door Adjustment Using J 39927

- Front side door forward or rearward.
A. Loosen door upper and lower body side hinge bolts/screws using J 39927 for the lower body side hinge bolts/screws.
B. Position door as necessary.

🔧 Tighten

- Door upper and lower door side hinge bolts/screws to 32 N.m (24 lb. ft.).

↔ Install or Connect

- Front side door lock striker (76) and bolts/screws (77) loosely.

🔑 Adjust

- Front side door lock striker. Refer to "Front Side Door Lock Striker Adjustment" in this section.

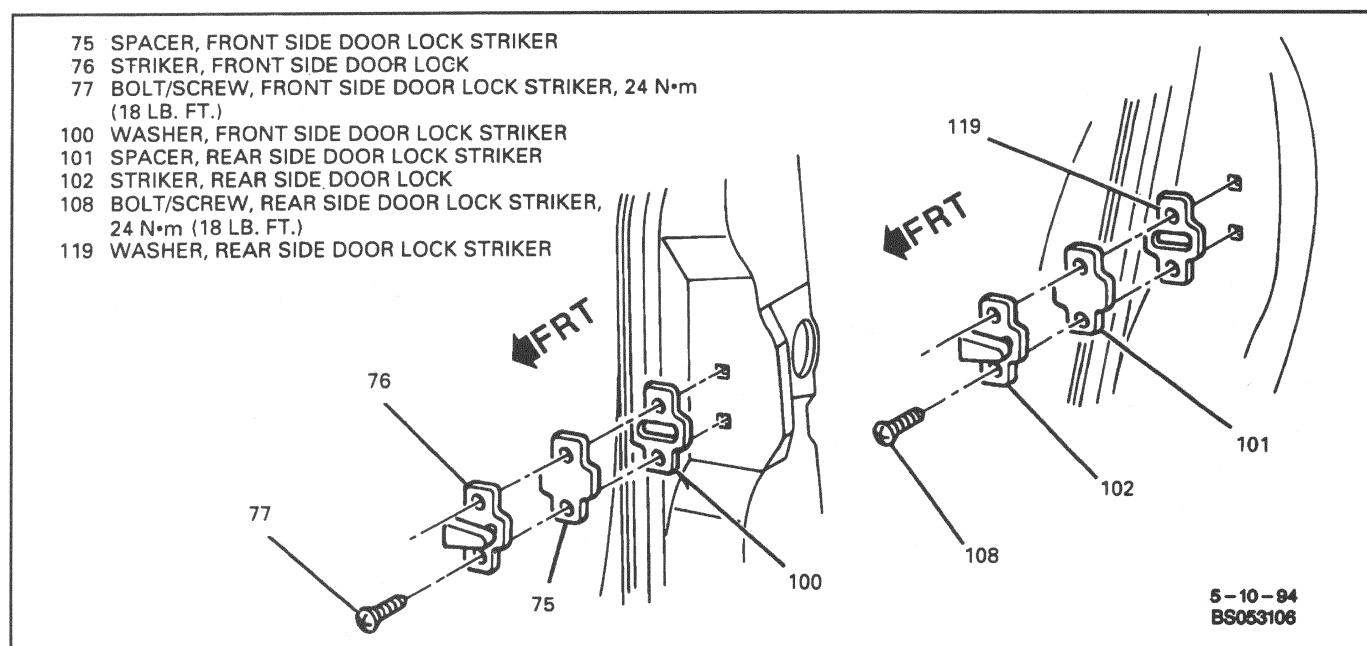


Figure 53 - Adjusting Front Side Door Lock Striker With J 39346(Typical)

Front Side Door Lock Striker Adjustment (with J 39346)

Figures 53 and 54

Tool Required
J 39346 "Mini-Wedge" Door Striker Aligner

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Be sure front side door is properly aligned.
2. Loosen bolts/screws (77). Do not remove.

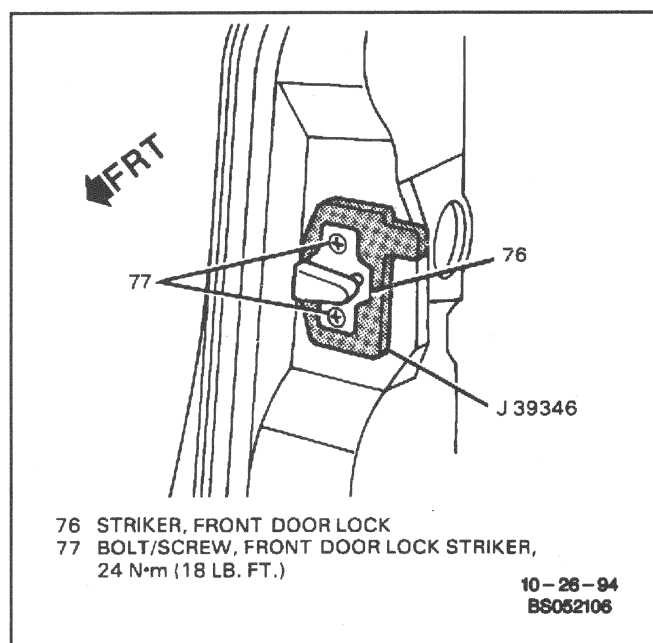


Figure 54 - Removing Front and Rear Side Door Lock Striker

3. Align J 39346 to striker (76).
 - Magnets will hold in place.
4. Hold outside door handle in open position and shut door.
 - Do not slam door.
5. Open door.

Tighten

- Bolts/screws (77) to 24 N·m (18 lb. ft.).
6. Remove J 39346.

Front Side Door Lock Striker Adjustment (without J 39346)

Figure 53 and 54

The front and rear side door lock strikers are adjusted the same way. Use the following procedure for both.

Important

- Front side door must be properly aligned prior to adjusting striker (76).

Adjust

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Striker (76).
 - A. Loosen striker (76).
 - B. Shift striker (76) up or down, inboard or outboard as required.
 - Striker (76) should enter center of striker opening and should not pull up or down when closed.

- C. Apply modeling clay or body caulking compound to striker (76) opening on door latch.
- D. Close door only far enough for striker (76) to make an impression in modeling clay or body caulking compound. Closing door too far will make it hard to remove clay or caulking compound.
- E. Open door and check forward and rearward adjustment.
 - Impression should be centered forward and rearward.
 - Spacers (75) are available to achieve desired forward and rearward alignment.
- F. If forward or rearward adjustment is needed:
 - Mark location of striker (76) on body.
 - Remove striker (76).
 - Add or remove spacers (75) as needed.
 - Install striker (76) and any spacers (75) to location marked on body.

**Tighten**

- Bolts/screws (77) to 24 N·m (18 lb. ft.).
2. Touch up any exposed, unpainted metal.

Front Side Door Lock Striker**Figure 54**

The front and rear side door lock strikers are serviced the same way. Use the following procedure for both.

**Remove or Disconnect**

1. Mark position of striker (76) on body using a pencil.
2. Bolts/screws (77).
3. Striker (76), any spacers (75) and washer (100).

**Install or Connect**

NOTICE: Refer to “Notice” on page 10-6-1 of this section.

1. Striker (76) and spacers (75) if needed, and washer (100) to location marked on body.
2. Bolts/screws (77).

**Tighten**

- Bolts/screws (77) to 24 N·m (18 lb. ft.).

**Inspect**

- For proper latch-to-striker (76) engagement. If adjustment is needed, refer to “Front Side Door Lock Striker Adjustment” in this section.

FRONT SIDE DOOR LOCK ACTUATORS**Remove or Disconnect**

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

1. Fully raise front side door window.
2. Front side door trim. Refer to “Front Side Door Trim” in this section.
3. Move front side door water deflector to gain access.
4. Front side door lock actuator rivets, using drill and 1/4-inch drill bit.
5. Electrical connector.
6. Front side door lock actuator.

**Install or Connect**

NOTICE: Refer to “Notice” on page 10-6-1 of this section.

1. Front side door lock actuator.
2. Electrical connector.
3. Front side door lock actuator rivets.
4. Reposition front side door water deflector.
5. Front side door trim. Refer to “Front Side Door Trim” in this section.

FRONT SIDE DOOR LOCK ROD LEVER**Figure 23****Remove or Disconnect**

1. Bolt/screw (8).
 - Unsnap bezel (7 or 211) to remove.
2. Front side door lock switch connector from front side door lock switch.
3. Retainer covering lever (15).
 - Use small screwdriver to unsnap retainer.
4. Lever (15).

**Install or Connect**

NOTICE: Refer to “Notice” on page 10-6-1 of this section.

1. Lever (15).
2. Retainer covering rear side of lever (15).
 - Snap in place.

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3. Front side door lock switch connector to front side door lock switch.
 - Snap into bezel (7 or 211).
4. Bolt/screw (8).



Tighten

- Bolt/screw (8) to 1.5 N.m (13 lb. in.).

FRONT SIDE DOOR LOCK CYLINDER

Figure 55



Remove or Disconnect

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

1. Fully raise window.
2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Peel back front side door water deflector to access cylinder (78).
4. Retainer (80).
 - Using screwdriver, slide retainer (80) forward until it disengages.
5. Rod (71) from cylinder (78) and gasket (79) by unsnapping clip (83).
6. Cylinder (78) and gasket (79) from door panel.



Disassemble

1. Pawl clip (82) from pawl (81) and cylinder (78) using pointed tool.
2. Pawl (81) from cylinder (78).



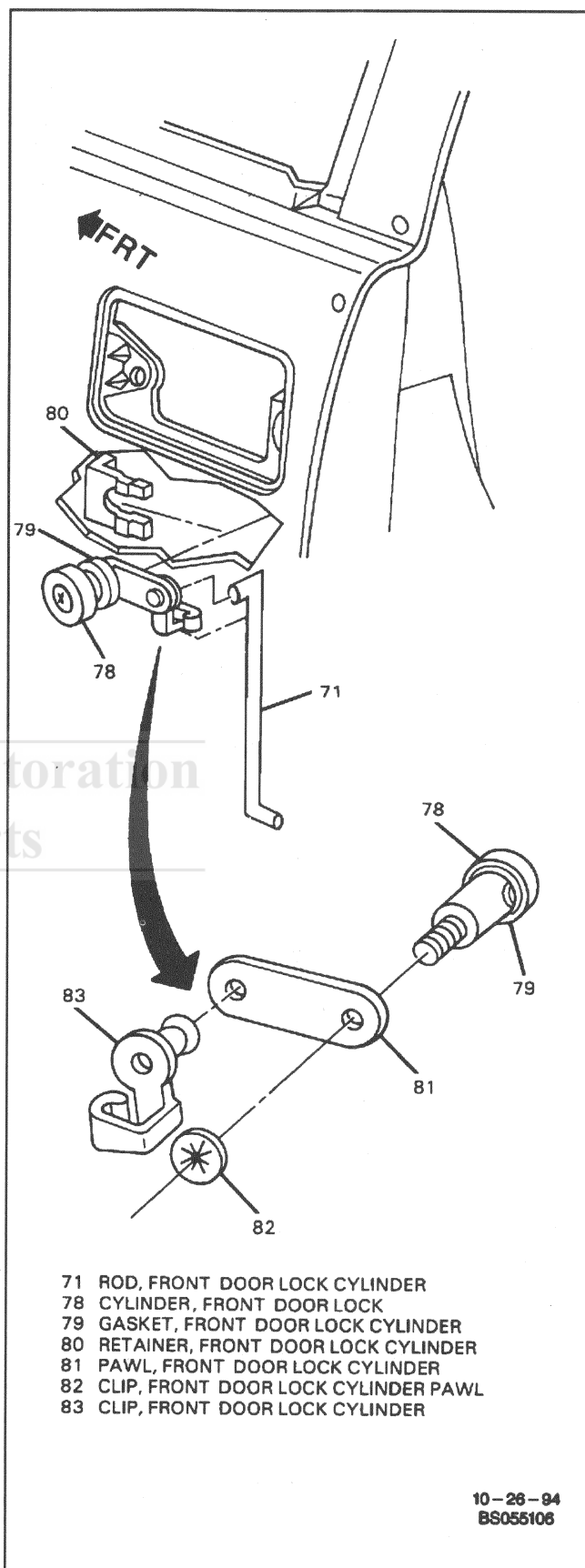
Assemble

1. For information on assembling tumblers to lock cylinders, refer to SECTION 0A.
2. Pawl (81) to cylinder (78).
3. Pawl clip (82) to pawl (81) and cylinder (78).



Install or Connect

1. Lubricate black cylinders (78) with light oil.
2. Lubricate all other cylinders (78) with general purpose silicone lubricant.
3. Cylinder (78) and gasket (79) to door panel.
4. Rod (71) to cylinder (78) and gasket (79) by snapping clip (83).



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Figure 55 - Disassembling Front Side Door Lock Cylinder

5. Retainer (80).
6. Reposition front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
7. Front side door trim. Refer to "Front Side Door Trim" in this section.

Front Side Door Lock Cylinder Inspection

Figure 55

1. Insert key into cylinder (78).
2. Move inside lock switch up and down.
 - A. Key should not move in cylinder (78).
 - B. Key should be able to be removed with inside lock switch in any position.
3. Move key to fully locked position and return key to neutral position.
 - A. Operate front side door inside handle lever. Door should not open.
 - B. Operate front side door outside handle. Door should not open.
4. Move key to unlocked position, then back to neutral position.
 - A. Operate front side door inside and outside handle levers. Doors should open.

FRONT SIDE DOOR UPPER AND LOWER HINGES

Front Side Door Upper Hinge

Figure 56

Tool Required:
J 28500 Door Hinge Wrench

Remove or Disconnect

1. Bolt/screws (84) with shim (165), if applicable.
2. Support door in full-open position.

3. Mark position of hinge (85) on hinge pillar, and on door.
4. Nuts (88).
5. Bolts/screws (86), using J 28500.
6. Hinge (85).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

NOTICE: Before installing a hinge, apply a coat of heavy-bodied sealer to the surface of the hinge that contacts the door and the hinge pillar to prevent corrosion damage.

1. Hinge (85).
 - Align hinge (85) with marks made before removing hinge (85).
2. Bolts/screws (86), using J 28500.
3. Nuts (88).

Tighten

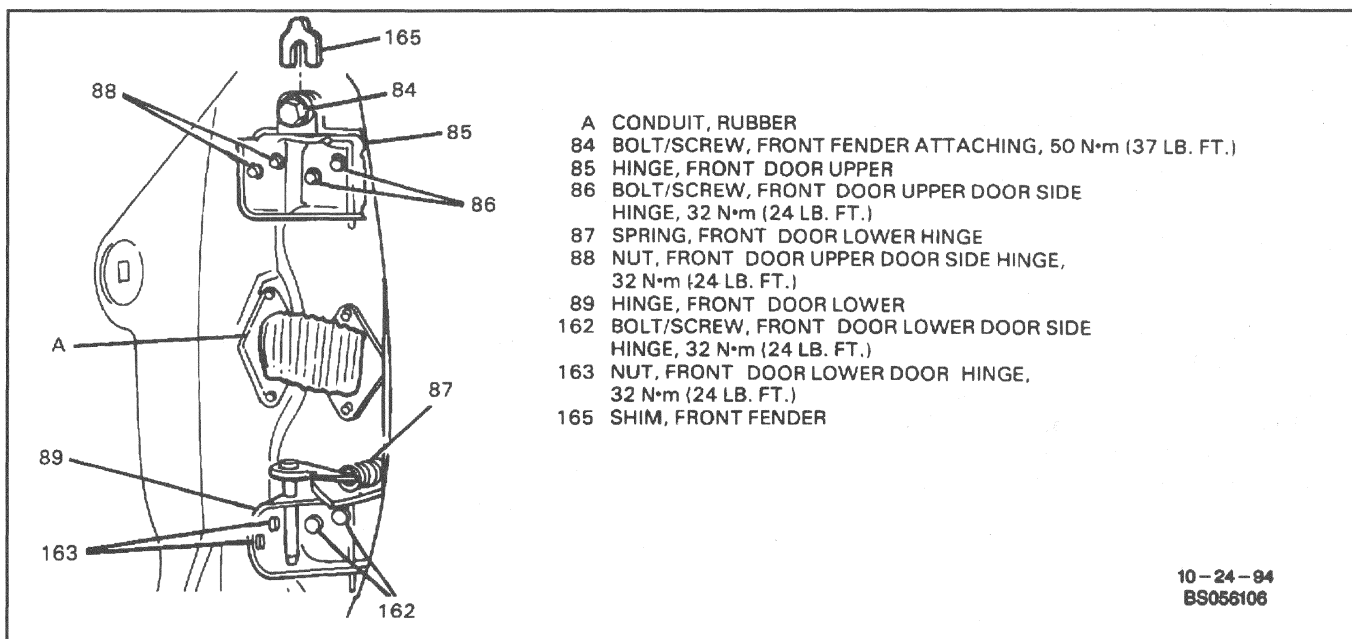
- A. Bolts/screws (86) to 32 N·m (24 lb. ft.).
- B. Nuts (88) to 32 N·m (24 lb. ft.).
4. Bolt/screws (84) and shim (165), if equipped.

Tighten

- Bolt (84) to 50 N·m (37 lb. ft.).

Adjust

- Front side door, if required. Refer to "Front Side Door Adjustment" in this section.



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Figure 56 - Front Side Door Upper and Lower Hinges

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Front Side Door Lower Hinge

Figures 56 through 58

Tools Required:

- J 39079 Door Hinge Spring Compressor
- J 28500 Door Hinge Wrench

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Support front side door and mark location of hinge (89).
4. Lower rear panel bolt/screw (172) with shim (165), if applicable.
5. Wheelhouse panel bolts/screws (185).
6. Lower bracket bolt/screw (171) with shim (165), if applicable.
7. Wheelhouse panel bolts/screws (164).
8. Hood rear outer seal.
9. Rear upper brace bolts/screws (182) with shims (165), if applicable.
10. Upper bracket bolt/screw (161) with shims (165), if applicable.
11. Bolt/screw (84) with shim (165), if applicable.
12. Support front fender away from body.

CAUTION: Do not remove front side door upper door side hinge bolts/screws. If removed, front side door will fall when the front side door lower hinge hardware is removed. This could cause personal injury as well as damage to the front side door.

13. Loosen bolts/screws (86).
14. Spring (87), using J 39079.
15. Nuts (163).
16. Bolts/screws (162), using J 28500.
17. Hinge (89), with aid of helper.

- One person raises front side door while other removes hinge (89).

Install or Connect

NOTICE: Refer to “Notice” on page 10-6-1 of this section.

NOTICE: Before installing a hinge, apply a coat of heavy-bodied sealer to the surface of the hinge that contacts the side door and the hinge pillar to prevent corrosion damage.

1. Hinge (89), with aid of helper.
 - A. One person raises front side door while other places hinge (89).
 - B. Align hinge (89) to marks made previously.

2. Bolts/screws (162).

Tighten

- Bolts/screws (162) to 32 N.m (24 lb. ft.).

3. Nuts (163).

Tighten

- Nuts (163) to 32 N.m (24 lb. ft.).

4. Spring (87).

Tighten

- Bolts/screws (86) to 32 N.m (24 lb. ft.).

Adjust

- Front side door, if necessary. Refer to “Front Side Door Adjustment” in this section.

5. Remove front fender support.

6. Bolt/screw (84) with shim (165), if removed.

Tighten

- Bolt/screw (84) to 50 N.m (37 lb. in.).

Adjust

- Front side door, if required. Refer to “Front Side Door Adjustment” in this section.

7. Upper bracket bolt/screw (161) with shims (165), if removed.

Adjust

- Upper bracket bolt/screw (161) to 50 N.m (37 lb. ft.).

8. Upper brace bolts/screws (182).

Tighten

- Upper brace bolts/screws (182) to 25 N.m (18 lb. ft.).

9. Hood rear outer seal.

10. Wheelhouse panel bolts/screws (164).

Tighten

- Wheelhouse panel bolts/screws (164) to 10 N.m (89 lb. in.).

11. Lower bracket bolt/screw (171) with shim (165), if removed.

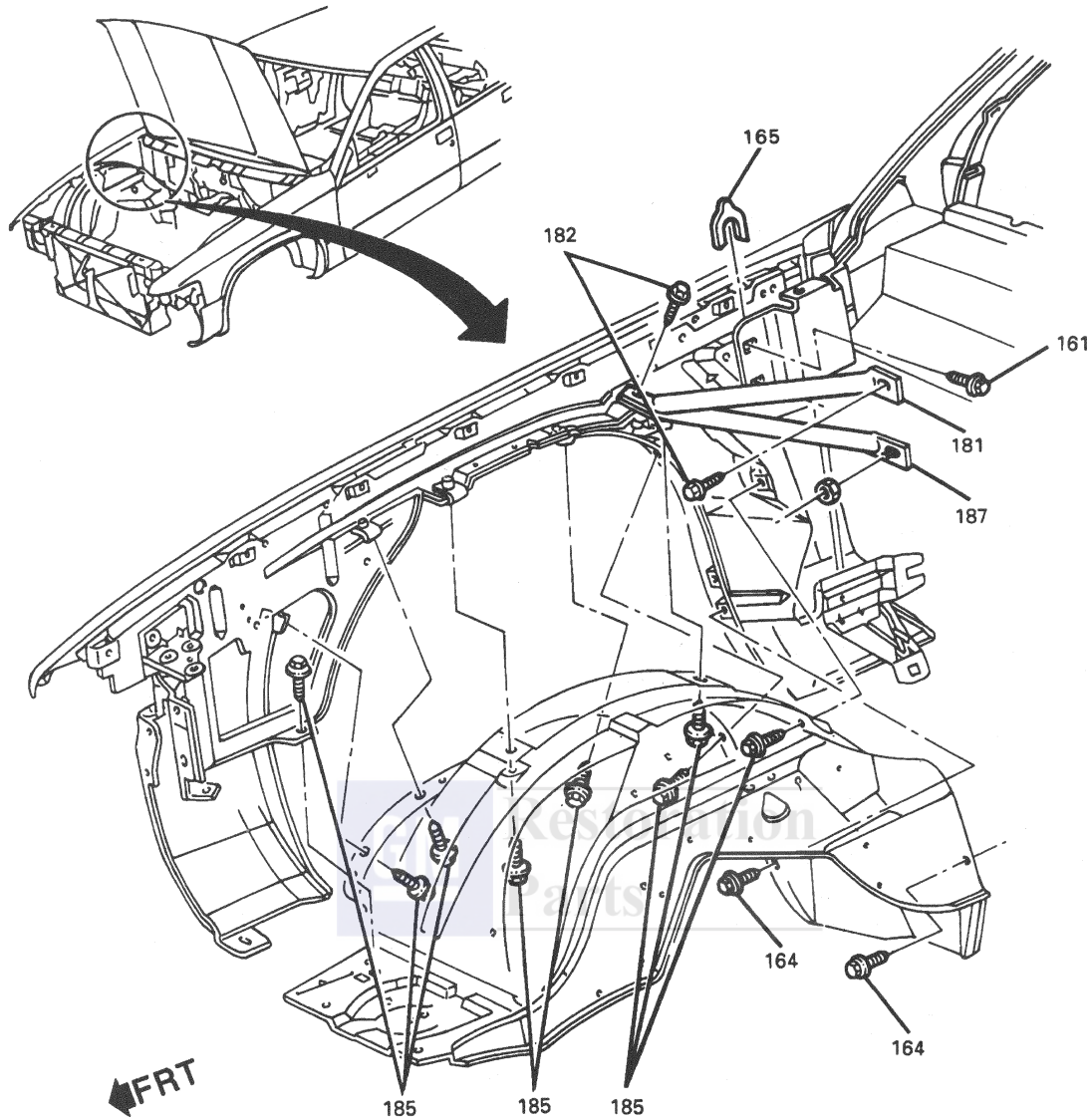
Tighten

- Lower bracket bolt/screw (171) to 50 N.m (37 lb. in.).

12. Wheelhouse panel bolts/screws (185).

Tighten

- Wheelhouse panel bolts/screws (185) to 10 N.m (89 lb. in.).



- 161 BOLT/SCREW, FRONT FENDER REAR UPPER BRACKET,
50 N·m (37 LB. FT.)
- 164 BOLT/SCREW, FRONT WHEELHOUSE PANEL, 10 N·m
(89 LB. IN.)
- 165 SHIM, FRONT FENDER
- 181 BRACE, FRONT FENDER REAR UPPER
- 182 BOLT/SCREW, FRONT FENDER REAR UPPER BRACE,
25 N·m (18 LB. FT.)
- 185 BOLT/SCREW, FRONT WHEELHOUSE PANEL, 10 N·m
(89 LB. IN.)
- 187 BRACE, FRONT FENDER REAR LOWER

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Figure 57 - Accessing Front Side Door Lower Hinge

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13. Lower rear panel bolt/screw (172) and shim (165), if removed.

Tighten

- Lower rear panel bolt/screw (172) to 10 N.m (89 lb. in.).

14. Remove support from front side door.
15. Tire and wheel. Refer to SECTION 3E.
16. Lower vehicle.

FRONT SIDE DOOR

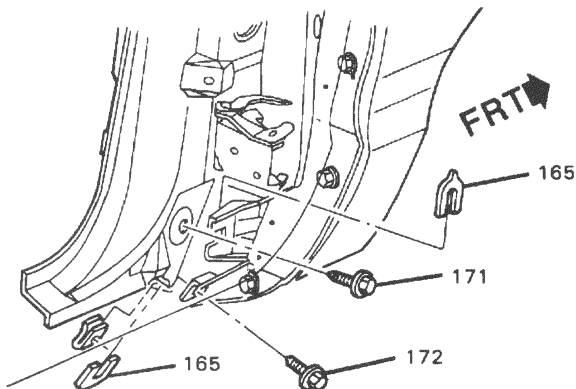
Figures 56 through 58

Tools Required:

- J 39079 Door Hinge Spring Compressor
- J 28500 Door Hinge Wrench

Remove or Disconnect

1. Front side door trim. Refer to "Front Side Door Trim" in this section.
2. Move front side door water deflector to access electrical connectors for front side door-mounted components.
3. Electrical connectors from front side door-mounted components.
4. Wire harness and rubber conduit.
5. Raise and suitably support vehicle.
6. Tire and wheel. Refer to SECTION 3E.
7. Support front side door in full-open position.



- 165 SHIM, FRONT FENDER
171 BOLT/SCREW, FRONT FENDER REAR LOWER BRACKET, 50 N.m (37 LB. FT.)
172 BOLT/SCREW, FRONT FENDER INNER LOWER REAR PANEL, 10 N.m (89 LB. IN.)

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Figure 58 - Loosening Front Fender Inner Panel

8. Lower rear panel bolt/screw (172) and shim (165), if applicable.
9. Wheelhouse panel bolts/screws (185).
10. Lower bracket bolt/screw (171) with shim (165), if applicable.
11. Wheelhouse panel bolts/screws (164).
12. Hood rear outer seal.
13. Upper brace bolts/screws (182).
14. Upper bracket bolt/screw (161) with shims (165), if applicable.
15. Bolt/screw (84) with shim (165), if applicable.
16. Support front fender away from body.
17. Nuts (88 and 163), using J 28500.
18. Front side door, with aid of helper.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Front side door, with aid of helper.
2. Nuts (88 and 163), using J 28500.

Tighten

- Nuts (88) to 32 N.m (24 lb. ft.).

Adjust

- Front side door. Refer to "Front Side Door Adjustment" in this section.
3. Remove front fender support.
 4. Bolt/screw (84) with shim (165), if removed.

Tighten

- Bolt/screw (84) to 50 N.m (37 lb. ft.).
5. Upper bracket bolt/screw (161) with shims (165), if removed.

Tighten

- Upper bracket bolt/screw (161) to 50 N.m (37 lb. ft.).
6. Upper brace bolts/screws (182).

Tighten

- Upper brace bolts/screws (182) to 25 N.m (18 lb. ft.).
7. Hood rear outer seal.
 8. Wheelhouse panel bolts/screws (164).

Tighten

- Wheelhouse panel bolts/screws (164) to 10 N.m (89 lb. in.).
9. Lower bracket bolt/screw (171) with shim (165), if removed.

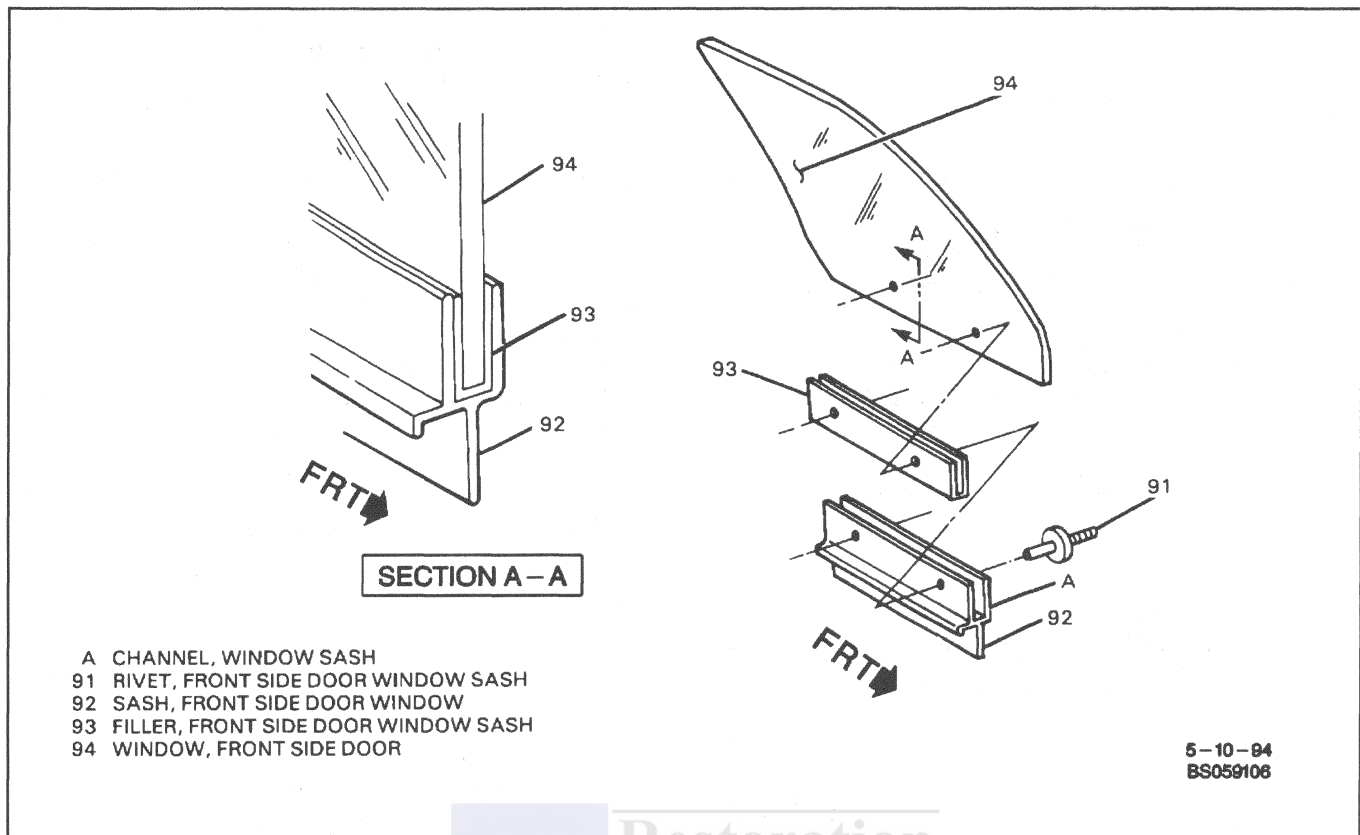


Figure 59 - Removing Front Side Door Window

Tighten

- Lower bracket bolt/screw (171) to 50 N.m (37 lb. ft.).

10. Wheelhouse panel bolts/screws (185).

Tighten

- Bolts/screws (185) to 10 N.m (89 lb. in.).

11. Lower rear panel bolt/screw (172) and shims (165), if removed.

Tighten

- Lower rear panel bolt/screw (172) to 10 N.m (89 lb. in.).

12. Remove front side door support.
13. Tire and wheel. Refer to SECTION 3E.
14. Lower vehicle.
15. Wire harness and wire conduit.
16. Electrical connectors to front side door-mounted components.
17. Reposition front side door water deflector.
18. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR WINDOW

Figures 59 through 61

The window (94) is riveted to the filler (93) and window sash channel. This is then riveted to a window regulator sash. The window (94) and the sash (92) with filler (93) are removed from the door as a unit. Replacement window is installed to the sash (92) as a bench operation.

CAUTION: Approved safety glasses and gloves should be worn when performing these procedures to reduce the chance of personal injury should window breakage occur.

Remove or Disconnect

CAUTION: When activated, the front side door window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door window regulator when operating the switch may result in personal injury and regulator damage.

1. Lower window (94) enough to access rivets (96).

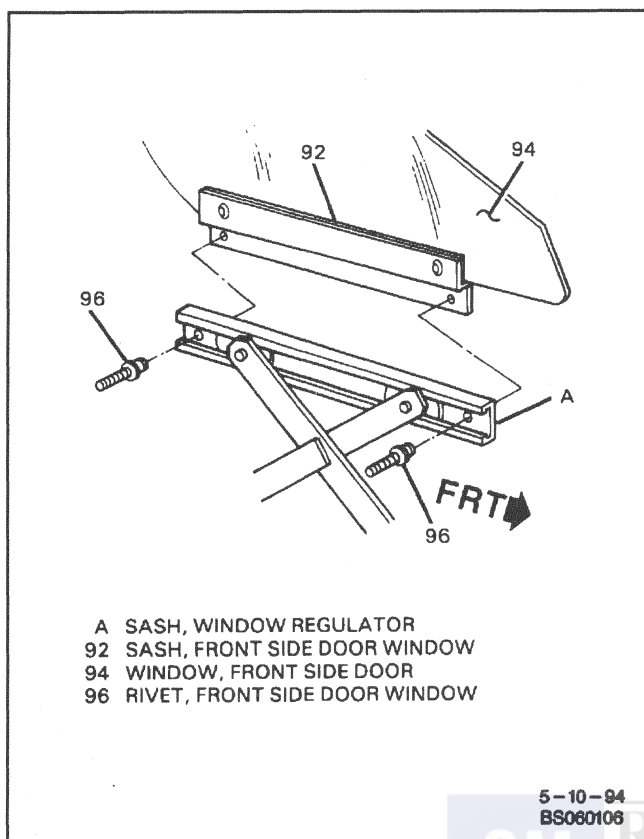


Figure 60 - Removing Front Side Door Window Sash

CAUTION: Tape the front side door window to the front side door frame. If the window drops into the door, personal injury or window damage may result.

2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Move front side door water deflector to access front side door window hardware.
4. Support window (94) in position needed to access rivets (96) by taping it to door frame using cloth-backed body tape.
5. Front side door window front channel bolt/screw.
6. Front side door window front channel.
7. Rivets (96) holding window sash (92) to window regulator sash, using a drill and 5/16-inch drill bit.
8. Window (94) with window sash (92).

A. Support window (94) and remove cloth-backed body tape.

CAUTION: Refer to Front Side Door Window Switch "Caution" above.

- B. Run regulator (98) to full-down position.
- C. Disengage rear edge of window (94) from front side door window rear channel.
- D. Slide window (94) forward and tilt it slightly to remove from front side door window rear channel.

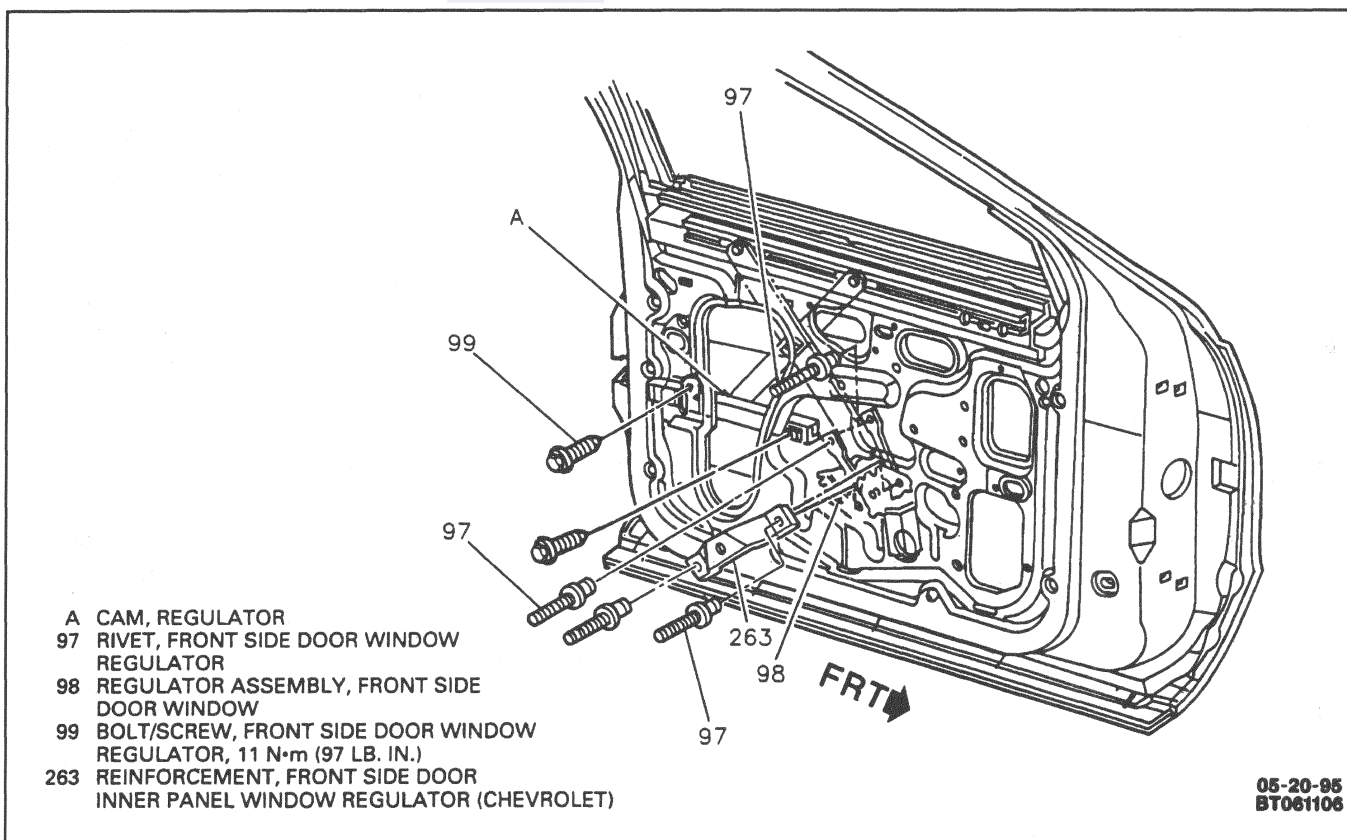


Figure 61 - Front Side Door Window Regulator

**Disassemble**

1. Rivets (91), using drill and 1/4-inch drill bit.
2. Window sash channel.
3. Filler (93) from window (94).

**Assemble**

1. Filler (93) to window (94).
2. Window sash channel.
3. Rivets (91).

**Install or Connect**

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Window (94) with sash (92).
 - A. Install window (94) front end first.
 - B. Engage rear edge of window (94) to front side door window rear channel.
2. Rivets (96).
3. Front side door window front channel.

CAUTION: Refer to Front Side Door Window Switch "Caution" above.

4. Front side door window front channel bolt/screw.
 - Run regulator (98) to position sash (92) for rivet (96) installation.

**Adjust**

- Window (94) if top edge is not parallel to front side door window weatherstrip.
 - A. Loosen bolts/screws (99).

- B. Raise window (94) to full upward position.
- C. Push up or down, as necessary, on rear of window regulator cam and secure with bolts/screws (99).

**Tighten**

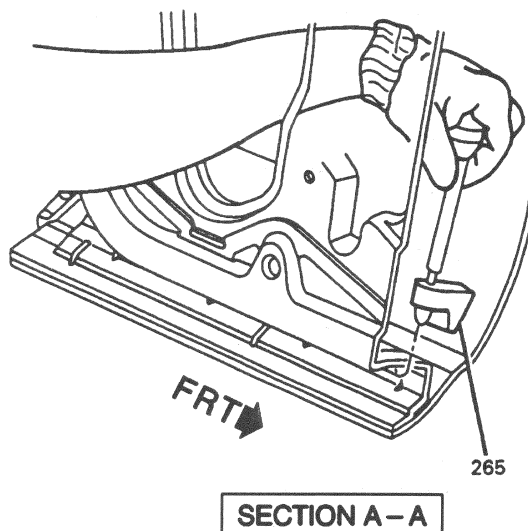
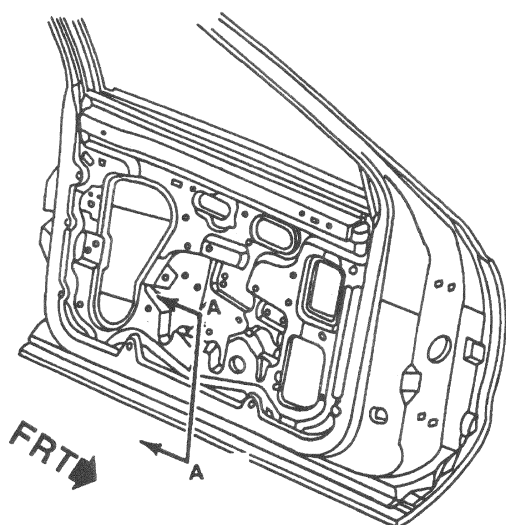
- Bolts/screws (99) to 11 N.m (97 lb. in.).
5. Reposition front side door water deflector.
 6. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR WINDOW DOWN STOP BUMPER**Figure 62****Remove or Disconnect**

- Down stop bumper (265).
 - Insert screwdriver under bumper and pry up.

**Install or Connect**

- Down stop bumper (265).
 - A. Align bumper to pierced hole in bottom of front door inner panel.
 - B. Press down with sufficient pressure to seat properly.



265 DOWN STOP BUMPER, FRONT SIDE DOOR WINDOW

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Figure 62 - Front Side Door Window Down Stop Bumper

FRONT SIDE DOOR WINDOW REGULATOR

Figures 60 and 61



Remove or Disconnect

CAUTION: When activated, the front side door power window switch may lock into the express down mode causing the driver's side front side door window to lower fully without stopping even though the switch has been released. Failure to exercise caution around the front side door power window regulator when operating the switch may result in personal injury and regulator damage.

1. Raise window (94) as necessary.

CAUTION: Tape the front side door window to the front side door frame. If the window drops into the door when the front side door window regulator is removed, personal injury or window damage may result.

2. Front side door trim. Refer to "Front Side Door Trim" in this section.
3. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
4. Support window (94) in position needed to access rivets (96) by taping it to door frame, using cloth-backed body tape.
5. Front side door locking system module. Refer to "Front Side Door Locking System Module" in this section.
6. Rivets (96) connecting sash (92) to window regulator sash, using drill and 5/16-inch drill bit.
7. Bolts/screws (99) securing regulator cam to door panel.
8. Electrical connection, if necessary.
9. Rivets (97) securing regulator (98) to door panel, using drill and 5/16-inch drill bit.
10. Reinforcement (263), if manual window regulator.
11. Regulator (98).



Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Regulator (98).
2. Reinforcement (263), if manual window regulator.
3. Rivets (97) securing regulator (98) to door panel.
 - Secure upper rearmost, center rearmost, center foremost, then lower rearmost.
4. Electrical connection, if removed.
5. Bolts/screws (99) securing regulator cam to door inner panel.



Tighten

- Bolts/screws (99) to 11 N.m (97 lb. in.).
6. Rivets (96) connecting sash (92) to window regulator sash.
 7. Front side door locking system module. Refer to "Front Side Door Locking System Module" in this section.
 8. Remove cloth-backed tape.



Inspect

CAUTION: Refer to Front Side Door Window Switch "Caution" above.

- A. Regulator (98) operation.
 - B. Window (94) alignment.
 - Refer to "Front Side Door Window" in this section for adjustment procedures.
9. Front side door water deflector. See "Front Side Door Water Deflector" in this section.
 10. Front side door trim. Refer to "Front Side Door Trim" in this section.

FRONT SIDE DOOR WINDOW REGULATOR MOTOR



Important

- Front Side Door Window Regulator Motor is not serviceable, and is replaced as a unit.

CENTER PILLAR INTERIOR TRIM

Center Pillar Upper Trim Finish Panel

Figure 63



Remove or Disconnect

1. Open cover (104).
2. Bolt/screw (105).
3. Panel (103) by unseating clip (106).



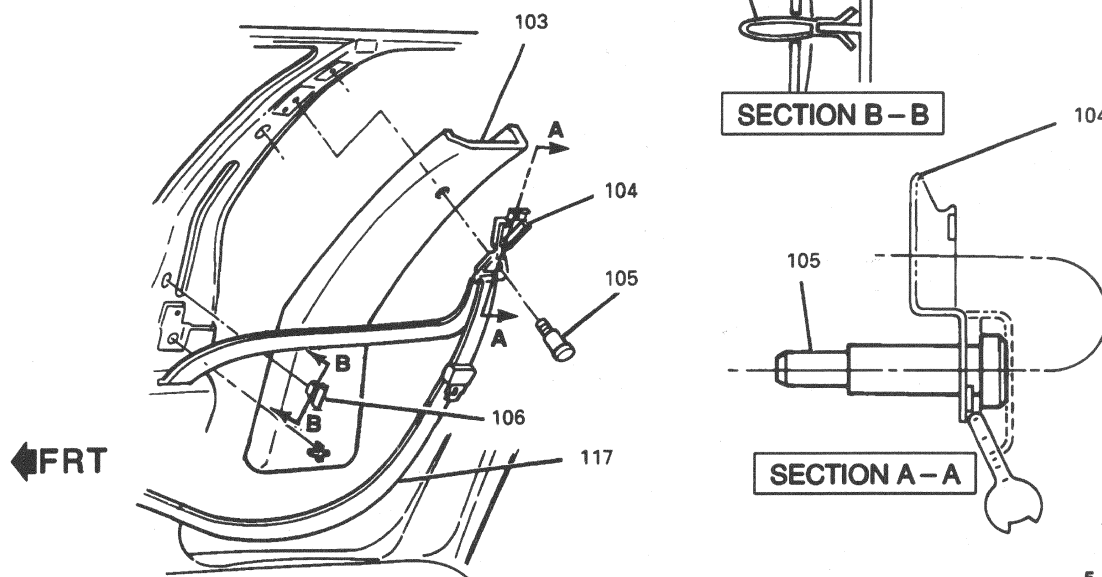
Install or Connect

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Panel (103) by seating clip (106).

- 103 PANEL, CENTER PILLAR UPPER TRIM FINISH
 104 COVER, FRONT SEAT BELT GUIDE
 105 BOLT/SCREW, FRONT SEAT BELT, 42 N·m (31 LB. FT.)
 106 CLIP, CENTER PILLAR UPPER TRIM FINISH PANEL
 117 BELT, FRONT SEAT



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Figure 63 - Removing Center Pillar Upper Trim Finish Panel

2. Bolt/screw (105).



Tighten

- Bolt/screw (105) to 48 N·m (35 lb. ft.).
3. Snap cover (104) closed.



Install or Connect

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Belt (117) through upper and lower slots in retainer (115).
2. Bolt/screw (107).



Tighten

- Bolt/screw (107) to 42 N·m (31 lb. ft.).
3. Retainer (115).

- A. Slide end underneath body lock pillar trim finish panel at rear.
- B. Position to center pillar and seat securely into front side door weatherstrip.
- C. Apply outward pressure to lock pillar trim finish panel to engage clips.

Floor Carpet Retainer

Figures 64 through 66



Remove or Disconnect

1. Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.
2. Unsnap escutcheon (114) from retainer (115).
3. Bolts/screws (109).
4. Forward carpet retainer (116).
5. Bottom edge of body lock pillar trim finish panel.
 - Carefully pull forward and inward to disengage clips.
6. Rear carpet retainer (113).
7. Retainer (115).
 - Slide from underneath lock pillar trim finish panel at rear.
8. Bolt/screw (107).
9. Belt (117) by removing through upper and lower slots in retainer (115).

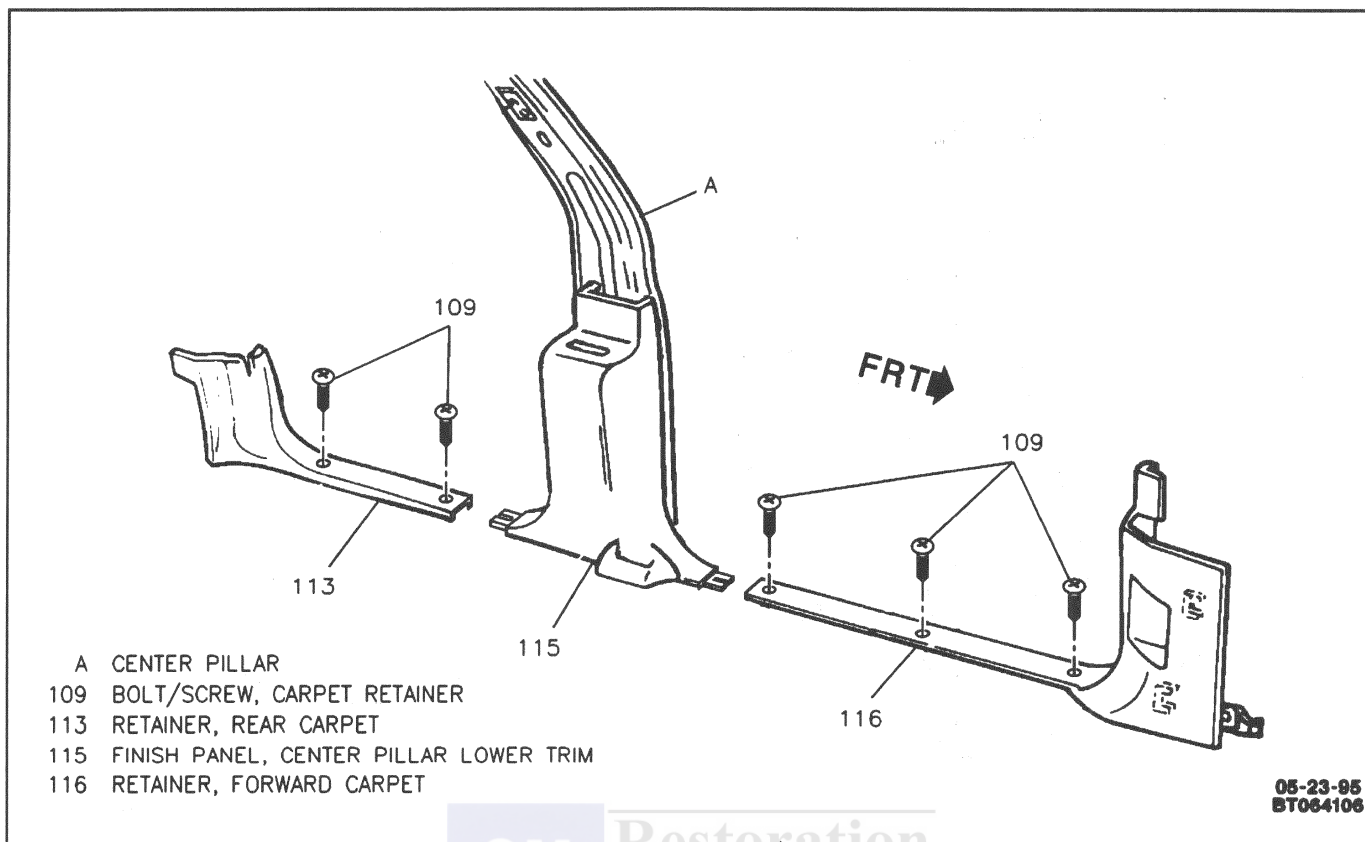


Figure 64 - Removing Floor Carpet Retainer

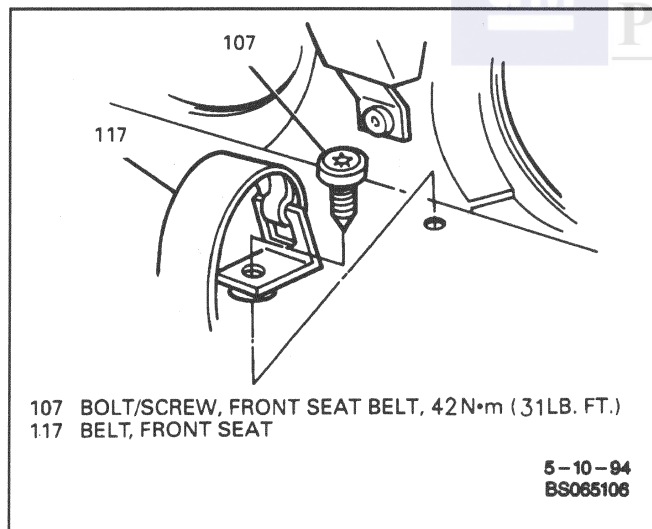


Figure 65 - Front Seat Belt Bolt/Screw

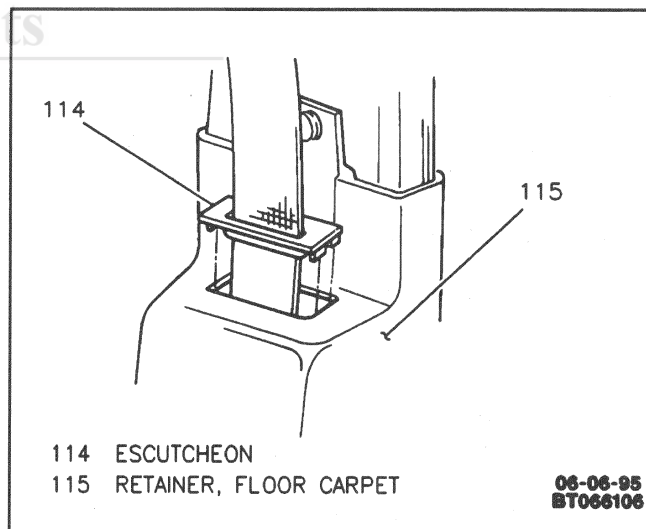


Figure 66 - Floor Carpet Retainer Escutcheon

4. Rear carpet retainer (113).
5. Bottom edge of body lock pillar trim finish panel.
6. Forward carpet retainer (116).
7. Bolts/screws (109).

8. Snap escutcheon (114) into retainer (115).
9. Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.



Tighten

- Bolts/screws (109) to 1.3 N.m (12 lb. in.).

CENTER PILLAR EXTERIOR TRIM**Center Pillar Applique**

BUICK SEDAN

Figure 67**↔ Remove or Disconnect**

1. Roof side rail auxiliary weatherstrip by pulling off flange.
2. Applique (118).
 - Use heat gun to soften adhesive.

**Clean**

- Surface with 50/50 alcohol and water solution.

→→ Install or Connect

1. Applique (118).
 - A. Surface temperature must be between 15° C and 32° C (60° F and 90° F). If necessary, adjust surface temperature by using heat gun or allowing surface to cool.
 - B. Partially remove paper backing from applique (118).
 - C. Align top of applique (118) to roof header.
 - D. Working downward, remove paper backing and position applique (118) to center pillar using a squeegee to smooth applique (118).
 - E. Carefully remove protective premask by pulling it back over itself in a smooth, steady motion, at a 180-degree angle.
2. Roof side rail auxiliary weatherstrip by pushing onto flange.

CENTER PILLAR SWITCHES**Door Jamb Switches****Figure 68**

Door jamb switches consist of a plunger, plunger collar, threaded retainer and terminals. They are installed in the door hinge pillars. When the door of the vehicle is closed, the plunger is pressed down creating an open in the ground circuit. When the door is opened, the plunger is released and completes the circuit to ground.

When a new door jamb switch is installed and the door is closed for the first time, the plunger is forced into the sleeve and automatically adjusts the switch for that particular door. If a door jamb switch fails, it should not be readjusted by hand. A new switch should be installed.

**Remove or Disconnect**

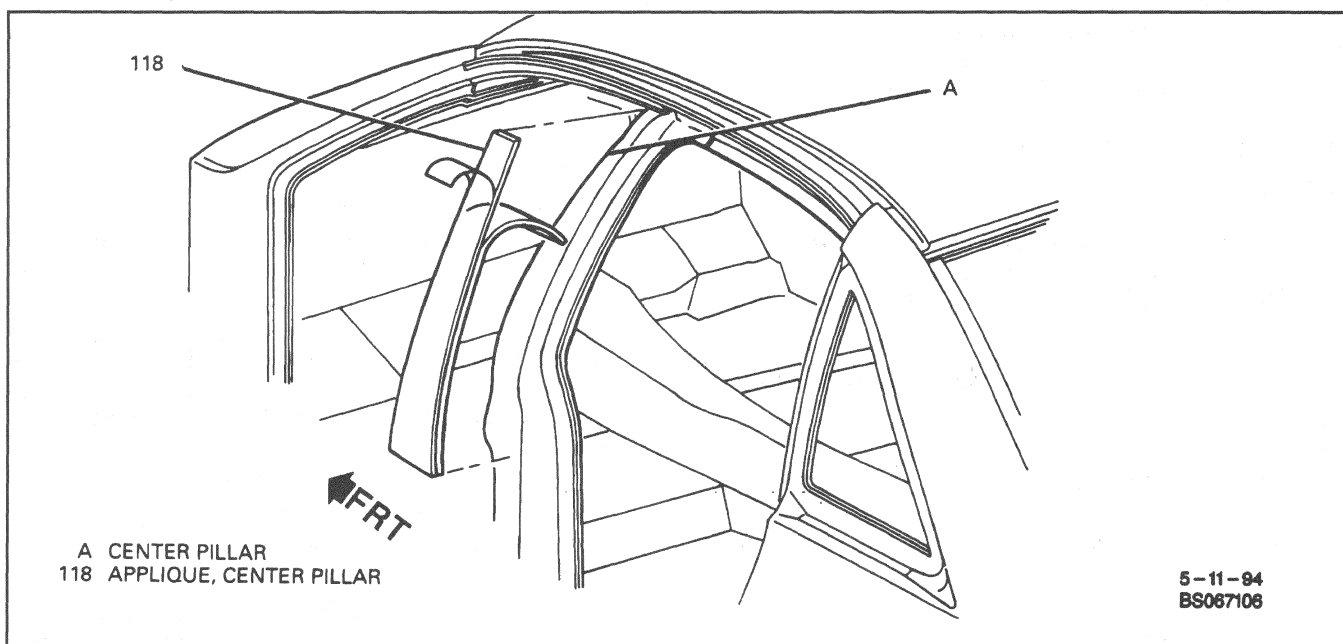
CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Switch (121).
3. Electrical connector(s).
4. Seal (120).

**Install or Connect**

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Seal (120).
2. Electrical connector(s).

**Figure 67 - Center Pillar Applique-(Buick Sedan)**

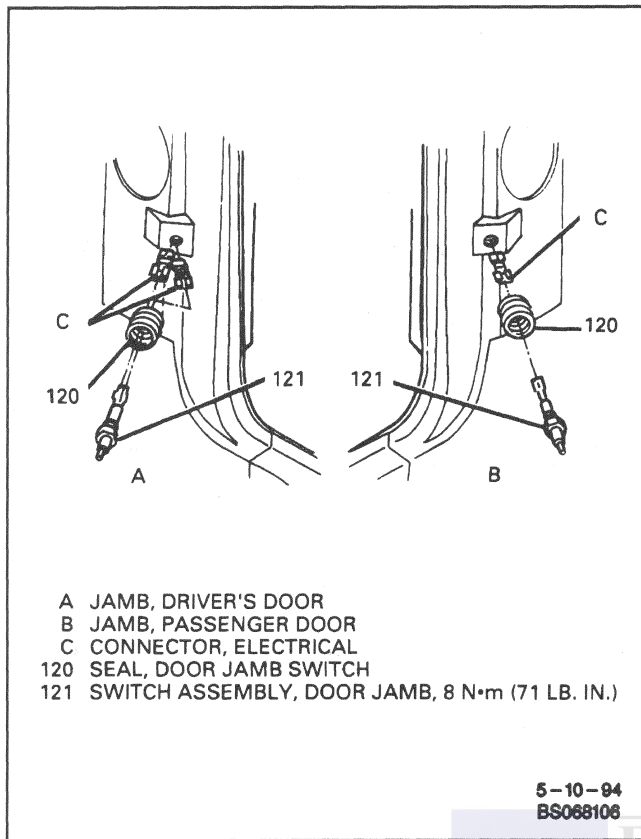


Figure 68 - Removing Door Jamb Switches

3. Switch (121).



Tighten

- Switch (121) to 8 N•m (71 lb. in.).
4. Battery negative cable.

REAR SIDE DOOR INTERIOR TRIM

Rear Side Door Trim

The rear side door trim is serviced the same way as the front side door trim. For service procedure, refer to "Front Side Door Trim" in this section.

Rear Side Door Armrest

CHEVROLET

The rear side door armrest is serviced the same way as the front side door armrest. For service procedure, refer to "Front Side Door Armrest" in this section.

Body Side Rear Window Garnish Molding

Figure 10



Remove or Disconnect

1. Rear side door trim. Refer to "Front Side Door Trim" in this section.
2. Bolts/screws.
3. Molding (208).
 - Disengage clips.



Clean

- Area of door inner panel where rear doughnut is to be positioned with a suitable solvent of isopropyl alcohol, 50-50 mixture by volume of water.



Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Molding (208).
 - A. Engage clips.
 - B. Peel back paper and press to secure doughnut.
2. Bolts/screws.



Tighten

- Bolts/screws to 1.3 N•m (12 lb. in.).
3. Rear side door trim. Refer to "Front Side Door Trim" in this section.

REAR SIDE DOOR EXTERIOR TRIM

Rear Side Door Moldings

NOTICE: When removing or installing any outside molding, cover adjacent finishes with masking tape to prevent damage to the finish. Use proper tools and care to prevent molding. Seal all holes for bolts/screws or clips in body panels with body caulking compound or presealed bolts/screws, nuts or clips to prevent water entry into the body interior.

REAR SIDE DOOR WINDOW REVEAL MOLDINGS

BUICK SEDAN

Figure 69



Remove or Disconnect

1. Fully lower window.
2. Rear side door window channel.
 - Peel rear side door window channel away from front reveal molding (142) and upper reveal molding (139).
3. Rear side door vent window, if removing upper reveal molding or rear reveal molding. Refer to "Rear Side Door Vent Window and Rear Side Door Stationary Window Division Channel" in this section.
4. Bolt/screw (143) in belt reveal molding (141).
5. Belt reveal molding (141) by sliding upward.
6. Front reveal molding (142).
7. Bolt/screw (123) in upper reveal molding (139).
8. Rock upper reveal molding (139) down and rear reveal molding (140) forward as one unit until removed from door flanges.

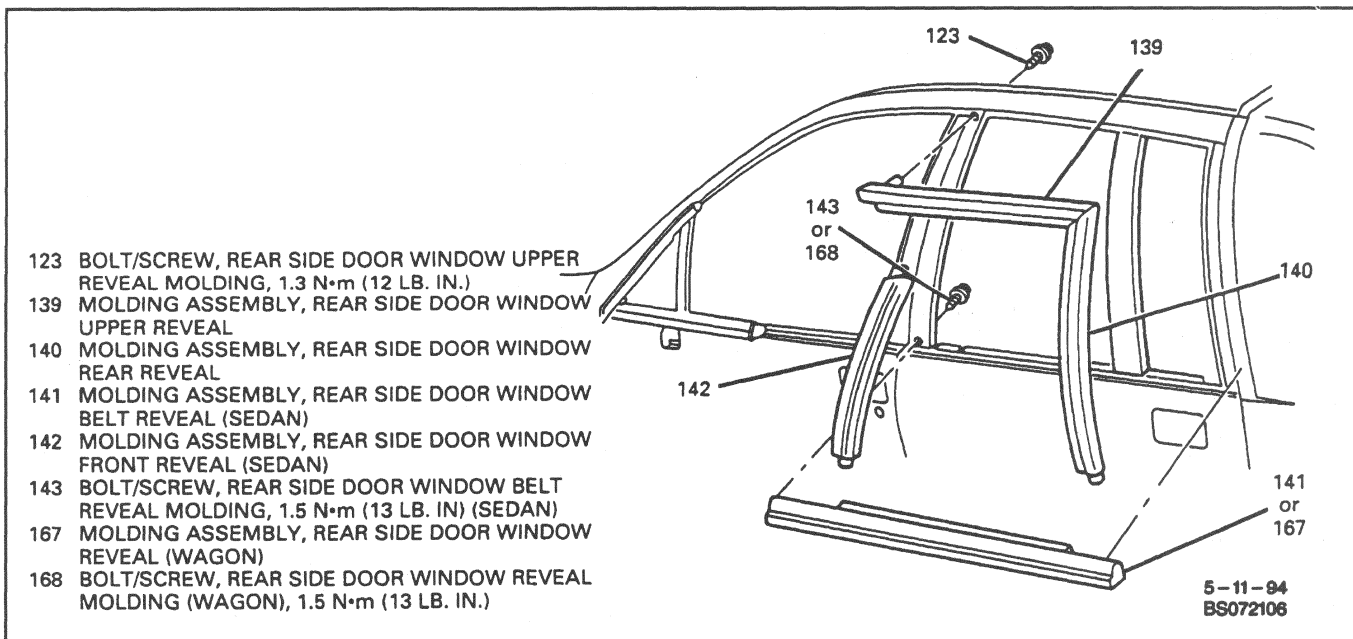


Figure 69 - Rear Side Door Window Reveal Molding-(Buick)

9. Slide rear reveal molding (140) out from upper reveal molding (139).

BUICK WAGON**Figure 69**

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Slide rear reveal molding (140) into upper reveal molding (139).
2. Rock rear reveal molding(140) rearward and upper reveal molding (139) upward until installed on door flanges.
3. Bolt/screw (123) to upper reveal molding (139).

Tighten

- Bolt/screw (123) to 1.3 N.m (12 lb. in.).
4. Front reveal molding (142), pushing upward and toward front of vehicle.
 5. Belt reveal molding (141).
 6. Bolt/screw (143) in belt reveal molding (141).

Tighten

- Bolt/screw (143) to 1.5 N.m (13 lb. in.).
7. Rear side door vent window if removed. Refer to "Rear Side Door Vent Window and Rear Side Door Stationary Window Division Channel" in this section.
 8. Rear side door window channel.
 - Push rear side door window channel over edge of front reveal molding (142) and upper reveal molding (139).

Remove or Disconnect

1. Fully lower window.
2. Body side rear window garnish molding. Refer to "Body Side Rear Window Garnish Molding" in this section.
3. Rear side door window channel. Refer to "Rear Side Door Window Channel and Rear Side Door Window Weatherstrip" in this section.
4. Rear side door window weatherstrip. Refer to "Rear Side Door Window Weatherstrip" in this section.
5. Bolt/screw (168) in reveal molding (167).
6. Reveal molding (167) by sliding upward.
7. Bolt/screw (123) in upper reveal molding (139).
8. Rock upper reveal molding (139) down and rear reveal molding (140) forward as one unit until removed from door flanges.
9. Slide rear reveal molding (140) out from upper reveal molding (139).

Install or Connect

1. Slide rear reveal molding (140) into upper reveal molding (139).
2. Rock rear reveal molding (140) rearward and upper reveal molding (139) upward until installed on door flanges.
3. Bolt/screw (123) to upper reveal molding (139).

Tighten

- Bolt/screw (123) to 1.3 N.m (12 lb. in.).

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4. Reveal molding (167).
5. Bolt/screw (168) in reveal molding (167).

Tighten

- Bolt/screw (168) to 1.5 N·m (13 lb. in.).
6. Rear side door window weatherstrip. Refer to "Rear Side Door Window Weatherstrip" in this section.
 7. Rear side door window channel. Refer to "Rear Side Door Window Channel and Rear Side Door Window Weatherstrip" in this section.
 8. Body side rear window garnish molding. Refer to "Body Side Rear Window Garnish Molding" in this section.
 9. Fully raise window.

CHEVROLET

Figure 70

Remove or Disconnect

1. Fully lower window.
2. Bolts/screws (123 and 224) in upper reveal molding (170).
3. Upper reveal molding (170).
4. Bolts/screws (225) in reveal molding (169).
5. Reveal molding (169).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Reveal molding (169).
2. Bolts/screws (225) in reveal molding (169).

Tighten

- Bolts/screws (225) to 1.5 N·m (13 lb. in.).
3. Upper reveal molding (170).
 4. Bolts/screws (123 and 224) in upper reveal molding (170).

Tighten

- Bolts/screws (123 and 224) to 1.3 N·m (12 lb. in.).

REAR SIDE DOOR EDGE GUARD MOLDING

Figure 33

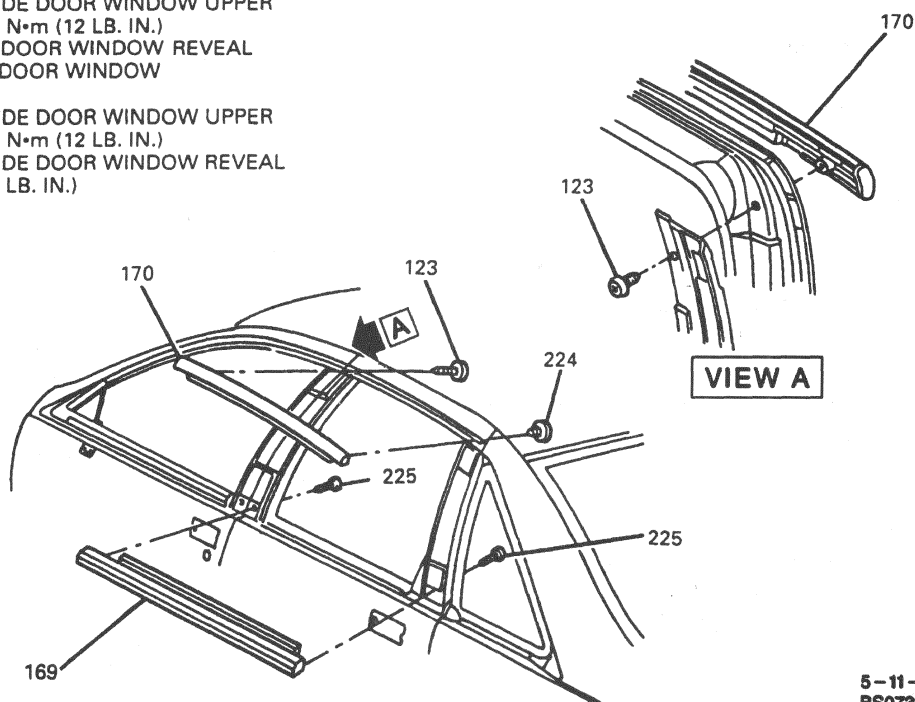
Remove or Disconnect

- Molding (138).
- Pull from edge of door.

Install or Connect

- Molding (138).
- A. Match to shape of door edge.
- B. Press along entire length to secure.

- 123 BOLT/SCREW, REAR SIDE DOOR WINDOW UPPER REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
- 169 MOLDING, REAR SIDE DOOR WINDOW REVEAL
- 170 MOLDING, REAR SIDE DOOR WINDOW UPPER REVEAL
- 224 BOLT/SCREW, REAR SIDE DOOR WINDOW UPPER REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
- 225 BOLT/SCREW, REAR SIDE DOOR WINDOW REVEAL MOLDING, 1.5 N·m (13 LB. IN.)



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Figure 70 - Rear Side Door Window Reveal Molding-(Chevrolet)

Rear Side Door Window Frame Rear Applique

BUICK WAGON

Figure 71

Remove or Disconnect

1. Bolt/screw (229).
2. Nuts (178).
3. Applique (177).
 - Pry applique (177) from rear side door, being careful not to damage surrounding surfaces.
4. Discard applique (177).

Clean

- Area with general purpose cleaner.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Clips (228) if missing or damaged.
2. New applique (177).
 - A. Heat surface to between 15° C and 32° C (60° F and 90° F), if necessary, by using a heat gun.
 - B. Align rosebuds at top of applique (177) with holes in door.
 - C. Align three studs on applique (177) to clips on door.
 - D. Press rosebuds and studs in place to secure.
 - E. Pull tabs (A) at top of applique (177) to remove protective liner from adhesive.
3. Nuts (178).
4. Bolt/screw (229).

Tighten

- Bolt/screw (229) to 1.5 N·m (13 lb. in.).
5. Roll front and rear edges of applique (177) to secure adhesive tape. Bottom of applique (177) should be within 1 mm (1/32 inch) of horizontal door surface.

REAR SIDE DOOR WEATHERSTRIP AND REAR SIDE DOOR UPPER FRONT AUXILIARY WEATHERSTRIP

Rear Side Door Weatherstrip

Figure 36

Remove or Disconnect

1. Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.

2. Rear side door lock pillar garnish molding (Sedan) or body lock pillar trim finish panel (Wagon). Refer to SECTION 10-7.
3. Floor carpet retainer. Refer to "Floor Carpet Retainer" in this section.
4. Weatherstrip (30).
 - Pull from pinch-weld flange.

Install or Connect

1. Weatherstrip (30).
 - A. Position to body by locating joint area of weatherstrip to rearward rocker panel sill plate hole. Engage weatherstrip (30) onto pinch-weld flange.
 - B. Engage each corner onto pinch-weld flange.
 - C. Finish installing by engaging between corners onto pinch-weld flange.
 - D. It may be necessary to tap weatherstrip (30) onto pinch-weld with rubber mallet.
2. Floor carpet retainer. Refer to "Floor Carpet Retainer" in this section.
3. Rear side door lock pillar garnish molding (Sedan) or body lock pillar trim finish panel (Wagon). Refer to SECTION 10-7.
4. Center pillar upper trim finish panel. Refer to "Center Pillar Upper Trim Finish Panel" in this section.

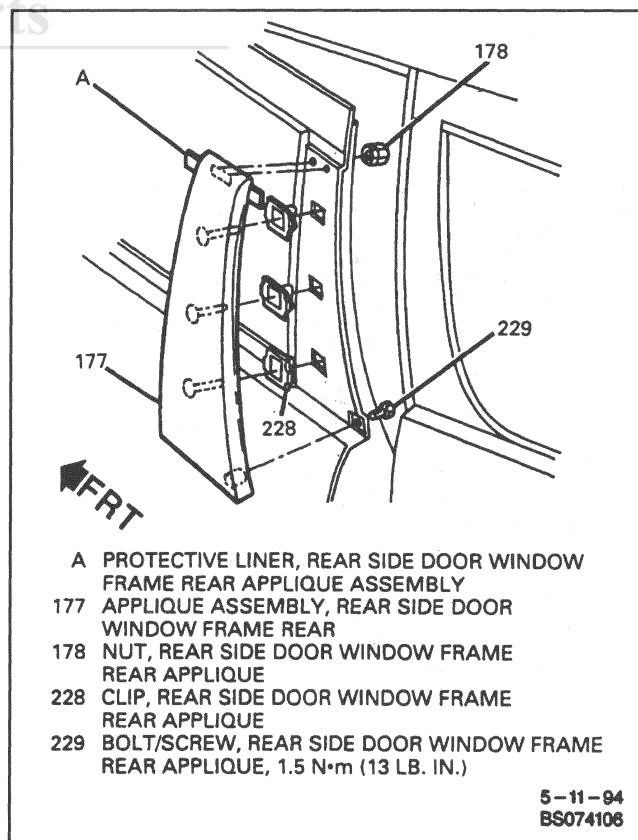


Figure 71 - Rear Side Door Window Frame Rear Applique-(Buick Sedan)

Rear Side Door Upper Front Auxiliary Weatherstrip

Figure 72

Remove or Disconnect

1. Body side rear window garnish molding. Refer to "Body Side Rear Window Garnish Molding" in this section.
2. Bolts/screws (143, 168 or 225).
3. Bolt/screw (123).
4. Retainers (231).
5. Auxiliary weatherstrip (230).

Install or Connect

1. Auxiliary weatherstrip (230).
 - Align holes in auxiliary weatherstrip (230) to holes in rear door frame.
2. Retainers (231).

Tighten

- Retainers (231) to 1.3 N·m (12 lb. in.).
3. Bolt/screw (123).

Tighten

- Bolt/screw (123) to 1.3 N·m (12 lb. in.).
4. Bolt/screw (143, 168 or 225).

Tighten

- Bolt/screw (143, 168 or 225) to 1.5 N·m (13 lb. in.).

REAR SIDE DOOR SEALING STRIPS

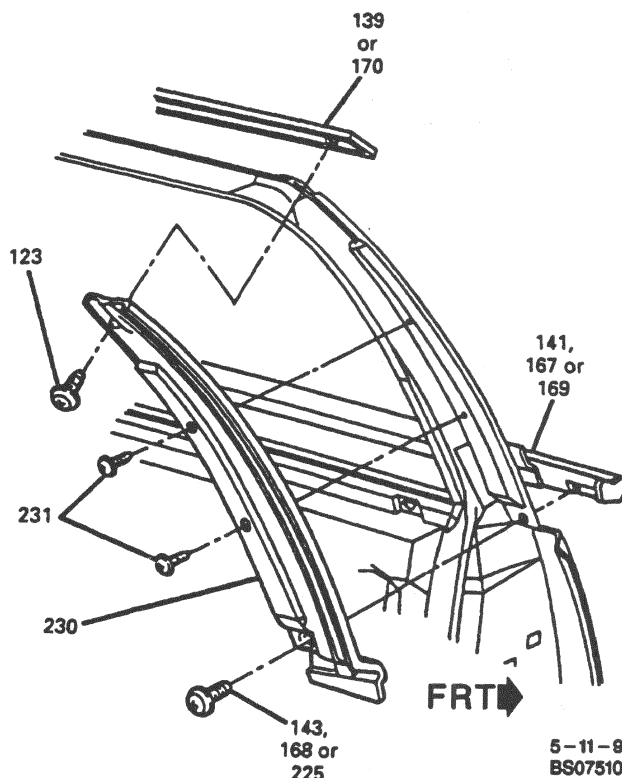
Window Belt Outer Sealing Strip

The rear side door window belt outer sealing strip is part of the rear side door window belt reveal molding. For procedure, refer to "Rear Side Door Window Belt Molding" under "Rear Side Door Moldings" in this section.

Window Belt Sealing Strip

The window belt sealing strip is part of the rear side door window reveal molding. For service information refer to "Rear Side Door Window Reveal Moldings" (Sedan) or "Rear Side Door Window Reveal Molding" (Wagon) under "Rear Side Door Moldings" in this section.

- 123 BOLT/SCREW, REAR SIDE DOOR WINDOW UPPER REVEAL MOLDING, 1.3 N·m (12 LB. IN.)
- 139 MOLDING, REAR SIDE DOOR WINDOW UPPER REVEAL (BUICK)
- 141 MOLDING REAR SIDE DOOR WINDOW BELT REVEAL (BUICK SEDAN)
- 143 BOLT/SCREW, REAR SIDE DOOR WINDOW REVEAL MOLDING (BUICK SEDAN), 1.5 N·m (13 LB. IN.)
- 167 MOLDING, REAR SIDE DOOR WINDOW REVEAL (BUICK WAGON)
- 168 BOLT/SCREW, REAR SIDE DOOR WINDOW REVEAL MOLDING, 1.5 N·m (13 LB. IN.)
- 169 MOLDING, REAR SIDE DOOR WINDOW REVEAL (CHEVROLET)
- 170 MOLDING, REAR SIDE DOOR WINDOW UPPER REVEAL (CHEVROLET)
- 225 BOLT/SCREW, REAR SIDE DOOR WINDOW REVEAL MOLDING, 1.5 N·m (13 LB. IN.) (CHEVROLET)
- 230 WEATHERSTRIP, REAR SIDE DOOR UPPER FRONT AUXILIARY
- 231 RETAINER, REAR SIDE DOOR UPPER FRONT AUXILIARY WEATHERSTRIP, 1.3 N·m (12 LB. IN.)



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Figure 72 - Rear Side Door Upper Front Auxiliary Weatherstrip

Rear Side Door Bottom Auxiliary Sealing Strip

The rear side door bottom auxiliary sealing strip is serviced the same way as the front side door bottom auxiliary sealing strip. For service procedure, refer to "Front Side Door Bottom Auxiliary Sealing Strip" in this section.

Rear Side Door Lower Rear Auxiliary Sealing Strip

BUICK SEDAN

Figure 73

↔ Remove or Disconnect

1. Bolts/screws (184 and 199).
2. Sealing strip (232).

→← Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Sealing Strip (232).
2. Bolt/screw (184).

⌚ Tighten

- Bolt/screw (184) to 1.3 N.m (12 lb. in.).
3. Bolt/screw (199).

⌚ Tighten

- Bolt/screw (199) to 1.3 N.m (12 lb. in.).

REAR SIDE DOOR WINDOW CHANNEL AND REAR SIDE DOOR WINDOW WEATHERSTRIP

Rear Side Door Window Front Channel

BUICK SEDAN

Figure 38

Procedure for rear side door window front channel is similar to that for the front side door window front channel. Refer to "Front Side Door Window Front Channel" in this section.

Rear Side Door Window Rear Channel

CHEVROLET SEDAN AND WAGON AND BUICK WAGON

Figure 74

↔ Remove or Disconnect

1. Rear door inner trim panel. Refer to "Rear Side Door Interior Trim," in this section.

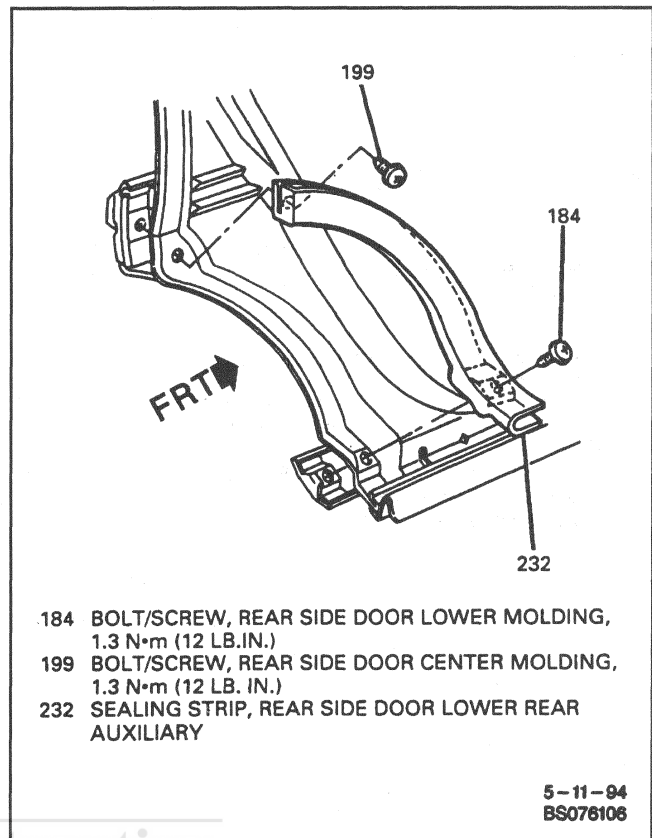


Figure 73 - Rear Side Door Lower Rear Auxiliary Sealing Strip-(Buick Sedan)

2. Rear door armrest hanger plate, by removing rivets.
3. Peel back rear door water deflector to gain access.
4. Rear door reveal molding. Refer to "Rear Side Door Window Reveal Moldings," under "REAR DOOR EXTERIOR TRIM," in this section.
5. Lower window to access rivets connecting window regulator to rear door window sash.
6. Rivets connecting window regulator sash to rear door window sash.
7. Lower window to full down position.
8. Window weather stripping from rear window channel.
9. Bolt/screw (133).
10. Rear window channel.

→← Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Position rear window channel.
2. Bolt/screw (133).

⌚ Tighten

- Bolt/screw (133) to 11 N.m (97 lb. in.).
3. Window weather-stripping to rear channel.

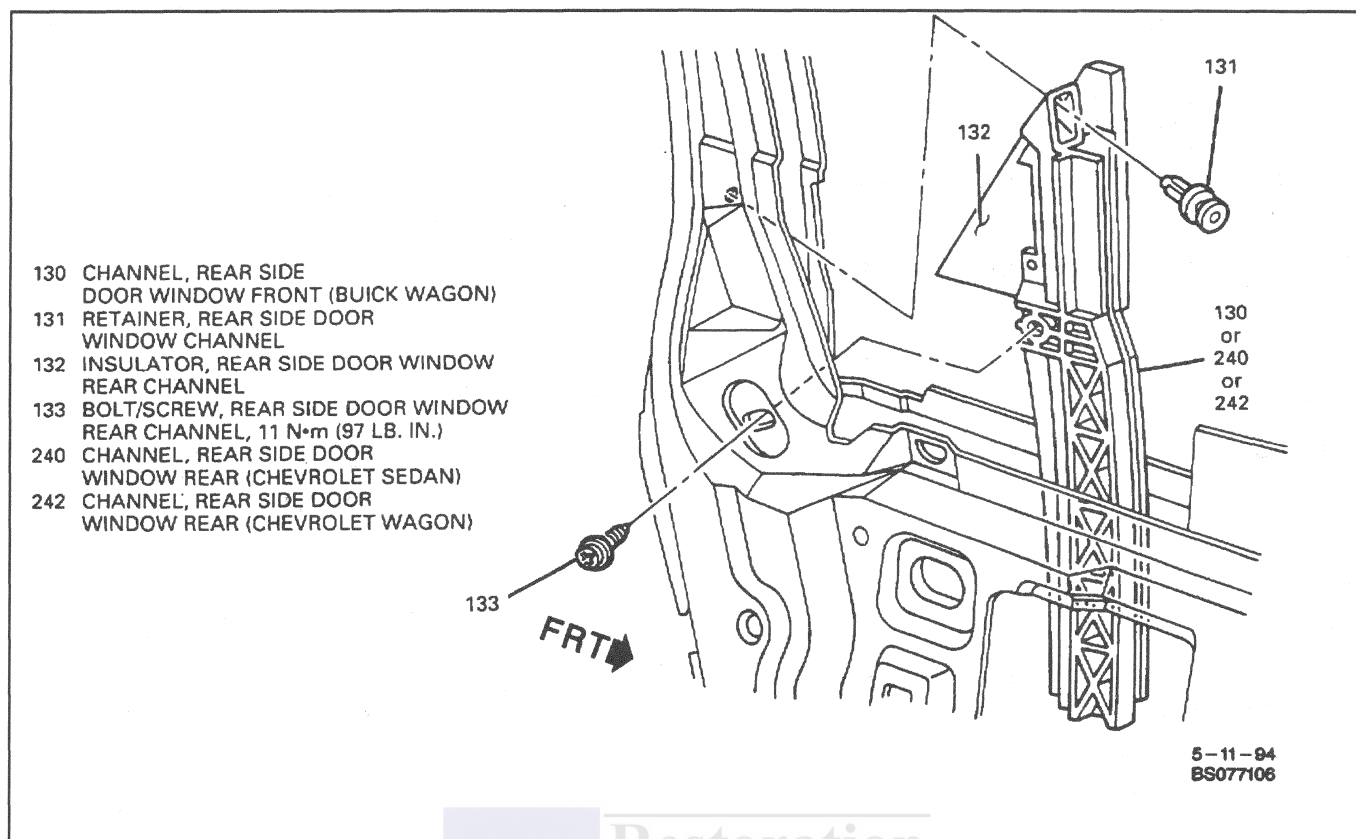


Figure 74 - Removing Rear Side Door Window Rear Channel-(Chevrolet Sedan and Wagon, Buick Wagon)

4. Raise window to access window regulator sash and rear door window sash.
5. Rivet window regulator to rear door window sash.
6. Raise window to full up position.
7. Rear door reveal molding. Refer to "Rear Side Door Window Reveal Moldings," under "REAR DOOR EXTERIOR TRIM," in this section.
8. Reposition rear door water deflector.
9. Rivet rear door armrest hanger plate.
10. Rear door inner trim panel. Refer to "Rear Side Door Interior Trim," in this section.



Remove or Disconnect

1. Rear side door window channel. Refer to "Rear Side Door Window Front Channel" (Buick Sedan) or "Rear Side Door Window Rear Channel" (Chevrolet Sedan and Wagon and Buick Wagon) in this section.
2. Rear side door window. Refer to "Front Side Door Window" in this section.
3. Rear side door window weatherstrip (26 or 223).
 - Using finger pressure, squeeze weatherstrip (26 or 223) together and pull from rear side door window frame.



Install or Connect

1. Rear side door window weatherstrip (26 or 223).
 - A. Squeeze weatherstrip (26 or 223) together.
 - B. Working from position A forward, along upper header toward position B, seat weatherstrip (26 or 223) into rear side door window frame.
2. Rear side door window. Refer to "Front Side Door Window" in this section.
3. Rear side door window channel. Refer to "Rear Side Door Window Front Channel" (Buick Sedan) or "Rear Side Door Window Rear Channel" (Chevrolet Sedan and Wagon and Buick Wagon) in this section.
4. Seat rear side door window channel into weatherstrip.

Rear Side Door Stationary Window Division Channel

BUICK SEDAN

For rear side door stationary window division channel service procedure, refer to "Rear Side Door Vent Window and Rear Side Door Stationary Window Division Channel" in this section.

Rear Side Door Window Weatherstrip

Figure 78

Procedure for the rear side door window weatherstrip is similar to that for the front side door window weatherstrip.

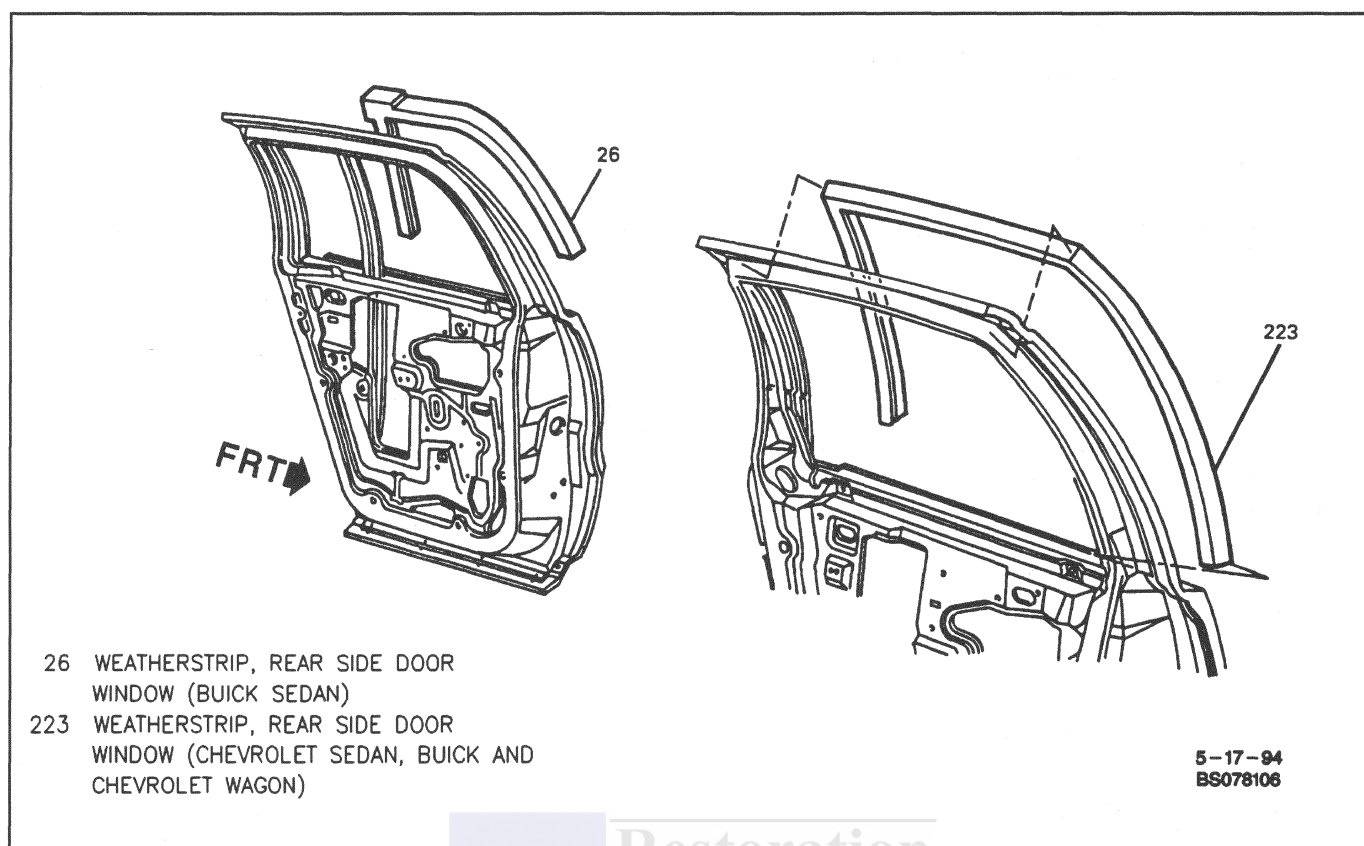


Figure 75 - Removing Rear Side Door Window Weatherstrip

REAR SIDE DOOR SWITCHES

Rear Side Door Armrest Switch Mount Plate

BUICK

Figure 76

Replace spring clip (GM P/N 10221260) whenever the switch mount plate is removed from the door trim.

 Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Switch mount plate (32).
 - A. Insert screwdriver under center of rearward edge of switch mount plate (32) to compress spring clip.
 - B. Slide up and rearward to remove switch mount plate (32).
3. Rear door power window connector from switch mount plate (32).
4. Window switch from switch mount plate (32).
 - Press on switch and insert screwdrivers between housing and switch on both sides.

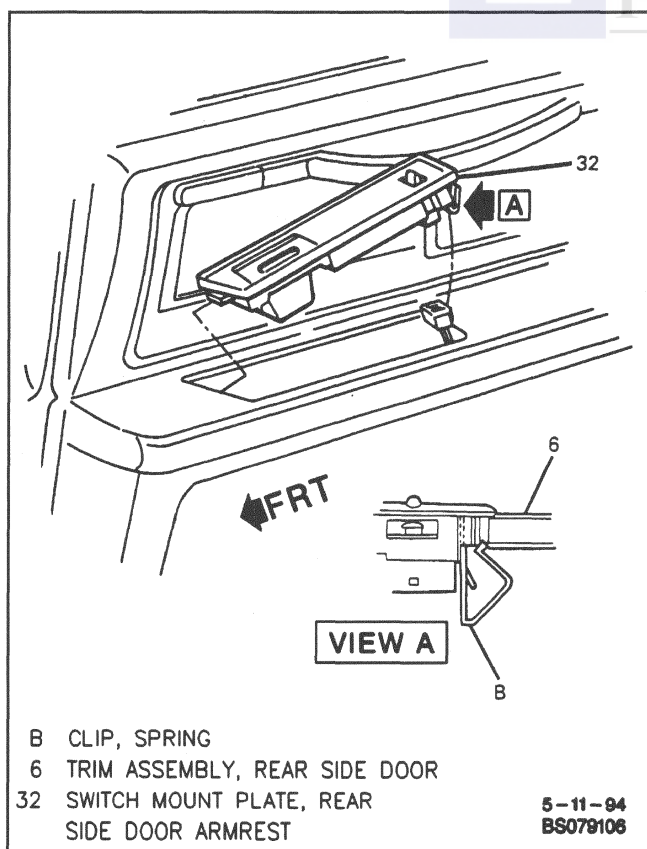


Figure 76 - Removing Rear Side Door Armrest Switch Mounted Plate-(Buick)

10-6-68 DOORS

5. Spring clip from switch mount plate (32).
 - Insert screwdriver between inner edge of spring clip and bezel. Then pry off and discard.

Install or Connect

1. New spring clip to switch mount plate (32).
 - Slide clip into groove on bezel until fully seated.
2. Window switch to switch mount plate (32).
 - Snap into place.
3. Rear door power window connector to switch mount plate (32).
4. Switch mount plate (32) to rear side door armrest.
 - Slide forward and snap into place.
5. Battery negative cable.

Rear Side Door Window Switch

CHEVROLET

Figure 77

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable" in SECTION 0A.

1. Battery negative cable.
2. Switch (125).
 - Insert flat-bladed tool between bottom edge of switch (125) and trim (366) to disengage.
3. Electrical connection.

Install or Connect

1. Electrical connection.
2. Switch (125) by engaging component clip to bottom of door trim panel cutout on each side.
3. Battery negative cable.

REAR SIDE DOOR WATER DEFLECTOR

The rear side door water deflector is serviced the same way as the front side door water deflector. For service procedure, refer to "Front Side Door Water Deflector" in this section.

REAR SIDE DOOR HANDLES

Rear side door handles are serviced the same way as the front side door handles. For service procedures, refer to "Front Side Door Handles" in this section.

REAR SIDE DOOR LOCKING SYSTEM MODULE

The rear side door locking system module is serviced the same way as the front side door locking system module. For service procedure, refer to "Front Side Door Locking System Module" in this section.

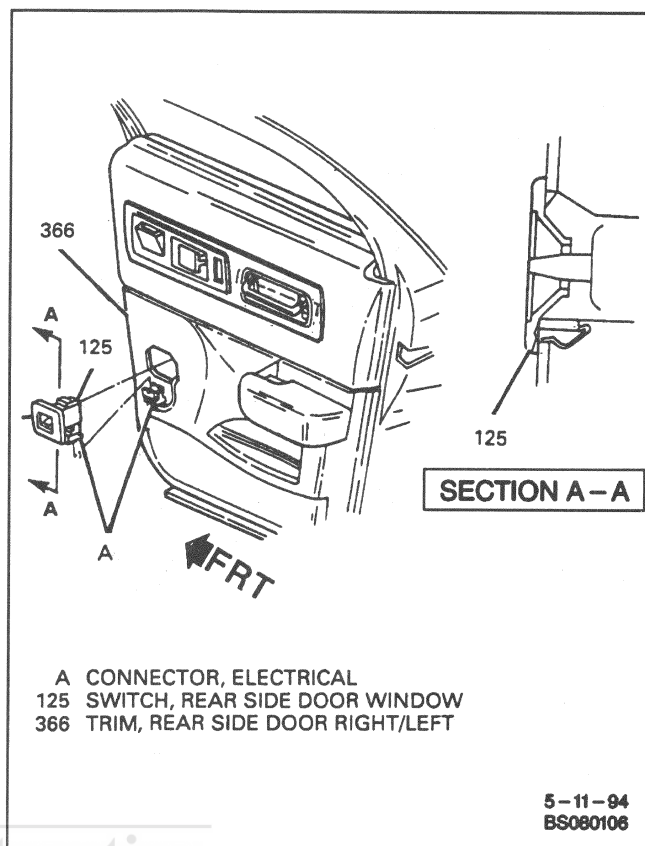


Figure 77 - Removing Rear Side Door Window Switch-Chevrolet

REAR SIDE DOOR SPECIAL EQUIPMENT OPTION

The rear door inside handle and door lock button are made inoperative as a special equipment option by disconnecting the inside handle rod and button pin from the lock module. For service procedures, refer to "Front Side Door Handles" and "Front Side Door Locking System Module" in this section.

REAR SIDE DOOR LATCH AND REAR SIDE DOOR LOCK STRIKER

The rear side door latch and rear side door lock striker are serviced the same way as those in the front side door. For service procedures, refer to "Front Side Door Latch and Front Side Door Lock Striker" in this section.

REAR SIDE DOOR LOCK ACTUATORS

The rear side door actuators are serviced the same way as the front side door actuators. For service procedures, refer to "Front Side Door Lock Actuators" in this section.

REAR SIDE DOOR LOCK ROD LEVER

The rear side door lock rod lever is serviced the same way as the front side door lock rod lever. For service procedure, refer to "Front Side Door Lock Rod Lever" in this section.

REAR SIDE DOOR UPPER AND LOWER HINGES

Figure 78

Tools Required:

J 36604 Door Hinge Spring Compressor
J 28500 Door Hinge Wrench

Remove or Disconnect

1. Support rear side door in full open position.
2. Mark position of hinge on body hinge pillar, and on door.
3. Spring (216) on lower hinge (213), using J 36604.
4. Nuts (217 or 218).
5. Bolts/screws (214 or 215), using J 28500.
6. Hinge (212 or 213).

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

NOTICE: Before installing a hinge, apply a coat of heavy-bodied sealer to the surface of the hinge that contacts the door and the hinge pillar to prevent corrosion damage.

1. Hinge (212 or 213).
 - Align hinge (212 or 213) with marks made before removing hinge (212 or 213).
2. Bolts/screws (214 or 215), using J 28500.
3. Nuts (217 or 218).

Tighten

- A. Bolts/screws (214 or 215) to 32 N·m (24 lb. ft.).
 - B. Nuts (217 or 218) to 32 N·m (24 lb. ft.).
4. Spring (216) on lower hinge (213).

Adjust

- Rear side door, if required. Refer to "Rear Side Door" in the following procedure.

REAR SIDE DOOR

Figure 78

Tool Required:

J 28500 Door Hinge Wrench

Remove or Disconnect

1. Rear side door trim. Refer to "Front Side Door Trim" in this section.
2. Move rear side door water deflector to access electrical connectors for door-mounted electrical components.

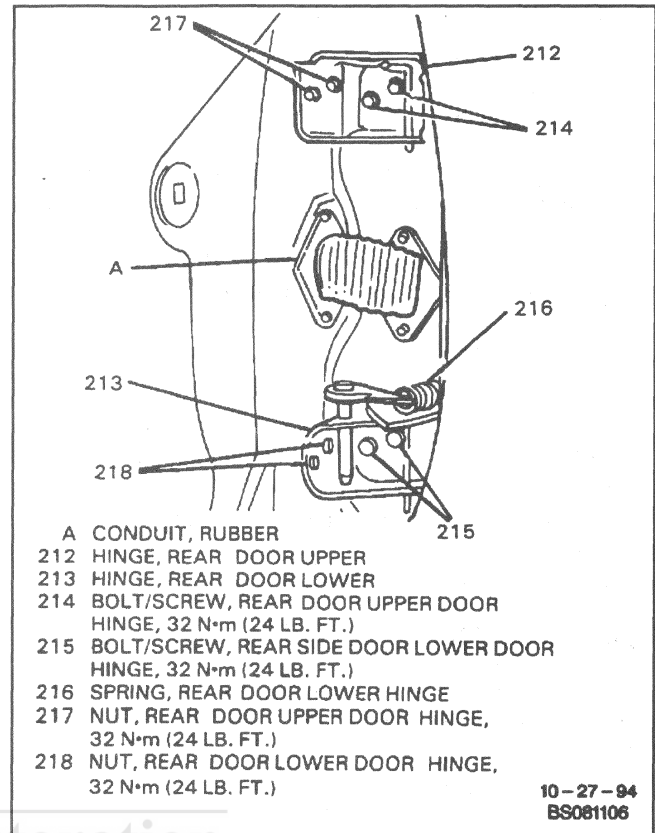


Figure 78 - Rear Side Upper and Lower Hinges

3. Electrical connectors from door-mounted components.
4. Wire harness and rubber conduit.
5. Support rear side door in full-open position.
6. Nuts (217 and 218).
7. Rear side door, with aid of helper.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Rear side door, with aid of helper.
2. Nuts (217 and 218).

Tighten

- Nuts (217 and 218) to 32 N·m (24 lb. ft.).
3. Rubber conduit and wire harness.
 4. Electrical connectors to door-mounted components.
 5. Reposition rear side door water deflector.
 6. Rear side door trim. Refer to "Front Side Door Trim" in this section.

Adjust

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

10-6-70 DOORS

1. Rear side door, if required.
 - A. Mark position of rear side door lock striker.
 - B. Remove rear side door lock striker. Refer to "Front Side Door Lock Striker" in this section.
 - C. To adjust door up, down, forward or rearward, loosen bolts/screws (214 and 215).
 - D. To adjust door inboard or outboard, loosen nuts (217 and 218), using J 28500.
 - E. Move door to desired position.

Tighten

- Nuts (217 and 218) to 32 N·m (24 lb. ft.).
2. Rear side door lock striker. Refer to "Front Side Door Lock Striker Adjustment" in this section.
 3. If rear side door was adjusted rearward, replace door jamb switches. Refer to "Door Jamb Switches" in this section.

REAR SIDE DOOR WINDOW

The rear side door window is serviced the same way as the front side door window. For service procedure, refer to "Front Side Door Window" in this section.

Rear Side Door Vent Window and Rear Side Door Stationary Window Division Channel

BUICK SEDAN

Figure 79

Remove or Disconnect

1. Rear side door trim. Refer to "Front Side Door Trim" in this section.
2. Move rear side door water deflector to access rear side door stationary window division channel hardware.
3. Rear side door window. Refer to "Front Side Door Window" in this section.
4. Bolts/screws (126, 128 and 176) and spacer (175).
5. Weatherstrip (122) from channel (124).
6. Channel (124) from door.
7. Window (129).
8. Seal from window (129), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 10-6-1 of this section.

1. Seal to window (129), if removed.
 - Seat with rubber mallet.

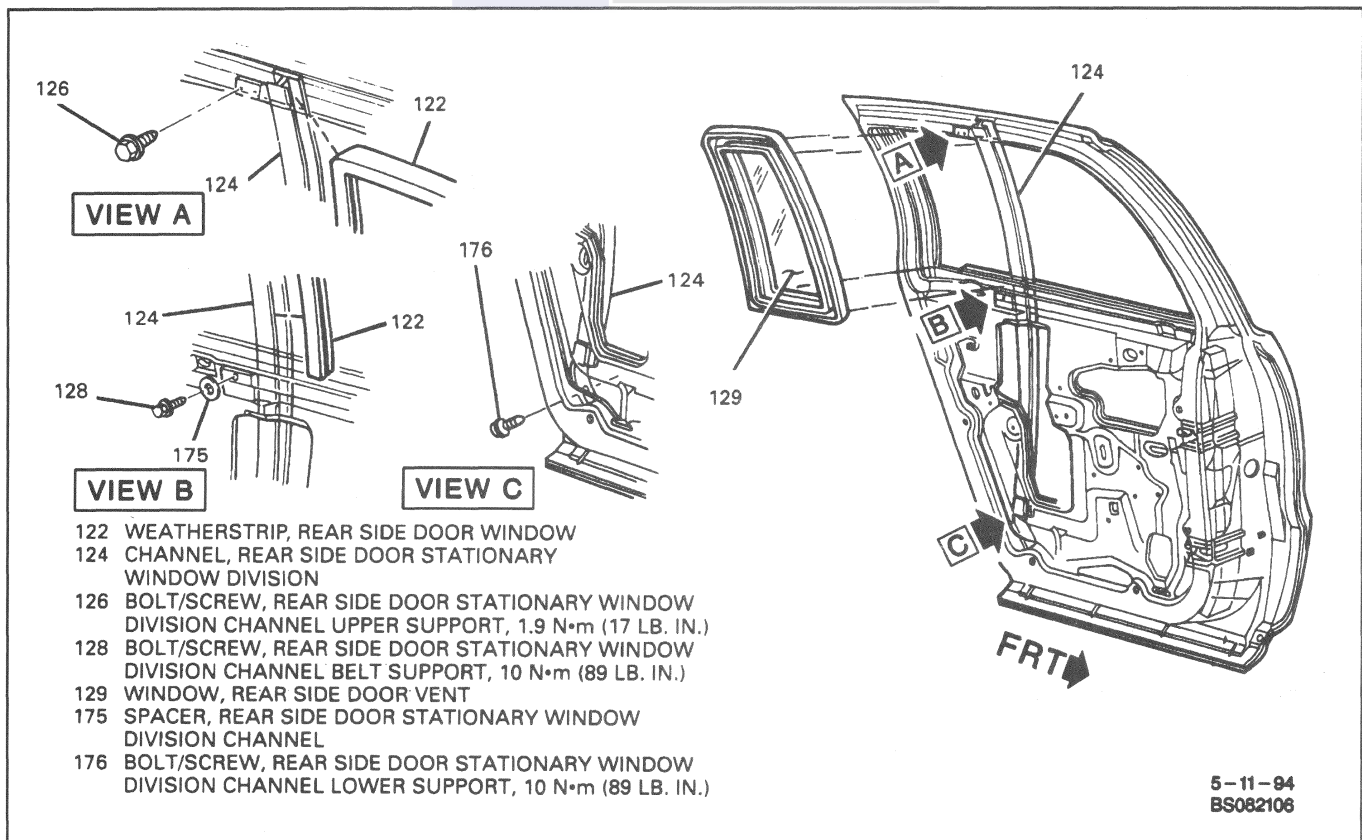


Figure 79 - Removing Rear Side Door Vent Window-(Buick Sedan)

2. Window (129).
3. Channel (124) to door.
4. Weatherstrip (122) to channel (124).
5. Spacer (175) and bolts/screws (126, 128 and 176).

Tighten

- A. Screws (126) to 1.9 N.m (17 lb. in.).
- B. Screws (128 and 176) to 10 N.m (89 lb. in.).
6. Rear side door window. Refer to "Front Side Door Window" in this section.
7. Rear side door trim. Refer to "Front Side Door Trim" in this section.

REAR SIDE DOOR WINDOW DOWN STOP BUMPER

Buick Sedan

Figure 80

The rear side door window down stop bumper is serviced the same way as the front side door window down stop bumper. For service procedure, refer to "Front Side Door Window Down Stop Bumper" in this section.

REAR SIDE DOOR WINDOW REGULATOR

Figure 81

Remove or Disconnect

1. Rear side door trim. Refer to "Front Side Door Trim" in this section.
2. Rear side door water deflector. Refer to "Front Side Door Water Deflector" in this section.

CAUTION: Tape rear side door window to rear side door frame. If rear side door window drops into rear side door, personal injury or rear side door window damage may result.

3. Support rear side door window in position needed to access rear side door window rivets, by taping it to front side door frame with cloth-backed body tape.
4. Rear side door locking system module. Refer to "Front Side Door Locking System Module" in this section.
5. Rear side door window rivets connecting rear side door window sash to window regulator sash, using drill and 5/16-inch bit.

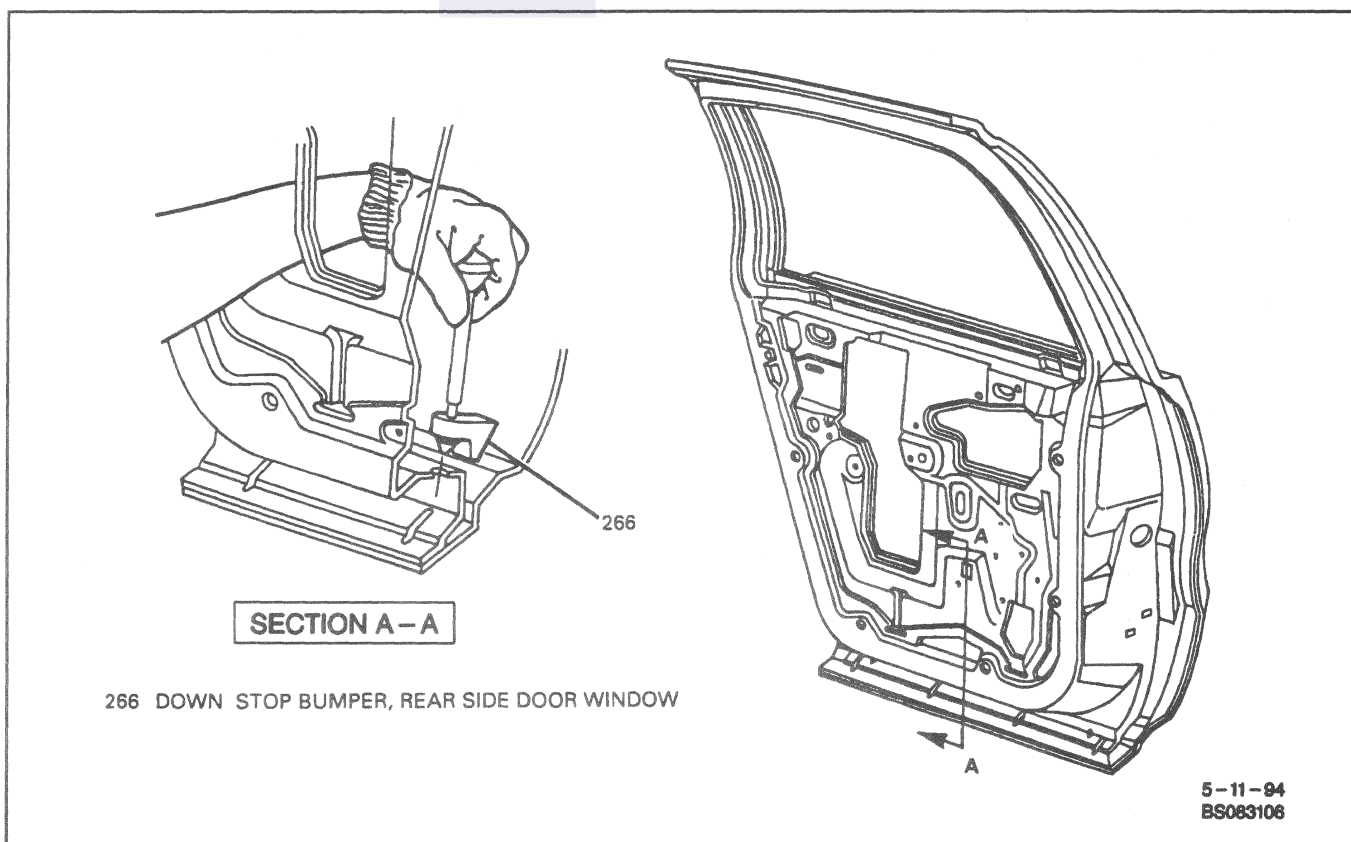


Figure 80 - Rear Side Door Window Down Stop Bumper-(Buick Sedan)

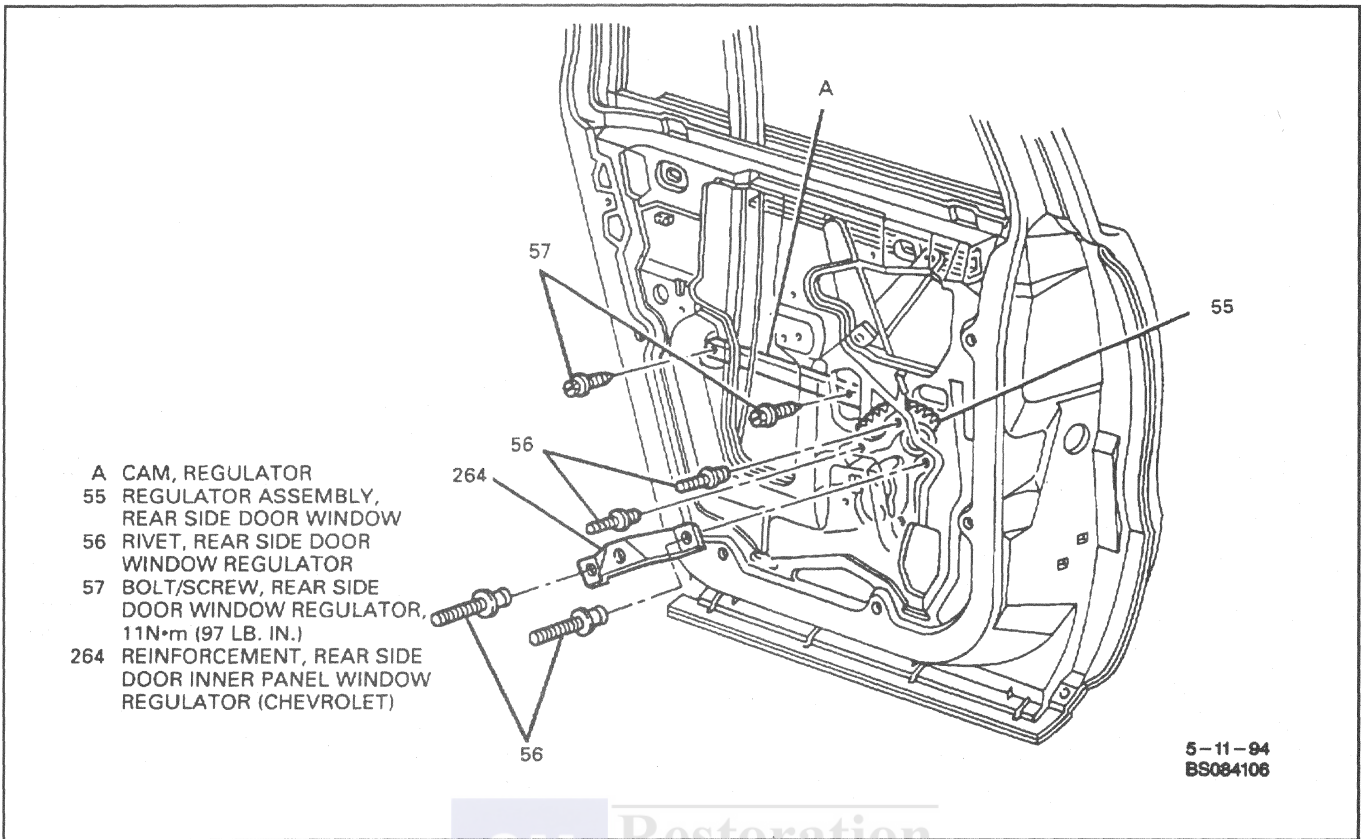


Figure 81 - Rear Side Door Window Regulator

6. Bolts/screws (57) securing regulator cam to rear side door panel.
7. Electrical connector.
8. Rivets (56), using drill and 5/16-inch bit.
9. Reinforcement (264), if manual window regulator (Chevrolet).
10. Regulator (55).

Install or Connect

NOTICE: Refer to “Notice” on page 10-6-1 of this section.

1. Regulator (55).
2. Reinforcement (264), if manual window regulator (Chevrolet).
3. Rivets (56).
 - Secure upper rearmost, center rearmost, center foremost, then lower rearmost.
4. Electrical connector.
5. Bolts/screws (57).

Tighten

- Bolts/screws (57) to 11 N·m (97 lb. in.).
6. Rear side door window rivets connecting rear side door window sash to window regulator sash.
 7. Rear side door locking system module. Refer to “Front Side Door Locking System Module” in this section.
 8. Remove tape.

Inspect

- A. Regulator (55) operation.
- B. Rear side door window alignment.
 - Refer to “Front Side Door Window” in this section for adjustment procedure.
9. Rear side door water deflector. Refer to “Front Side Door Water Deflector” in this section.
10. Rear side door trim. Refer to “Front Side Door Trim” in this section.

REAR SIDE DOOR WINDOW REGULATOR MOTOR

Rear door window regulator and motor is serviced as a assembly, not separately.

SPECIFICATIONS

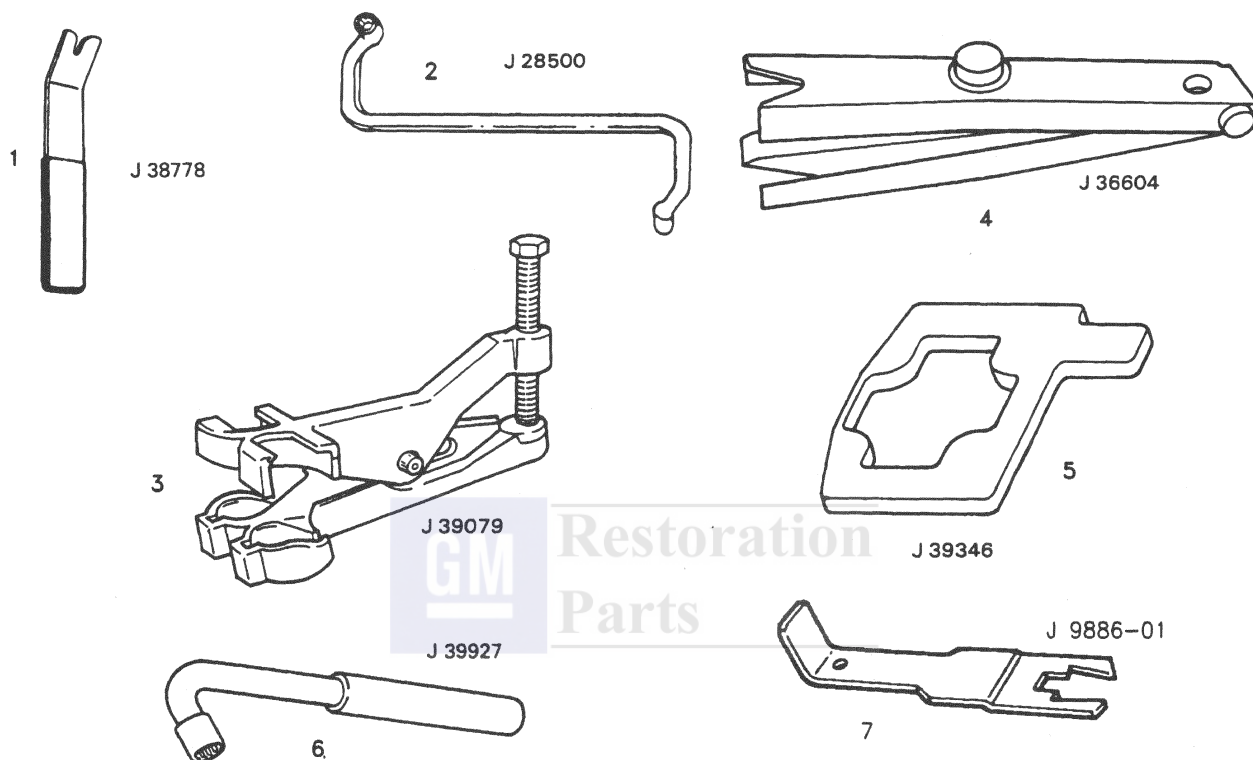
FASTENER TIGHTENING SPECIFICATIONS

Body Side Front Window Garnish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Body Side Rear Window Garnish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Door Jamb Switch	8 N.m (71 lb. in.)
Floor Carpet Retainer Bolt/Screw	1.3 N.m (12 lb. in.)
Front Fender Attaching Bolt/Screw	50 N.m (37 lb. ft.)
Front Fender Inner Lower Rear Panel Bolt/Screw	10 N.m (89 lb. in.)
Front Fender Rear Lower Bracket Bolt/Screw	50 N.m (37 lb. ft.)
Front Fender Rear Upper Brace Bolt/Screw	25 N.m (18 lb. ft.)
Front Fender Rear Upper Bracket Bolt/Screw	50 N.m (37 lb. ft.)
Front Seat Belt Bolt/Screw	42 N.m (31 lb. ft.)
Front Side Door Armrest Bolt/Screw	2.4 N.m (21 lb. in.)
Front Side Door Center Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Side Door Center Molding Nut	3.5 N.m (31 lb. in.)
Front Side Door Inside Handle Bezel Bolt/Screw	1.5 N.m (13 lb. in.)
Front Side Door Lock Striker Bolt/Screw	24 N.m (18 lb. ft.)
Front Side Door Locking System Module Bolt/Screw	10 N.m (89 lb. in.)
Front Side Door Lower Door Side Hinge Bolt/Screw	32 N.m (24 lb. ft.)
Front Side Door Lower Door Side Hinge Nut	32 N.m (24 lb. ft.)
Front Side Door Lower Molding Nut	3.5 N.m (31 lb. in.)
Front Side Door Map Pocket Bolt/Screw	1.5 N.m (13 lb. in.)
Front Side Door Outside Handle Nut	5 N.m (44 lb. in.)
Front Side Door Pull Handle Bolt/Screw	3.5 N.m (31 lb. in.)
Front Side Door Transfer Lower Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Side Door Transfer Lower Finish Molding Nut	3.5 N.m (31 lb. in.)
Front Side Door Transfer Upper Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Side Door Upper Door Side Hinge Bolt/Screw	32 N.m (24 lb. ft.)
Front Side Door Upper Door Side Hinge Nut	32 N.m (24 lb. ft.)
Front Side Door Window Front Channel Bolt/Screw	11 N.m (97 lb. in.)
Front Side Door Window Front Reveal Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Side Door Window Rear Channel Bolt/Screw	11 N.m (97 lb. in.)
Front Side Door Window Regulator Bolt/Screw	11 N.m (97 lb. in.)
Front Side Door Window Reveal Molding Bolt/Screw	1.5 N.m (13 lb. in.)
Front Side Door Window Upper Reveal Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Front Wheelhouse Panel Bolt/Screw	10 N.m (89 lb. in.)
Outside Rearview Mirror Nut	5 N.m (44 lb. in.)
Radio Front Side Door Speaker Bolt/Screw	1.9 N.m (17 lb. in.)
Radio Front Side Door Speaker Housing Bolt/Screw	1.5 N.m (13 lb. in.)
Rear Side Door Center Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Rear Side Door Center Molding Nut	3.5 N.m (31 lb. in.)
Rear Side Door Lock Striker Bolt/Screw	24 N.m (18 lb. ft.)
Rear Side Door Locking System Module Bolt/Screw	10 N.m (89 lb. ft.)
Rear Side Door Lower Door Side Hinge Bolt/Screw	32 N.m (44 lb. ft.)
Rear Side Door Lower Door Side Hinge Nut	32 N.m (24 lb. ft.)
Rear Side Door Lower Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Rear Side Door Lower Molding Nut	3.5 N.m (31 lb. in.)
Rear Side Door Outside Handle Nut	5 N.m (44 lb. in.)
Rear Side Door Stationary Window Division Channel Belt Support Bolt/Screw	10 N.m (89 lb. in.)
Rear Side Door Stationary Window Division Channel Lower Support Bolt/Screw	10 N.m (89 lb. in.)
Rear Side Door Stationary Window Division Channel Upper Support Bolt/Screw	1.9 N.m (17 lb. in.)
Rear Side Door Transfer Lower Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Rear Side Door Transfer Lower Finish Molding Nut	3.5 N.m (31 lb. in.)
Rear Side Door Transfer Upper Finish Molding Bolt/Screw	1.3 N.m (12 lb. in.)
Rear Side Door Transfer Upper Finish Molding Nut	3.5 N.m (31 lb. in.)
Rear Side Door Trim Finish Panel Bolt/Screw	1.5 N.m (13 lb. in.)
Rear Side Door Upper Door Side Hinge Bolt/Screw	32 N.m (24 lb. ft.)
Rear Side Door Upper Door Side Hinge Nut	32 N.m (24 lb. ft.)
Rear Side Door Upper Front Auxiliary Weatherstrip Retainer	1.3 N.m (12 lb. in.)
Rear Side Door Window Belt Reveal Molding Bolt/Screw	1.5 N.m (13 lb. in.)
Rear Side Door Window Frame Rear Applique Bolt/Screw	1.5 N.m (13 lb. in.)
Rear Side Door Window Front Channel Bolt/Screw	11 N.m (97 lb. in.)

10-6-74 DOORS

Rear Side Door Window Rear Channel Bolt/Screw	11 N.m (97 lb. in.)
Rear Side Door Window Regulator Bolt/Screw	11 N.m (97 lb. in.)
Rear Side Door Window Reveal Molding Bolt/Screw	1.5 N.m (13 lb. in.)
Rear Side Door Window Upper Reveal Molding Bolt/Screw	1.5 N.m (13 lb. in.)

SPECIAL TOOLS



- 1 REMOVER, DOOR TRIM PAD AND GARNISH CLIP
- 2 WRENCH, DOOR HINGE
- 3 COMPRESSOR, DOOR HINGE SPRING
- 4 COMPRESSOR, DOOR HINGE SPRING
- 5 ALIGNER, "MINI-WEDGE" DOOR STRIKER
- 6 WRENCH, DOOR HINGE ADJUSTMENT
- 7 REMOVER, DOOR HANDLE CLIP

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SECTION 10-7

REAR QUARTERS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "On-Vehicle Service" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: The theft deterrent label found on some major sheet metal must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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10-7-2 REAR QUARTERS

GENERAL DESCRIPTION

REAR QUARTERS

Figures 1, 2, 3 and 4

The information in this section provides service procedures that apply to all rear quarter components, as shown in (Figures 1, 2, 3 and 4).

ON-VEHICLE SERVICE

INTERIOR TRIM

Quarter Window Garnish Molding

CHEVROLET SEDAN

Figure 5

Remove or Disconnect

1. Grille (42) by pulling gently.
2. Garnish molding (37) and lace (43) from inner panel (1).
 - Disengage fasteners (38).
3. Lace (52) from garnish molding (2).

Install or Connect

1. Garnish molding (37) to inner panel (1).
 - A. Attach lace (43) to garnish molding (37).
 - B. Fasteners (38).
2. Grille (42).

Quarter Upper Trim

BUICK SEDAN

Figure 6

Tool Required:
J 24595-C Door Trim Pad and Garnish Clip Remover

Remove or Disconnect

NOTICE: Disengage quarter upper trim retainers carefully or damage to quarter upper trim may result.

- Trim (2) from inner panel (1).
 - Carefully disengage retainers (3) by inserting J 24595-C behind trim (2).

Install or Connect

- Trim (2) to inner panel (1).
 - Attach retainers (3) by pressing to inner panel (1).

Spare Tire Cover

WAGON

The passenger side quarter inner rear trim finish panel serves as the spare tire cover in the wagon. For removal and installation, refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.

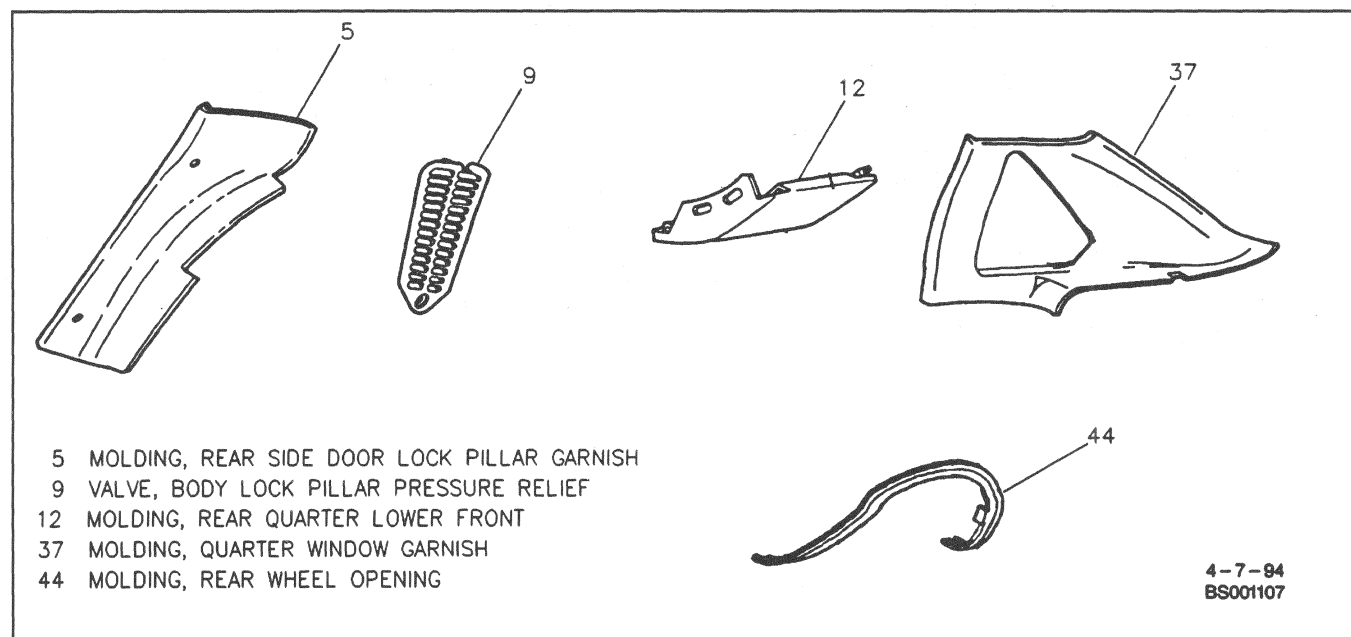


Figure 1 - Rear Quarter Components -(Chevrolet Sedan)

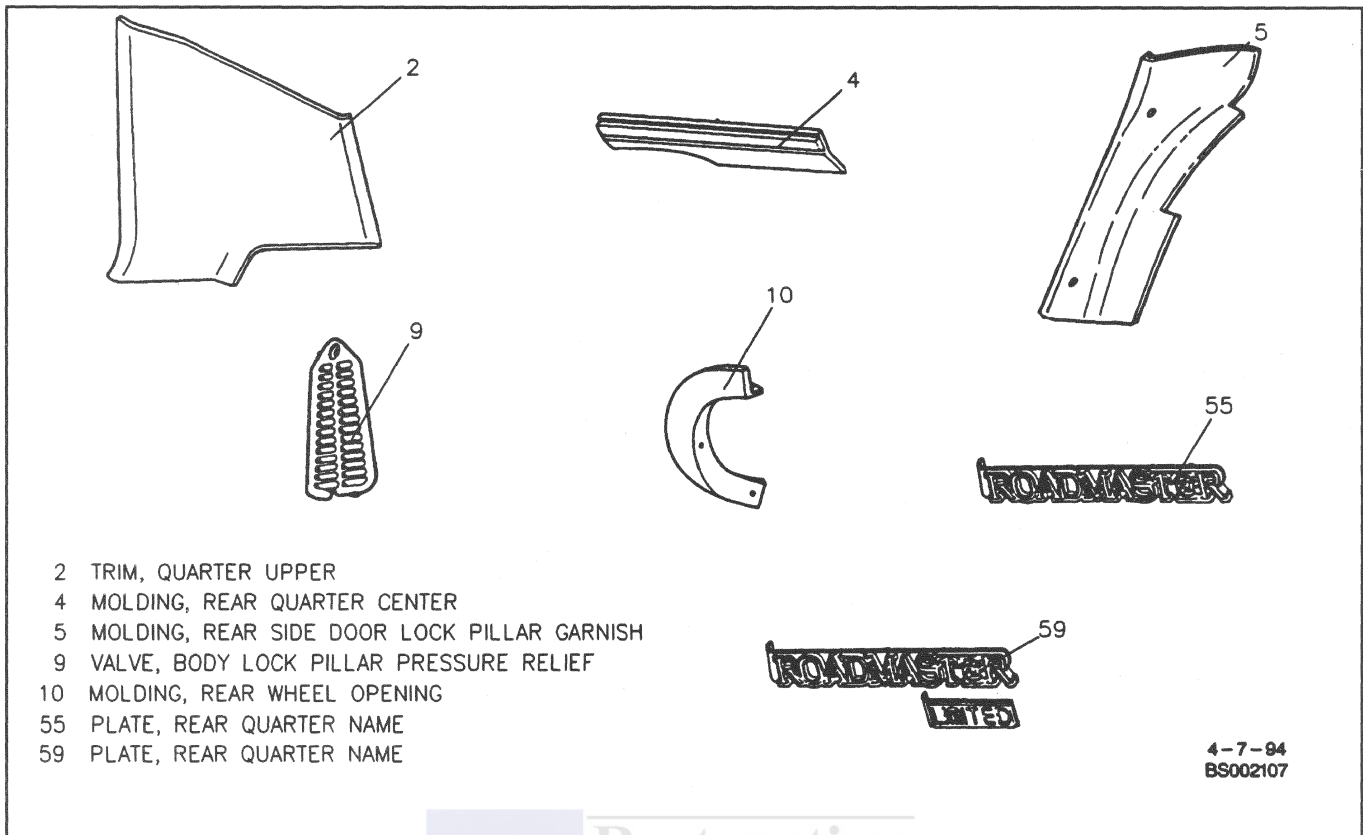


Figure 2 - Rear Quarter Components - (Buick Sedan)

Quarter Inner Rear Trim Finish Panel WAGON

Figure 7

↔ Remove or Disconnect

1. Retract luggage shade, if extended. Disengage from slots in back body pillar panel (16).
2. Turn slotted release button (81).
3. Top edge of trim panel (17) from groove in garnish molding (24).
4. Tabs on trim panel (17) from slots in lock pillar trim panel (21) by sliding trim (17) rearward.
5. Bottom edge of trim panel (17) from groove on load floor.
6. Trim panel (17).

→← Install or Connect

1. Trim panel (17).
2. Bottom edge of trim panel (17) to groove on load floor.
3. Tabs on trim panel (17) to slots in lock pillar trim panel (21) by sliding trim (17) forward.
4. Top edge of trim panel (17) to groove in garnish molding (24).
5. Turn slotted release button (81) on trim panel (17) to secure.
6. Extend luggage shade. Connect to slots in back body pillar panel (16).

Rear Side Door Lock Pillar Garnish Molding

CHEVROLET SEDAN

Figures 5 and 8

↔ Remove or Disconnect

1. Grille (42).
2. Garnish molding (37) from inner panel (1).
 - A. Disengage fasteners (38).
 - B. Remove lace (43) from garnish molding (37).
3. Rear seat. Refer to SECTION 10-10.
4. Bolts/screws (6).
5. Molding (5).

→← Install or Connect

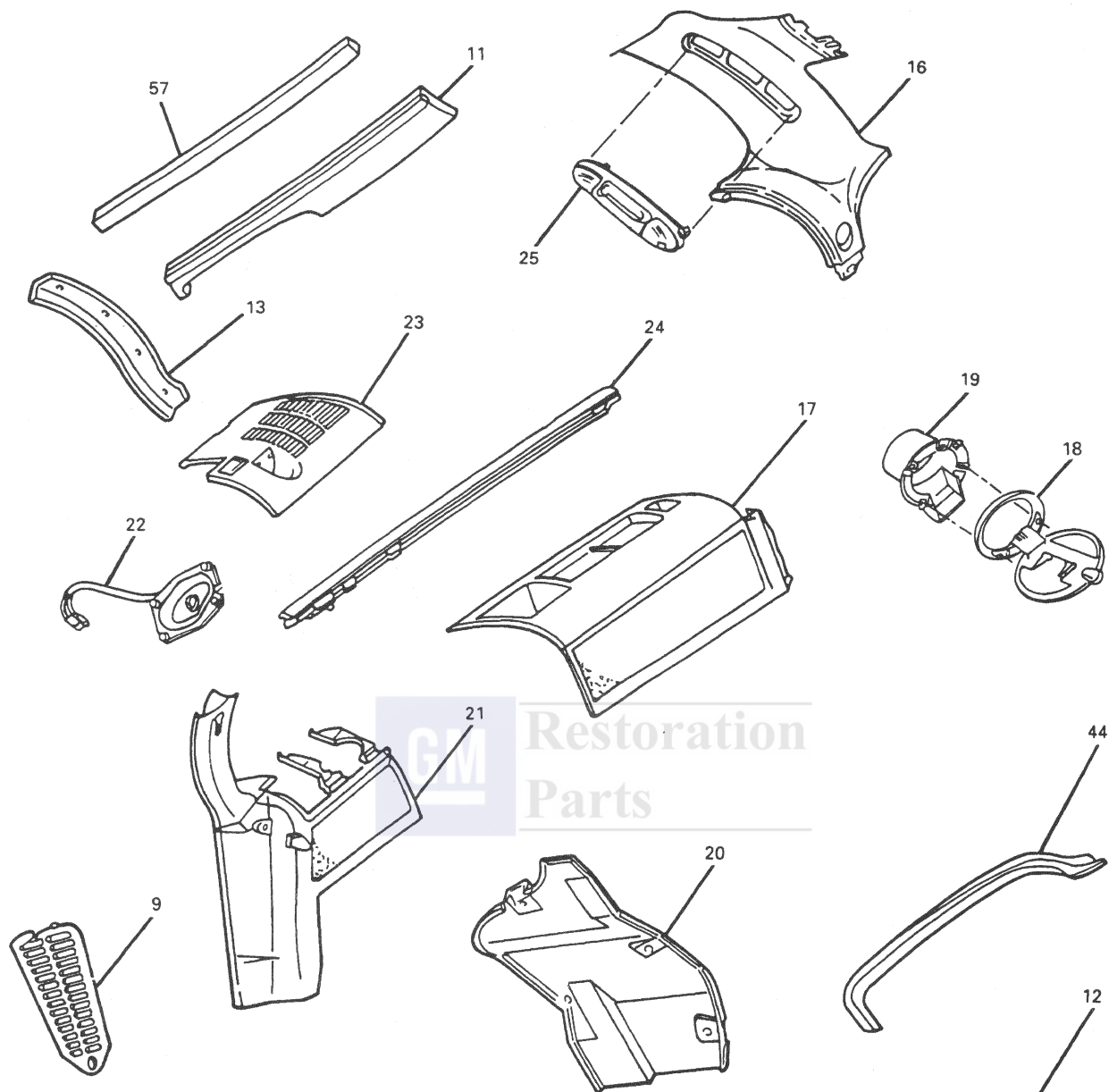
NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Molding (5).
 - Align star boss on back of molding (5) to slot in carpet retainer (7).
2. Bolts/screws (6).

Tighten

- Bolts/screws (6) to 1.3 N.m (12 lb. in.).

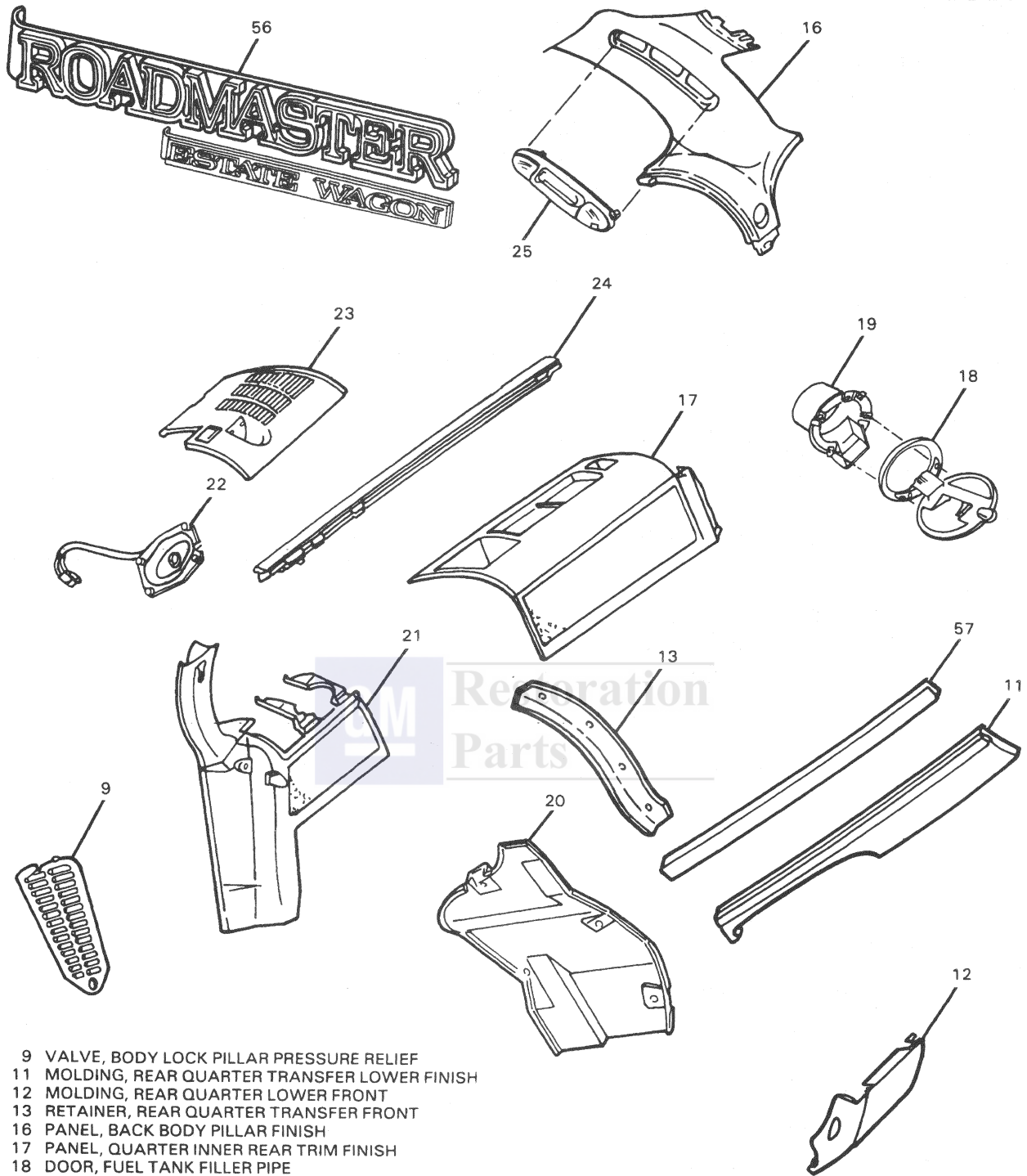
10-7-4 REAR QUARTERS



- 9 VALVE, BODY LOCK PILLAR PRESSURE RELIEF
- 11 MOLDING, REAR QUARTER TRANSFER LOWER FINISH
- 12 MOLDING, REAR QUARTER LOWER FRONT
- 13 RETAINER, REAR QUARTER TRANSFER FRONT
- 16 PANEL, BACK BODY PILLAR FINISH
- 17 PANEL, QUARTER INNER REAR TRIM FINISH
- 18 DOOR, FUEL TANK FILLER PIPE
- 19 POCKET, FUEL TANK FILLER PIPE
- 20 SHIELD, FUEL TANK FILLER PIPE
- 21 PANEL, BODY LOCK PILLAR TRIM FINISH
- 22 SPEAKER, RADIO REAR
- 23 GRILLE, RADIO QUARTER SPEAKER
- 24 MOLDING, QUARTER WINDOW GARNISH
- 25 HANDLE, BACK BODY PILLAR ASSIST (WITH COURTESY LAMP)
- 44 MOLDING, REAR WHEEL OPENING
- 57 MOLDING, REAR QUARTER TRANSFER UPPER FINISH

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Figure 3 - Rear Quarter Components -(Chevrolet Wagon)



- 9 VALVE, BODY LOCK PILLAR PRESSURE RELIEF
- 11 MOLDING, REAR QUARTER TRANSFER LOWER FINISH
- 12 MOLDING, REAR QUARTER LOWER FRONT
- 13 RETAINER, REAR QUARTER TRANSFER FRONT
- 16 PANEL, BACK BODY PILLAR FINISH
- 17 PANEL, QUARTER INNER REAR TRIM FINISH
- 18 DOOR, FUEL TANK FILLER PIPE
- 19 POCKET, FUEL TANK FILLER PIPE
- 20 SHIELD, FUEL TANK FILLER PIPE
- 21 PANEL, BODY LOCK PILLAR TRIM FINISH
- 22 SPEAKER, RADIO REAR
- 23 GRILLE, RADIO QUARTER SPEAKER
- 24 MOLDING, QUARTER WINDOW GARNISH
- 25 HANDLE, BACK BODY PILLAR ASSIST (WITH COURTESY LAMP)
- 56 PLATE, REAR QUARTER NAME
- 57 MOLDING, REAR QUARTER TRANSFER UPPER FINISH

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Figure 4 - Rear Quarter Components - (Buick Wagon)

10-7-6 REAR QUARTERS

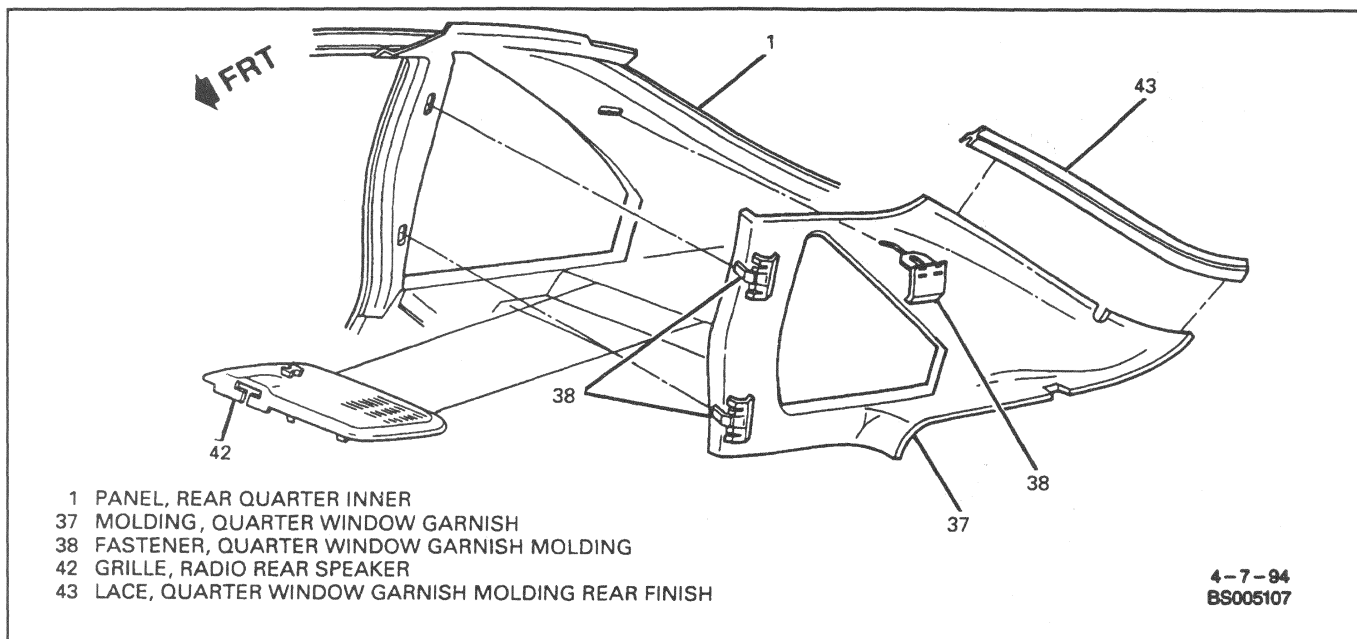


Figure 5 - Quarter Window Garnish Molding - (Chevrolet Sedan)

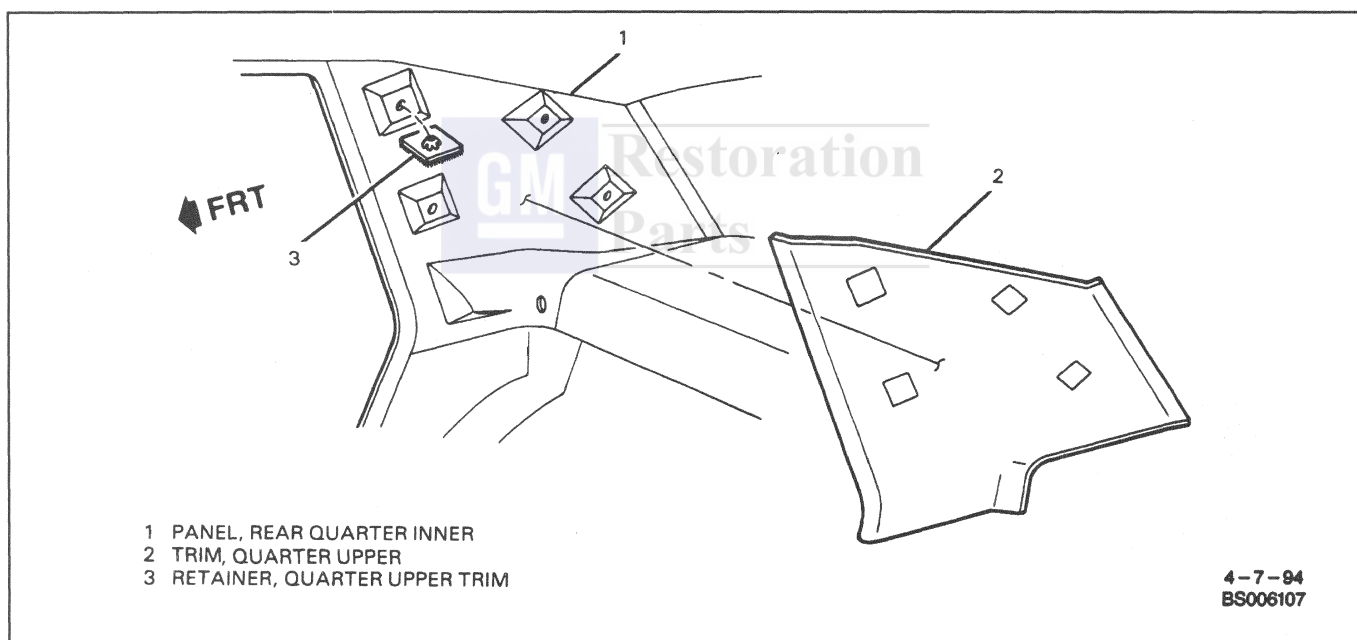


Figure 6 - Quarter Upper Trim - (Buick Sedan)

3. Rear seat. Refer to SECTION 10-10.
4. Garnish molding (37) to inner panel (1).
 - A. Attach lace (43) to garnish molding (37).
 - B. Attach fasteners (38) by pressing to inner panel (1).
5. Grille (42).

BUICK SEDAN

Figures 6 and 8

Tool Required:
J 24595-C Door Trim Pad and Garnish Clip Remover

↔ Remove or Disconnect

1. Trim (2) from inner panel (1).
 - Carefully disengage retainers (3) by inserting J 24595-C behind trim.
2. Rear seat. Refer to SECTION 10-10.
3. Bolts/screws (6).
4. Molding (5).

→ Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

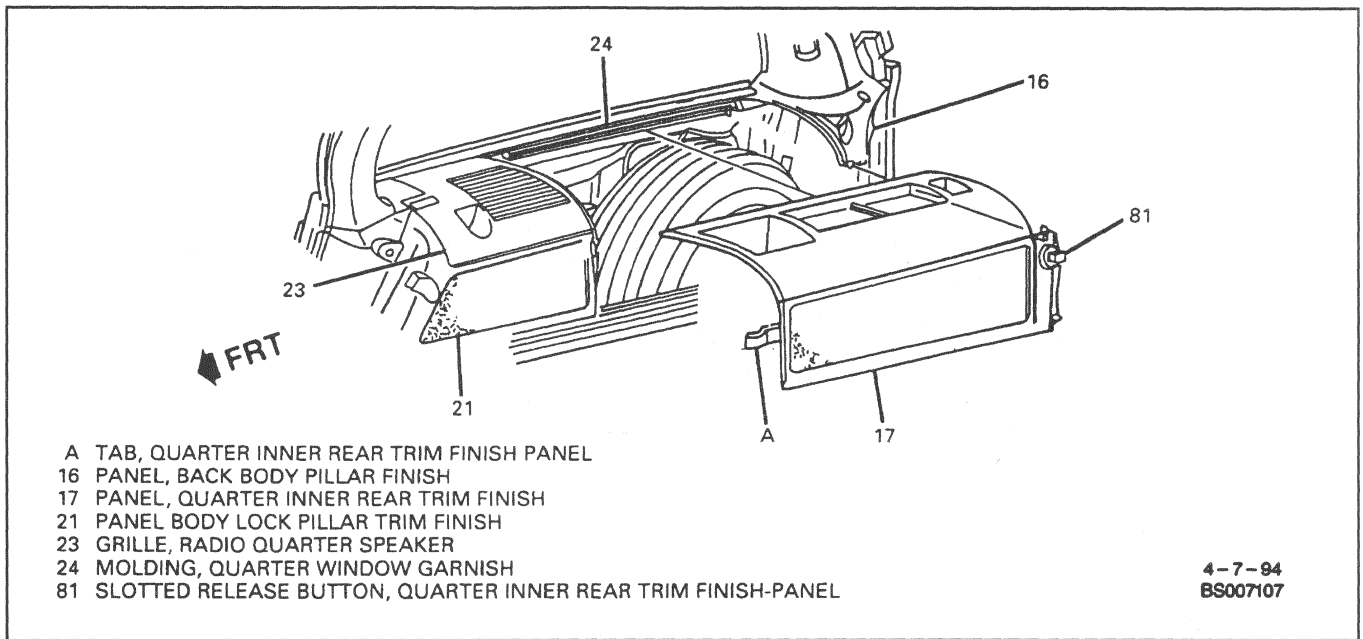


Figure 7 - Quarter Inner Rear Trim Finish Panel - (Wagon)



Tighten

- Bolts/screws (6) to 1.3 N·m (12 lb. in.).
- 3. Rear seat. Refer to SECTION 10-10.
- 4. Trim (2) to inner panel (1).
 - Attach retainers (3) by pressing to inner panel (1).

Body Lock Pillar Trim Finish Panel

WAGON

Figure 9



Remove or Disconnect

1. Luggage shade. Refer to SECTION 10-8.
2. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
3. Radio quarter speaker grille and radio rear speaker. Refer to "Radio Quarter Speaker Grille and Radio Rear Speakers" (Wagon) in this section.
4. Bolts/screws (27).
5. Bolt/screw (54).
6. Rear seat folding outer retractor side belt bolt/screw. Refer to SECTION 10-1.
7. Unscrew rear seat release knob, if removing passenger side trim panel (21).
8. Bolt/screw (26).
9. Side edge of trim panel (21) from clips (28) on body lock pillar.
10. Top edge of trim panel (21) from groove in garnish molding (24).

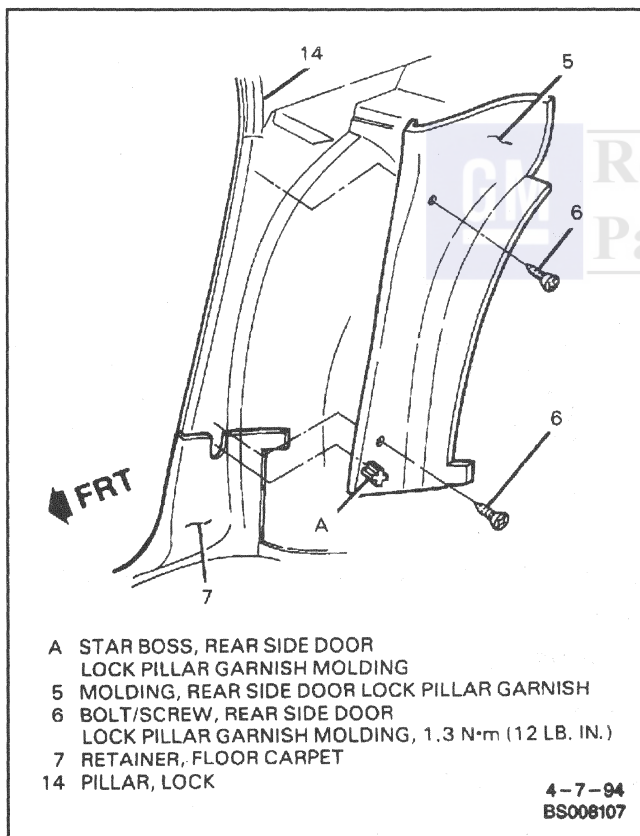


Figure 8 - Rear Side Door Lock Pillar Garnish Molding - (Sedan)

1. Molding (5).
 - Align star boss on back of molding (5) to slot in carpet retainer (7).
2. Bolts/screws (6).

10-7-8 REAR QUARTERS

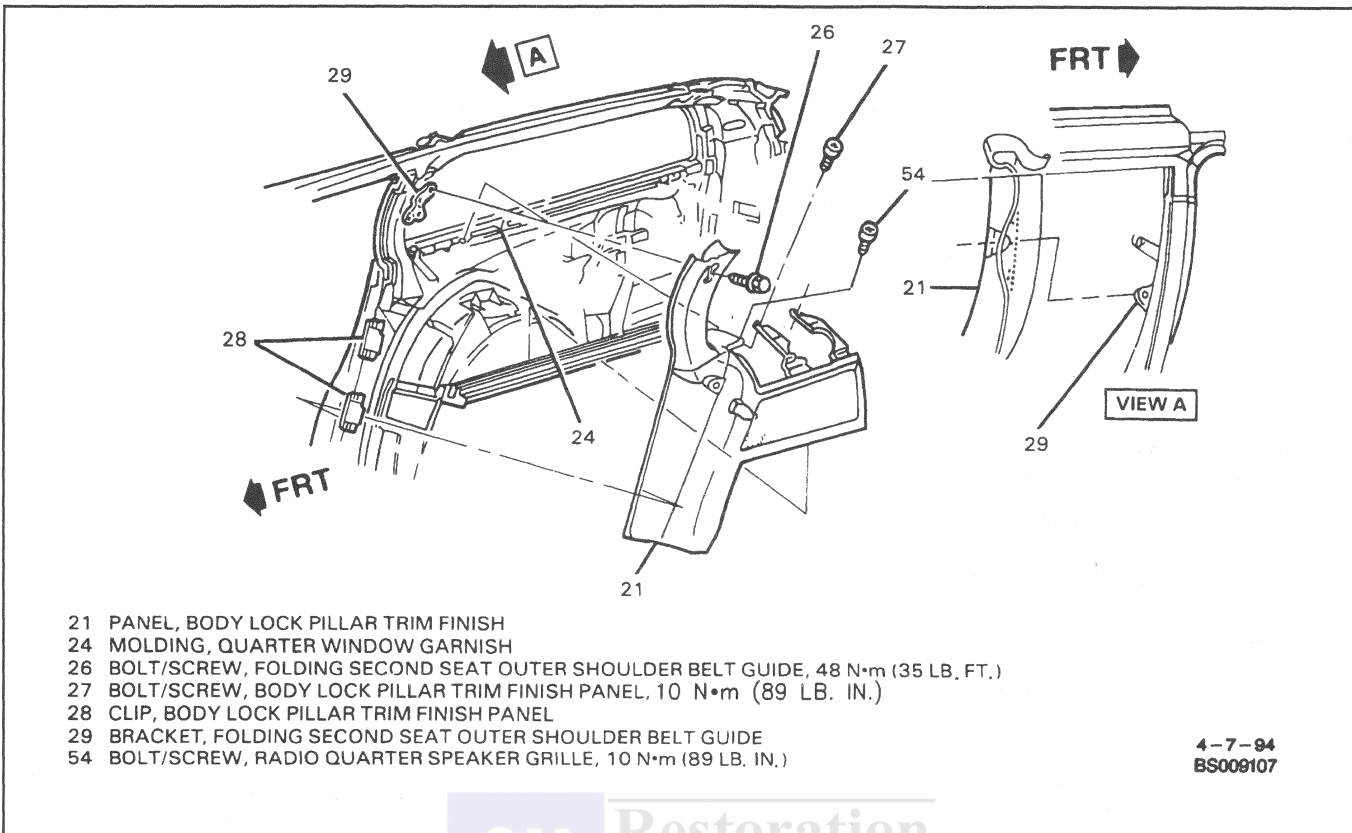


Figure 9 - Body Lock Pillar Trim Finish Panel -(Wagon)

11. Bottom edge of trim panel (21) from groove in load floor.
12. Trim panel (21).

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Bottom edge of trim panel (21) to groove in load floor.
2. Trim panel (21).
 - Align slot in trim panel (21) to bracket (29).
3. Top edge of trim panel (21) to groove in garnish molding (24).
4. Side edge of trim panel (21) to clips (28) on body lock pillar.
5. Bolt/screw (26) attaching trim panel (21) to bracket (29).

Tighten

- Bolt/screw (26) to 48 N•m (35 lb. ft.).
6. Rear seat release knob, if removed.
 7. Rear seat folding outer retractor side bolt/screw. Refer to SECTION 10-11.
 8. Bolt/screw (54).
 9. Bolts/screws (27).

Tighten

- A. Bolts/screws (27) to 1.3 N•m (12 lb. in.).
- B. Bolt/screw (54) to 10 N•m (89 lb. in.).
10. Radio quarter speaker grille and radio rear speaker. Refer to "Radio Quarter Speaker Grilles and Speakers" (Wagon) in this section.
11. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
12. Luggage shade. Refer to SECTION 10-8.

Radio Quarter Speaker Grille, Radio Rear Speakers

WAGON

Figure 10

Remove or Disconnect

1. Luggage shade. Refer to SECTION 10-8.
2. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
3. Grille (23).
 - A. Pull to remove clips from slots in trim panel (21).
 - B. Remove star boss from slot in trim panel (21).
 - C. Pull top edge of grille (23) from groove in garnish molding.

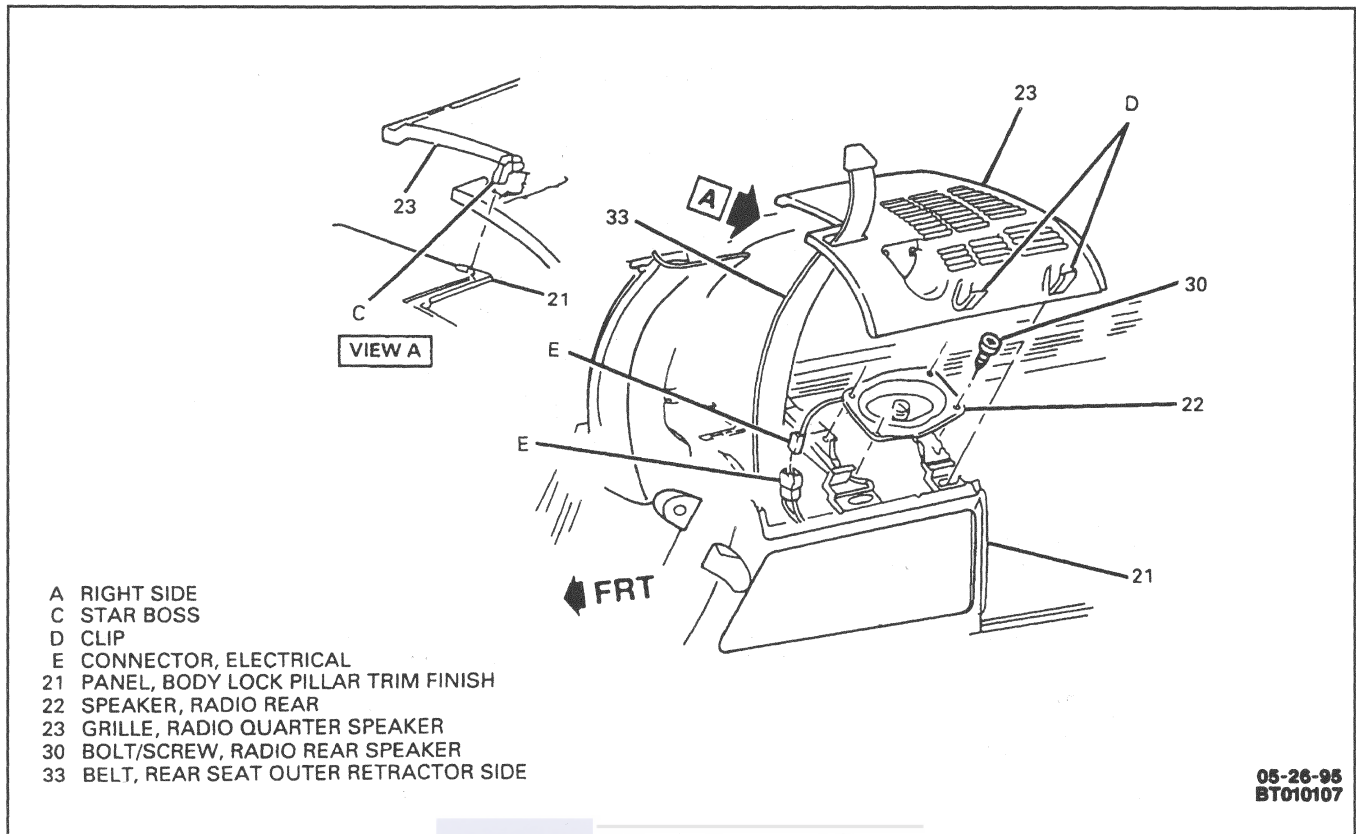


Figure 10 - Radio Quarter Speaker Grille, Radio Rear Speakers - (Wagon)

- D. Belt (33) from slot in grille (23).
4. Bolts/screws (30).
5. Electrical connectors.
6. Speaker (22) from trim panel (21).
7. Electrical connectors.

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Electrical connectors.
2. Speaker (22) to trim panel (21).
3. Remaining electrical connectors.
4. Bolts/screws (30).

Tighten

- Bolts/screws (30) to 1.9 N.m (17 lb. in.).
5. Grille (23).
 - A. Insert belt (33) into slot in grille (23).
 - B. Put top edge of grille (23) into groove in garnish molding.
 - C. Align star boss with slot in trim panel (21).
 - D. Push down firmly so clips on grille (23) lock into slots on trim panel (21).
 6. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
 7. Luggage shade. Refer to SECTION 10-8.

Quarter Window Garnish Molding WAGON

Figure 11

Remove or Disconnect

1. Luggage shade. Refer to SECTION 10-8.
2. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
3. Back body pillar finish panel and back body pillar assist (with courtesy lamp) handle. Refer to "Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle" (Wagon) in this section.
4. Radio quarter speaker grille and radio rear speaker. Refer to Radio Quarter Speaker Grille, Radio Rear Speakers. (Wagon) in this section.
5. Body lock pillar trim finish panel. Refer to "Body Lock Pillar Trim Finish Panel" (Wagon) in this section.
6. Nuts (34) from studs on quarter window.
7. Garnish molding (24).

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

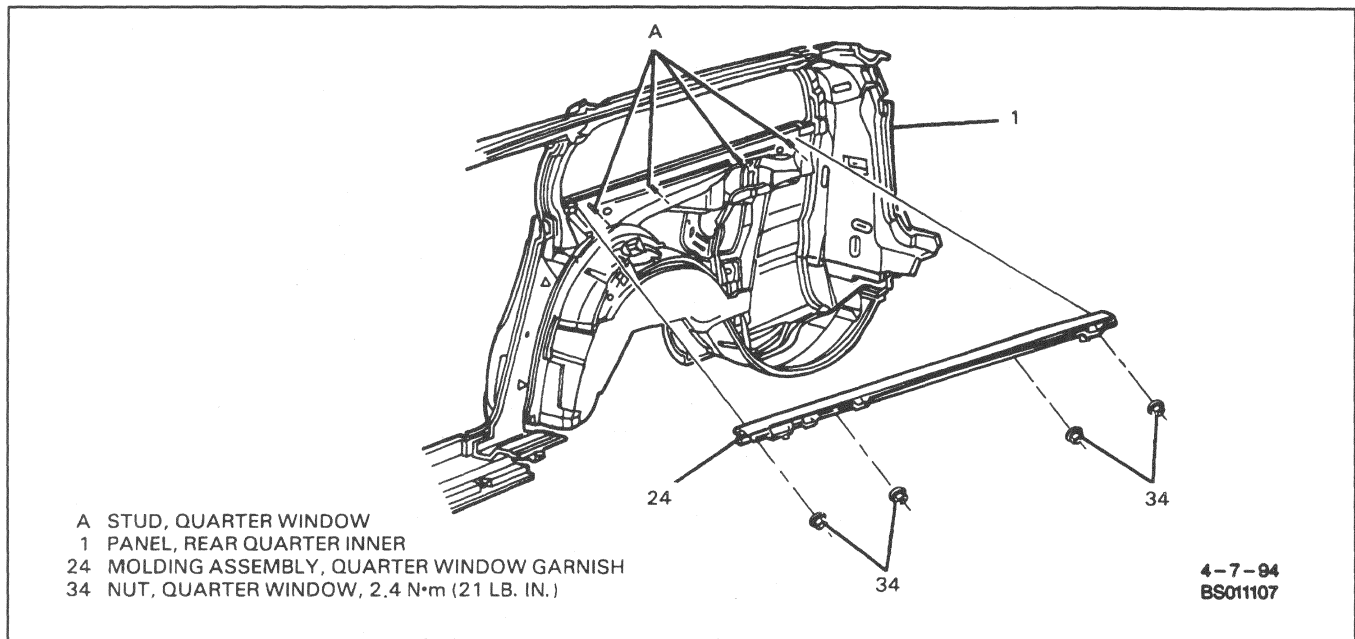


Figure 11 - Quarter Window Garnish Molding -(Wagon)

1. Garnish molding (24).
2. Nuts (34) to studs on quarter window.

Tighten

- Nuts (34) to 2.4 N·m (21 lb. in.).
- 3. Body lock pillar trim finish panel. Refer to “Body Lock Pillar Trim Finish Panel” (Wagon) in this section.
- 4. Radio quarter speaker grille and radio rear speaker. Refer to Radio Quarter Speaker Grille, Radio Rear Speakers (Wagon) in this section.
- 5. Back body pillar finish panel and back body pillar assist (with Courtesy Lamp) handle. Refer to “Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle” (Wagon) in this section.
- 6. Quarter inner rear trim finish panel. Refer to “Quarter Inner Rear Trim Finish Panel” (Wagon) in this section.
- 7. Luggage shade. Refer to SECTION 10-8.

Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle

WAGON

Figure 12

Remove or Disconnect

1. Retract luggage shade, if extended. Disconnect from slots in back body pillar panel (16).
2. Quarter window latch from back body pillar finish panel. Refer to “Quarter Window and Quarter Window Latch” in this section.

3. Quarter inner rear trim finish panel. Refer to “Quarter Inner Rear Trim Finish Panel” (Wagon) in this section.
4. Cover (39) and lens (41) to expose bolts/screws (40).
5. Bolts/screws (36) connecting back body pillar panel (16) to inner panel (1).
6. Bolts/screws (40) from nuts (35) on inner panel (1).
7. Handle (25) from back body pillar panel (16).
8. Electrical connectors.
9. Back body pillar panel (16).

- A. Slide edge out of groove in garnish molding (24).
- B. Slide back body pillar panel (16) out from underneath endgate trim panel molding.

Install or Connect

NOTICE: Refer to “Notice” on page 10-7-1 of this section.

1. Back body pillar panel (16).
 - A. Insert edge of back body pillar panel (16) into groove in garnish molding (24).
 - B. Slide back body pillar panel (16) under endgate trim panel molding.
2. Handle (25) to back body pillar panel (16).
3. Electrical connectors.
4. Bolts/screws (40) to nuts (35) on inner panel (1).

Tighten

- Bolts/screws (40) to 10 N·m (89 lb. in.).
- 5. Bolts/screws (36) connecting back body pillar panel (16) to inner panel (1).

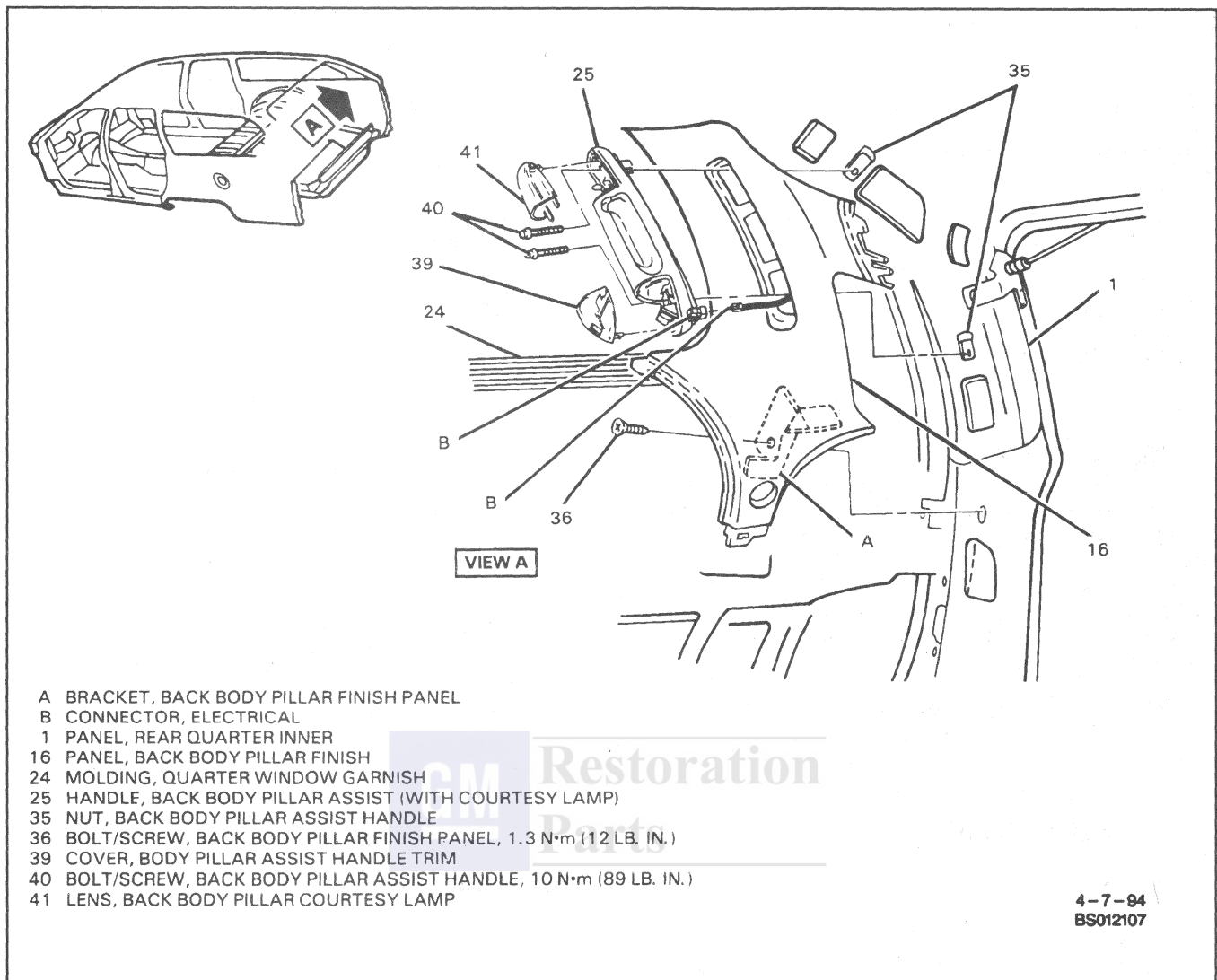


Figure 12 - Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle -(Wagon)



Tighten

- Bolts/screws (36) to 1.3 N·m (12 lb. in.).
- 6. Cover (39) and lens (41).
- 7. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
- 8. Quarter window latch to back body pillar finish panel. Refer to "Quarter Window and Quarter Window Latch" in this section.
- 9. Extend luggage shade. Connect luggage shade to slots in back body pillar panel (16).

Body Lock Pillar Pressure Relief Valve

Figure 13

The body lock pillar pressure relief valve is on the rear door lock pillar. It allows air to exit the passenger compartment.

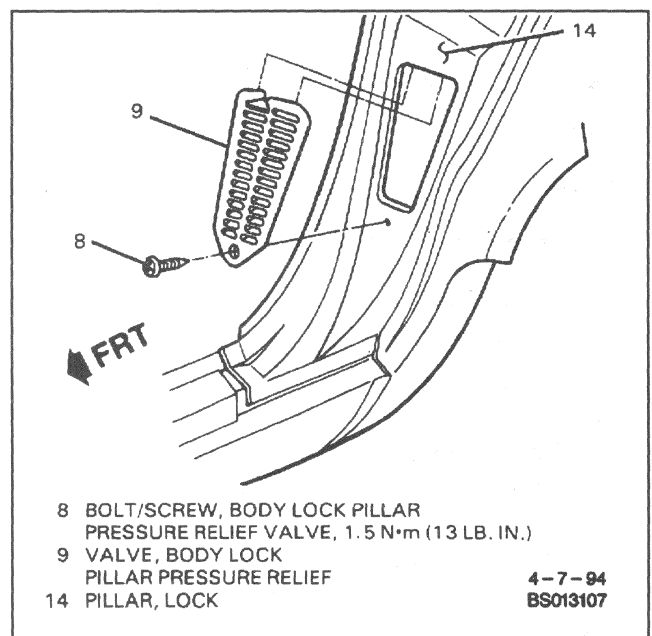


Figure 13 - Body Lock Pillar Pressure Relief Valve

10-7-12 REAR QUARTERS

↔ Remove or Disconnect

1. Bolt/screw (8).
2. Valve (9) from lock pillar (14).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Valve (9) to lock pillar (14).
2. Bolt/screw (8).

🔧 Tighten

- Bolt/screw (8) to 1.5 N.m (13 lb. in.).

EXTERIOR TRIM

When removing or installing any outside molding, cover adjacent finishes with masking tape to prevent damage to the finish. Use proper tools and take care to prevent damage to the molding. Seal all holes for bolts/screws or clips in body panels with body caulking compound or presealed bolts/screws, nuts, or clips to prevent water entry into the body interior.

Molding Clip Replacement

If a weld stud on an outer panel becomes damaged or broken off, a replacement molding clip must be installed.

↔ Install or Connect

- Replacement molding clip.
 - A. Drill small hole in panel next to original weld stud location.
 - B. Insert self-sealing bolt/screw through original clip and into quarter outer panel, or replace stud with self-sealing bolt/screw-type weld stud.

Rear Wheel Opening Molding

SEDAN

Figures 14

↔ Remove or Disconnect

1. Bolts/screws (60).
2. Molding (44).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Molding (44).
2. Bolts/screws (60).

🔧 Tighten

- Bolts/screws (60) to 1.3 N.m (12 lb. in.).

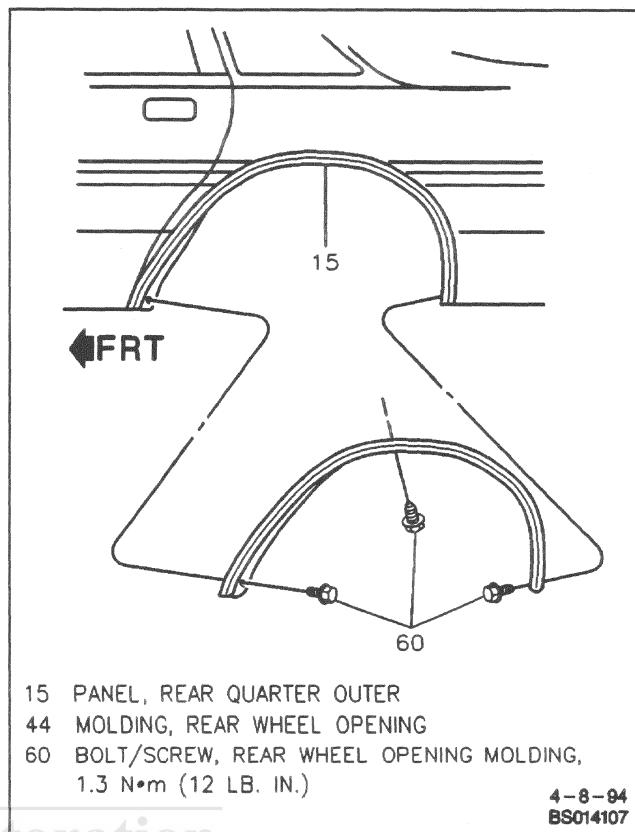


Figure 14 - Rear Wheel Opening Molding -(Chevrolet Sedan Shown, Chevrolet Wagon Similar)

Rear Quarter Center Molding Adhesive

BUICK SEDAN

Figure 15

The rear quarter center molding has changed from a screw and clip attachment type to an adhesively attached type.

↔ Remove or Disconnect

1. Molding by starting at one edge and peeling molding from rear quarter.
 - Application of heat to molding at point of removal aids removal operation.
2. All traces of adhesive residue from painted surfaces with a silicone, wax, and grease remover.

↔ Install or Connect

NOTICE: Always refer to manufacturer's packaged instructions to avoid damaged.

1. Prepare surface.

🧼 Clean

- A. Painted surface with silicone, wax, and grease remover.

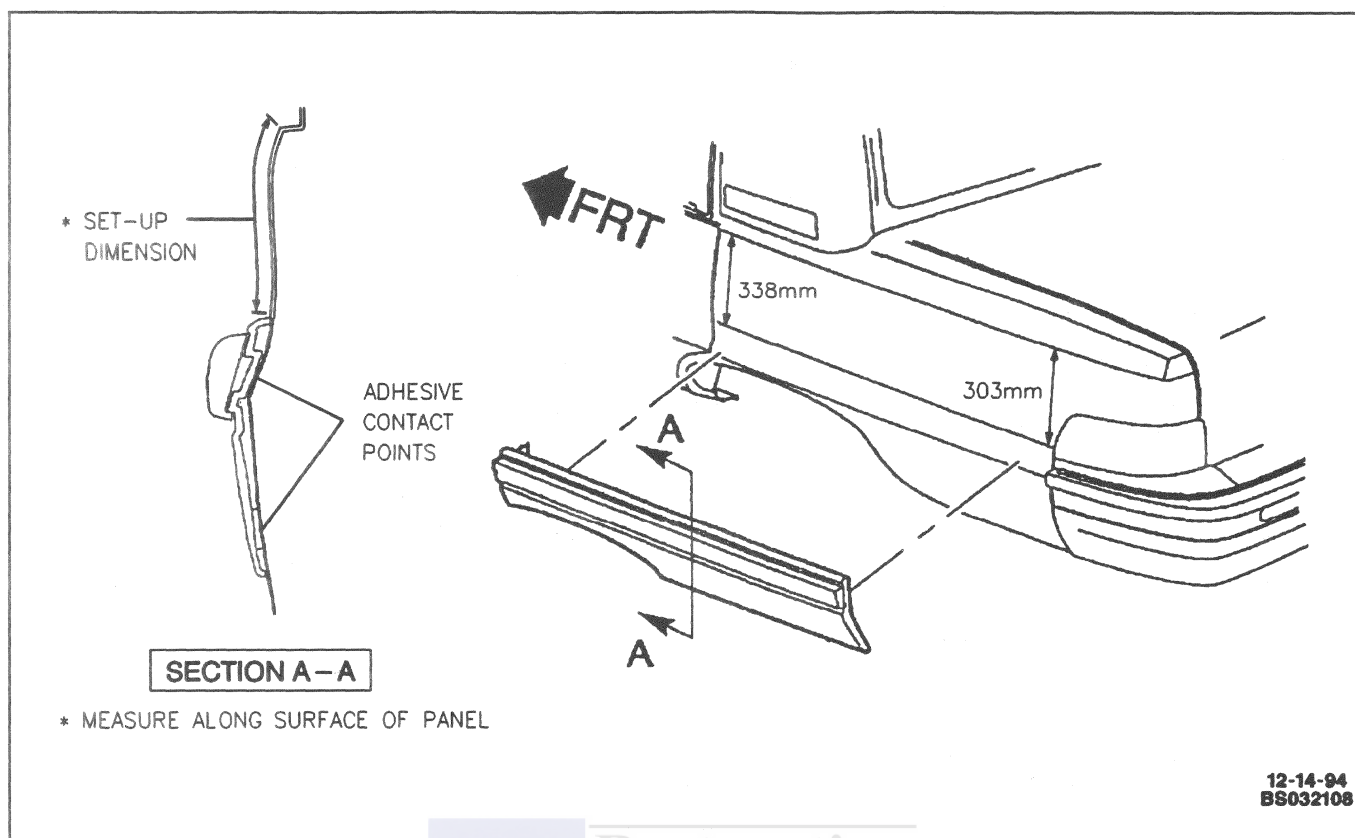


Figure 15 - Rear Quarter Molding Adhesive - (Sedan)

- B. Area where molding will be applied with a 50-50 mixture of isopropyl alcohol and water.
- Wipe panel surface with a clean cloth while solvent is still wet and allow to dry.

2. Remove backing material of molding as necessary.
3. Molding to quarter.
 - For up/down location, see (Figures 2 and 3) for set-up dimensions.
 - For fore/aft location, place exterior center molding to trailing edge of outer door panel to provide the most door swing clearance at leading edge.

! Important

- Roll the molding with approximately 25 lb. of force over each adhesive contact point.
- Be certain that adhesive contact points make full contact on surface or molding will not adhere.

Rear Quarter Transfer Lower Finish Molding

WAGON

Figure 16

↔ Remove or Disconnect

1. Bolts/screws (47).
2. Bolt/screw (48).
3. Molding (11) from clips (46, 49 and 53).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Molding (11) to clips (46, 49 and 53).
2. Bolt/screw (48).
3. Bolts/screws (47).

⌚ Tighten

- Bolts/screws (47 and 48) to 1.3 N.m (12 lb. in.).

Rear Quarter Transfer Upper Finish Molding

WAGON

Figure 17

↔ Remove or Disconnect

1. Molding (57) from clips (50).
 - Pull molding (57) gently until it disengages from clips (50).

↔ Install or Connect

1. Molding (57) to clips (50).
 - Molding (57) gently to secure to clips (50).

10-7-14 REAR QUARTERS

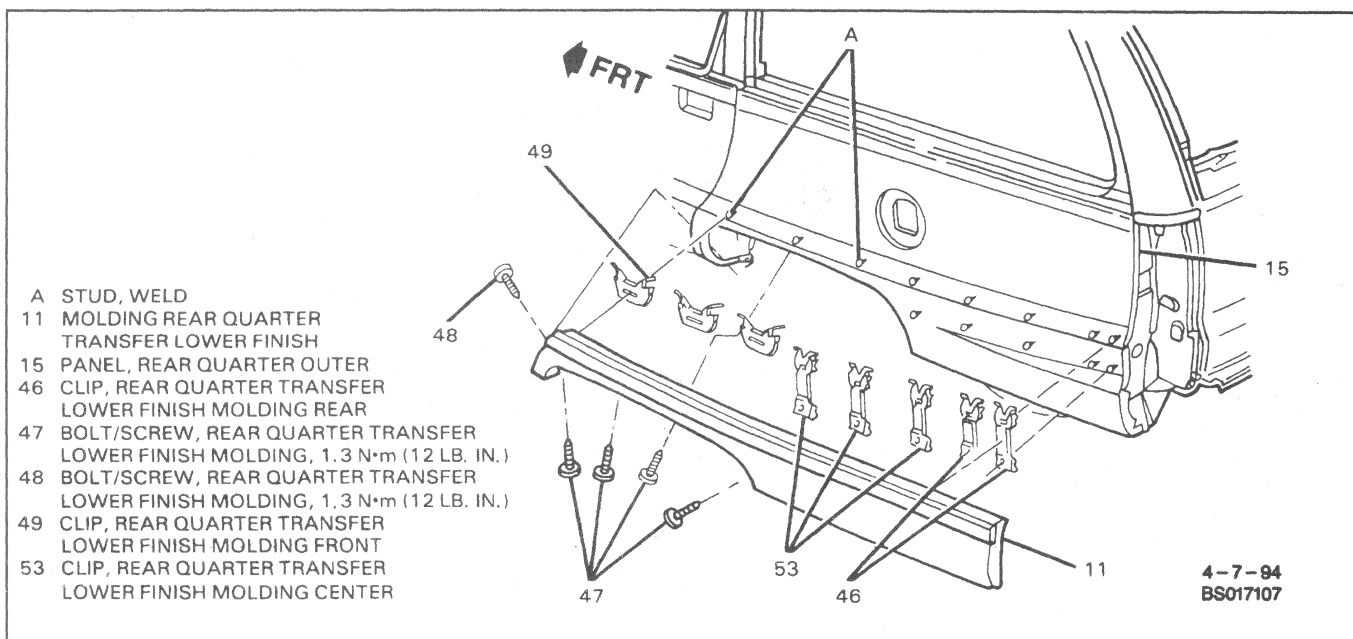


Figure 16 - Rear Quarter Transfer Lower Finish Molding - (Wagon)

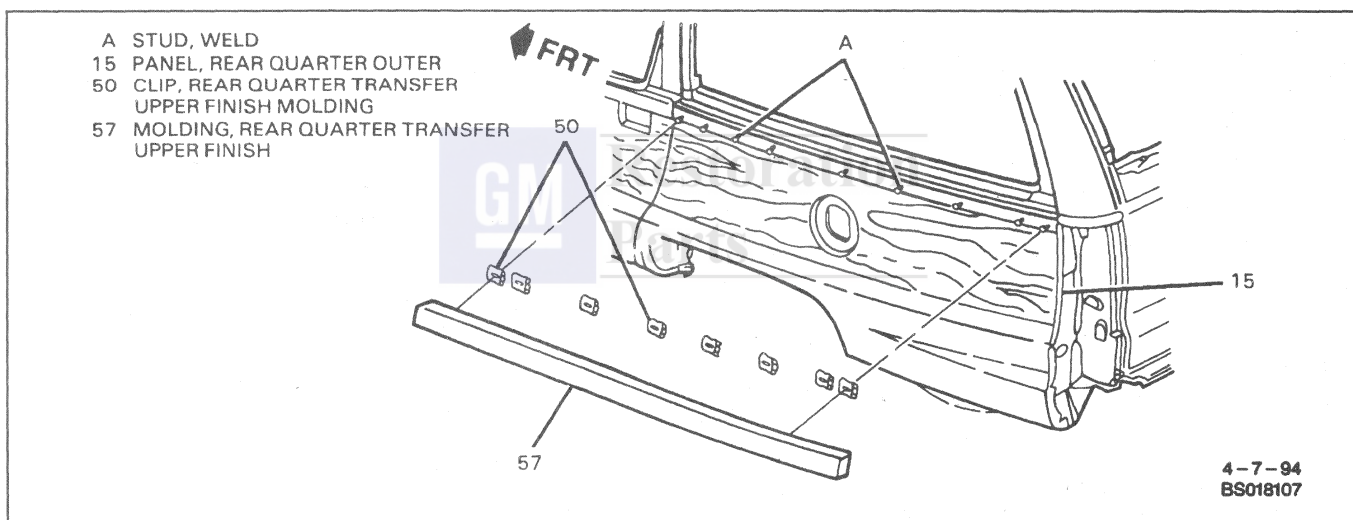


Figure 17 - Rear Quarter Transfer Upper Finish Molding - (Wagon)

Rear Quarter Transfer Front Retainer

WAGON

Figure 18



Remove or Disconnect

1. Bolts/screws (51) connecting retainer (13) to lock pillar (14) and outer panel (15).
2. Retainer (13).



Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Retainer (13).

2. Bolts/screws (51) connecting retainer (13) to lock pillar (14) and outer panel (15).



Tighten

- Bolts/screws (51) to 1.3 N·m (12 lb. in.).

Rear Quarter Lower Front Molding

EXCEPT BUICK SEDAN

Figure 19



Remove or Disconnect

1. Bolts/screws (52).
2. Molding (12).

- 13 RETAINER, REAR QUARTER TRANSFER FRONT
- 14 PILLAR, LOCK
- 15 PANEL, REAR QUARTER OUTER
- 51 BOLT/SCREW, REAR QUARTER TRANSFER FRONT RETAINER, 1.3 N·m (12 LB. IN.)

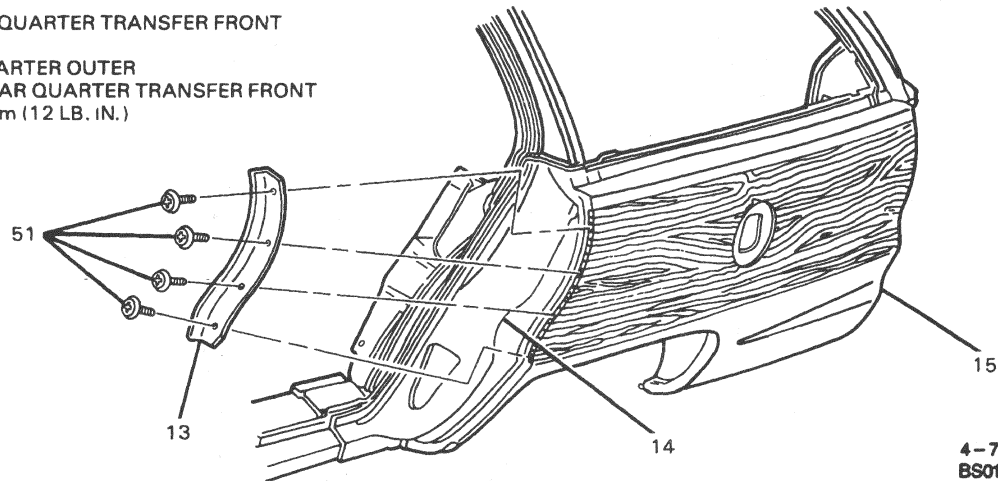


Figure 18 - Rear Quarter Transfer Front Retainer - (Wagon)

- 12 MOLDING, REAR QUARTER LOWER FRONT
- 15 PANEL, REAR QUARTER OUTER
- 52 BOLT/SCREW, REAR QUARTER LOWER FRONT MOLDING, 1.3 N·m (12 LB. IN.)

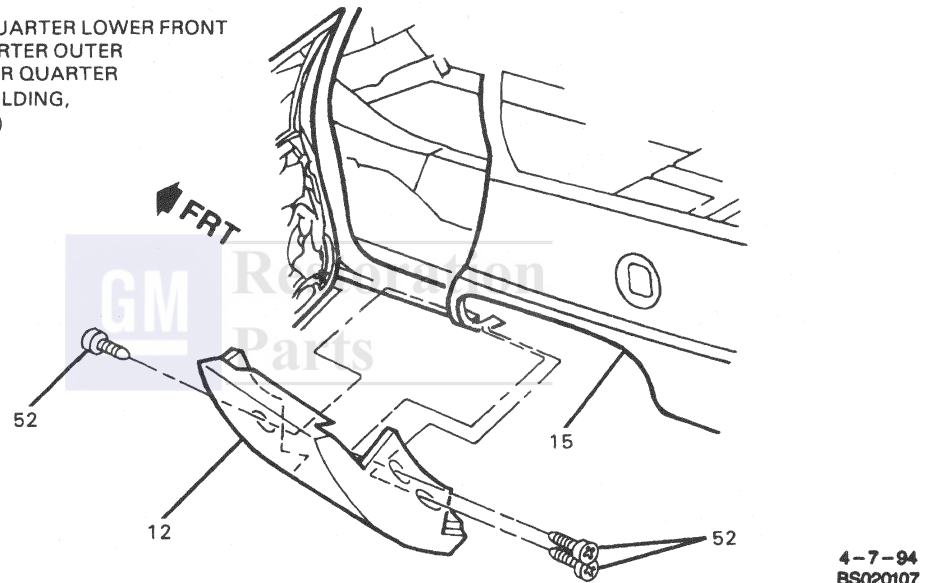


Figure 19 - Rear Quarter Lower Front Molding -(Typical Wagon Shown, Chevrolet Sedan Similar)

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Molding (12).
2. Bolts/screws (52).

Tighten

- Bolts/screws (52) to 1.3 N·m (12 lb. in.).

Rear Quarter Name Plates

BUICK

Figure 20

For service procedure on roof side name plate, refer to SECTION 10-9.

Remove or Disconnect

- Plate (55, 56 or 59).
 - A. Hold hot air gun 152 mm (6 inches) from surface of part to be removed.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Use flat-bladed tool, being careful not to break plate (55, 56 or 59) or damage paint, and peel plate (55, 56 or 59) from panel surface.
 - D. Discard plate (55, 56 or 59).

10-7-16 REAR QUARTERS

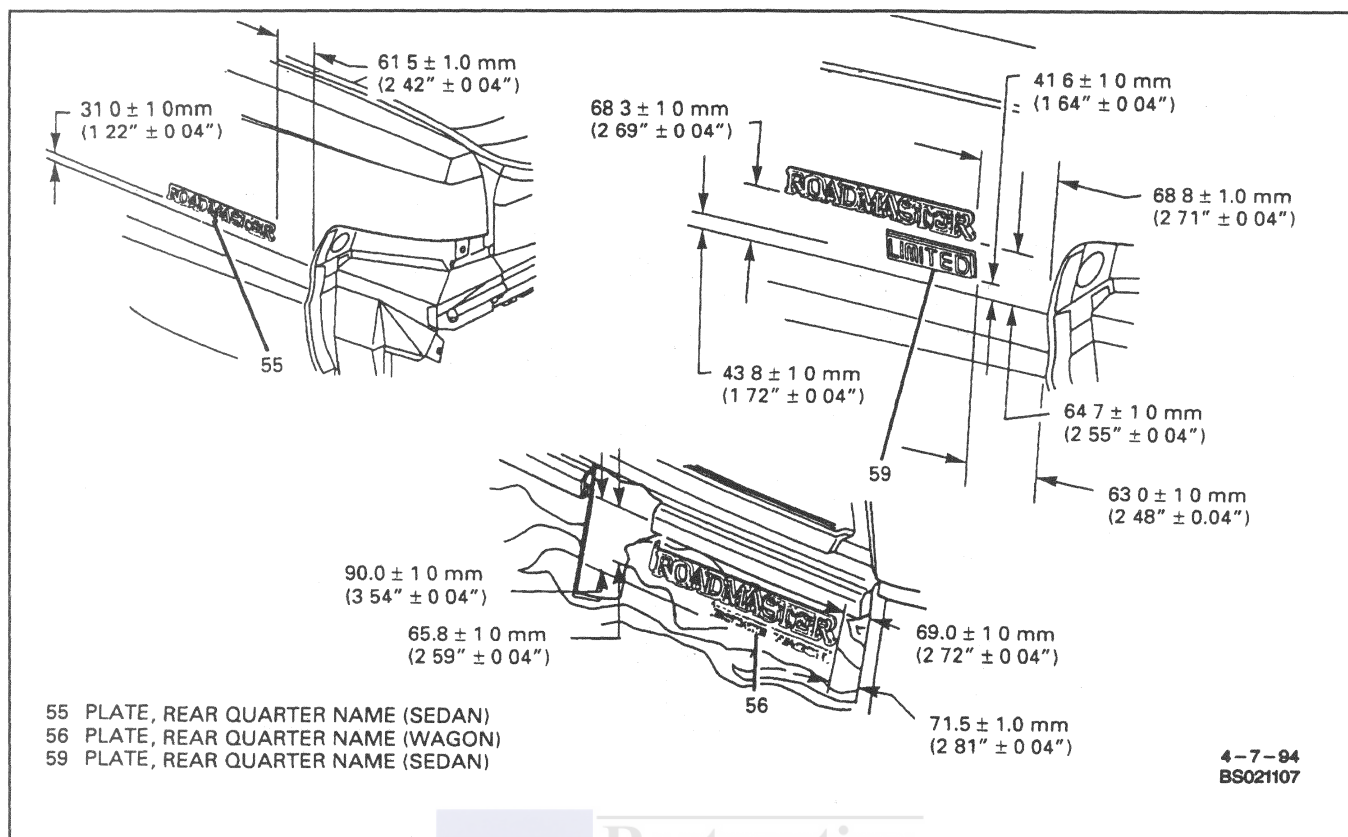


Figure 20 - Rear Quarter Name Plate - (Buick)



Install or Connect

- New plate (55, 56 or 59).



Clean

- Area with suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha.

- Remove backing from plate (55, 56 or 59).
- Body and part temperature at time of installation must be 26° C (80° F) minimum or 6° C (40° F) above air temperature in application area, whichever is higher but not exceeding 40° C (105° F).

NOTICE: Position the rear quarter name plate carefully on the vehicle.

- Plate (55, 56 or 59) cannot be removed without damage after contact with vehicle.
- Press plate (55, 56 or 59) into place.
- Refer to illustration for positioning.
- Apply constant pressure for 30 seconds.

FUEL TANK FILLER PIPE SHIELD

WAGON

Figure 21

The shield (20) is a plastic panel that bolts to the inner panel (1) and rear wheelhouse. It helps protect the fuel tank filler pipe neck from damage.



Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel. Refer to SECTION 3E.
3. Bolts/screws (42) from inner panel (1) and rear wheelhouse.
4. Shield (20).



Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Shield (20).
2. Bolts/screws (42) to inner panel (1) and rear wheelhouse.



Tighten

- Bolts/screws (42) to 1.6 N.m (14 lb. in.).
3. Tire and wheel. Refer to SECTION 3E.
 4. Lower vehicle.

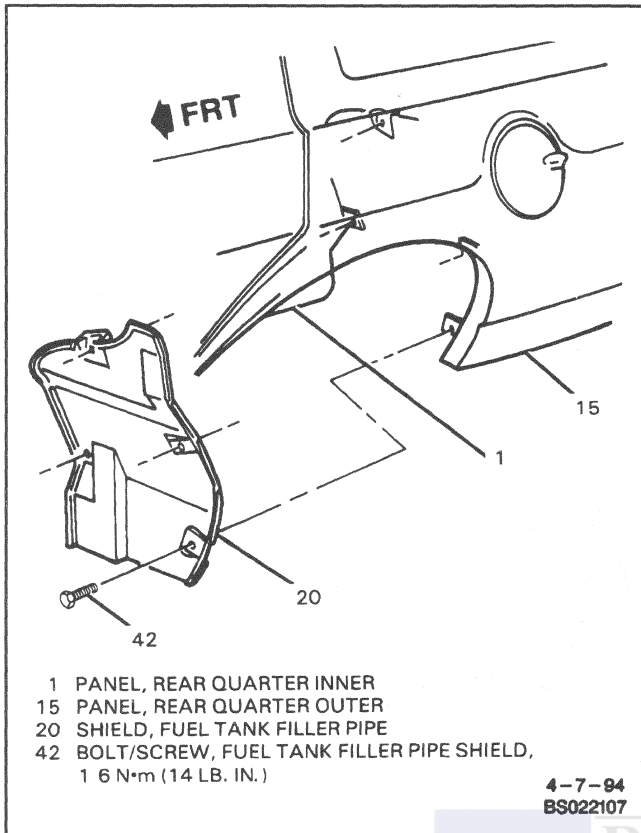


Figure 21 - Fuel Tank Filler Pipe Shield - (Wagon)

FUEL TANK FILLER PIPE DOOR AND POCKET

WAGON

Figure 22

Remove or Disconnect

1. Open door (18) and remove cap.
2. Bolts/screws (45) connecting door (18) to pocket (19) and outer panel (15).
 - Drill out two rivets connecting door (18) to outer panel (15), using 1/4-inch drill bit.
3. Slide fuel tank filler door and bracket to rear of vehicle and pull out.
4. Bolts/screws (44) connecting pocket (19) to neck (43).
5. Pocket (19).

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Pocket (19).
2. Bolts/screws (44) connecting pocket (19) to neck (43).

Tighten

- Bolts/screws (44) to 1.2 N·m (11 lb. in.).
3. Door (18).
 - Insert fuel tank filler door and bracket into outer panel (15) and slide toward front of vehicle.

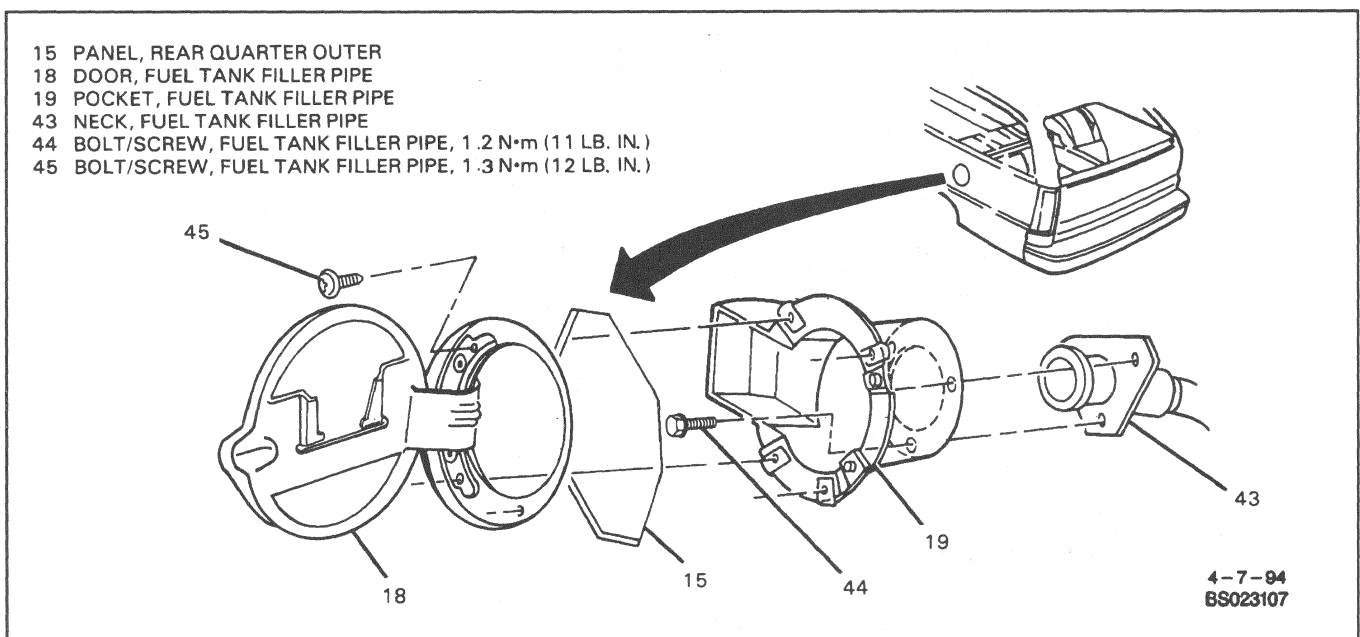


Figure 22 - Fuel Tank Filler Pipe Door and Pocket - (Wagon)

10-7-18 REAR QUARTERS

4. Two 3/16 inch rivets connecting door (18) to outer panel (15).
5. Bolts/screws (45) connecting door (18) to pocket (19) and outer panel (15).



Tighten

- Bolts/screws (45) to 1.9 N.m (17 lb. in.).
6. Cap.
 7. Close door (18).

QUARTER WINDOW

CHEVROLET SEDAN

Figures 23 and 24

Tool Required:

J 24402-A Glass Sealant Remover Knife (Cold Knife) or J 24709-01 or J 24899-01 Urethane Glass Sealant Remover (Hot Knife).

The quarter window (65) is stationary and is made of solid tempered safety plate glass with the reveal molding and fastening studs attached. Quarter windows (65) are installed from the outside of the vehicle.

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

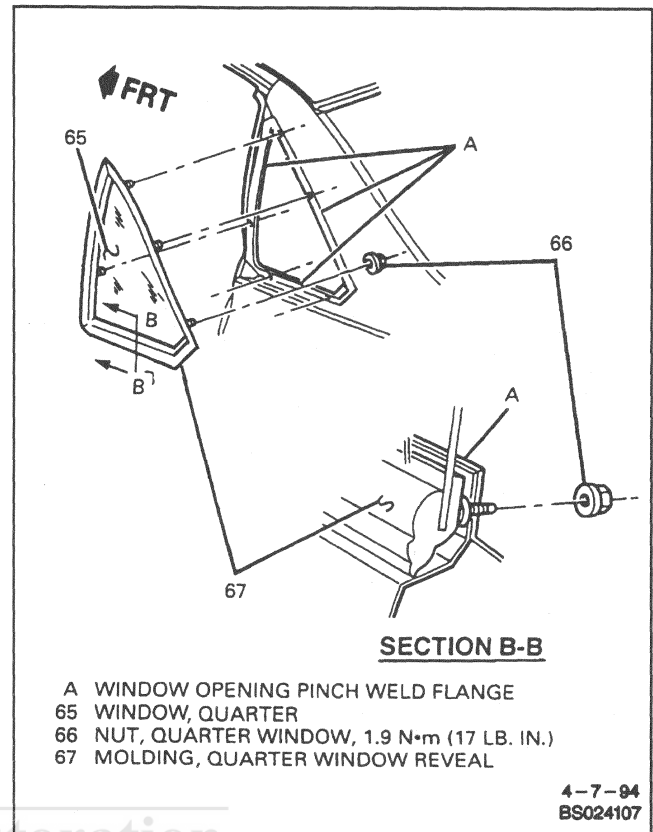


Figure 23 - Quarter Window - (Chevrolet Sedan)

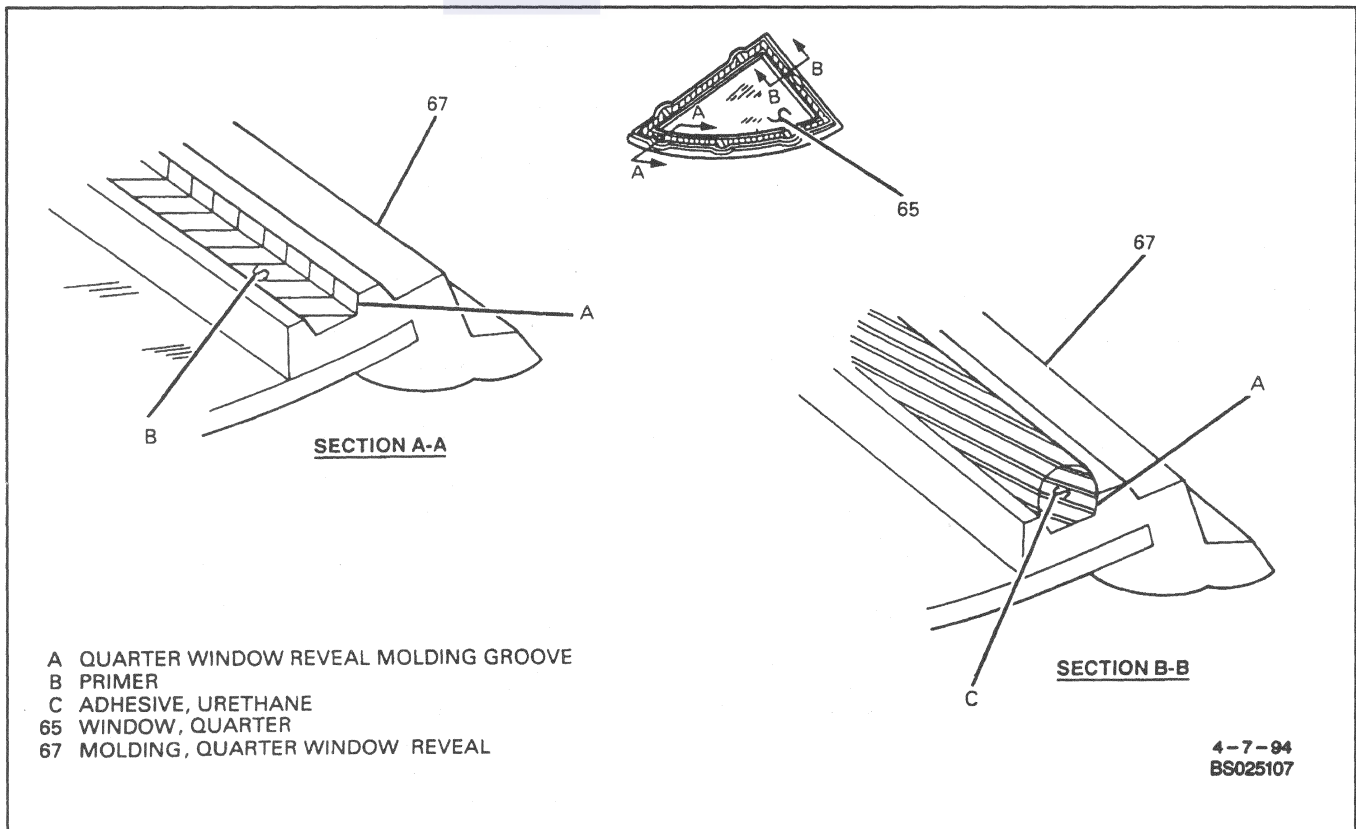


Figure 24 - Applying Primer and Adhesive to Quarter Window - (Chevrolet Sedan)



Remove or Disconnect

1. Radio rear speaker grille. Refer to SECTION 10-8.
2. Quarter window garnish molding. Refer to "Quarter Window Garnish Molding" (Sedan) in this section.
3. Rear seat and rear seatback cushions. Refer to SECTION 10-10.
4. Rear side door lock pillar garnish molding. Refer to "Rear Side Door Lock Pillar Garnish Molding" (Sedan) in this section.
5. Rear window panel trim. Refer to SECTION 10-8.
6. Nuts (66).
7. Window (65).
 - Cut out window (65) from inside using J 24402-A or J 24899-01.



Clean

- Window opening of any loose material. If original window (65) will be reinstalled, remove all adhesive from window (65) with alcohol-dampened cloth.



Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Window (65) into opening.
2. Masking tape over each edge of reveal molding (67) and adjacent body panels.
 - A. Slit tape at edge of reveal molding (67).
 - B. During installation, align tape on reveal molding (67) with tape on body.
3. Remove window (65).
4. Primer from urethane adhesive kit, GM P/N 12346284, or equivalent, in and around the perimeter of the seal track. Allow primer to dry five minutes.
 - Two primers are used in the urethane adhesive kit.
 - A. Clear primer is used in seal track prior to application of urethane adhesive. This primer acts as agent to bond urethane adhesive to window (65).
 - B. Black primer is used on flange if paint has been exposed during window removal or cleaning, or if painting or refinishing is required. This primer acts as agent to bond urethane adhesive to body surface.



Important

- Maximum body temperature must not exceed 49° C (120° F) at time of primer application.
5. Urethane adhesive from kit to primed seal track with cartridge caulking gun and nozzle.
 - Use smooth, continuous line of adhesive 6 mm (1/4-inch) wide and 13 mm (1/2-inch) high.

6. Window (65) into opening.
 - A. Use tape guides to align window (65) to flange.
 - B. Press window (65) firmly to pinch-weld surface to wet and set adhesive.
 - C. Avoid excessive squeezeout that would cause an appearance problem.
7. Using small, disposable brush or flat, soft fiberglass tool, paddle adhesive into gap between pinch-weld flange and reveal molding (67) for water-tight seal.
 - Paddle in additional adhesive to fill any voids in seal.
8. Water test vehicle with soft spray.
 - Use warm or hot water if available.
 - Do not direct hard stream of water at fresh adhesive.
 - Water applied on top of urethane adhesive will speed up cure of adhesive.



Inspect

- Window installation for leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.

9. Nuts (66).



Tighten

- Nuts (66) to 1.9 N·m (17 lb. in.).

10. Rear side door lock pillar garnish molding. Refer to "Rear Side Door Lock Pillar Garnish Molding" (Sedan) in this section.
11. Rear window panel trim. Refer to SECTION 10-10.
12. Rear seat and rear seatback cushions. Refer to SECTION 10-10.
13. Quarter window garnish molding. Refer to "Quarter Window Garnish Molding" (Sedan) in this section.
14. Radio rear speaker grille. Refer to SECTION 10-8.

WAGON

Figures 25 through 27

Tool Required:

J 24402-A Glass Sealant Remover Knife (Cold Knife) or J 24709-01 or J 24899-01 Urethane Glass Sealant Remover (Hot Knife)

This procedure is for replacing the whole quarter window (91), including both stationary and movable portions, and quarter window reveal molding (93). If only the movable portion needs replaced, refer to "Quarter Window and Quarter Window Latch" in this section.

The quarter window (91) is made of solid tempered safety plate glass with reveal molding (93) and fastening studs attached. It is installed from the outside of the vehicle.

10-7-20 REAR QUARTERS

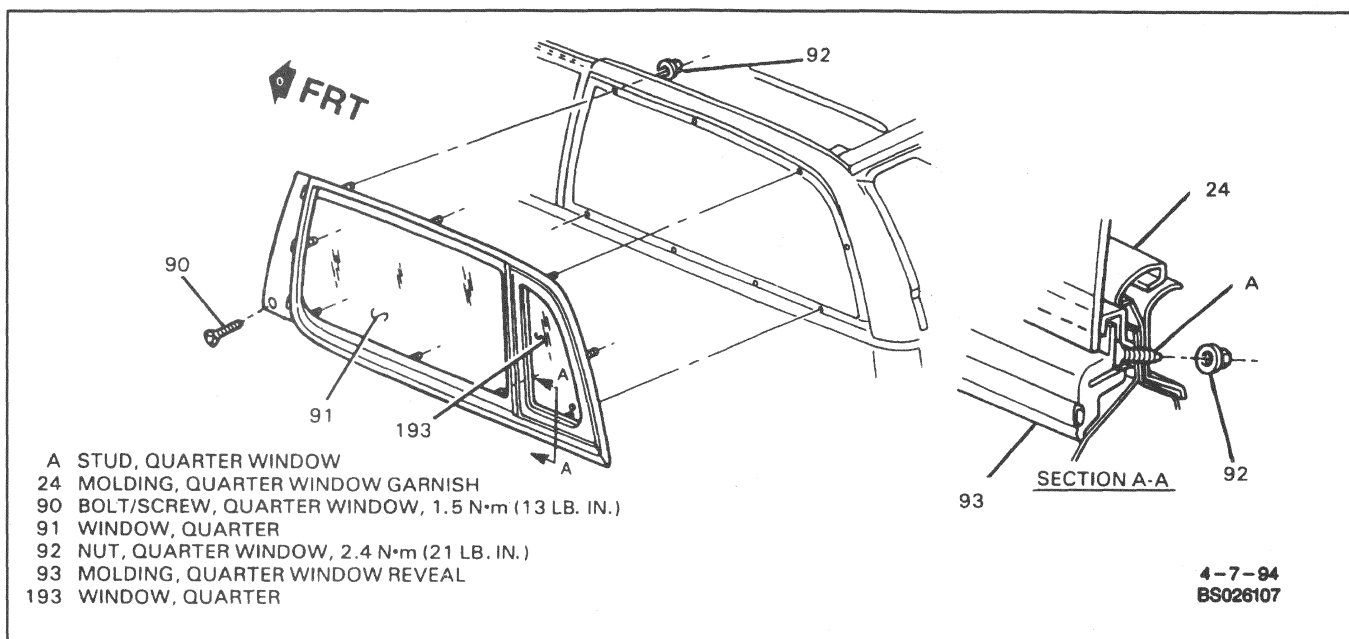


Figure 25 - Quarter Window - (Wagon)

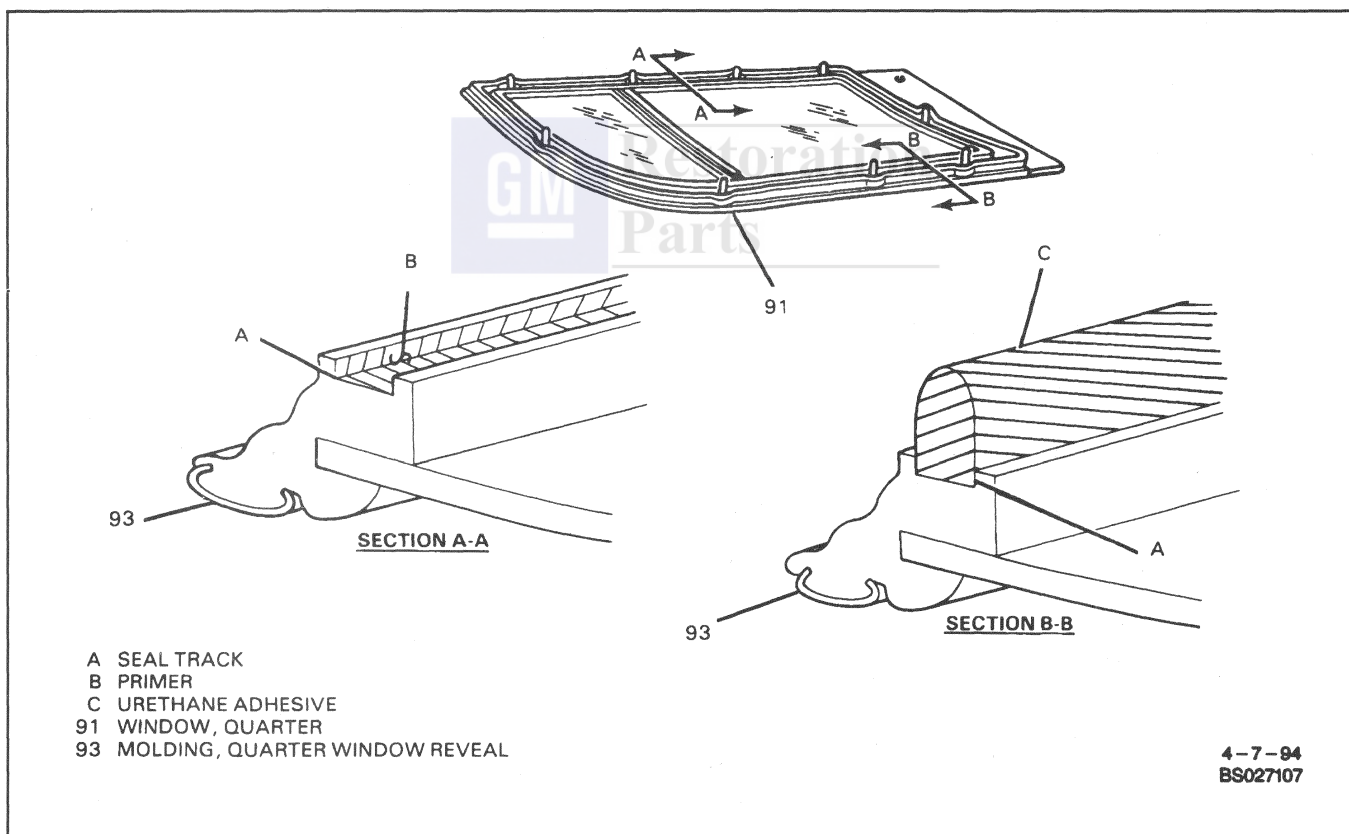


Figure 26 - Applying Primer and Adhesive to Quarter Window - (Wagon)

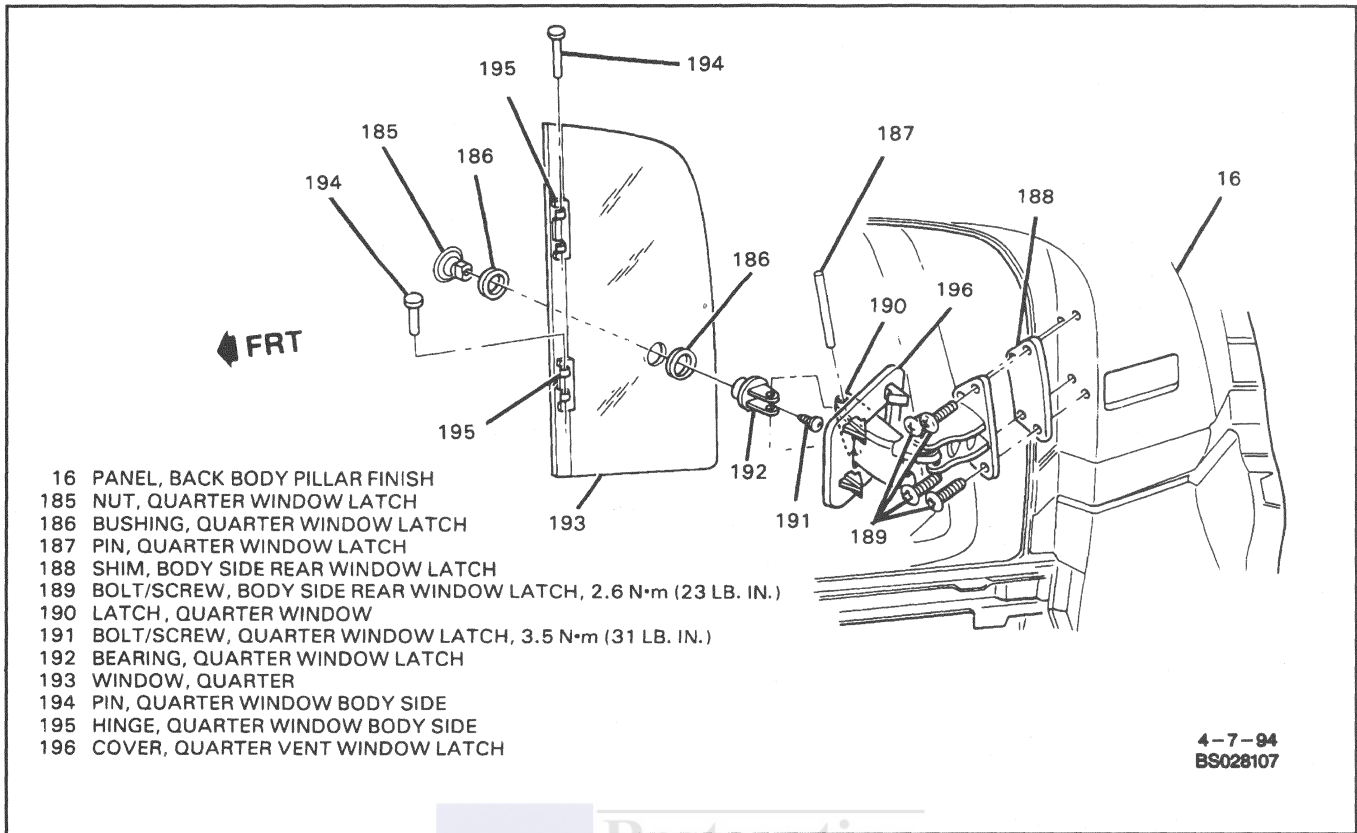


Figure 27 - Quarter Window Latch - (Wagon)

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.



Clean

- Window opening of any loose material. Remove all adhesive with an alcohol-dampened cloth.



Remove or Disconnect

1. Open window (193).
2. Body lock pillar applique (Buick). Refer to SECTION 10-6.
3. Pin (187) connecting latch (190) to bearing (192).
4. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
5. Back body pillar finish panel. Refer to "Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle" (Wagon) in this section.
6. Body lock pillar trim finish panel. Refer to "Body Lock Pillar Trim Finish Panel" (Wagon) in this section.
7. Quarter window garnish molding. Refer to "Quarter Window Garnish Molding" (Wagon) in this section.
8. Headlining trim finish panel. Refer to SECTION 10-9.
9. Nuts (92) from studs.
10. Bolt/screw (90) (Buick).
11. Window (91).

- Cut out window (91) from inside using J 24402-A or J 24709-01 or J 24899-01.



Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Window (91) into opening.
2. Bolt/screw (90) (Buick).
3. Body lock pillar applique (Buick). Refer to SECTION 10-6.



Adjust

- Window (91) in opening.
4. Put masking tape over each edge of reveal molding (93) and adjacent body panels.
 - A. Slit tape at edge of reveal molding (93).
 - B. During installation, align tape on reveal molding (93) to tape on body.
 5. Remove body lock pillar applique (Buick). Refer to SECTION 10-6.
 6. Remove bolt/screw (90) (Buick).
 7. Remove window (91).
 8. Primer from urethane adhesive kit, GM P/N 12346284 or equivalent, in and around perimeter of seal track. Allow primer to dry five minutes.

10-7-22 REAR QUARTERS

- Urethane adhesive kit has two primers.
 - A. Clear primer is used in seal track prior to application of urethane adhesive. This primer acts as agent to bond urethane adhesive to window (91).
 - B. Black primer is used on window opening pinch-weld flange if paint has been exposed during window removal or cleaning, or if painting or refinishing is required. Primer acts as agent to bond urethane adhesive to body surface.

Important

- Maximum body temperature must not exceed 49° C (120° F) at time of primer application.
- 9. Urethane adhesive from kit to primed seal track with cartridge caulking gun and nozzle.
 - Use smooth, continuous line of adhesive 6 mm (1/4-inch) wide and 13 mm (1/2-inch) high.
- 10. Window (91) into opening.
 - A. Use tape guides to align window (91) to pinch-weld flange.
 - B. Press window (91) firmly to the pinch-weld surface to wet and set adhesive.
 - C. Avoid excessive squeezeout that would cause an appearance problem.
- 11. Bolt/screw (90) (Buick).
- 12. Using small, disposable brush or flat, soft fiberglass tool, paddle adhesive into gap between pinch-weld flange and reveal molding (93) for watertight seal.
 - Paddle in additional adhesive to fill any voids in seal.
- 13. Water test vehicle with soft spray.
 - Use warm or hot water if available.
 - Do not direct hard stream of water at fresh adhesive.
 - Water applied on top of urethane adhesive will speed up cure of adhesive.

Inspect

- Window installation for leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.

Tighten

- Bolt/screw (90) to 1.5 N·m (13 lb. in.).

14. Nuts (92).

Tighten

- Nuts (92) to 2.4 N·m (21 lb. in.).

15. Headlining trim finish panel. Refer to SECTION 10-9.

16. Quarter window garnish molding. Refer to "Quarter Window Garnish Molding" (Wagon) in this section.

17. Body lock pillar trim finish panel. Refer to "Body Lock Pillar Trim Finish Panel" (Wagon) in this section.
18. Back body pillar finish panel. Refer to "Back Body Pillar Finish Panel and Back Body Pillar Assist (with Courtesy Lamp) Handle" in this section.
19. Quarter inner rear trim finish panel. Refer to "Quarter Inner Rear Trim Finish Panel" (Wagon) in this section.
20. Pin (187) connecting latch (190) to bearing (192).
21. Body lock pillar applique (Buick). Refer to SECTION 10-2.

Quarter Window and Quarter Window Latch

Figure 27

Remove or Disconnect

1. Open window (193).
2. Pin (187) connecting latch (190) to bearing (192).
3. Pins (194) from window and vehicle hinge leaves.
 - A. Use small screwdriver or other flat-bladed tool.
 - B. Pry pins (194) from hinge leaves by pushing upward on heads of pins (194) with tool.
4. Window (193).
5. Latch (190) from back body pillar panel (16), if necessary.
 - Remove cover (196), bolts/screws (189), latch assembly (190) and shim (188).

Install or Connect

NOTICE: Refer to "Notice" on page 10-7-1 of this section.

1. Latch (190) to back body pillar panel (16), if removed.
 - Install shim (188) and latch (190) with bolts/screws (189) and cover (196).

Tighten

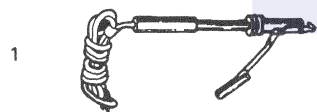
- Bolts/screws (189) to 2.6 N·m (23 lb. in.).
- 2. Window (193).
- 3. Pins (194) to window and vehicle hinge leaves.
 - Fit window hinge leaves to vehicle hinge leaves before installing pins (194).
- 4. Pin (187) connecting latch (190) to bearing (192) on window (193).
 - Install latch (190) to bearing (192) and drive pin (187) to secure.
- 5. Close window (193).

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Back Body Pillar Assist Handle Bolt/Screw (Wagon)	10 N.m (89 lb. in.)
Back Body Pillar Finish Panel Bolt/Screw (Wagon)	1.3 N.m (12 lb. in.)
Body Lock Pillar Pressure Relief Valve Bolt/Screw	1.5 N.m (13 lb. in.)
Body Lock Pillar Trim Finish Panel Bolt/Screw (Wagon)	3 N.m (12 lb. in.)
Body Side Rear Window Latch Bolt/Screw (Wagon)	2.6 N.m (23 lb. in.)
Fuel Tank Filler Pipe Bolt/Screw (Door) (Wagon)	1.3 N.m (12 lb. in.)
Fuel Tank Filler Pipe Bolt/Screw (Pocket) (Wagon)	1.2 N.m (11 lb. in.)
Fuel Tank Filler Pipe Shield Bolt/Screw (Wagon)	1.6 N.m (14 lb. in.)
Folding Second Seat Outer Shoulder Belt Guide Bolt/Screw (Wagon)	48 N.m (35 lb. ft.)
Quarter Window Bolt/Screw (Wagon)	1.5 N.m (13 lb. in.)
Quarter Window Latch Bolt/Screw (Wagon)	3.5 N.m (31 lb. in.)
Quarter Window Nut (Sedan)	1.9 N.m (17 lb. in.)
Quarter Window Nut (Wagon)	2.4 N.m (21 lb. in.)
Radio Quarter Speaker Grille Bolt/Screw (Wagon)	10 N.m (89 lb. in.)
Radio Rear Speaker Bolt/Screw (Wagon)	1.9 N.m (17 lb. in.)
Rear Quarter Center Molding Bolt/Screw (Sedan)	1.3 N.m (12 lb. in.)
Rear Quarter Lower Front Molding Bolt/Screw (Wagon)	1.3 N.m (12 lb. in.)
Rear Quarter Transfer Front Retainer Bolt/Screw (Wagon)	1.3 N.m (12 lb. in.)
Rear Quarter Transfer Lower Finish Molding Bolt/Screw (Wagon)	1.3 N.m (12 lb. in.)
Rear Side Door Lock Pillar Garnish Molding Bolt/Screw (Sedan)	1.3 N.m (12 lb. in.)
Rear Wheel Opening Molding Bolt/Screw (Sedan)	1.3 N.m (12 lb. in.)

SPECIAL TOOLS



J 24709-01
OR
J 24899-01



J 24402-A

3



J 24595-C

- 1 URETHANE GLASS SEALANT REMOVER (HOT KNIFE)
- 2 GLASS SEALANT REMOVER KNIFE (COLD KNIFE)
- 3 DOOR TRIM PAD AND GARNISH CLIP REMOVER

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BLANK



Restoration
Parts

SECTION 10-8

BODY REAR END

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

BODY REAR END

Figures 1 through 6

The service operations necessary for the removal, installation, adjustment and sealing of the components listed in figures 1 through 6 for the sedan and wagon are contained in this section.

ON-VEHICLE SERVICE

REAR COMPARTMENT LID

The rear compartment lid consists of an inner and outer panel that is hemmed around the perimeter and bonded together with structural adhesive. The compartment lid hinge is welded to the body and bolted to the rear compartment lid. All styles use torque rods for opening assistance.

Rear Compartment Lid Replacement

Figure 7

Prop rear compartment lid open and place protective covering along edges of rear compartment opening to prevent damage to painted surfaces.

Remove or Disconnect

1. Mark location of lid hinge (17) and bolts/screws (16).
2. Rear compartment wiring harness from lid (14).
3. Get assistance from helper to support rear compartment lid (14).
4. Bolts/screws (16).
5. Rear compartment lid (14).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Rear compartment lid (14).
 - A. Get assistance from helper to support rear compartment lid (14) in position.
 - B. Position rear compartment lid (14) to marked locations of lid hinge (17) and bolts/screws.

Tighten

- Bolts/screws (16) to 29 N.m (21 lb. ft.).
2. Rear compartment wiring harness to lid (14).

Torque Rods

Figure 8

Rear compartment torque rods are adjustable to increase or decrease operating effort. To increase assist, reposition the end of the torque rod to a higher torque rod bracket adjusting notch. To decrease assist, reposition the end of the torque rod to a lower torque rod bracket adjusting notch.

Remove or Disconnect

CAUTION: Prop lid in full-open position to keep rear compartment lid from falling when torque rods are disengaged from torque rod bracket. Personal injury or damage to vehicle could result if the rear compartment lid falls.

1. Torque rod (41) from brackets on hinges (17) using 1/2-inch inside diameter pipe.
 - Place pipe over torque rod end and lift up and out of bracket.
2. Hinge end of torque rod (41).
3. Repeat operation for other torque rod (41).

Install or Connect

1. Hinge end of torque rod (41).
2. Bracket end of torque rod (41) using 1/2-inch inside diameter pipe.
3. Repeat operation for other torque rod (41).

Adjust

- Bracket end of torque rod (41) as necessary.

Hinges

The rear compartment lid hinges are welded. They are precisely installed and spot-welded into the vehicle. Except for adjustment of the torque rods and removal of the rear compartment lid from the lid hinges, no other adjustments can be made.

REAR COMPARTMENT LOCK SYSTEM

Lock Cylinder

Figure 9

The cylinder is attached with a retainer which is secured by two rivets. It is necessary to remove the lock cylinder cover emblem prior to lock cylinder removal.

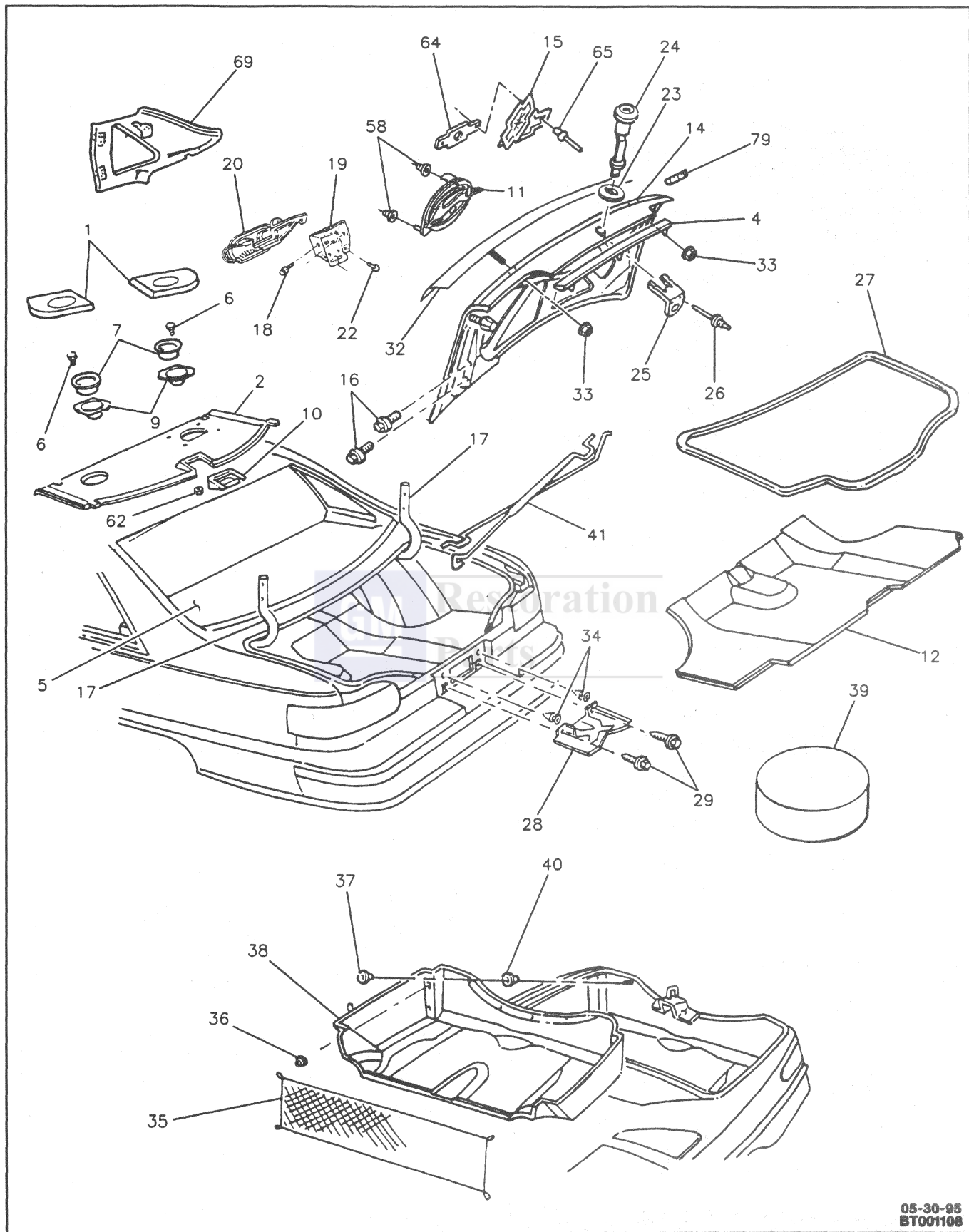


Figure 1 - Body Rear End-(Chevrolet Sedan)

10-8-4 BODY REAR END

- | | |
|---|---|
| 1 GRILLE, RADIO REAR SPEAKER | 27 WEATHERSTRIP, REAR COMPARTMENT LID |
| 2 TRIM, REAR WINDOW PANEL | 28 DOOR, FUEL TANK FILLER |
| 4 MOLDING, REAR COMPARTMENT LID LOWER | 29 BOLT/SCREW, FUEL TANK FILLER DOOR INNER COVER |
| 5 PANEL, REAR WINDOW | 32 SPOILER, REAR COMPARTMENT LID |
| 6 BOLT/SCREW, RADIO REAR SPEAKER | 33 NUT, REAR COMPARTMENT LID SPOILER |
| 7 SPEAKER, RADIO REAR | 34 BUMPER, FUEL TANK FILLER DOOR |
| 9 COVER, RADIO REAR SPEAKER OPENING | 35 NET, CONVENIENCE |
| 10 STOPLAMP, HIGH-MOUNT | 36 RETAINER, CONVENIENCE NET |
| 11 EMBLEM, REAR COMPARTMENT LID LOCK CYLINDER | 37 RETAINER, REAR COMPARTMENT TRIM |
| 12 TRIM, REAR COMPARTMENT FLOOR | 38 TRIM, REAR COMPARTMENT |
| 14 LID, REAR COMPARTMENT | 39 COVER, REAR COMPARTMENT SPARE WHEEL STOWAGE |
| 15 EMBLEM, REAR COMPARTMENT LID LOCK CYLINDER COVER | 40 SPACER, REAR END PANEL TRIM |
| 16 BOLT/SCREW, REAR COMPARTMENT LID HINGE LID SIDE | 41 TORQUE ROD, REAR COMPARTMENT LID HINGE |
| 17 HINGE, REAR COMPARTMENT LID | 58 NUT, REAR COMPARTMENT LID LOCK CYLINDER EMBLEM PUSH-ON |
| 18 BOLT/SCREW, REAR COMPARTMENT LID LOCK | 62 NUT, HIGH-MOUNT STOPLAMP SUPPORT |
| 19 LOCK, REAR COMPARTMENT LID | 64 GASKET, REAR COMPARTMENT LID LOCK COVER |
| 20 ACTUATOR, REAR COMPARTMENT LID LOCK RELEASE | 65 RIVET, REAR COMPARTMENT LID LOCK COVER |
| 22 BOLT/SCREW, REAR COMPARTMENT LID LOCK RELEASE | 69 MOLDING, QUARTER WINDOW GARNISH |
| 23 GASKET, REAR COMPARTMENT LID LOCK CYLINDER | 79 NAMEPLATE, REAR COMPARTMENT LID |
| 24 CYLINDER, LOCK | |
| 25 RETAINER, REAR COMPARTMENT LID LOCK CYLINDER | |
| 26 RIVET, REAR COMPARTMENT LID LOCK CYLINDER RETAINER | |

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Figure 2 - Body Rear End-(Chevrolet Sedan)-Legend

↔ Remove or Disconnect

1. Open rear compartment lid (14).
2. Rear compartment lid lock cylinder cover emblem, if equipped. Refer to "Rear Compartment Lid Lock Cylinder Cover Emblem" in this section.
3. Rear license lamp. Refer to SECTION 8B.
4. Retainer rivets (26) by carefully drilling them out with a 3/16-inch drill bit.
5. Retainer (25) away from lock cylinder (24) to release.
6. Lock cylinder (24) and gasket (23) from rear compartment lid (14).

→ Install or Connect

1. Gasket (23) to lock cylinder (24).
2. Lock cylinder (24) through hole in rear compartment lid (14).

! Important

- Check to ensure that lock cylinder shaft engages with lock and gasket (23) mates properly with rear compartment lid (14) for a watertight seal.
 - Check operation of lock cylinder (24) with key.
3. Retainer (25) through slot in rear compartment lid (14) and secure to lock cylinder (24).

4. Retainer rivets (26) through hole in rear compartment lid (14) aligned to retainer (25).
5. Rear license lamp. Refer to SECTION 8B.
6. Rear compartment lid lock cylinder cover emblem, if equipped. Refer to "Rear Compartment Lid Lock Cylinder Cover Emblem" in this section.

Lid Lock

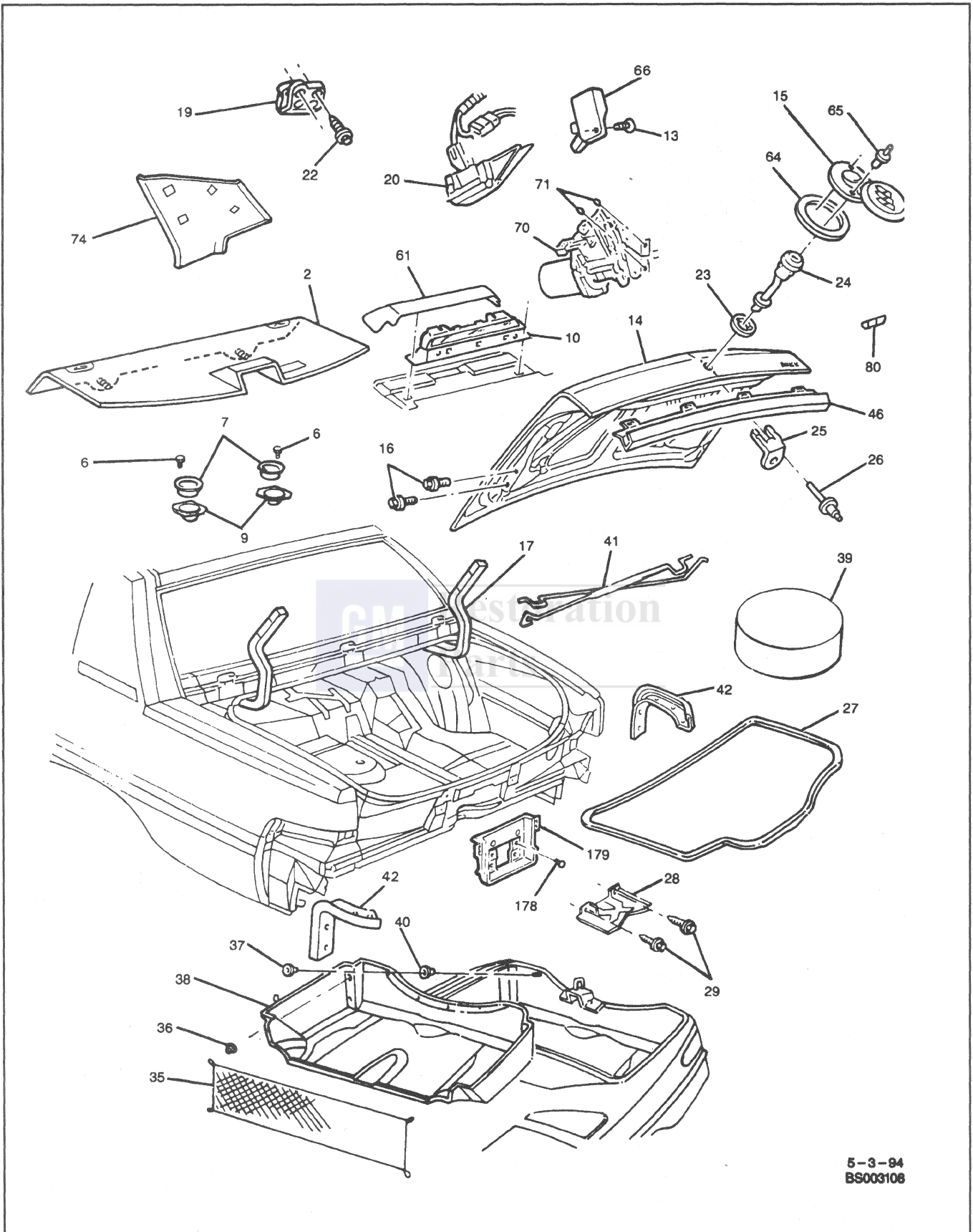
Figures 10 and 11

The rear compartment lid has an open face lock. Open face refers to the construction of a lock frame which does not completely encase the lock mechanism. The lock mechanism becomes encased by the panel or reinforcement to which it is attached. When the electric lid release option is specified, an actuator is bolted onto the existing lock.

The lid lock is used to adjust the quarter panel-to-rear compartment lid fit. By moving the lid lock up or down, the rear compartment lid can be positioned flush to the rear quarter panels.

↔ Remove or Disconnect

1. Mark location of lid lock (19).
2. Electrical connector from release actuator (20), if equipped.
3. Release actuator bolts/screws (22).
4. Release actuator (20) from lid lock (19).
5. Bolts/screws (18).
6. Lid lock (19) from rear compartment lid (14).



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Figure 3 - Body Rear End-(Buick Sedan)

10-8-6 BODY REAR END

- 2 TRIM, REAR WINDOW PANEL
- 6 BOLT/SCREW, RADIO REAR SPEAKER, 1.9 N·m (17 LB. IN.)
- 7 SPEAKER, RADIO REAR
- 9 COVER, RADIO REAR SPEAKER OPENING
- 10 STOPLAMP, HIGH-MOUNT
- 13 BOLT/SCREW, REAR COMPARTMENT LID PULL-DOWN SWITCH, 1.6 N·m (14 LB. IN.)
- 14 LID, REAR COMPARTMENT
- 15 EMBLEM, REAR COMPARTMENT LID LOCK CYLINDER COVER
- 16 BOLT/SCREW, REAR COMPARTMENT LID HINGE LID SIDE, 29 N·m (21 LB. FT.)
- 17 HINGE, REAR COMPARTMENT LID
- 19 LOCK, REAR COMPARTMENT LID
- 20 ACTUATOR, REAR COMPARTMENT LID LOCK RELEASE
- 22 BOLT/SCREW, REAR COMPARTMENT LID LOCK RELEASE ACTUATOR, 2.5 N·m (22 LB. IN.)
- 23 GASKET, REAR COMPARTMENT LID LOCK CYLINDER
- 24 CYLINDER, LOCK
- 25 RETAINER, REAR COMPARTMENT LID LOCK CYLINDER
- 26 RIVET, REAR COMPARTMENT LID LOCK CYLINDER RETAINER
- 27 WEATHERSTRIP, REAR COMPARTMENT LID
- 28 DOOR, FUEL TANK FILLER
- 29 BOLT/SCREW, FUEL TANK FILLER DOOR INNER COVER, 10 N·m (89 LB. IN.)
- 35 NET, CONVENIENCE
- 36 RETAINER, CONVENIENCE NET, 2.5 N·m (22 LB. IN.)
- 37 RETAINER, REAR COMPARTMENT FRONT TRIM
- 38 TRIM, REAR COMPARTMENT FRONT
- 39 COVER, REAR COMPARTMENT SPARE WHEEL STOWAGE
- 40 SPACER, REAR END PANEL TRIM
- 41 ROD, REAR COMPARTMENT LID HINGE TORQUE
- 42 MOLDING, REAR QUARTER TAILLAMP UPPER
- 46 MOLDING, REAR COMPARTMENT LID LOWER
- 61 COVER, HIGH-MOUNT STOPLAMP
- 64 GASKET, REAR COMPARTMENT LID LOCK COVER
- 65 RIVET, REAR COMPARTMENT LID LOCK COVER
- 66 SWITCH, REAR COMPARTMENT LID PULL-DOWN
- 70 ACTUATOR, REAR COMPARTMENT LID PULL-DOWN
- 71 NUT, REAR COMPARTMENT LID PULL-DOWN ACTUATOR, 10 N·m (89 LB. IN.)
- 74 TRIM, QUARTER UPPER
- 80 NAMEPLATE, REAR COMPARTMENT LID
- 178 RETAINER, REAR LICENSE POCKET
- 179 POCKET, REAR LICENSE

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Figure 4 - Body Rear End-(Buick Sedan)-Legend



Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Lid lock (19) to rear compartment lid (14).
 - Position lid lock (19) to marked location.
 - If new lid lock (19) is installed, bend back the metal tab that covers the slot into which the actuator tab fits.
2. Bolts/screws (18).



Adjust

- If a new lid lock (19) is used, make sure bolts/screws (18) are finger tight, then move lid lock (19) to desired position and close rear compartment lid (14). If necessary, repeat procedure until lid lock (19) latches and rear compartment lid (14) is flush with rear quarter panels.



Tighten

- Bolts/screws (18) to 4 N·m (35 lb. in.).
3. Release actuator (20) to lid lock (19) by hooking actuator tab into lock slot.
 4. Actuator bolts/screws (22).



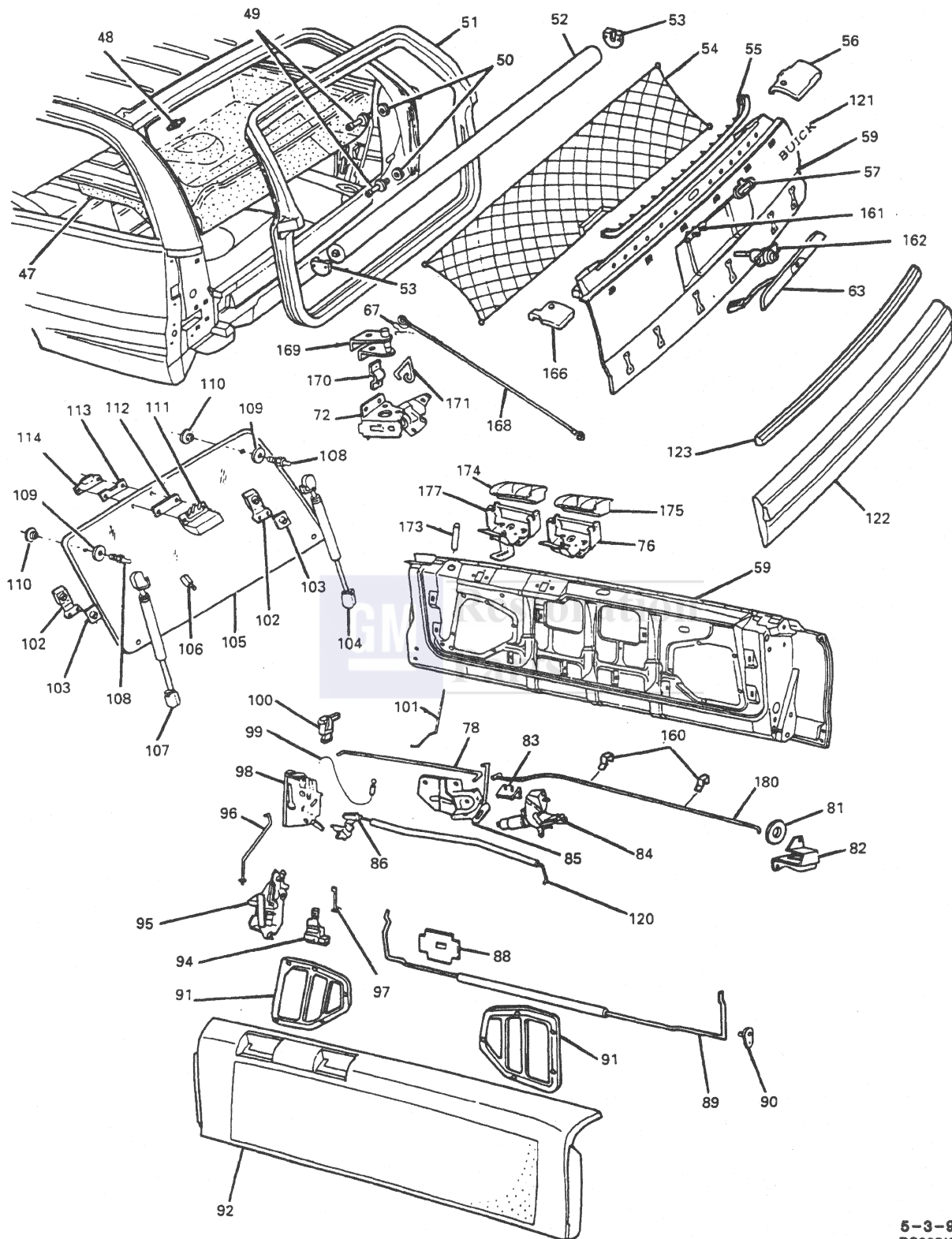
Tighten

- Actuator bolts/screws (22) to 2.5 N·m (22 lb. in.).
5. Electrical connector to release actuator (20), if equipped.



Inspect

- Close rear compartment lid (14) and check for proper rear compartment lid (14), lid lock (19) and key operation.
- Electric lid release for proper operation, if equipped.



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Figure 5 - Body Rear End-(Wagon)

10-8-8 BODY REAR END

- | | |
|---|--|
| 47 CARPET ASSEMBLY, THIRD SEAT FOOTWELL | 98 LOCK ASSEMBLY, END GATE UPPER |
| 48 STUD, END GATE WINDOW STRUT BODY SIDE,
12 N·m (106 LB. IN.) | 99 CABLE ASSEMBLY, END GATE DOOR RELEASE
HANDLE |
| 49 STRIKER ASSEMBLY, END GATE LATCH,
53 N·m (39 LB. FT.) | 100 SWITCH ASSEMBLY, END GATE LOCK |
| 50 WASHER, END GATE LOCK STRIKER | 101 ROD, END GATE LOCKING |
| 51 WEATHERSTRIP ASSEMBLY, END GATE | 102 HINGE ASSEMBLY, END GATE WINDOW |
| 52 SHADE ASSEMBLY, LUGGAGE | 103 GASKET, END GATE WINDOW WINDOW SIDE HINGE |
| 53 SUPPORT, LUGGAGE SHADE | 104 STRUT ASSEMBLY, END GATE WINDOW |
| 54 NET ASSEMBLY, CONVENIENCE | 105 WINDOW ASSEMBLY, END GATE |
| 55 WEATHERSTRIP ASSEMBLY, END GATE WINDOW | 106 STOP, REAR WINDOW WIPER BLADE |
| 56 MOLDING ASSEMBLY, END GATE UPPER OUTER
FINISHING | 107 STRUT ASSEMBLY, END GATE WINDOW |
| 57 BEZEL, END GATE WINDOW STRIKER | 108 STUD, END GATE WINDOW STRUT WINDOW SIDE,
9 N·m (80 LB. IN.) |
| 59 END GATE ASSEMBLY | 109 SPACER, END GATE WINDOW STRUT |
| 63 MOLDING ASSEMBLY, REAR LICENSE LAMP | 110 NUT, END GATE WINDOW STRUT |
| 67 SPRING, END GATE SUPPORT | 111 STOPLAMP ASSEMBLY, HIGH-MOUNT |
| 72 HINGE ASSEMBLY, END GATE LOWER | 112 GASKET, END GATE WINDOW STRIKER |
| 76 HANDLE ASSEMBLY, END GATE | 113 GASKET, END GATE WINDOW HANDLE |
| 78 ROD ASSEMBLY, END GATE UPPER LOCK | 114 HANDLE ASSEMBLY, END GATE WINDOW |
| 81 GROMMET, END GATE UPPER HINGE GATE SIDE
LOCK ROD | 120 ROD ASSEMBLY, END GATE LOCK CYLINDER |
| 82 LOCK ASSEMBLY, END GATE UPPER HINGE GATE
SIDE | 122 MOLDING ASSEMBLY, END GATE TRANSFER LOWER
FINISH |
| 83 LOCATOR ASSEMBLY, END GATE WINDOW | 123 MOLDING ASSEMBLY, END GATE TRANSFER UPPER
FINISH |
| 84 LATCH ASSEMBLY, END GATE WINDOW | 160 CLIP, END GATE UPPER HINGE GATE SIDE LOCK ROD |
| 85 BELLCRANK ASSEMBLY, END GATE UPPER HINGE
GATE SIDE LOCK ROD | 161 CONTACT ASSEMBLY, HIGH-MOUNT STOPLAMP |
| 86 BELLCRANK ASSEMBLY, END GATE LOCKING ROD | 162 CYLINDER ASSEMBLY, END GATE LOCK |
| 88 RETAINER ASSEMBLY, END GATE TORQUE ROD | 166 MOLDING ASSEMBLY, END GATE UPPER OUTER
FINISHING |
| 89 ROD, END GATE TORQUE | 168 SUPPORT ASSEMBLY, END GATE |
| 90 GROMMET, END GATE TORQUE ROD | 169 STRIKER ASSEMBLY, END GATE UPPER HINGE |
| 91 COVER, END GATE INNER PANEL ACCESS HOLE | 170 RETAINER, END GATE TORQUE ROD LINK |
| 92 PANEL ASSEMBLY, END GATE TRIM | 171 LINK, END GATE TORQUE ROD |
| 94 ACTUATOR ASSEMBLY, END GATE LOCK | 173 KNOB, END GATE LOCKING ROD |
| 95 LOCK ASSEMBLY, END GATE LOWER | 174 COVER, END GATE DOOR RELEASE HANDLE TRIM |
| 96 ROD ASSEMBLY, END GATE UPPER-TO-LOWER
LOCK CONNECTOR | 175 COVER, END GATE HANDLE TRIM |
| 97 ROD ASSEMBLY, END GATE LOCK ACTUATOR | 177 HANDLE ASSEMBLY, END GATE DOOR RELEASE |
| | 180 ROD ASSEMBLY, END GATE UPPER HINGE GATE
SIDE LOCK |

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Figure 6 - Body Rear End-(Buick Wagon)-Legend

Lid Lock Release Actuator

Figure 11

The rear compartment lid release allows the rear compartment lid to be unlocked from either the inside of the vehicle by means of a switch in the instrument panel compartment, or from the outside of the vehicle with the key or remote control door lock transmitter.

The rear compartment lid release consists of a release actuator and a wiring harness. The wiring harness is routed from the passenger compartment area to the rear compartment lid and connected to the release actuator. When the switch is pressed, the release actuator motor is energized, and the release lever pulls back and unlatches the rear compartment lid lock. The rear compartment lid then raises off the striker and may be raised to the open position.

The release actuator is internally protected against overheating by a plastic thermal coefficient device which is not serviceable.



Remove or Disconnect

1. Electrical connector from release actuator (20).
2. Actuator bolts/screws (22).
3. Switch bolt/screw (13), if Buick.
4. Switch (66), if Buick.
5. Actuator tab from slot in lid lock (19).



Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Actuator (20) to lid lock (19) by hooking actuator tab into lock slot.
 - If a new lid lock (19) is installed, bend back the metal tab that covers the slot into which the actuator tab fits.
2. Actuator bolts/screws (22).

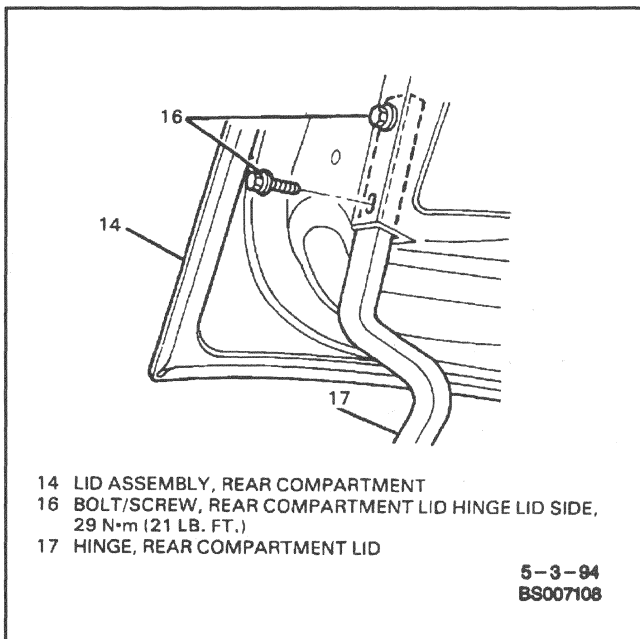


Figure 7 - Rear Compartment Lid Replacement

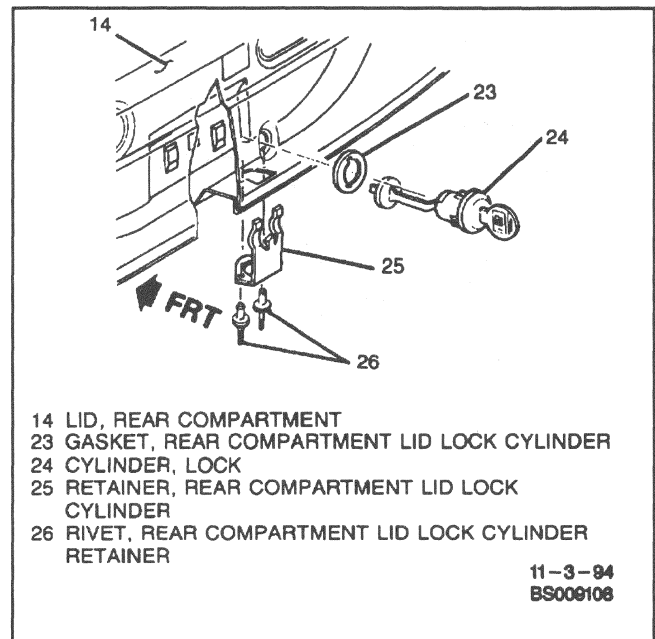


Figure 9 - Rear Compartment Lid Lock Cylinder

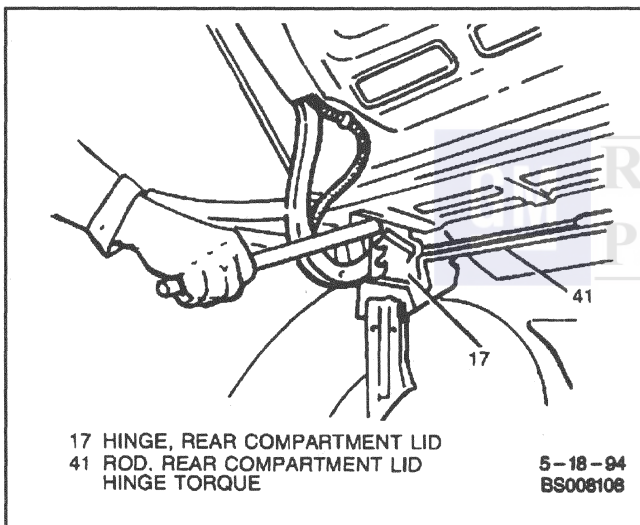


Figure 8 - Removing or Adjusting the Rear Compartment Lid Hinge Torque Rod



Tighten

- Actuator bolts/screws (22) to 2.5 N·m (22 lb. in.).
- 3. Switch (66), if Buick.
- 4. Switch bolt/screw (13), if Buick.



Tighten

- Switch bolt/screw (13) to 1.6 N·m (14 lb. in.).
- 5. Electrical connector to actuator (20).

Lid Lock Striker

CHEVROLET

The lid lock striker is welded to a reinforcement and the rear end panel and is therefore not adjustable.

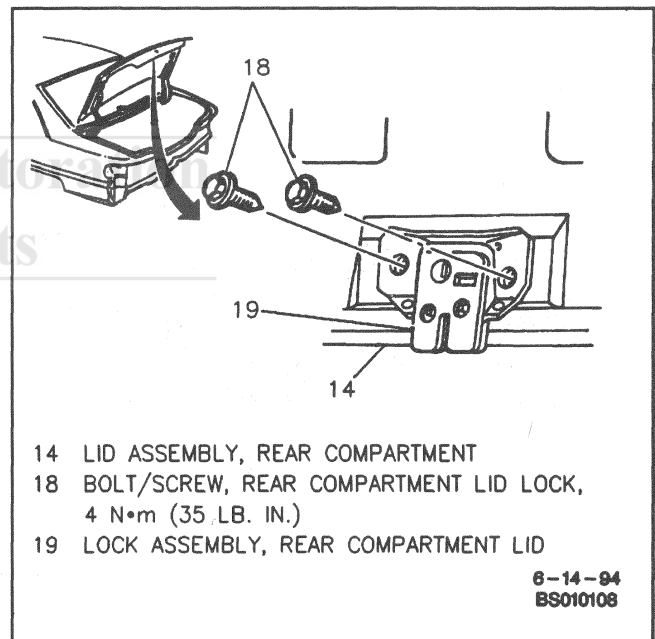


Figure 10 - Rear Compartment Lid Lock

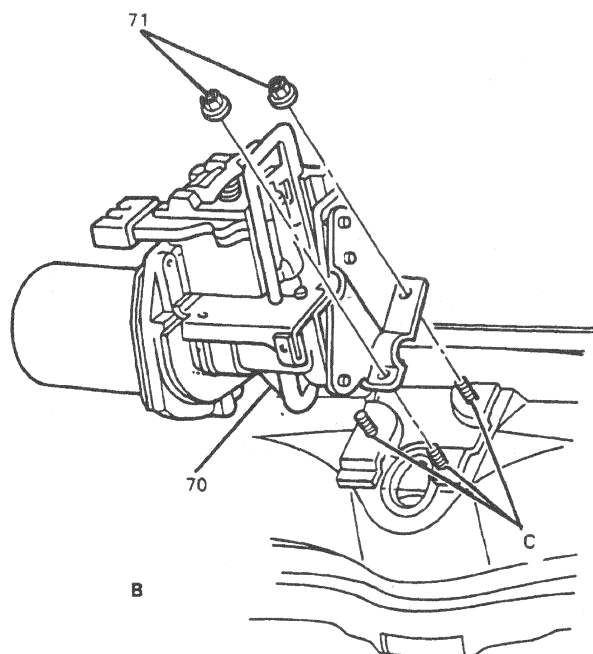
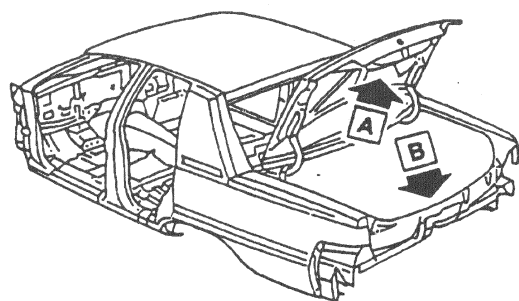
BUICK

Figure 12

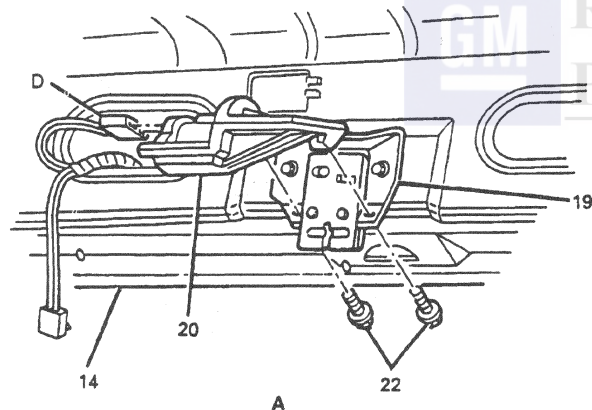


Remove or Disconnect

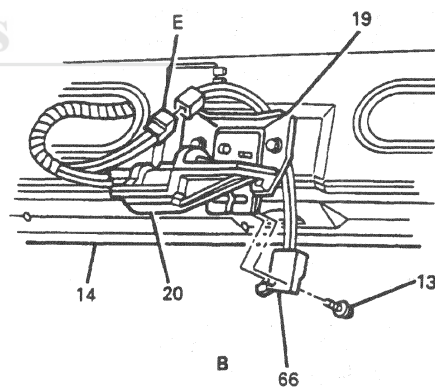
1. Open rear compartment lid.
2. Reposition rear compartment trim.
3. Nuts (77) from studs.
4. Lid lock striker (68).



VIEW B



VIEW A



- A WITHOUT PULL-DOWN OPTION (CHEVROLET AND BUICK)
- B WITH PULL-DOWN OPTION (BUICK)
- C STUD
- D CONNECTOR, ELECTRICAL
- E CONNECTOR, ELECTRICAL
- 13 BOLT/SCREW, REAR COMPARTMENT LID PULL-DOWN SWITCH, 1.6 N·m (14 LB. IN.)
- 14 LID ASSEMBLY, REAR COMPARTMENT
- 19 LOCK ASSEMBLY, REAR COMPARTMENT LID

- 20 ACTUATOR ASSEMBLY, REAR COMPARTMENT LID LOCK RELEASE
- 22 BOLT/SCREW, REAR COMPARTMENT LID LOCK RELEASE ACTUATOR, 2.5 N·m (22 LB. IN.)
- 66 SWITCH ASSEMBLY, REAR COMPARTMENT LID PULL-DOWN (BUICK)
- 70 ACTUATOR ASSEMBLY, REAR COMPARTMENT LID PULL-DOWN (BUICK)
- 71 NUT, REAR COMPARTMENT LID PULL-DOWN ACTUATOR, 10 N·m (89 LB. IN.) (BUICK)

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Figure 11 - Lid Lock Release Actuator and Pull-Down Actuator

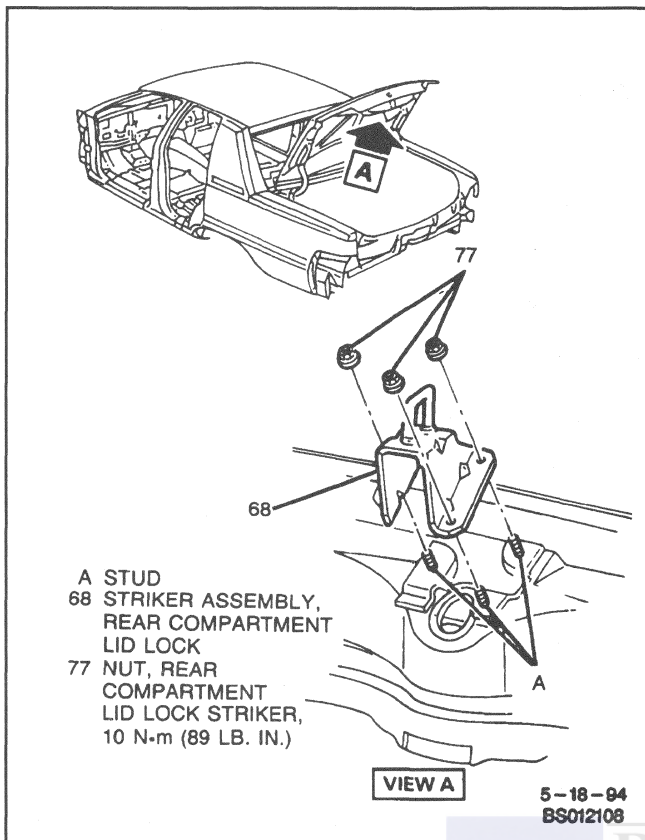


Figure 12 - Lid Lock Striker-(Buick)

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Lid lock striker (68).
2. Nuts (77) to studs.

Tighten

- Nuts (77) to 10 N-m (89 lb. in.).
3. Position rear compartment trim.
 4. Close rear compartment lid.

Pull-Down Actuator

BUICK

Figure 11

The rear compartment lid pull-down actuator allows the rear compartment lid to be closed with little effort from outside the vehicle.

Remove or Disconnect

1. Nuts (71) from pull-down actuator (70).
2. Electrical connector.
3. Pull-down actuator (70).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Pull-down actuator (70).
2. Electrical connector.
3. Nuts (71) to pull-down actuator (70).

Tighten

- Nuts (71) to 10 N-m (89 lb. in.).

REAR COMPARTMENT LID WEATHERSTRIP

Figure 13

A foam clinch type weatherstrip is used on all styles. The foam has an integral metal reinforced section which grips and seals the weatherstrip to the pinch-weld flange.

Remove or Disconnect

- Weatherstrip (27) by pulling from pinch-weld flange toward lower corners and then around complete opening.

Install or Connect

1. Weatherstrip (27).
 - A. Push centerline of weatherstrip (27) (marked with paint) on to the pinch-weld flange at the forward center line of the opening between the rear compartment lid hinges.
 - B. Use a rubber mallet to install weatherstrip (27) on the pinch-weld flange for proper seating.

Important

- Hit weatherstrip (27) square to pinch-weld flange.

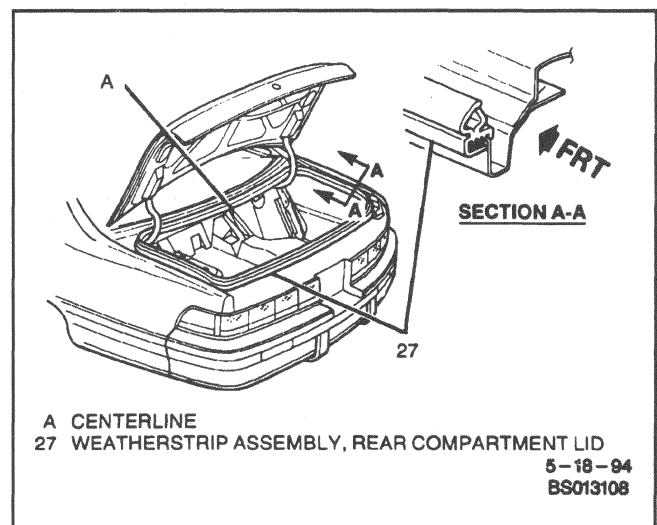


Figure 13 - Rear Compartment Lid Weatherstrip

10-8-12 BODY REAR END

- C. Continue installation from the forward centerline in both directions toward the rear center of the rear compartment.

Inspect

- Weatherstrip clinch cavity for proper seating to pinch-weld flange around entire opening.
2. Watertest around weatherstrip (27) for waterleaks. Refer to SECTION 10-1.
 - If waterleaks are present, remove and dry off weatherstrip (27) and install weatherstrip adhesive to cavity of weatherstrip (27) and reinstall.

REAR COMPARTMENT EXTERIOR TRIM

Rear Quarter Taillamp Upper Molding

BUICK

Figure 14

Remove or Disconnect

1. Rear lamps. Refer to SECTION 8B.
2. Bolts/screws (44).
3. Rear quarter taillamp upper molding (42).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Rear quarter taillamp upper molding (42).
2. Bolts/screws (44).

Tighten

- Bolts/screws (44) to 1.3 N·m (12 lb. in.).
3. Rear lamps. Refer to SECTION 8B.

Rear Quarter Nameplate Decal

IMPALA SS

Figure 15

Remove or Disconnect

- Decal.
 - A. Apply heat for about 30 seconds using a heat gun, making sure heat gun is moved in a circular motion and is held at least 152 mm (6 inches) from decal.
 - B. Peel the decal from the rear compartment lid (14) with a plastic flat-bladed tool making sure not to damage the paint.

Clean

- Area with a suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha, (Flammable Solvent).

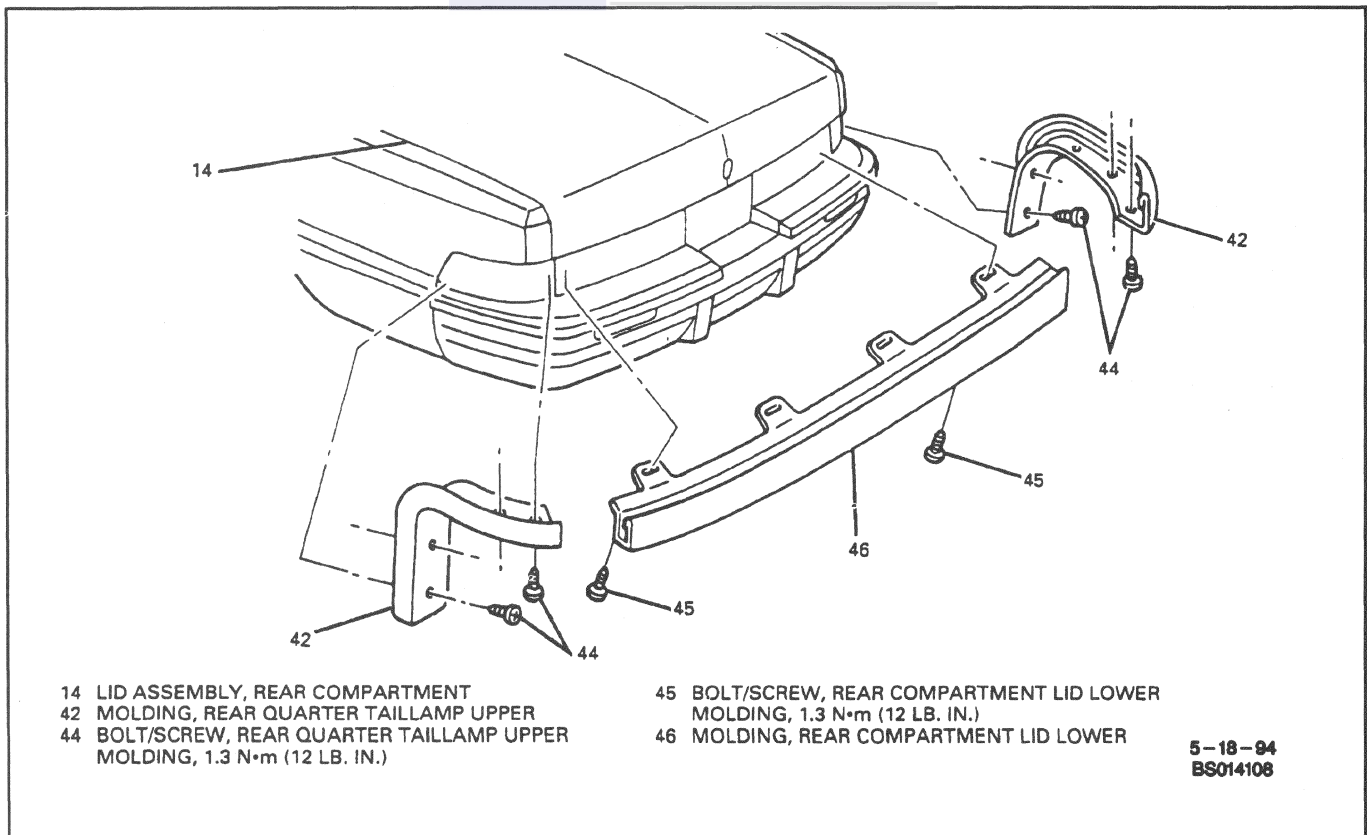


Figure 14 - Body Rear End Moldings-(Buick)

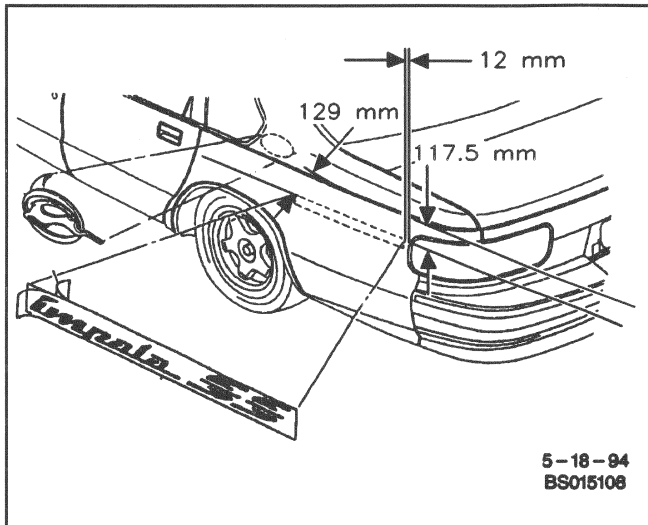


Figure 15 - Rear Quarter Nameplate Decal and Rear Quarter Emblem Positioning-(Chevrolet)

Install or Connect

- New decal.
 - A. Remove backing.
 - B. Body and part temperature must be 26° C (80° F) minimum or 6° C (10° F) above the ambient air temperature, whichever is higher, but not to exceed 40° C (105° F) during installation.

Important

- Position the decal as noted in figure 15 carefully on vehicle. The decal cannot be removed after contact with the vehicle.
- C. Press decal into place and apply constant pressure for 30 seconds.

Rear Quarter Emblem

IMPALA SS

Figure 15

The emblem is serviced the same way as the rear quarter nameplate decal. Refer to "Rear Quarter Nameplate Decal" in this section.

Rear Compartment Lid Lower Molding

CHEVROLET

Figure 16

Remove or Disconnect

1. Open rear compartment lid (14).
2. Nuts (44).
3. Close rear compartment lid (14).

4. Rear compartment lid lower molding (4).

- Peel rear compartment lid lower molding (4) from rear compartment lid (14) with a flat-bladed tool, making sure not to damage the paint. A heat gun can be used to aid in removal.



Clean

- Area with a suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha.



Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Rear compartment lid lower molding (4).

- A. Remove backing.
- B. Body and part temperature must be 26° C (80° F) minimum or 6° C (10° F) above the ambient air temperature, whichever is higher, but not to exceed 40° C (105° F) during installation.

2. Open rear compartment lid (14).

3. Nuts (44).



Tighten

- Nuts (44) to 4 N.m (35 lb. in.).

4. Close rear compartment lid (14).

BUICK

Figure 14



Remove or Disconnect

1. Open rear compartment lid (14).

2. Bolts/screws (45).

3. Rear compartment lid lower molding (46).



Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Rear compartment lid lower molding (46).

2. Bolts/screws (45).



Tighten

- Bolts/screws (45) to 1.3 N.m (12 lb. in.).

3. Close rear compartment lid (14).

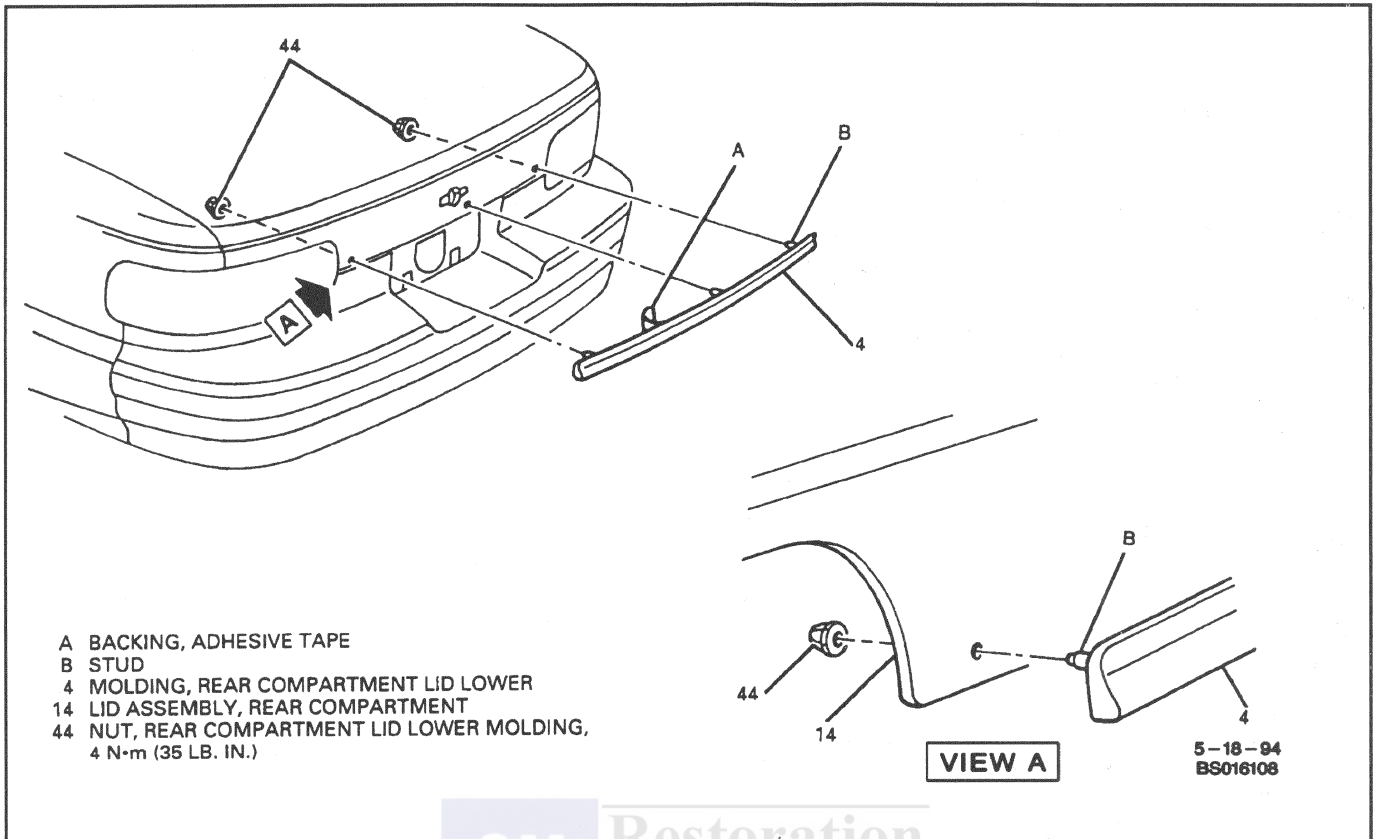


Figure 16 - Rear Compartment Lid Lower Molding-(Chevrolet)

Rear Compartment Lid Spoiler

IMPALA SS

Figure 17

Remove or Disconnect

1. Nuts (33).
2. Spoiler (32) from compartment lid.
 - A. Use a mono-filament fishing line (60 lb. test or equivalent) using a sawing motion back and forth, cut the adhesive bond.
 - B. Be careful not to damage the paint, remove the spoiler from the compartment lid.



Clean

1. Old tape from compartment lid using a plastic flat bladed tool.
2. Area with soap and water. Wipe dry.
3. Area with 50/50 mix of alcohol and water.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Spoiler (32) to compartment lid.
 - A. If needed, warm compartment lid surface with heat lamp or heat gun to 21° C (70° F).

- B. Pre-start removal of carrier papers from all tapes. Confirm that 4 Pull Tabs are positioned beyond spoiler (not tucked under spoiler).



Important

- If spoiler is being re-used, an adhesive such as double coated foam tape (3M#-06380) must be used.
- C. Insert spoiler studs into holes in compartment lid. If compartment lid is new, drill holes to 5mm.
 - D. While holding spoiler at center, take tabs and remove protective paper from center first. Left to right direction. Don't let go of center.



Important

- Pull Backing Paper backwards on itself. Do not exceed a 45° angle.
- E. Using a soft cloth, hand wipe front tape down onto compartment lid. Starting from the center going out in each direction.
 - F. Pull end tabs next. Right hand first.
 - G. Using a soft cloth. Hand press end tapes down (15 lbs pressure). Wipe from top to bottom.



Tighten

- Nuts (33) to 6 N·m (53 lb. in.).

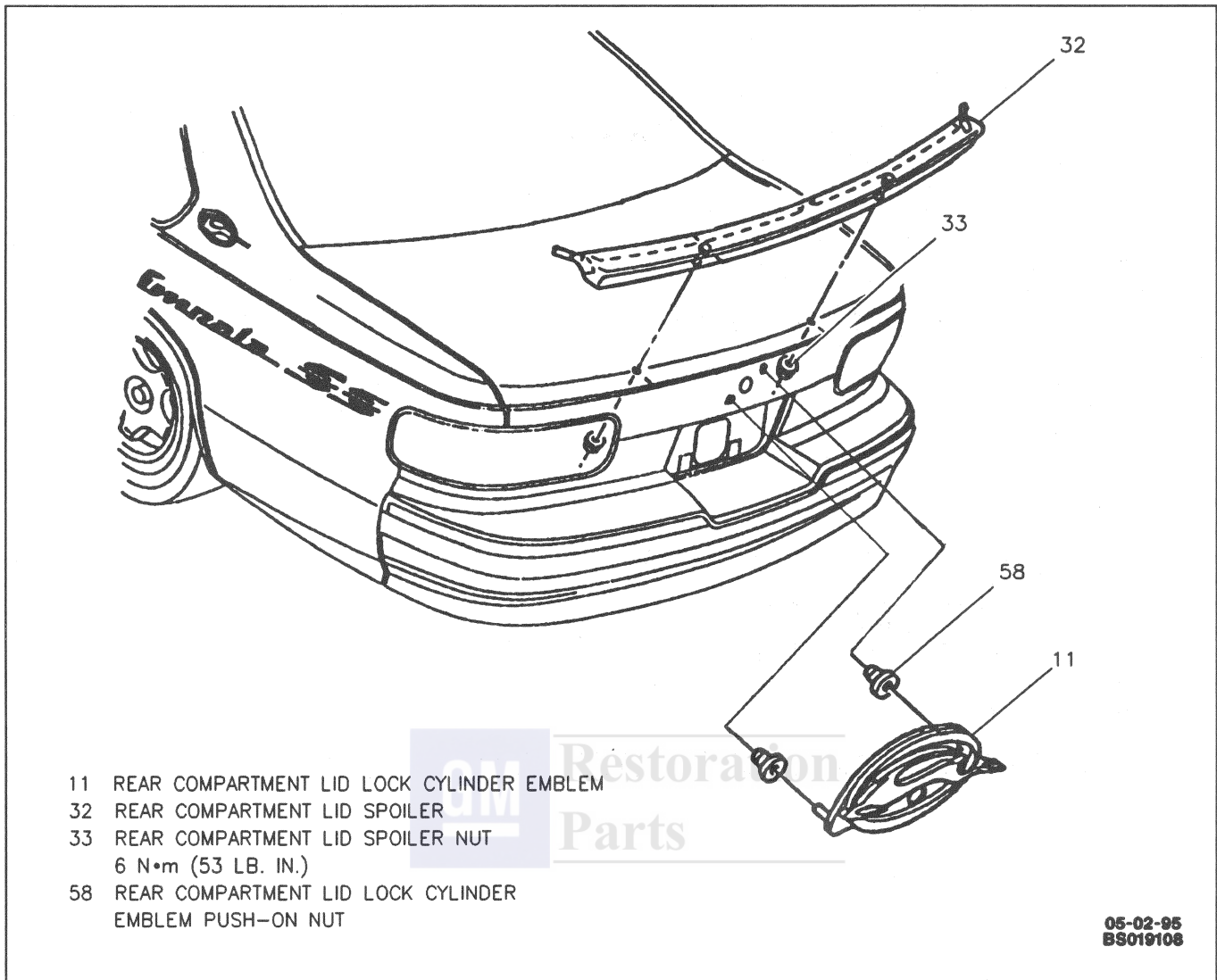


Figure 17 - Rear Compartment Lid Spoiler and Emblem-(Chevrolet)

! Important

- Be careful not to over tighten nuts (33) or spoiler may become warped. Foam tape will hold the spoiler in place. Nuts are only used for placement.

🧼 Clean

- Area with a suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha, (Flammable Solvent).

➡ Install or Connect

- New nameplate (79 or 80).
 - A. Remove backing.
 - B. Body and part temperature must be 26° C (80° F) minimum or 6° C (10° F) above the ambient air temperature, whichever is higher, but not to exceed 40° C (105° F) during installation.

! Important

- Position the nameplate (79 or 80) carefully on vehicle. The nameplate (79 or 80) cannot be removed after contact with the vehicle. Refer to Figures 18 and 19.
- C. Press nameplate (79 or 80) into place and apply constant pressure for 30 seconds.

Rear Compartment Lid Nameplate

Figures 18 and 19

↔ Remove or Disconnect

- Nameplate (79 or 80).
 - A. Apply heat for about 30 seconds using a heat gun, making sure heat gun is moved in a circular motion and is held at least 152 mm (6 inches) from nameplate (79 or 80).
 - B. Peel the nameplate (79 or 80) from the rear compartment lid (14) with a flat-bladed tool making sure not to damage the paint.

10-8-16 BODY REAR END

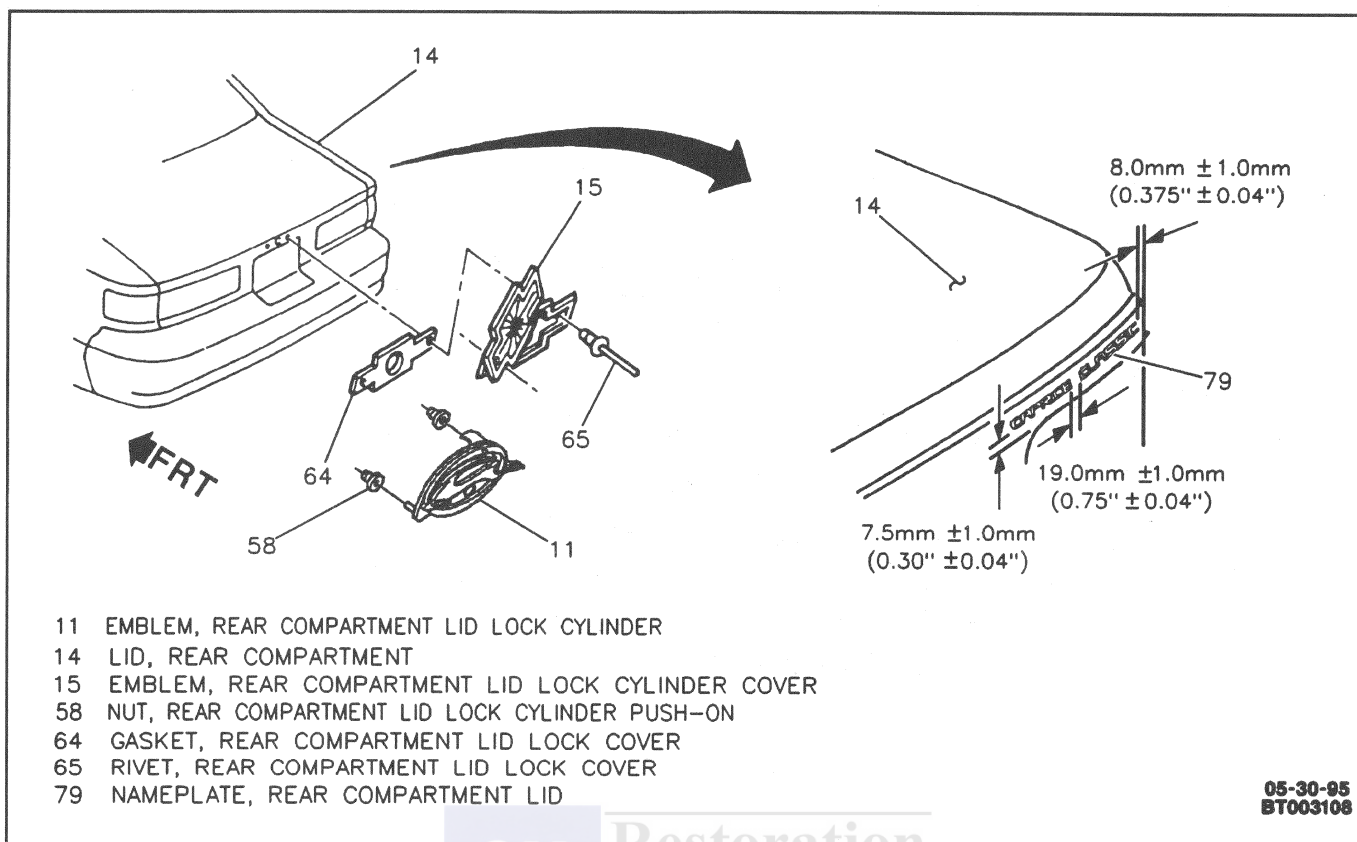


Figure 18 - Rear Compartment Lid Nameplate and Lid Lock Cylinder Cover Emblem-(Chevrolet)

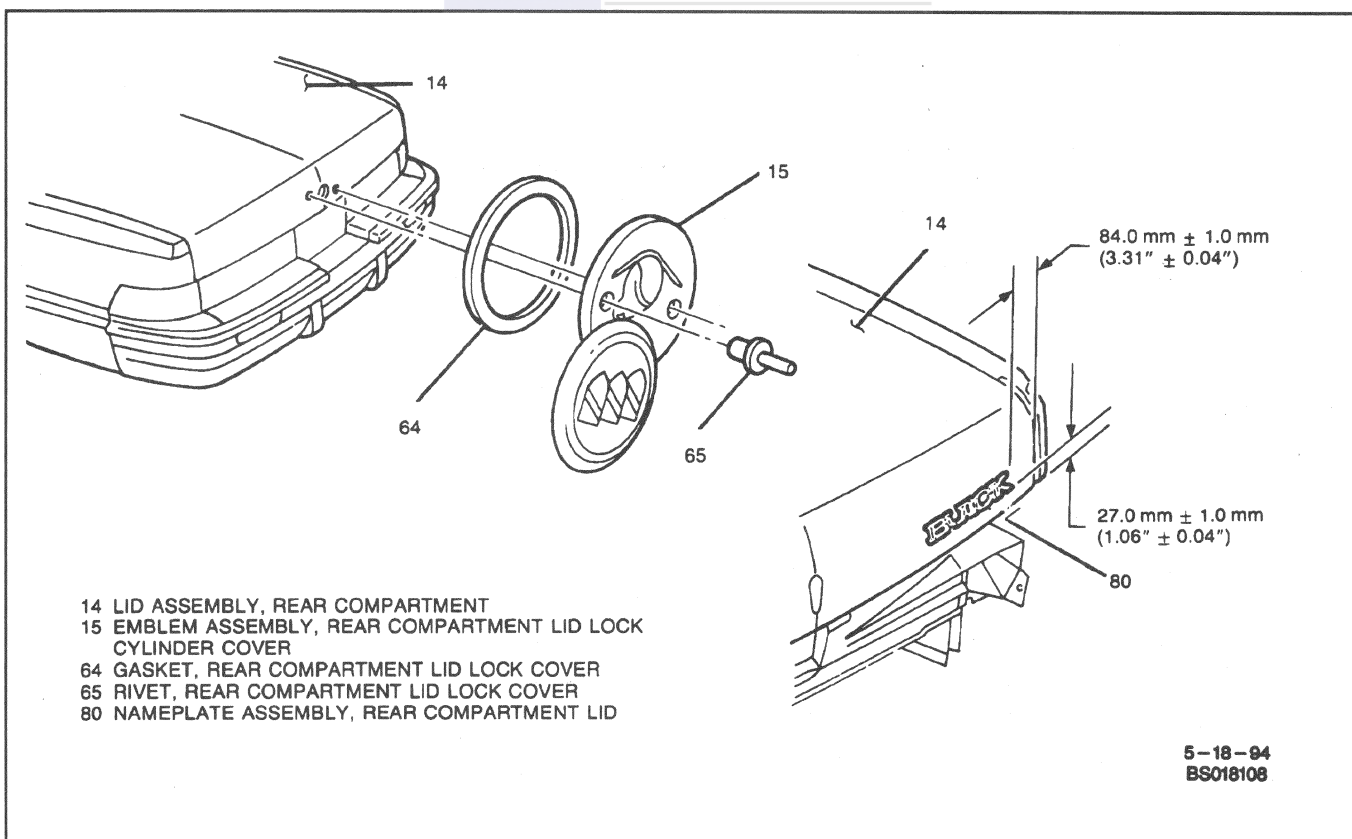


Figure 19 - Rear Compartment Lid Nameplate and Lid Lock Cylinder Cover Emblem-(Buick)

Rear Compartment Lid Lock Cylinder Cover Emblem

EXCEPT IMPALA SS

Figures 18 and 19

A swivel emblem attached with rivets is installed over the lock cylinder for all sedans except Impala SS. The Impala SS emblem uses both press in nuts and adhesive backing. These emblems must be removed prior to lock cylinder replacement except Impala SS.

Remove or Disconnect

1. Rivets (65) by drilling out with 3/16-inch diameter drill bit.
2. Emblem (15) and gasket (64).

Install or Connect

1. Emblem (15) and gasket (64).
 - Align emblem (15) and gasket (64) with attaching holes in rear compartment lid (14).
2. Rivets (65).

Important

- For proper installation use special rivets, GM P/N 9432137 or equivalent.

IMPALA SS

Figure 18

Remove or Disconnect

1. Emblem (11).
 - A. Hold air gun 152 mm (6 inches) away from emblem surface.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Use flat-bladed tool, being careful not to damage paint, and remove emblem (11) from door.
 - D. Discard emblem (11).
2. Nuts (58), if necessary.
 - Pry out.

Clean

1. Area with soap and water. Wipe dry.
2. Area with 50/50 mix of alcohol and water.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Nuts (58), if removed.
 - Press in.
2. Emblem (11).
 - A. If needed, warm Compartment Lid surface with heat lamp or heat gun to 21° C (70° F).

- B. Peel Paper from emblem (11).
 - Do not touch adhesive backing.
- C. Press emblem (11) to rear compartment lid to secure, aligning pins with nuts (58).

Rear License Pocket and Fuel Tank Filler Doors

Figures 20 and 21

Remove or Disconnect

1. Rear compartment trim, if Buick. Refer to "Rear Compartment Trim" in this section.
 - Reposition trim to provide access to rear lamps.
2. Rear lamps, if Buick. Refer to SECTION 8B.
3. Bolts/screws (29).
4. Door (28).
5. Splash shield (31) and nuts (30), if equipped.
6. Rear license pocket, if Buick.
 - A. Retainers (178), if necessary.
 - B. Rear license pocket (179), if necessary.
7. Bumpers (34), if Chevrolet.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Bumpers (34), if Chevrolet.
2. Rear license pocket, if Buick.
 - A. Rear license pocket (179), if removed.
 - B. Retainers (178), if removed.
3. Splash shield (31) and nuts (30), if removed.
4. Door (28).
5. Bolts/screws (29).

Tighten

- Bolts/screws (29) to 10 N.m (89 lb. in.).
6. Rear lamps, if Buick. Refer to SECTION 8B.
 7. Rear compartment trim, if Buick. Refer to "Rear Compartment Trim" in this section.

REAR COMPARTMENT INTERIOR TRIM

Convenience Net

Figures 1 through 6

Remove or Disconnect

1. Convenience net (35 or 54).
 - Detach convenience net loops from retainers (36), if sedan, or upper and lower retainers, if wagon.
2. Retainers (36), if necessary (sedan only).

10-8-18 BODY REAR END

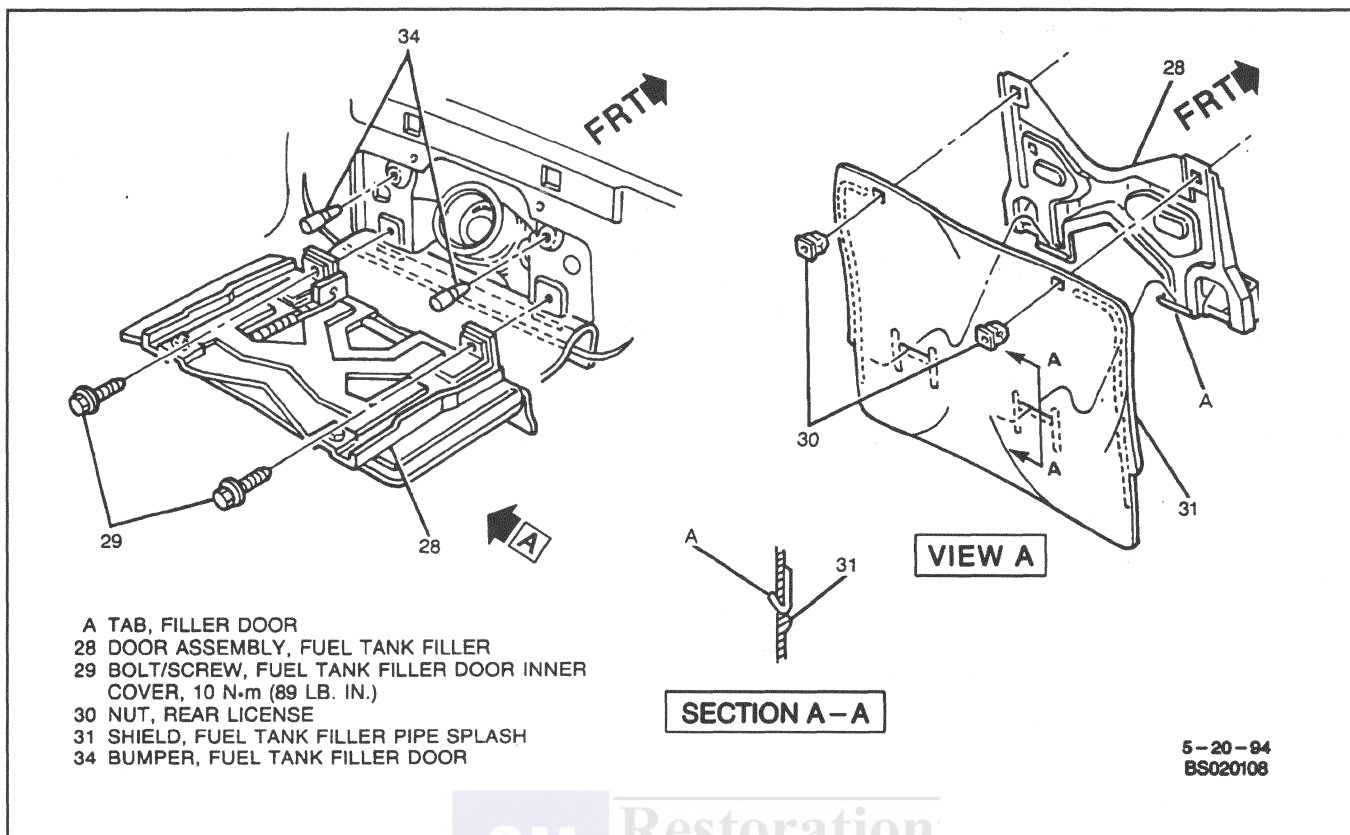


Figure 20 - Fuel Tank Filler Door-(Chevrolet)

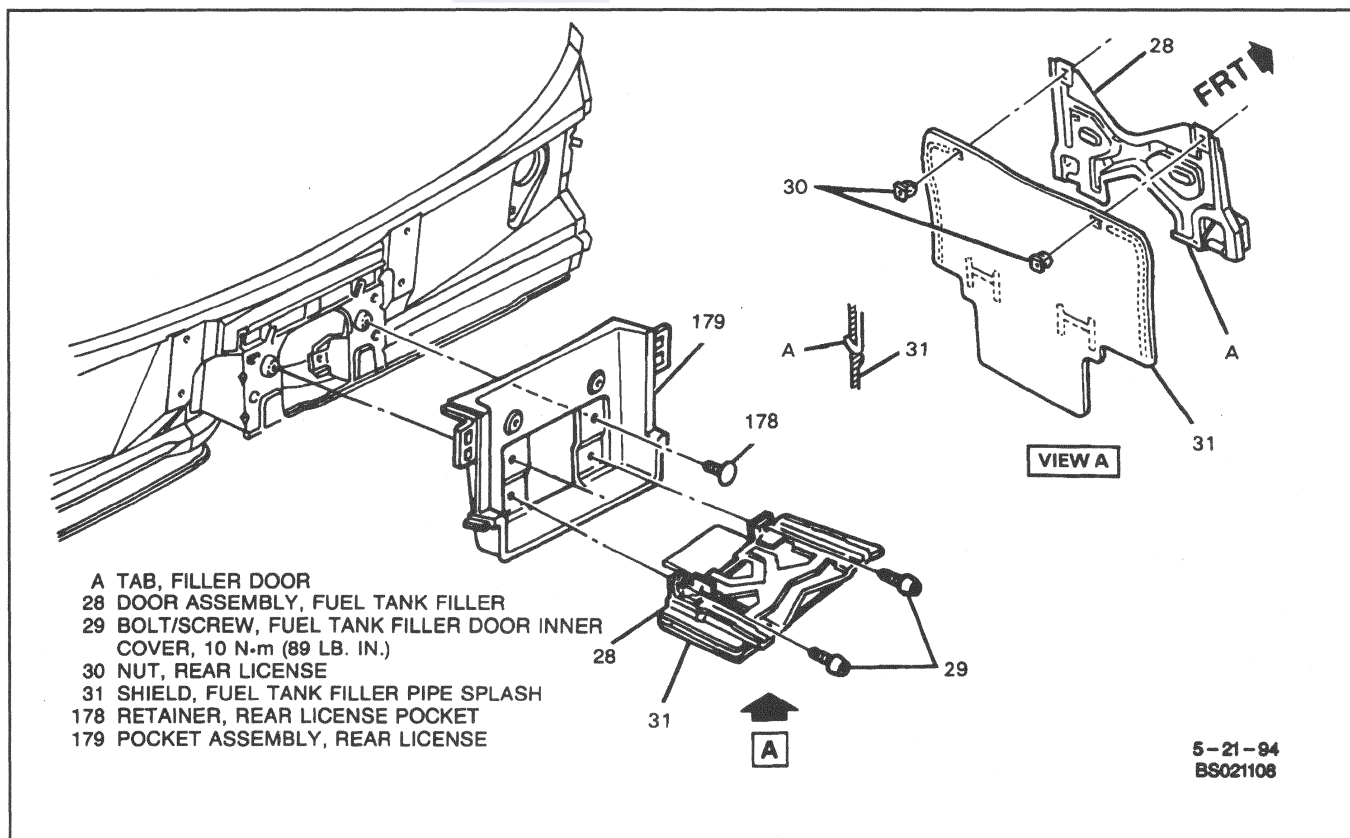


Figure 21 - Rear License Pocket and Fuel Tank Filler Doors-(Buick)

Install or Connect

NOTICE: Refer to “Notice” on page 10-8-1 of this section.

1. Retainers (36), if removed (sedan only).

Tighten

- Retainers (36) to 2.5 N·m (22 lb. in.).
2. Convenience net (35 or 54).
 - Attach convenience net loops to retainers (36), if sedan, or upper and lower retainers, if wagon.

Rear Compartment Trim

Figures 1 through 4

Remove or Disconnect

1. Spare tire and jack.
2. Convenience net (35).
 - Detach convenience net loops from retainers (36).
3. Retainers (36).
4. Trim retainers (37).
5. Trim (38).
6. Spacers (40), if necessary.

Install or Connect

NOTICE: Refer to “Notice” on page 10-8-1 of this section.

1. Spacers (40), if removed.
2. Trim (38).
3. Trim retainers (37).
4. Retainers (36).

Tighten

- Retainers (36) to 2.5 N·m (22 lb. in.).
5. Convenience net (35).
 - Attach convenience net loops to retainers (36).
 6. Jack and spare tire.

Rear Compartment Floor Trim

Figures 1 and 2

Remove or Disconnect

1. Spare tire and jack.
2. Rear compartment floor trim (12).

Install or Connect

1. Rear compartment floor trim (12).
2. Spare tire and jack.

Spare Wheel Storage Cover

The spare wheel storage cover is constructed of sewn carpet that fits over and around the spare tire. To remove, just pull off the cover.

REAR WINDOW UPPER PANEL

BUICK

Figure 22

Remove or Disconnect

1. Bolts/screws (183).
2. Rear window upper panel (182).

Install or Connect

NOTICE: Refer to “Notice” on page 10-8-1 of this section.

1. If necessary, replace spacers.
 - A. Place spacer (184) on quarter panel flange, aligning it between break lines on shelf panel.
 - B. Press firmly into position.
 - C. Slip spacers (185) onto outer rear shelf brackets with thick side of spacer (185) to rear of vehicle.
 - D. Slip spacer (186) onto center rear shelf bracket with thick side of spacer (186) to rear of vehicle.
2. Rear window upper panel (182).
 - Align rear window upper panel (182) to rear compartment lid and rear window opening.

Tighten

3. Bolts/screws (183) to 1.9 N·m (17 lb. in.).

REAR SEAT-TO-REAR WINDOW TRIM

Rear Window Panel Trim

CHEVROLET

Figures 1, 2, 23 and 24

Remove or Disconnect

1. Speaker grilles (1).
 - Remove retractor-side belts (43) from speaker grilles (1) and pull speaker grille (1) up and away from panel trim (2).
2. Quarter window garnish molding (69) from both sides of vehicle.
 - Disengage spring clips by pulling quarter window garnish molding (69) straight out.
3. Rear seatback cushion. Refer to SECTION 10-10.
4. Panel trim (2).
 - Carefully lift panel trim (2) up and away from stoplamp (10).

10-8-20 BODY REAR END

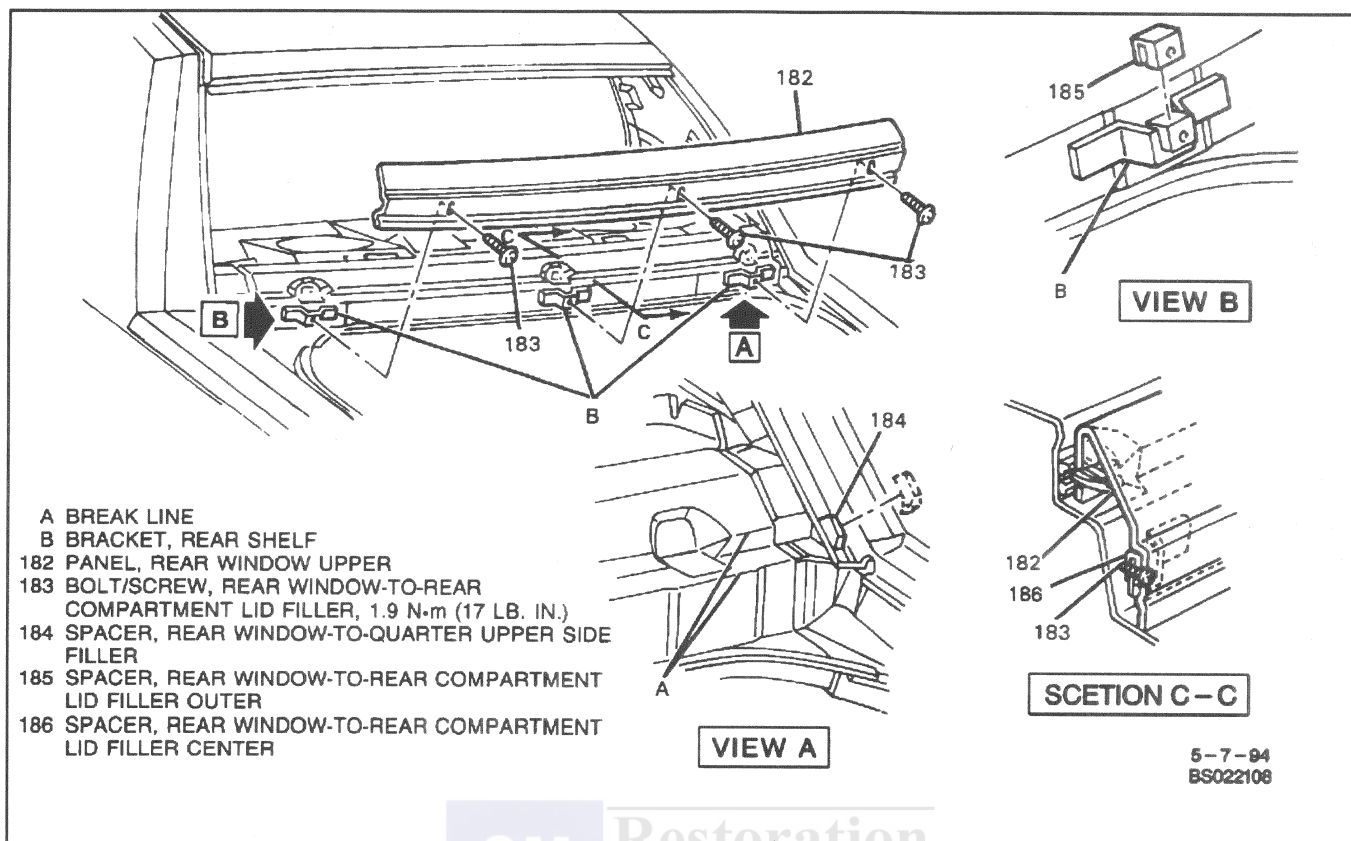


Figure 22 - Install Rear Window Upper Panel (without Vinyl Top)-(Buick)

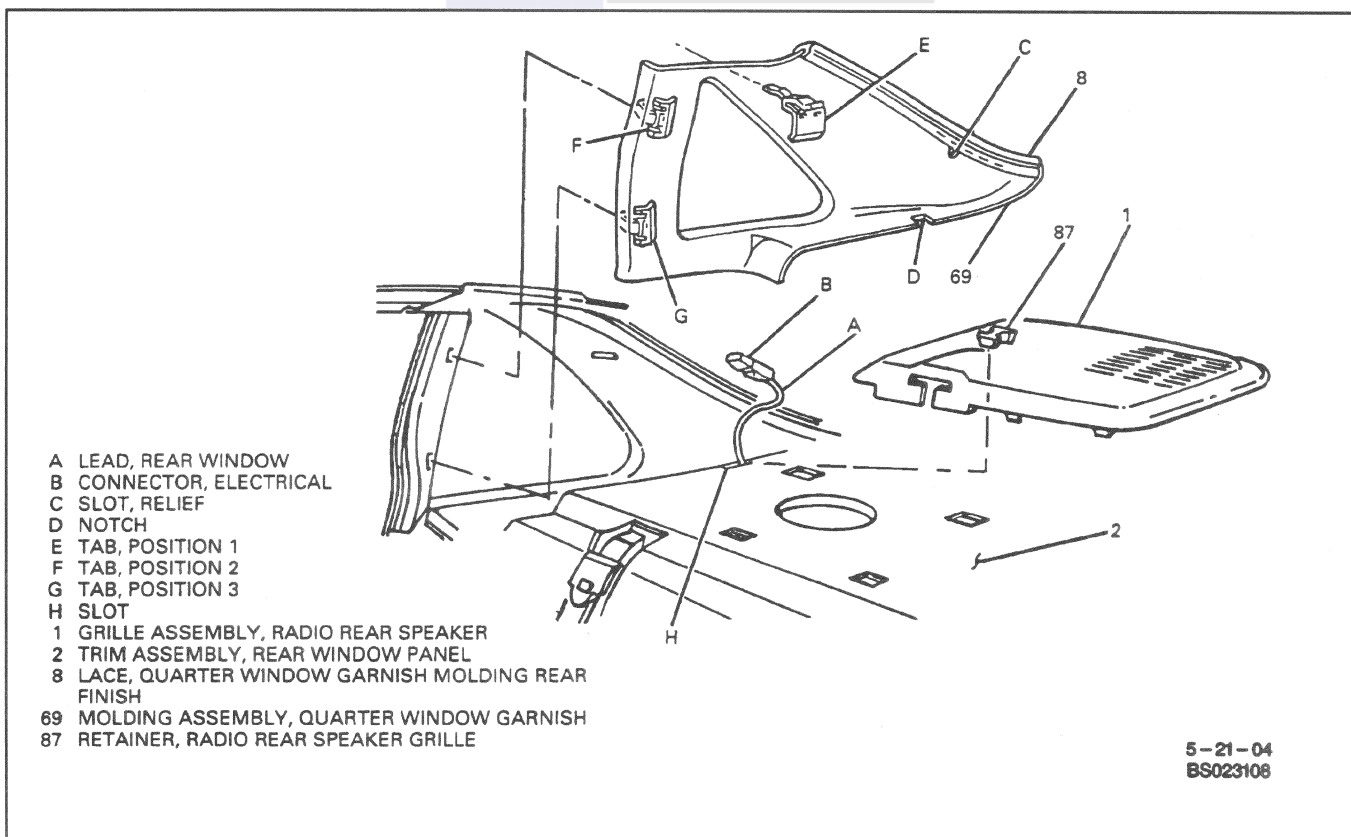


Figure 23 - Removing Quarter Window Garnish Molding and Speaker Grille-(Chevrolet)

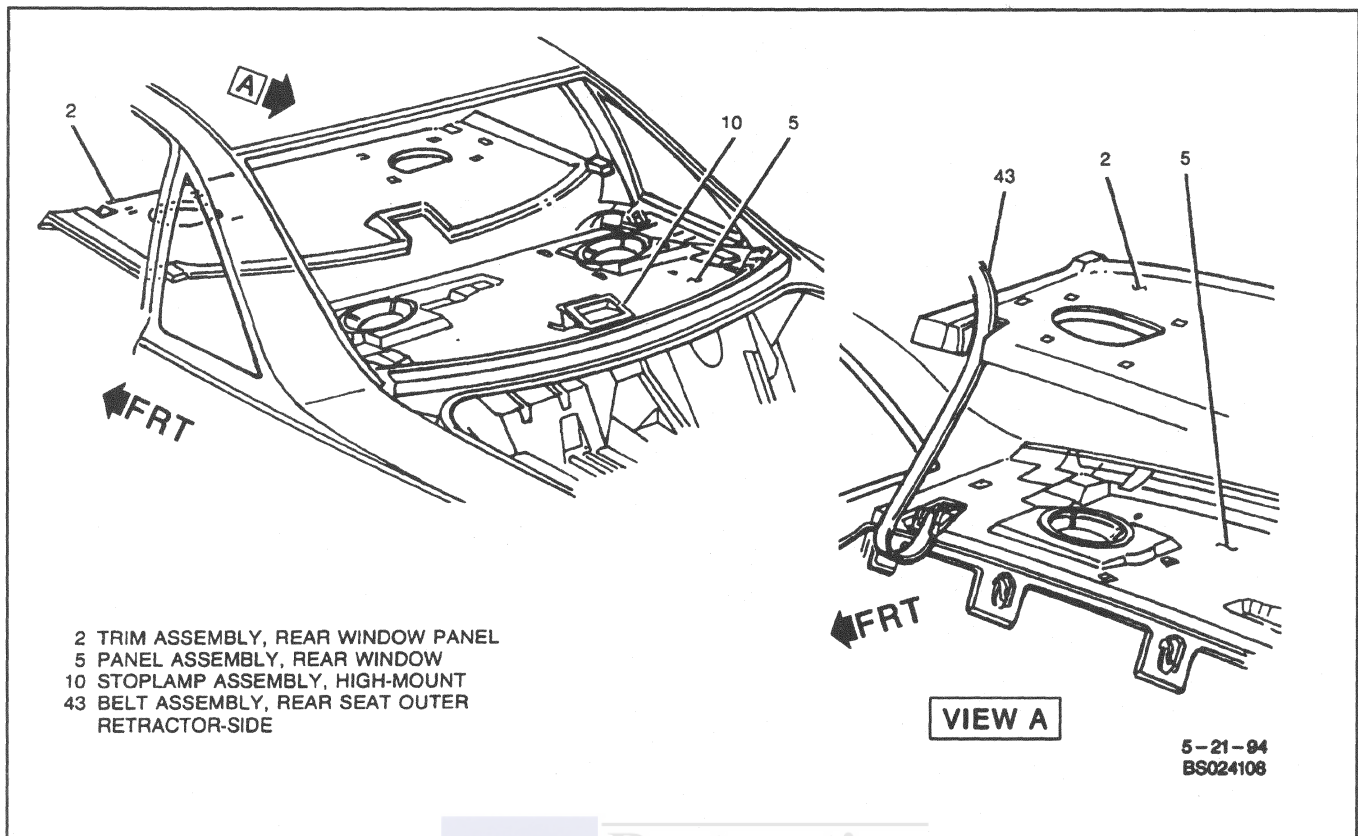


Figure 24 - Rear Window Panel Trim-(Chevrolet)

Install or Connect

1. Panel trim (2).
 - Push panel trim (2) back toward the rear window and around stoplamp (10).
2. Rear seatback cushion. Refer to SECTION 10-10.
3. Quarter window garnish molding (69) to both sides of vehicle.
 - Engage spring clips.
4. Speaker grilles (1).
 - A. Position retractor-side belt (43) into speaker grille slot.
 - B. Push in to engage speaker grille tabs in cutout slots in panel trim (2).
 - C. Make sure retainer (87), beneath speaker grille (1), is placed into slot on panel trim (2).

BUICK

Figures 3, 4, 25 and 26

Tool Required:
J 24595-C Door Trim Pad and Garnish Clip Remover

Remove or Disconnect

NOTICE: Disengage retainers carefully or damage to quarter upper trim may result.

1. Quarter upper trim (74) from both sides of vehicle.
 - Insert J 24595-C behind quarter upper trim (74) to carefully disengage retainers (75).
2. Rear seatback cushion. Refer to SECTION 10-10.
3. Stoplamp cover (61).
 - Disengage from clips by pulling straight back.
4. Retainers (3) from panel trim (2).
5. Panel trim (2).
 - A. Pull seat belts (43) from panel trim (2).
 - B. Carefully lift panel trim (2) up and away from stoplamp (10).

Install or Connect

1. Panel trim (2).
 - A. Insert seat belts (43) through slots in panel trim (2).
 - B. Push panel trim (2) back toward the rear window and around stoplamp (10).
2. Retainers (3) to panel trim (2) using sufficient pressure to fully seat retainers (3).
3. Stoplamp cover (61).
 - Slide stoplamp cover (61) onto stoplamp (10) until clips engage.
4. Rear seatback cushion. Refer to SECTION 10-10.
5. Quarter upper trim (74) to both sides of vehicle.
 - Apply sufficient pressure to secure retainers (75).

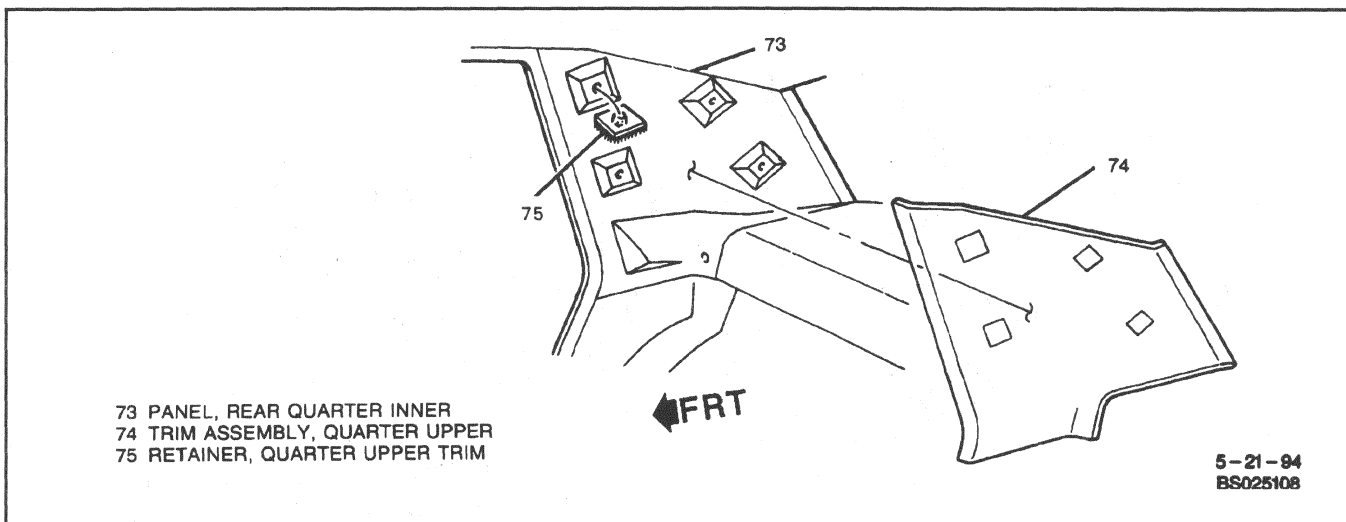


Figure 25 - Removing Quarter Upper Trim-(Buick)

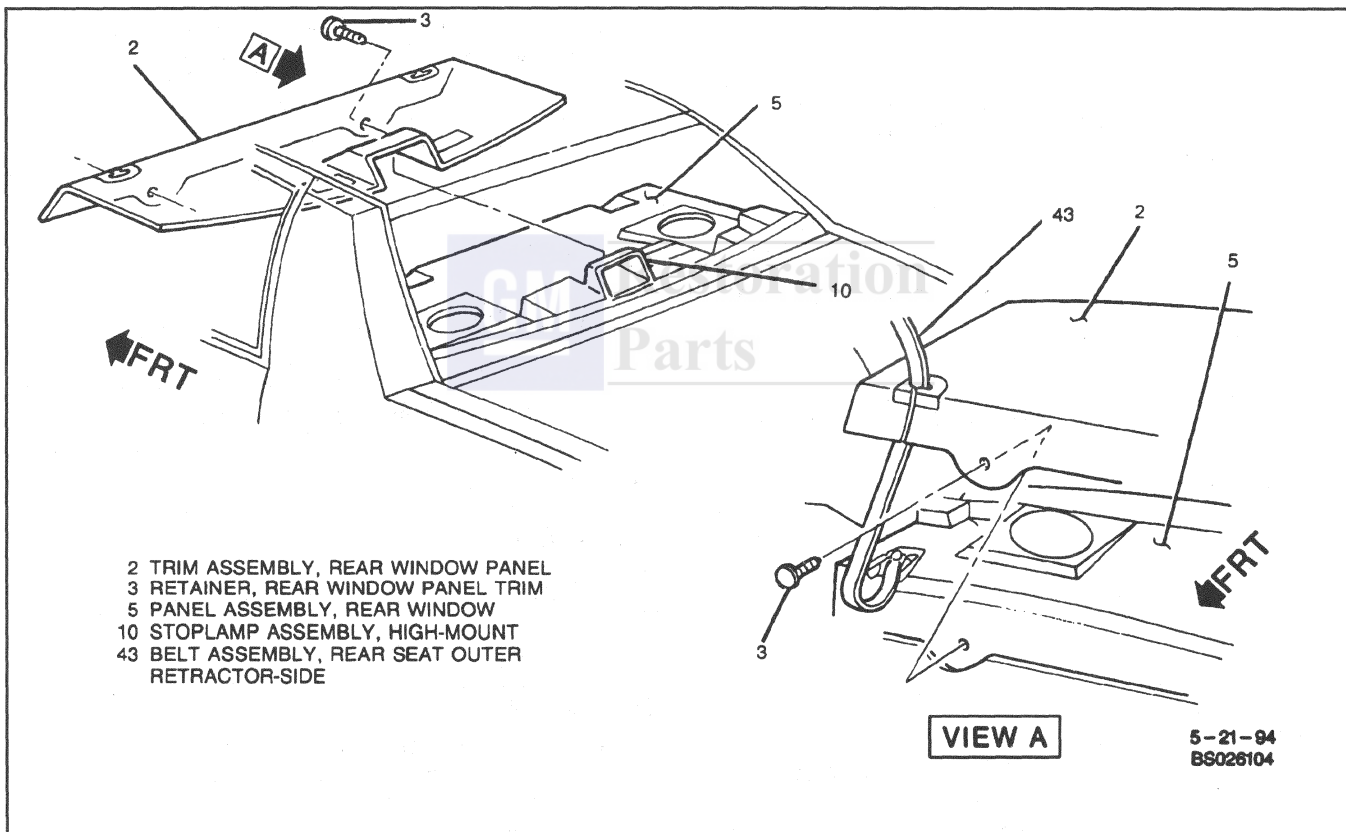


Figure 26 - Rear Window Panel Trim-(Buick)

Rear Speaker

Figures 23 and 27

The speakers is installed in the rear window panel. Access for removal is gained from inside of vehicle.

Remove or Disconnect

1. Speaker grille (1), if Chevrolet.

- Remove rear seat outer retractor-side belt from speaker grille (1) and pull speaker grille (1) up and away from panel trim (2).
2. Rear window panel trim. If Buick. Refer to "Rear Window Panel Trim" in this section.
 3. Bolts/screws (6).
 4. Speaker (7).
 5. Speaker connector from speaker (7).
 6. Speaker opening cover (9), if necessary.
 - Pull speaker connector through speaker opening cover slot.

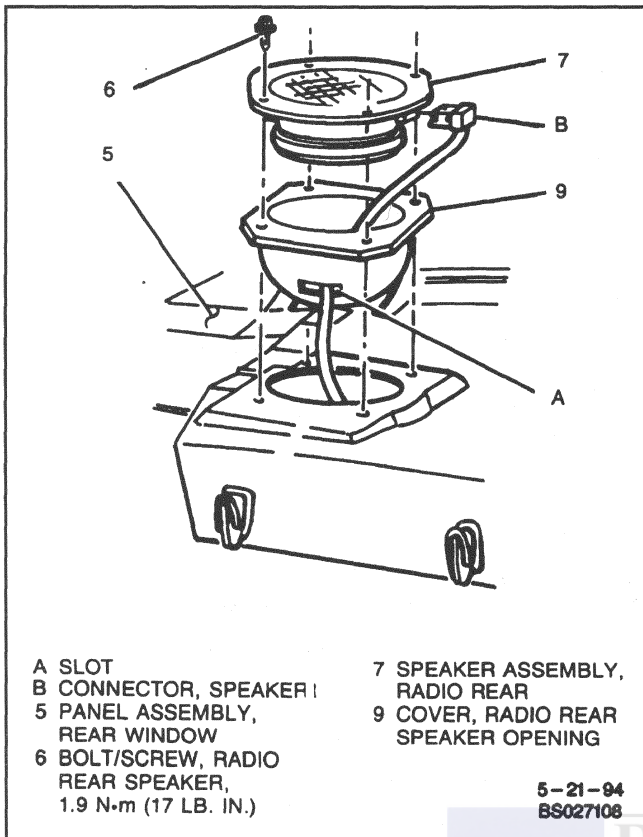


Figure 27 - Speaker-(Typical)

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Speaker opening cover (9), if removed.
 - Push speaker connector through speaker opening cover slot.
2. Speaker connector to speaker (7).
3. Speaker (7).
4. Bolts/screws (6).

Tighten

- Bolts/screws (6) to 1.9 N·m (17 lb. in.).
5. Speaker grille (1), if Chevrolet.
 - A. Position rear seat outer retractor-side belt into speaker grille slot.
 - B. Push in to engage speaker grille tabs in cutout slots in panel trim (2).
 - C. Make sure retainer (87), beneath speaker grille (1), is placed into slot on panel trim (2).
 6. Rear window panel trim. If Buick. Refer to "Rear Window Panel Trim" in this section.

High-Mount Stoplamp

CHEVROLET

Figure 28

Remove or Disconnect

1. Rear window panel trim. Refer to "Rear Window Panel Trim" in this section.
2. Nuts (62) from bolts/screws (60) on stoplamp (10).
3. Stop-lamp (10).
4. Electrical connector from stoplamp (10).
 - Squeeze tab on electrical connector to release it from stoplamp (10).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Electrical connector to stoplamp (10).
2. Stoplamp (10) to rear window panel (5).
 - Adjust stoplamp (10) so that there is a 2.5 mm (1/10-inch) gap between the top of the stoplamp (10) and the rear window (61).
3. Nuts (62).

Tighten

- Nuts (62) to 6 N·m (53 lb. in.).
4. Rear window panel trim. Refer to "Rear Window Panel Trim" in this section.

BUICK

Figure 29

Remove or Disconnect

1. Stoplamp cover (61).
 - Disengage from clips by pulling straight back.
2. Bolts/screws (60).
3. Electrical connector from stoplamp (10).
 - Squeeze tab on electrical connector to release it from stoplamp (10).
4. Stoplamp (10).
5. Nuts (62) from rear shelf panel, if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Nuts (62) into rear shelf panel, if removed.
2. Stoplamp (10) to rear shelf panel.
3. Electrical connector to stoplamp (10).
4. Bolts/screws (60).

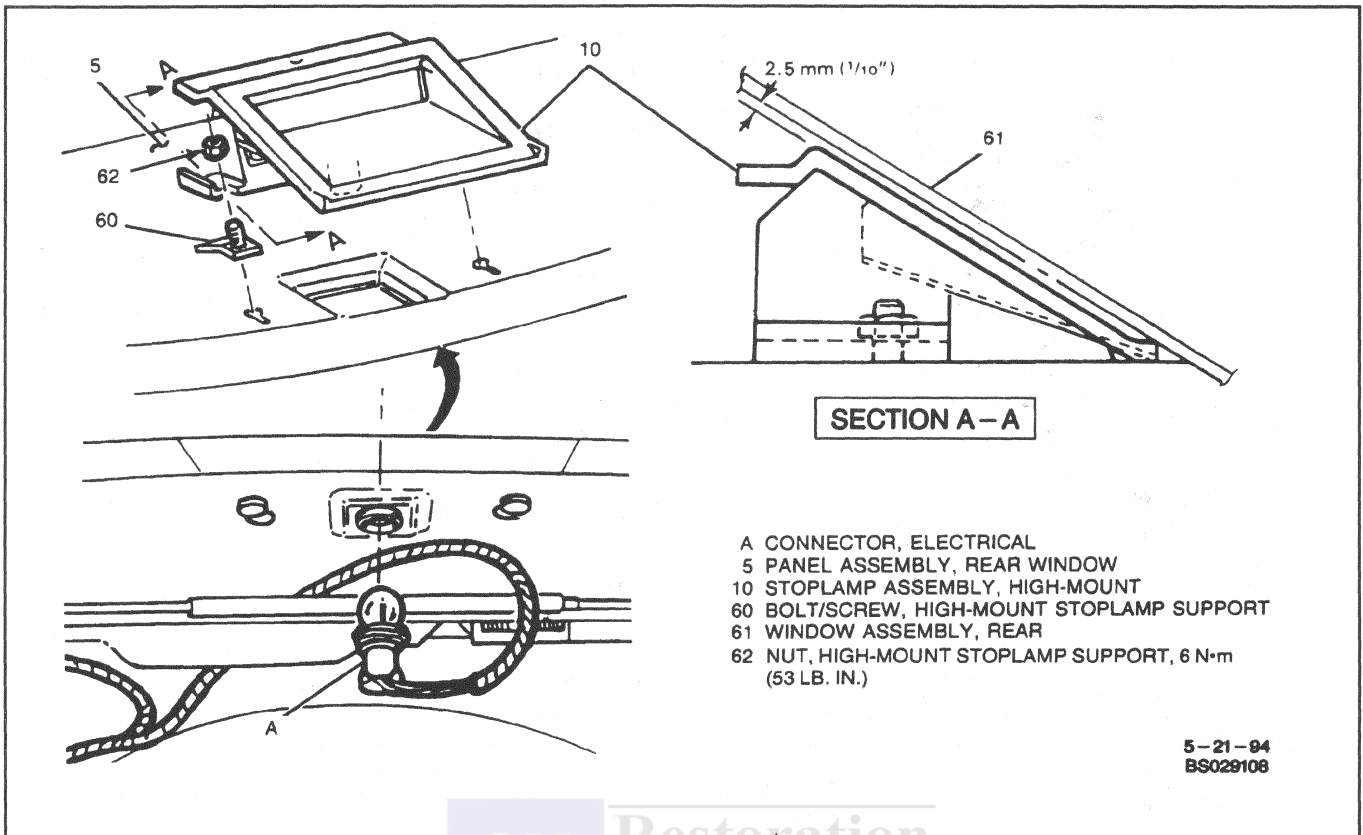


Figure 28 - High-Mount Stoplamp-(Chevrolet)

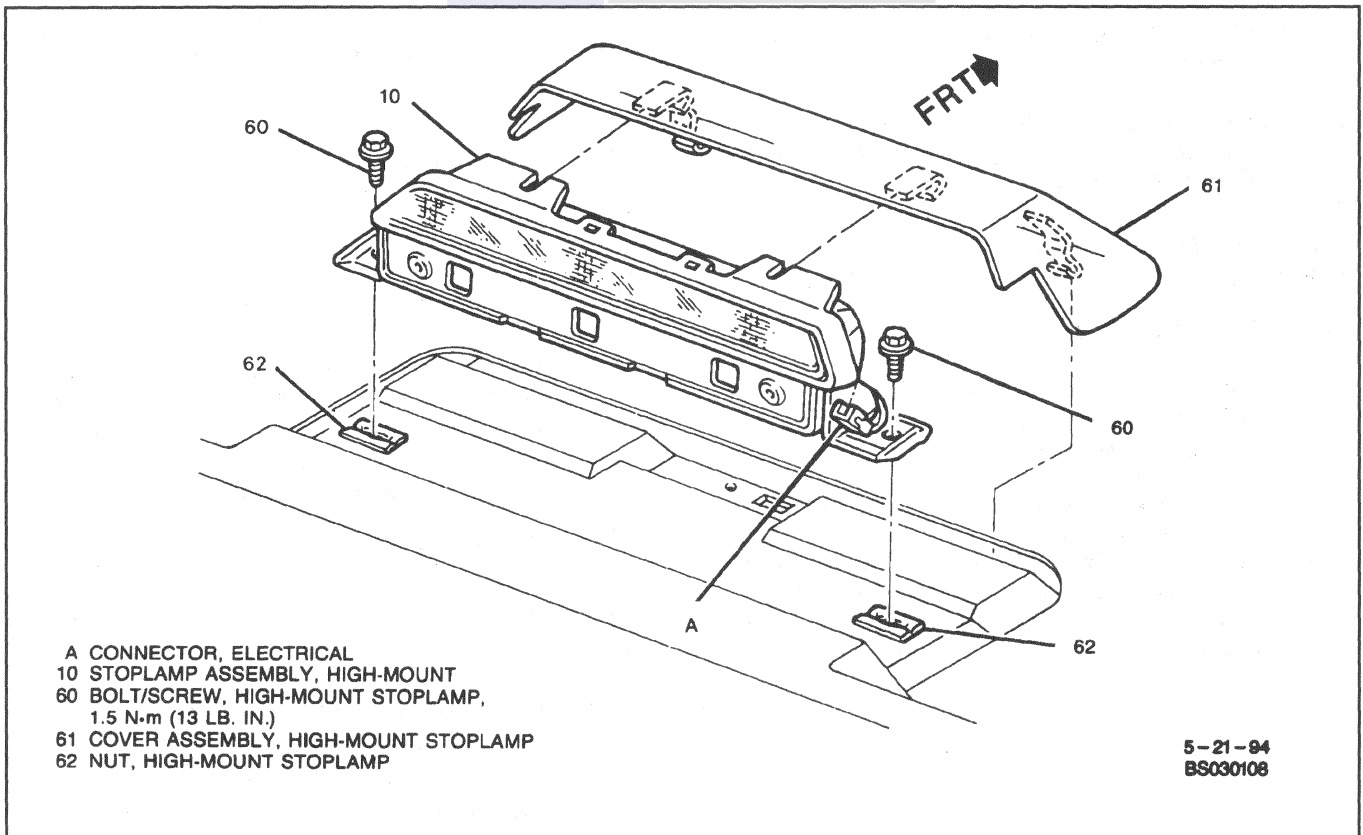


Figure 29 - High-Mount Stoplamp-(Buick)

**Tighten**

- Bolts/screws (60) to 1.5 N.m (13 lb. in.).
5. Stoplamp cover (61).
- Slide stoplamp cover (61) onto stoplamp (10) until clips engage.

TWO-WAY END GATE

The two-way end gate has a hinge and locking arrangement that allows the end gate to be operated as a door or gate when the end gate is closed but unlocked, and the window is raised. With power door locks, the end gate can be locked or unlocked by the

power door lock switch. The window can be unlatched by a switch on the instrument panel and, when equipped with manual door locks, this switch also locks or unlocks the end gate. A key turned in the end gate lock cylinder also unlocks the end gate and unlatches the window. Pressing the lock cylinder button will unlatch the window when the end gate is already unlocked. The end gate also has an inside locking knob.

To operate the end gate as a door, pull up on the end gate door release handle. To operate the end gate as a gate, pull up on the end gate handle. The end gate is counterbalanced by a torque rod that reduces the effort required to open or close the end gate.

TWO-WAY END GATE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
End gate does not open as a gate.	1. Lower right lock not latched. 2. Handle rod portion right upper lock rod, and/or left upper hinge gate side lock rod are disconnected.	1. Open as a door and slam it to latch. If the lock still is unlatched, the right lower latch striker should be adjusted. Open as a door, check operation of right lower lock by manually latching. Then activate end gate door release handle to unlatch. 2. This condition can be determined by trying to unlatch the upper locks. Either the right upper lock, the left upper hinge gate side lock or neither of the locks will unlatch. Open end gate as door and remove end gate handle trim cover and trim panel. NOTICE: Do not pull on left upper hinge gate side lock rod or the left upper hinge gate side lock will unlatch and drop end gate on rear bumper. • Close end gate as door. NOTICE: Be careful not to bend lock rod. Carefully pull the left upper hinge gate side lock rod toward the centerline of body, while activating the end gate release handle. Open to gate position. Synchronize locks and make lock synchronization check. Refer to "Two-Way End Gate Lock and Synchronization Check" in this section.

10-8-26 BODY REAR END

CONDITION	POSSIBLE CAUSE	CORRECTION
End gate does not open as a door, end gate is out of flush, or chucks at right upper corner.	1. Right upper latch striker too far rearward. 2. Left upper hinge gate side lock not latched. 3. Right upper to lower lock connector rod not engaged at upper and/or lower locks. 4. Cable disconnected from end gate door release handles.	1. This condition can prevent the left upper hinge gate side lock from latching. Readjustment of the right upper latch striker forward is necessary to allow both upper locks to latch. 2. Check for unlatched left upper hinge gate side lock by pulling on corner of end gate (end gate will chuck if unlatched). Open end gate and slam to latch. If the lock is still unlatched, the left upper hinge gate side lock will have to be adjusted forward. Refer to "Two-Way End Gate Adjustments" in this section. 3. Determine if rod is detached by visually inspecting with end gate open in the gate position and trim panel and access hole covers removed. 4. Connect or replace cable. NOTICE: Do not pull up on right upper-to-lower lock connector rod or the right lower lock will unlatch and drop the end gate on rear bumper. If right upper-to-lower lock connector rod is disconnected at either lock, attach right upper-to-lower lock connector rod and perform lock synchronization. Make lock synchronization check. Refer to "Two-Way End Gate Lock and Synchronization Check" in this section.
With end gate open as door and end gate release handle activated, left upper hinge gate side lock unlatches.	1. Improper synchronization of upper locks. 2. Bent upper horizontal lock rods.	1. Refer to "Two-Way End Gate Lock and Synchronization Check" in this section. 2. Replace rods and synchronize locks as outlined in "Two-Way End Gate Lock and Synchronization Check" in this section.
With end gate open as gate and end gate release handle activated, right lower lock unlatches.	1. Improper synchronization of right upper and lower locks. 2. Bent right upper-to-lower lock connector rod caused by using rod to unlock door.	1. Synchronize locks by following lock synchronization procedure. Refer to "Two-Way End Gate Lock and Synchronization Check" in this section. 2. Replace rods and synchronize locks as outlined in "Two-Way End Gate Lock and Synchronization Check" in this section.
End gate window will not open.	1. Defective lock switch on right upper lock, or solenoid or switch on window latch. 2. Broken shaft on lock cylinder.	1. Replace lock switch or window latch. 2. Replace lock cylinder.

TWO-WAY END GATE INTERIOR TRIM

Luggage Shade

Figure 30

↔ Remove or Disconnect

1. Luggage shade (52) from luggage shade supports (53).
2. Bolts/screws (125), if necessary.
3. Luggage shade supports (53), if necessary.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Luggage shade supports (53), if removed.
2. Bolts/screws (125), if removed.

⌚ Tighten

- Bolts/screws (125) to 1.9 N.m (17 lb. in.).
3. Luggage shade (52) to luggage shade supports (53).

Convenience Net

Figures 5 through 8

For procedure refer to "Convenience Net" under "Rear Compartment Interior Trim" in this section.

Rear Seat #2 Footwell Carpet

Figures 5 through 6

↔ Remove or Disconnect

1. Folding rear seat #2 cushion, if necessary. Refer to SECTION 10-10.

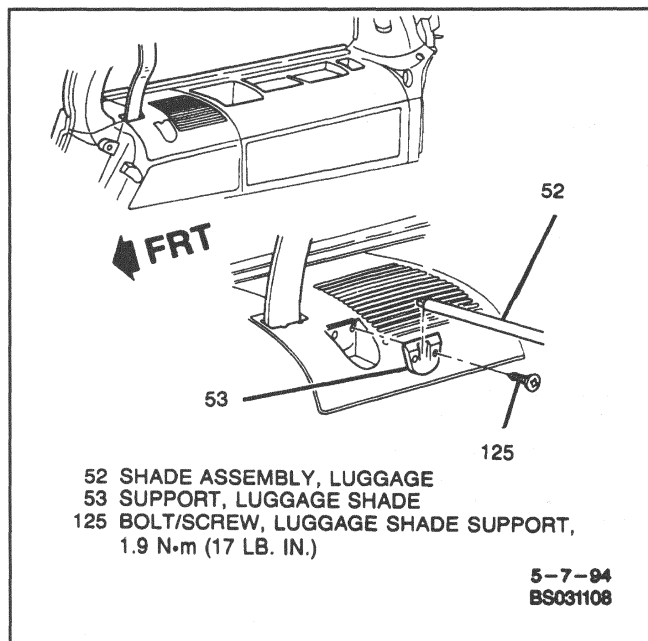


Figure 30 - Luggage Shade

2. Rear seat #2 footwell carpet (47).

⌚ Clean

- Glue residue from floor pan using solvent-dampened cloth.

↔ Install or Connect

1. Glue to floor pan.
2. Fold rear seat #2 footwell carpet (47) prior to installing.
3. Rear seat #2 footwell carpet (47).
 - Position and smooth out third seat footwell carpet (47) to fit contours of floor pan.
4. Folding third seat cushion, if removed. Refer to SECTION 10-10.

Handle Trim Covers

Figure 31

↔ Remove or Disconnect

1. Trim cover bolts/screws (164 or 165).
2. End gate door release handle cover (174) or end gate handle trim cover (175).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. End gate door release handle cover (174) or end gate handle trim cover (175).
2. Trim cover bolts/screws (164 or 165).

⌚ Tighten

- Trim cover bolts/screws (164 or 165) to 1.9 N.m (17 lb. in.).

Trim Panel

Figure 32

Tool Required:

J 24595-C Door Trim Pad and Garnish Clip Remover

The end gate trim panel hangs over the inner panel across the top and is secured by plastic trim retainers across the top and bottom and down the sides.

↔ Remove or Disconnect

1. Handle trim covers. Refer to "Handle Trim Covers" in this section.
2. Unthread locking rod knob.
3. Bolts/screws (126).
4. Plastic retainers using J 24595-C.
5. Trim panel (92).

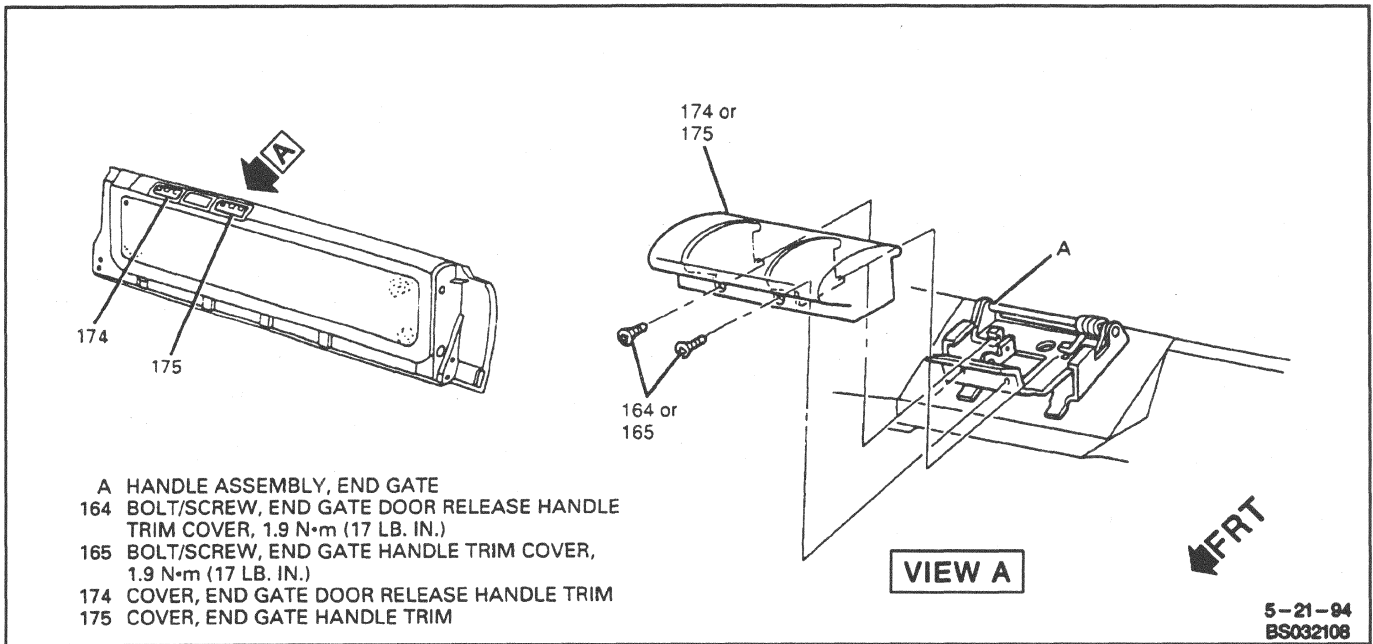


Figure 31 - Handle Trim Covers

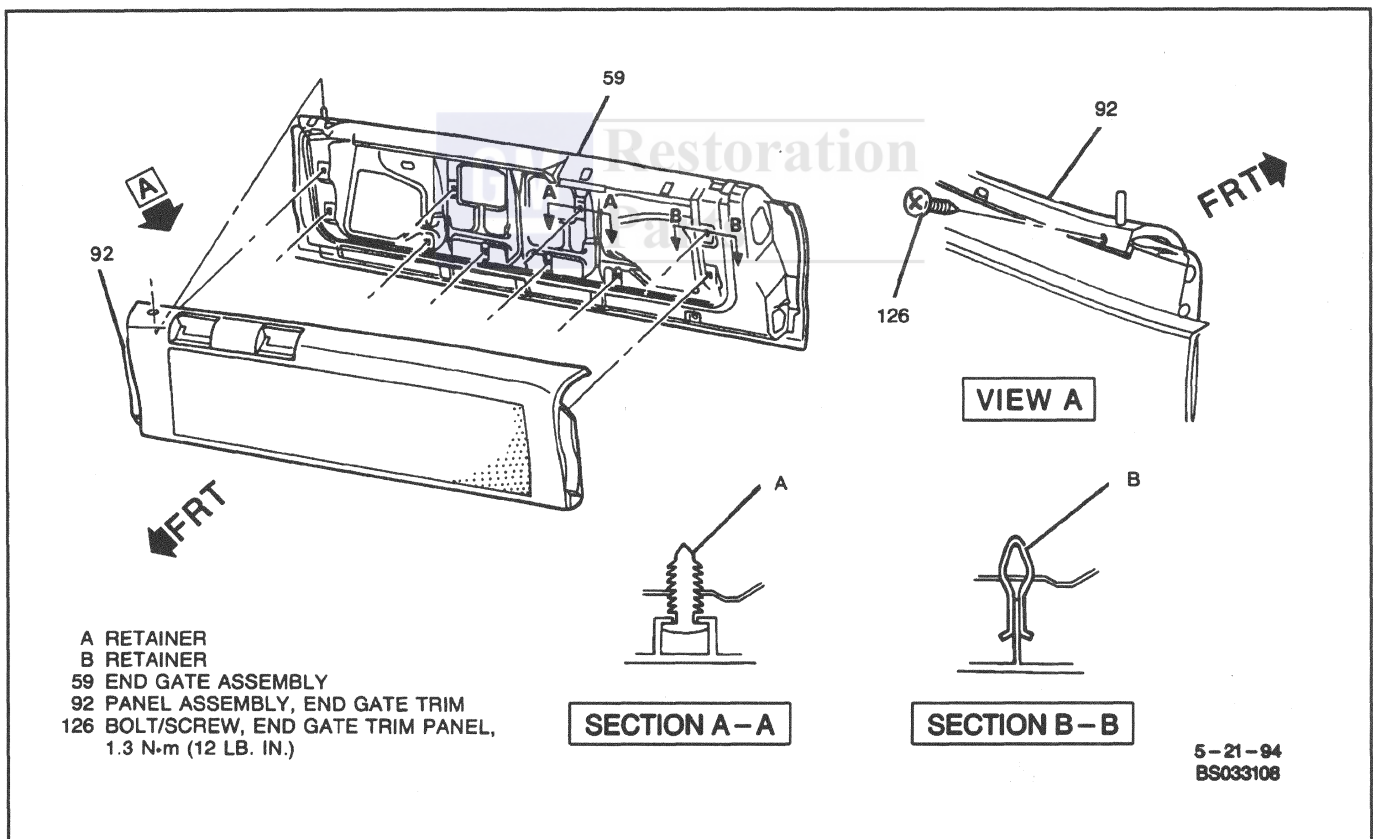


Figure 32 - Trim Panel

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Trim panel (92).
 - Hang trim panel (92) over top of end gate inner panel.

2. Plastic retainers using sufficient pressure to fully seat retainers.
3. Bolts/screws (126).

Tighten

- Bolts/screws (126) to 1.3 N·m (12 lb. in.).
4. Locking rod knob.

5. Handle trim covers. Refer to "Handle Trim Covers" in this section.

Locking Rod Knob

Figures 5 through 6

The locking rod knob (173) is removed by unthreading it from the locking rod (101).

Inner Panel Access Hole Covers

Figure 33

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Bolts/screws (133).
3. Inner panel access hole covers (91).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Inner panel access hole covers (91).
2. Bolts/screws (133).

Tighten

- Bolts/screws (133) to 1.5 N.m (13 lb. in.).
3. Trim panel. Refer to "Trim Panel" in this section.

TWO-WAY END GATE EXTERIOR TRIM

Nameplate

Figures 34 and 35

Remove or Disconnect

- Nameplate (117, 124 or 121).
 - A. Apply heat for about 30 seconds, using a heat gun, making sure heat gun is moved in a circular motion and is held at least 152 mm (6 inches) from nameplate (117, 124 or 121).
 - B. Peel the nameplate (117, 124 or 121) from the end gate (59) with a flat-bladed tool making sure not to damage the paint.

Clean

- Area with a suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha.

Install or Connect

- New nameplate (117, 124 or 121).
 - A. Remove backing.
 - B. Body and part temperature must be 26° C (80° F) minimum or 6° C (10° F) above the ambient air temperature, whichever is higher, but not to exceed 40° C (105° F) during installation.

Important

- Position the nameplate (117, 124 or 121) carefully on vehicle. The nameplate (117, 124 or 121) cannot be removed after contact with the vehicle. Refer to Figures 35 and 36.

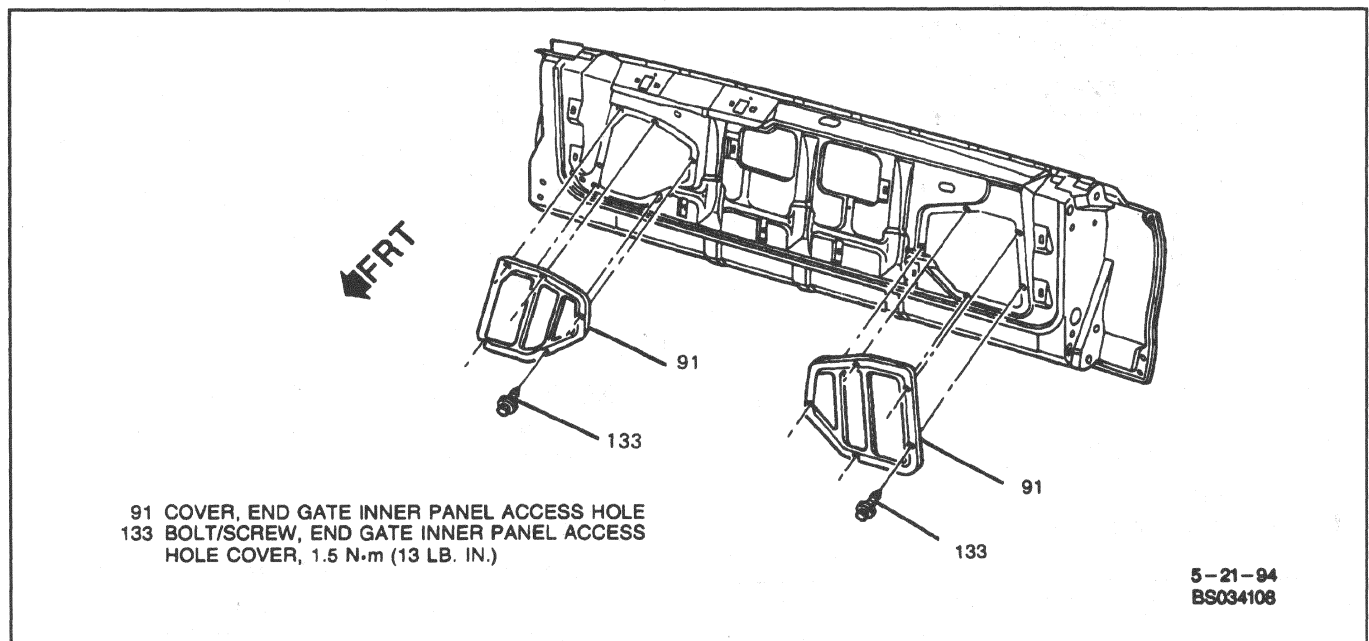


Figure 33 - Inner Panel Access Hole Covers

10-8-30 BODY REAR END

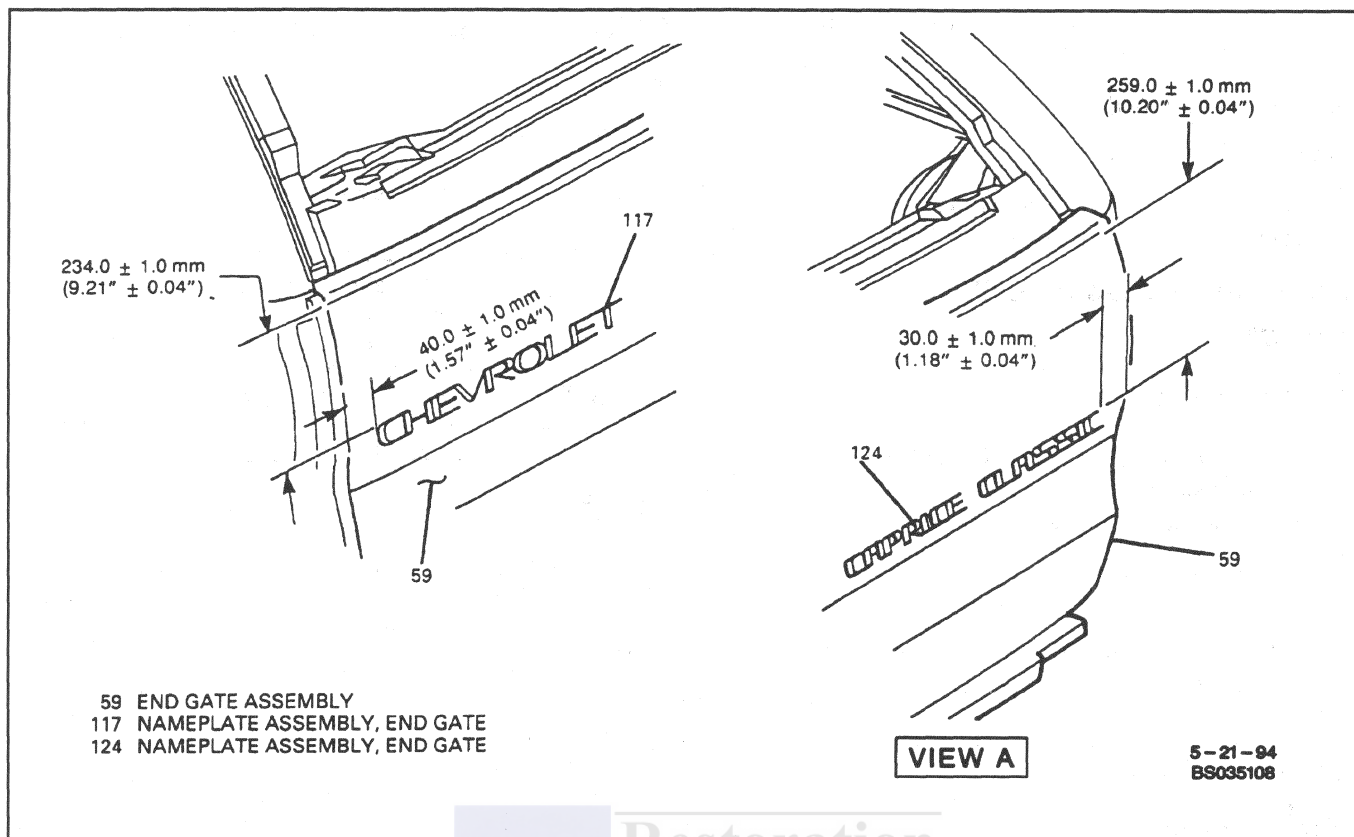


Figure 34 - End Gate Nameplates-(Chevrolet)

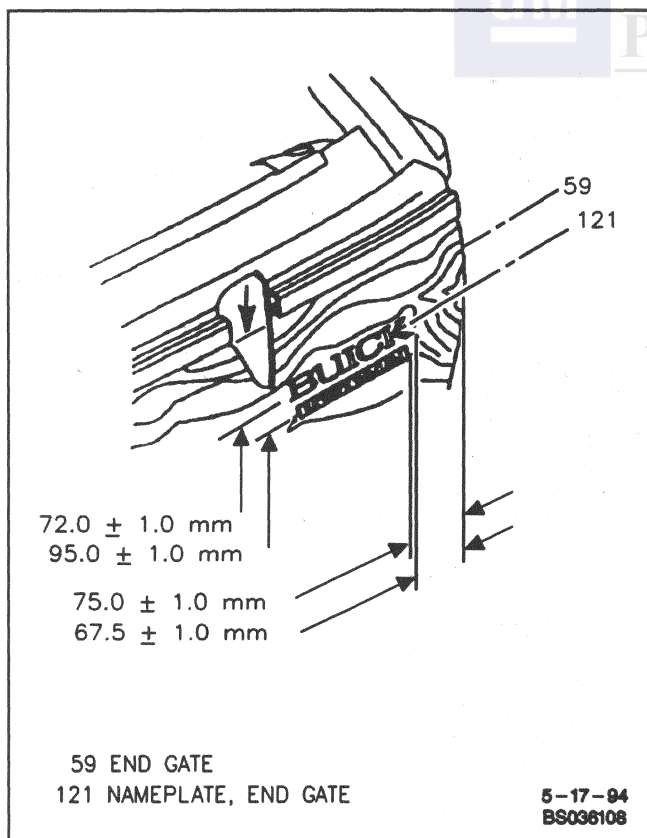


Figure 35 - End Gate Nameplate-(Buick)

- C. Press nameplate (117, 124 or 121) into place and apply constant pressure for 30 seconds.

Center Molding CHEVROLET

Figure 36

Remove or Disconnect

- Molding (119).
 - A. Hold hot air gun 152 mm (6 inches) away from molding surface.
 - B. Apply heat, using circular motion for about 30 seconds.
 - C. Use flat-bladed tool, being careful not to damage paint, and remove molding (119) from end gate.
 - D. Discard molding (119).

Install or Connect

- Molding (119).
 - A. Mark position of molding (119) with length of masking tape.



Clean

- Area with soap and water. Wipe dry.
- Area with oil-free naphtha or alcohol.
- B. If needed, warm end gate surface with heat lamp or heat gun to 21° C (70° F).

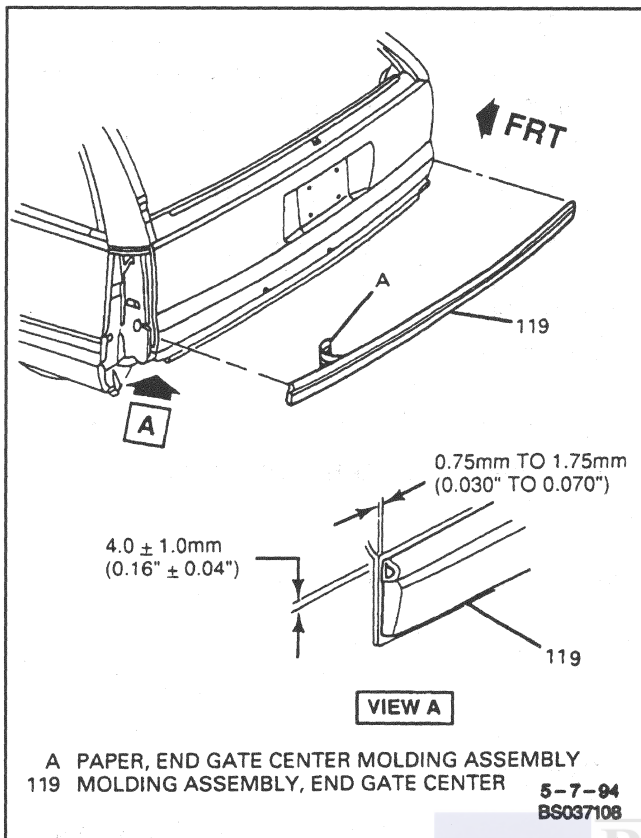


Figure 36 - Center Molding-(Chevrolet)

- C. Peel paper from molding (119).
 - Do not touch adhesive backing.
- D. Press molding (119) to end gate to secure.
- E. Hand-roll molding (119) to ensure proper adhesion.

Inspect

- Molding ends for bonding. Hand-roll loose ends.

Transfer Upper Finish Molding

BUICK

Figure 37

Remove or Disconnect

1. Bolts/screws (158).
2. Transfer upper finish molding (123).
 - Unsnap transfer upper finish molding (123) from clips.
3. Clips, if necessary.
 - Slide clips to left to disengage.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Clips, if removed.
 - Slide clips to right to engage.

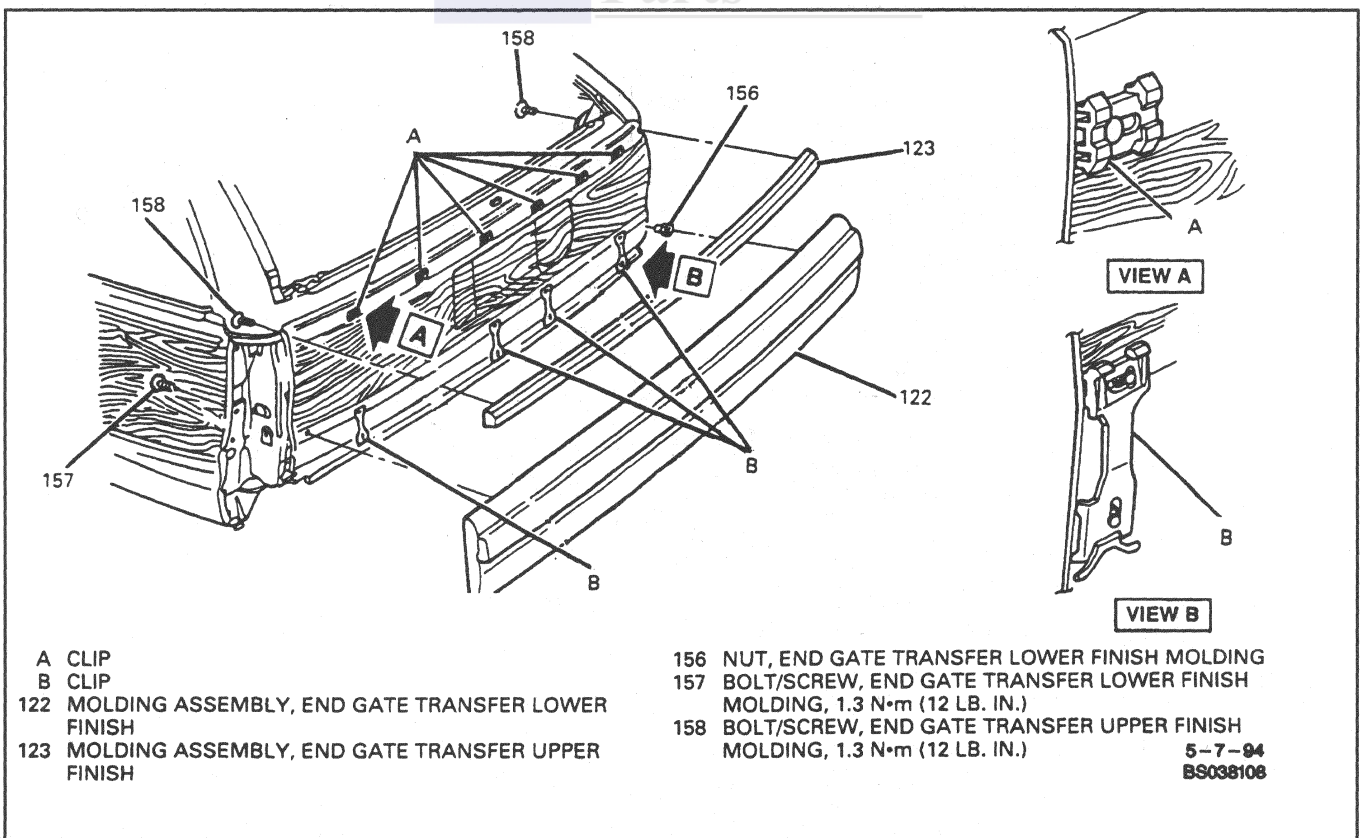


Figure 37 - Transfer Upper and Lower Finish Moldings-(Buick)

10-8-32 BODY REAR END

2. Transfer upper finish molding (123).
 - Snap transfer upper finish molding (123) over clips.
3. Bolts/screws (158).



Tighten

- Bolts/screws (158) to 3 N.m (12 lb. in.).

Transfer Lower Finish Molding

BUICK

Figure 37



Remove or Disconnect

1. Bolt/screw (157).
2. Transfer lower finish molding (122).
 - Push upward on transfer lower finish molding (122) until top edge disengages from clips.
3. Clips, if necessary.
 - Slide clips to the right and down to disengage.
4. Nut (156), if necessary.



Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Nut (156), if removed.

2. Clips, if removed.
 - Place clip over lower stud and slide clip up. Engage clip with upper stud and slide clip left.
3. Transfer lower finish molding (122).
 - A. Align stud of transfer lower finish molding (122) to nut (156).
 - B. Engage bottom edge of transfer lower finish molding (122) to clips.
 - C. Push up on transfer lower finish molding (122) until top edge snaps over clips.
4. Bolt/screw (157).



Tighten

- Bolt/screw (157) to 1.3 N.m (12 lb. in.).

Upper Outer Finishing Moldings

Figure 38



Remove or Disconnect

1. Bolt/screw (129).
2. Upper outer finishing moldings (56 or 166).
 - Use flat-bladed tool to pry adhesive tape from end gate (59).



Clean

- Upper outer finishing molding (56 or 166), if reusing, and attaching surface with general purpose cleaner to remove adhesive tape residue.

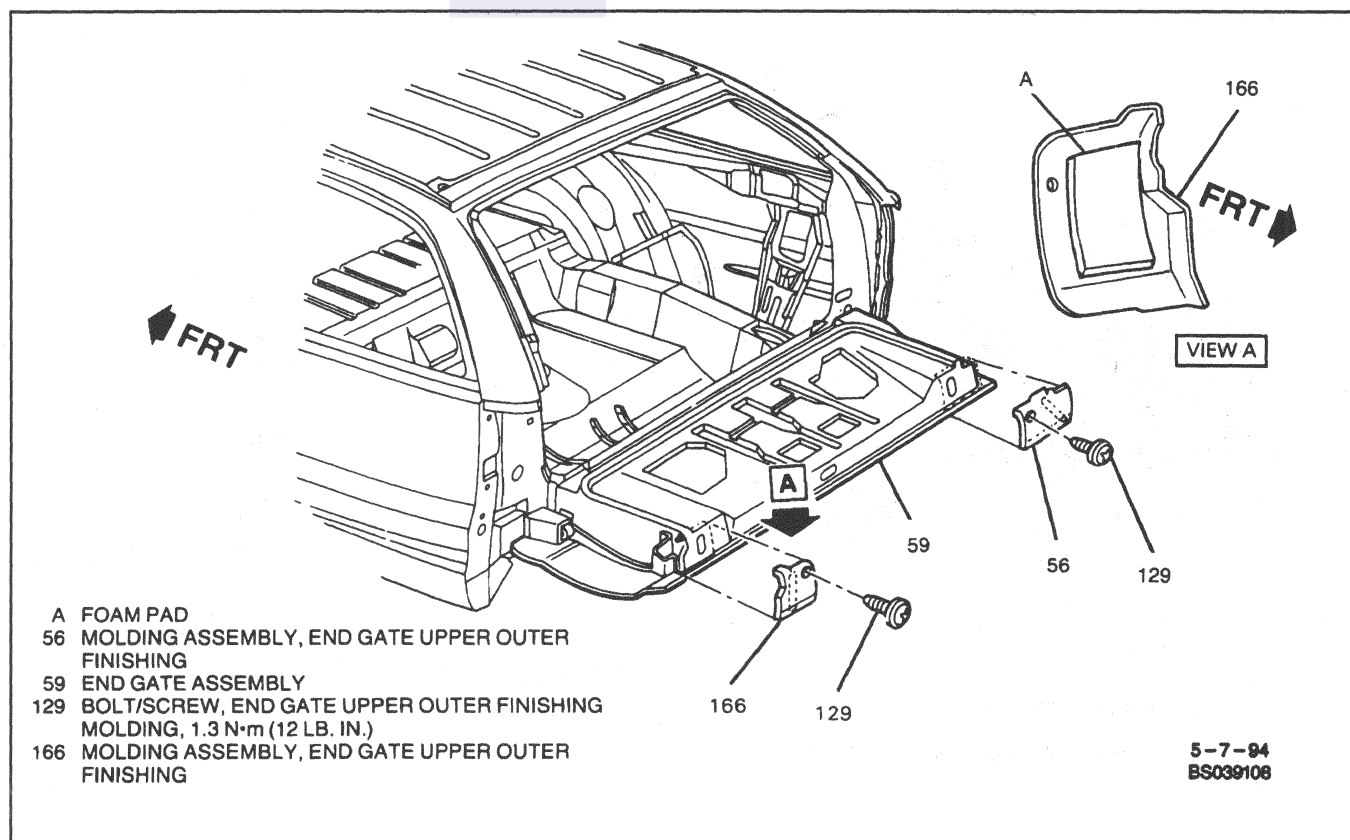


Figure 38 - Upper Outer Finishing Moldings

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Upper outer finishing molding (56 or 166).
 - A. Remove backing of adhesive tape or apply new adhesive tape.
 - B. Position upper outer finishing molding (56 or 166) to top of end gate (59) and press to secure.
2. Bolt/screw (129).

Tighten

- Bolt/screw (129) to 1.3 N·m (12 lb. in.).

Rear License Lamp Molding

Figure 39

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Nuts (130).
3. Rear license lamp molding (63).
4. Electrical connector.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Electrical connector.
2. Rear license lamp molding (63).
3. Nuts (130).

Tighten

- Nuts (130) to 6 N·m (53 lb. in.).
4. Trim panel. Refer to "Trim Panel" in this section.

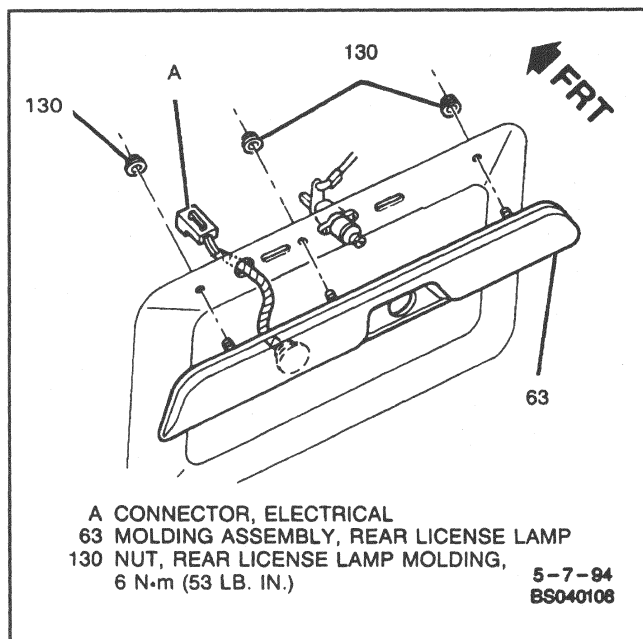


Figure 39 - Rear License Lamp Molding

WEATHERSTRIP

End Gate Weatherstrip

Figure 40

Remove or Disconnect

1. Quarter inner rear trim finish panel. Refer to SECTION 10-7.
2. Caps (115) from bolts/screws (131).
3. Bolts/screws (131).
4. Weatherstrip (51).
 - Pull weatherstrip (51) from pinchweld and body pillar flanges.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Weatherstrip (51).
 - Position weatherstrip (51) to body pillar flanges at belt line.
2. Bolts/screws (131).

Tighten

- Bolts/screws (131) to 1.3 N·m (12 lb. in.).
3. Caps (115) onto bolts/screws (131).
 4. Corners of weatherstrip (51) onto pinch-weld flange.
 5. Engage rest of weatherstrip (51) on pinch-weld flange.
 - Use rubber mallet to tap weatherstrip (51) onto pinch-weld flange, if necessary.
 6. Quarter inner rear trim finish panel. Refer to SECTION 10-7.

Window Weatherstrip

Figure 41

Remove or Disconnect

1. Bolts/screws (132).
2. Window weatherstrip (55) by unseating retainers.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Window weatherstrip (55).
 - Push to secure retainers.
2. Bolts/screws (132).

Tighten

- Bolts/screws (132) to 1.3 N·m (12 lb. in.).

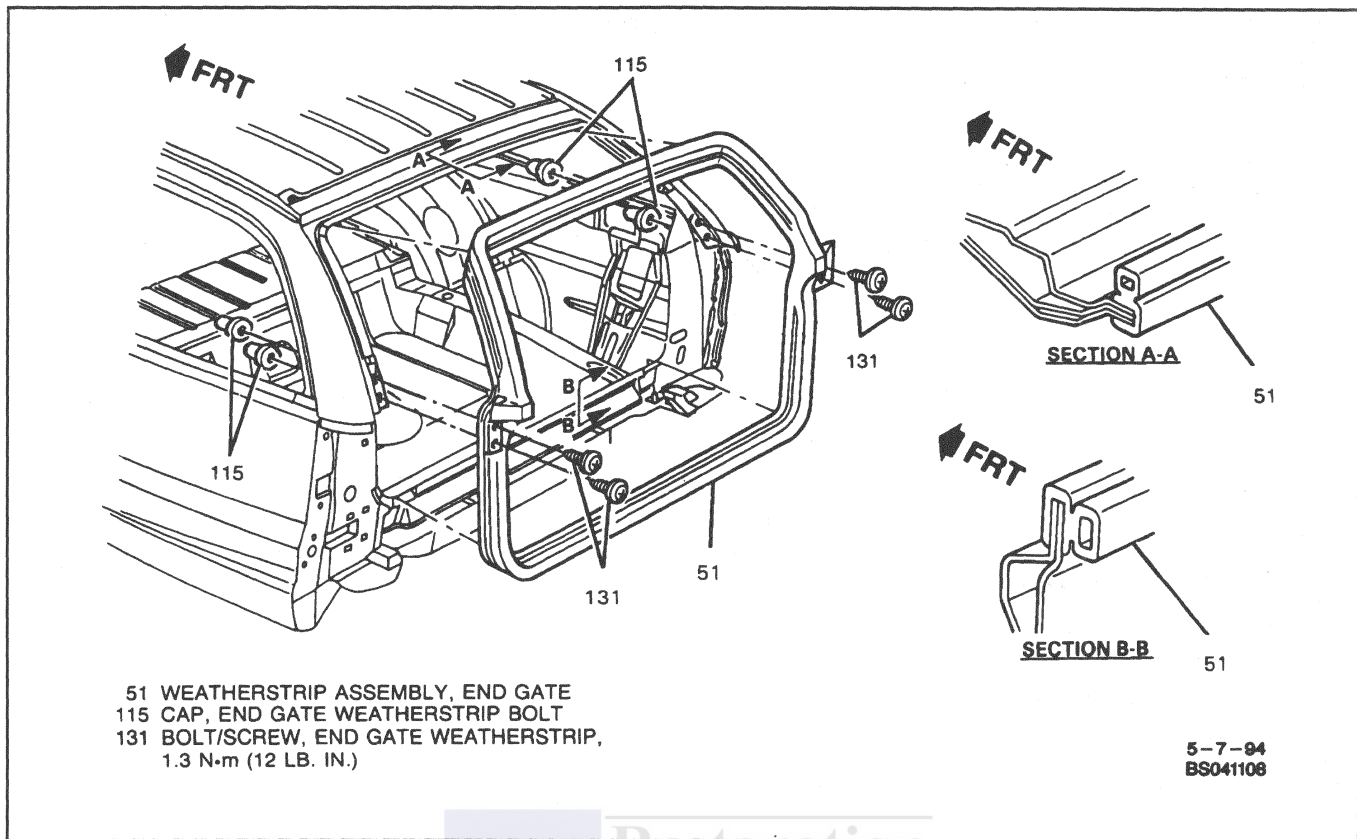


Figure 40 - Weatherstrip

TWO-WAY END GATE HANDLES

Release Handles

Figure 42

↔ Remove or Disconnect

1. Handle trim cover. Refer to "Handle Trim Covers" in this section.
2. Handle rod, if removing end gate handle (76).
3. Bolts/screws (167 or 163).
4. Drill out rivets (172 or 134) using 5/16-inch drill bit.
5. End gate handle (76) or end gate door release handle (177).
6. Door release handle cable (99), if removing end gate door release handle (177).
 - Make sure door release handle cable (99) does not fall inside trim panel.

→→ Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Door release handle cable (99), if installing end gate door release handle (177).
2. End gate handle (76) or end gate door release handle (177).
3. Rivets (172 or 134).

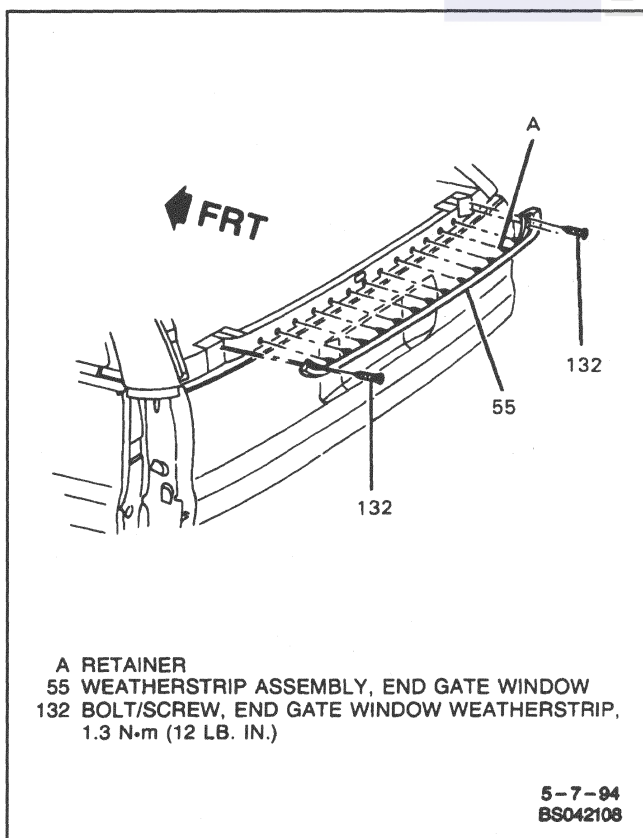


Figure 41 - Window Weatherstrip

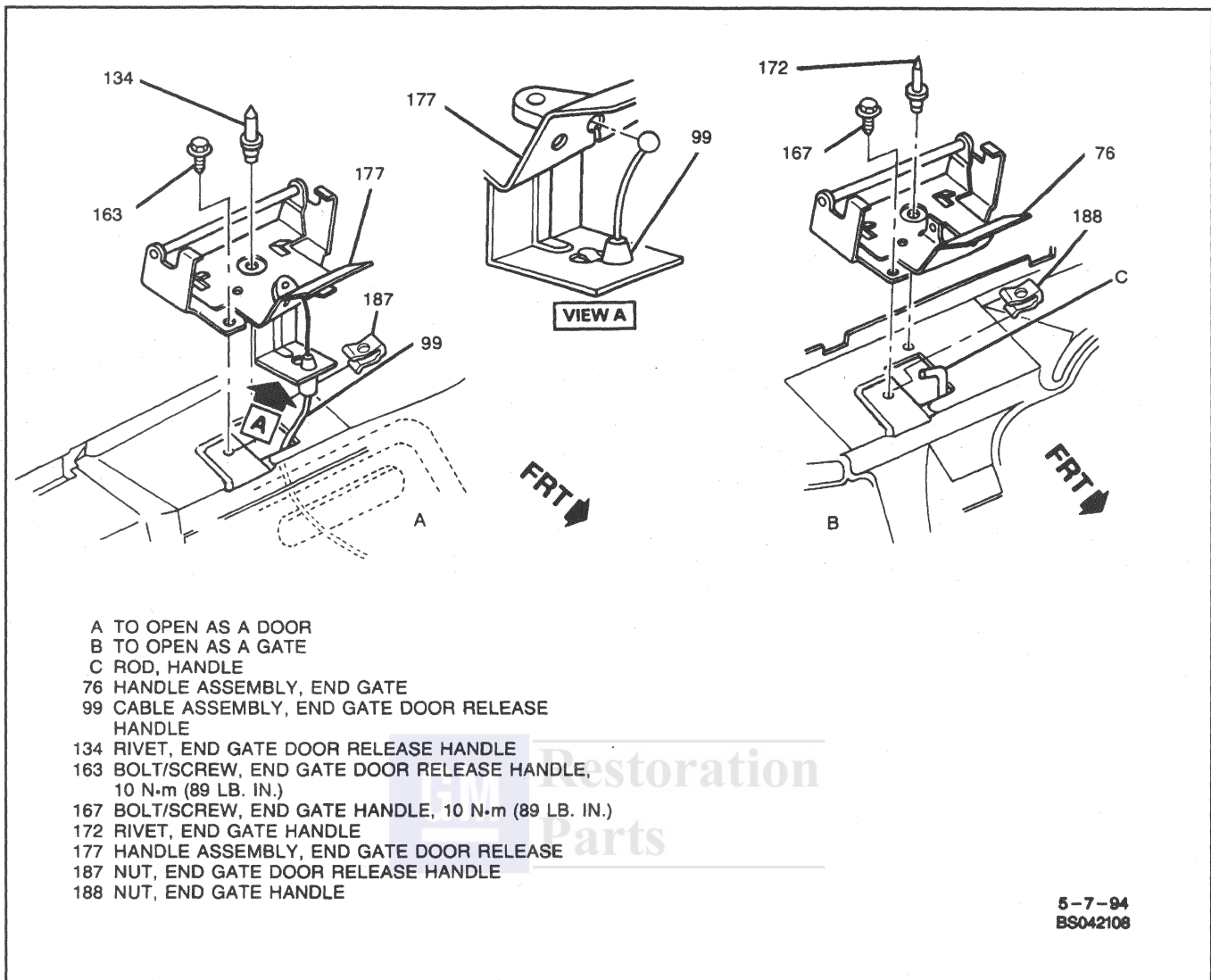


Figure 42 - Release Handles

4. Bolts/screws (167 or 163).

Tighten

- Bolts/screws (167 or 163) to 10 N·m (89 lb. in.).
5. Handle rod, if installing end gate handle (76).
 6. Handle trim cover. Refer to "Handle Trim Covers" in this section.

TWO-WAY END GATE LOCKS AND STRIKERS

Lock Cylinder and Sleeve

Figure 43

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Rear license lamp molding. Refer to "Rear License Lamp Molding" in this section.

3. Rivets (136) using a drill and 3/16-inch drill bit.
4. Lock cylinder rod (120) from clip on lock cylinder (162).
5. Lock cylinder (162).

Install or Connect

1. Lock cylinder (162).
 - Stem of lock cylinder (162) must be inserted into window latch.
2. Lock cylinder rod (120) to clip on lock cylinder (162).
3. Rivets (136).
4. Rear license lamp molding. Refer to "Rear License Lamp Molding" in this section.
5. Remove and discard shipping retainer if installing new lock cylinder (162).
6. Trim panel. Refer to "Trim Panel" in this section.

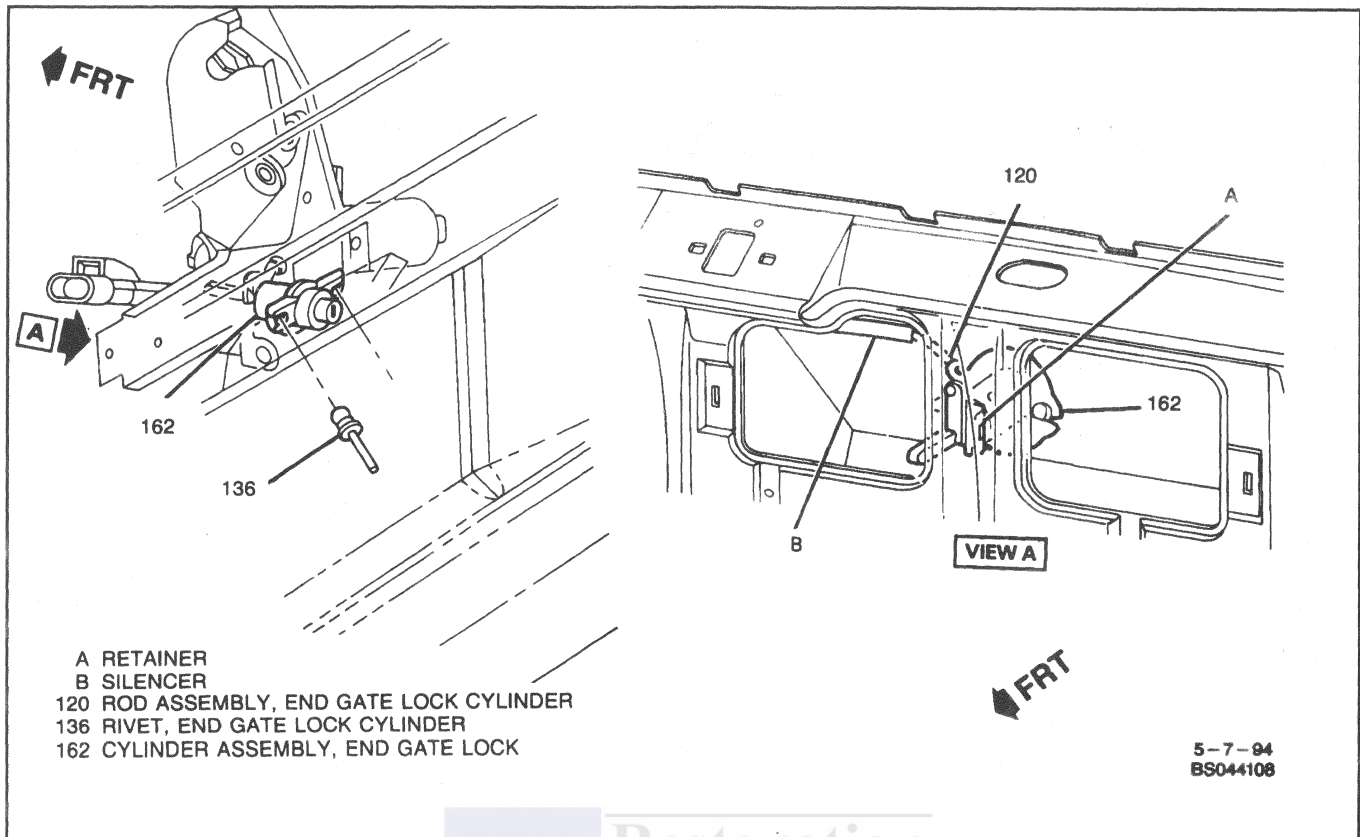


Figure 43 - Lock Cylinder and Sleeve Removal

Lock Cylinder Disassembly**Figure 44****Disassemble**

1. "Lock Cylinder and Case" from endgate. Refer to "Lock Cylinder and Case" in this section.

- Gently clamp bottom of cylinder and case into vise with cylinder face down.
- 1. Roll pin, tailpiece and spring with arm facing 12 o'clock.
- 2. Insert key, turn clockwise and depress button to expose tailpiece retainer pin hole in cylinder.
- 3. Carefully pull retaining clip from case to release washer and spring.

NOTICE: Extra care should be used when working with the large spring and washer under pressure.

- 4. Carefully pull work washer and spring out of case.
- 5. Pull Lock cylinder and sleeve from case.
- Gently clamp bottom of cylinder and sleeve into vise with cylinder face up.
- Hold unit shutter and springs in place using Kent Moore tool-BT8401-B.
- 6. Using a soft faced mallet, tap cylinder cap off of sleeve.

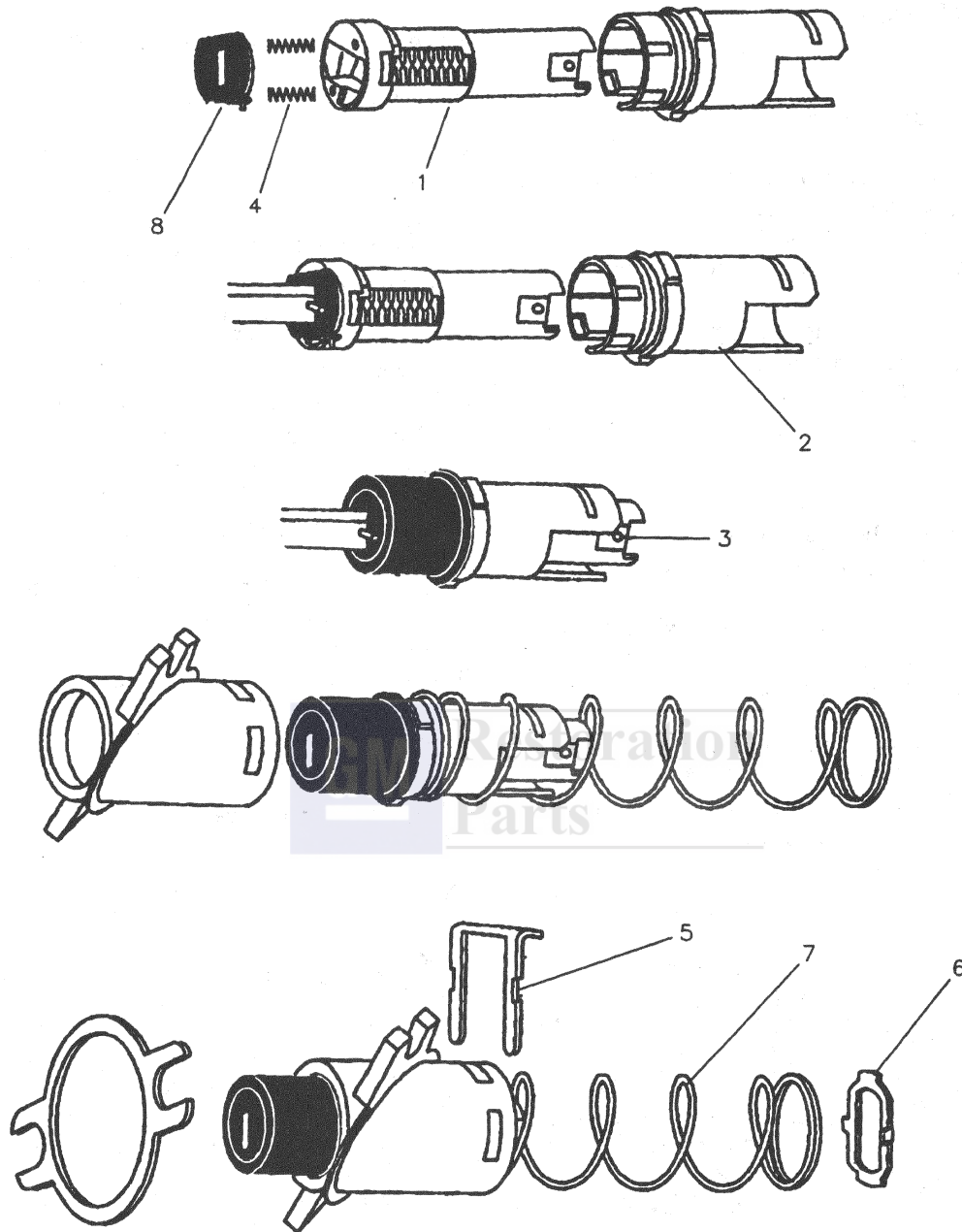
- 7. Remove unit shutter and springs from cylinder face.

**Install or Connect**

- 1. Code lock cylinder. Refer to SECTION 0A.
- 2. Lubricate lock cylinder with GM P/N 10528-64 and insert into lock sleeve without key.
 - Gently clamp bottom of cylinder and sleeve into vise with cylinder face up.
- 3. Hold shutter and springs in place using Kent Moore tool-BT8401-B.
- 4. Align dimples on cap, with grooves on the lock sleeve. Using a soft faced mallet, tap cylinder onto sleeve until fully seated.
- 5. Place large spring over cylinder and sleeve and place into rear of lock case.
 - Gently clamp lock case in vise, cylinder face down.

NOTICE: Extra care should be used when working with the large spring and washer under pressure.

- 6. Place retaining washer over the large spring with tabs up. Carefully work washer into lock case until retaining clip can be inserted through case from top to washer and spring in place.
- 7. Insert key, turn clockwise, and depress button to expose tailpiece retainer pin hole in cylinder.
- 8. Spring and tailpiece with arm facing 12 o'clock, roll pin.



- 1 LOCK CYLINDER
- 2 SLEEVE
- 3 ROLL PIN
- 4 SMALL SPRING
- 5 RETAINING CLIP
- 6 WASHER
- 7 LARGE SPRING
- 8 UNIT SHUTTER

5-22-94
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Figure 44 - Lock Cylinder Disassembly

9. Lock cylinder and case to endgate. Refer to "Lock Cylinder and Case" in this section.

Locking Rod Bellcrank

Figure 45

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
3. Rivet (137) using drill and 5/16-inch drill bit.
4. Bellcrank (86).
5. Locking rod (101) from clip on upper lock (98).
6. Lock cylinder rod from bellcrank (86).
7. Locking rod (101) from bellcrank (86).

Install or Connect

1. Locking rod (101) to bellcrank (86).
2. Lock cylinder rod to bellcrank (86).
3. Locking rod (101) to clip on upper lock (98).
4. Bellcrank (86).
 - Insert tab of bellcrank (86) through slot in inner panel.
5. Rivet (137) attaching bellcrank (86) to inner panel.
6. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
7. Trim panel. Refer to "Trim Panel" in this section.

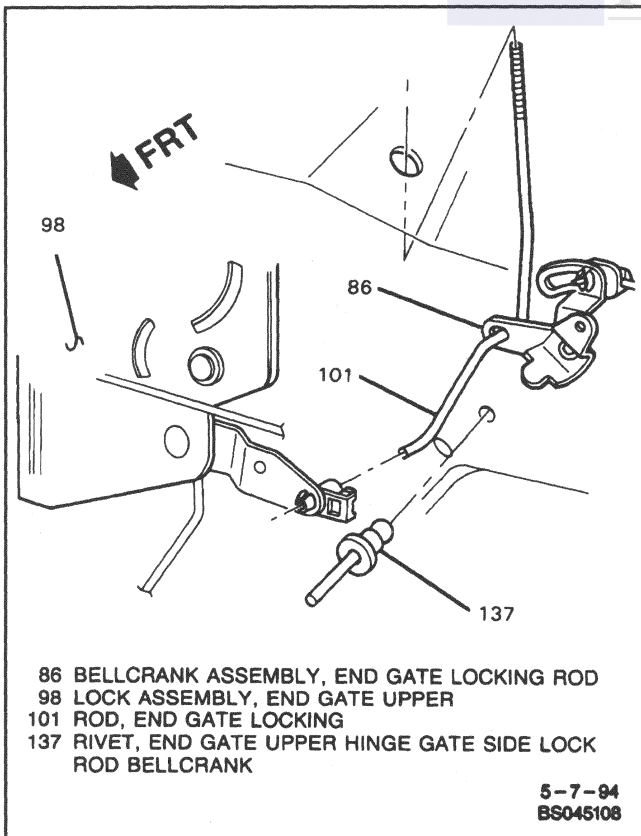


Figure 45 - Locking Rod Bellcrank

Upper Lock

RIGHT SIDE

Figures 5, 6, 45, 46, 47, and 48

Remove or Disconnect

1. Open end gate (59) as a door.
2. Trim panel. Refer to "Trim Panel" in this section.
3. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
4. Upper lock rod (78) from upper lock (98).
5. Door release handle cable (99) from end gate door release handle (177).
6. Upper lock rod (78) from bellcrank (85).
7. Locking rod (101) from upper lock (98).
8. Electrical connector from lock switch (100).
9. Lock actuator rivets attaching lock actuator (94) to inner panel using a drill and 5/16-inch drill bit.
10. Electrical connector from lock actuator (94).
11. Upper-to-lower lock connector rod (96) from lower lock (95) by removing retaining clip.
 - Reinstall retaining clip on lower lock (95).
12. Bolts/screws (139).
13. Upper lock (98) and lock actuator rod (97) with lock actuator (94).
14. Lock actuator rod (97) with lock actuator (94) from upper lock (98).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

Important

- All locks must be installed in the latched position for proper lock synchronization. Service replacement locks will have a synchronization wire installed and will be in the latched position when received. The synchronization wire must be removed after lock installation and synchronization for proper lock operation.

1. Open end gate (59) as a door.
2. Lock actuator rod (97) with lock actuator (94) to upper lock (98).
3. Upper lock (98) and lock actuator rod (97) with lock actuator (94).
4. Bolts/screws (139).

Tighten

- Bolts/screws (139) to 8 N.m (71 lb. in.).
5. Electrical connector to lock actuator (94).
 6. Lock actuator rivets attaching lock actuator (94) to inner panel.
 7. Electrical connector to upper lock switch (100).
 8. Locking rod (101) to lock (98).

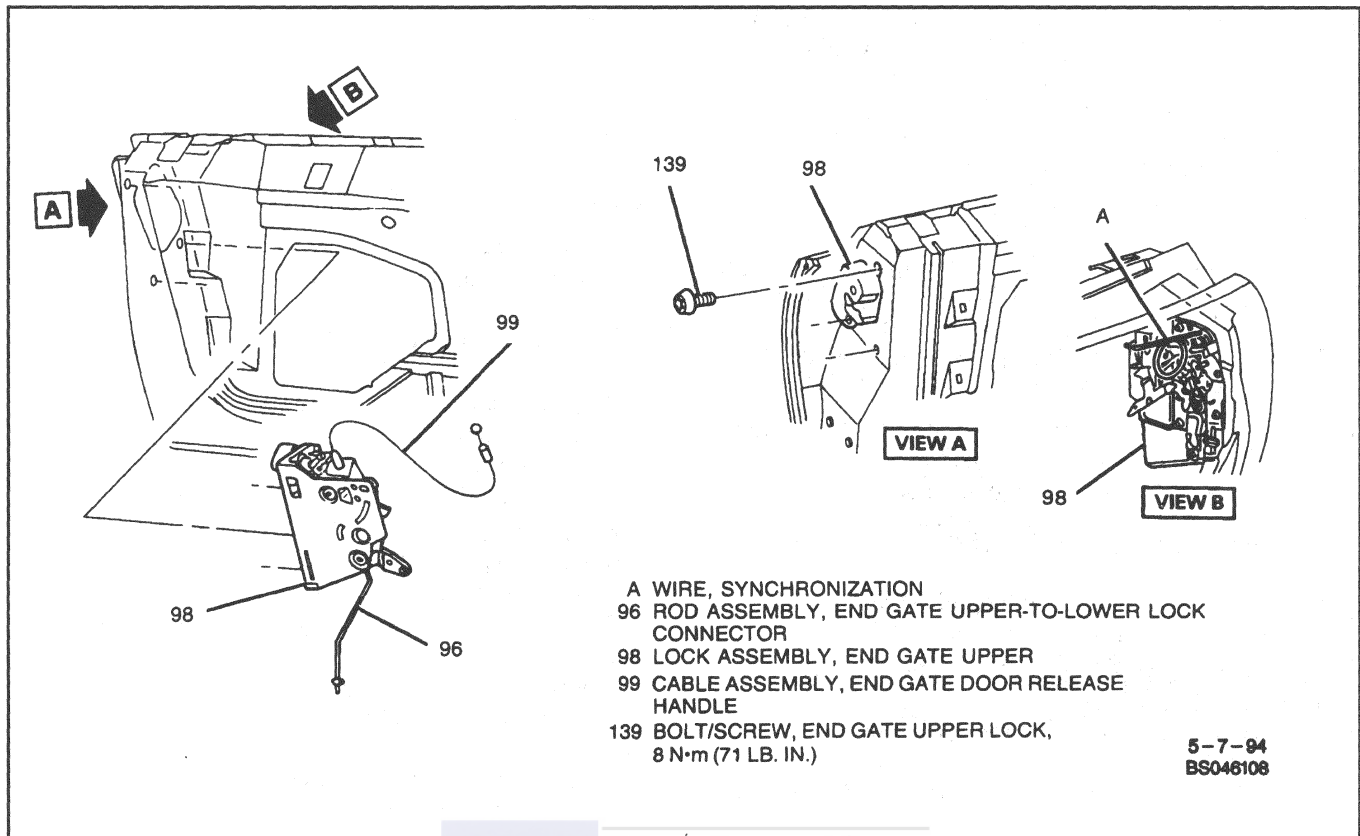


Figure 46 - Upper Lock (Right Side)

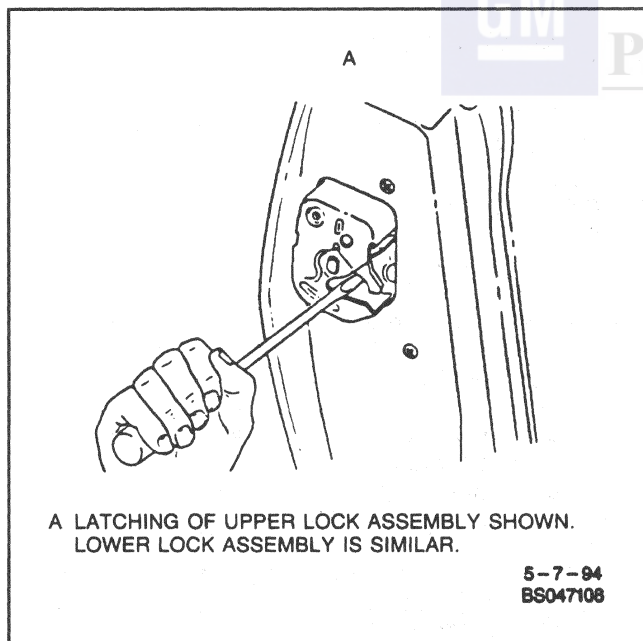


Figure 47 - Manually Latching Locks (Right Side)

9. Upper lock rod (78) to bellcrank (85).
10. Door release handle cable (99) to end gate door release handle (177).
11. Disengage upper hinge gate side lock rod (180) from bellcrank (85) by removing retaining clip.
 - Reinstall retaining clip on bellcrank (85).
12. Manually latch lower lock (95).

CAUTION: With end gate open in the door position and the right upper and lower locks manually engaged, the end gate has been placed in a vulnerable position and could drop from the left upper lock if the synchronization locking rod is activated by pulling it inboard. When making swivel nut adjustment on left upper hinge gate side lock rod, do not pull on rod. Personal injury and/or damage to the end gate could result.



Adjust

- A. Swivel nut on upper hinge gate side lock rod (180) until it aligns with hole in bellcrank (85). Insert swivel end through hole in bellcrank (85) and engage retaining clip.
- B. Swivel nut on upper-to-lower lock connector rod (96) until it aligns with hole in right lower lock (95). Insert swivel end through hole in lower lock (95) and engage retaining clip.
13. Upper lock rod (78) to upper lock (98).
14. Remove and discard synchronization wire from upper lock (98) and unlatch lower and upper locks (95 and 98) by actuating end gate door release handle (177). Perform synchronization checks. Refer to "Lock Synchronization Checks" under "Two-Way End Gate Lock and Synchronization Check" in this section.
15. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
16. Trim panel. Refer to "Trim Panel" in this section.

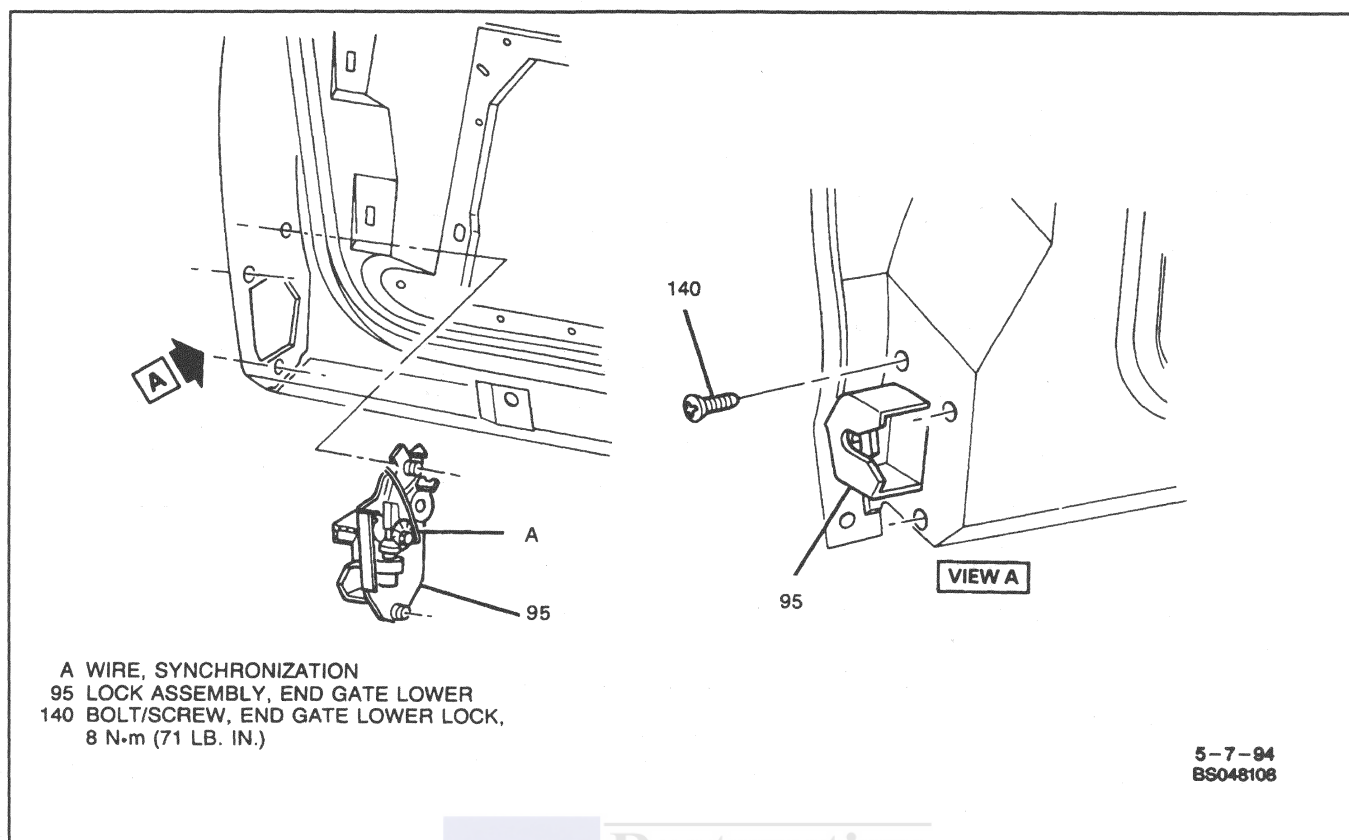


Figure 48 - Lower Lock-(Right Side)

Lower Lock**RIGHT SIDE****Figures 5, 6, 47 and 48****↔ Remove or Disconnect**

1. Open end gate as a door.
2. Trim panel. Refer to "Trim Panel" in this section.
3. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
4. Upper-to-lower lock connector rod (96) from lower lock (95) by removing retaining clip.
 - Reinstall retaining clip on lower lock (95).
5. Electrical connector from end gate ajar switch lead-in wire on lower lock (95).
6. Bolts/screws (140).
7. Lower lock (95).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

! Important

- All locks must be installed in the latched position for proper lock synchronization. Service replacement locks will have a synchronization wire installed and will be in

the latched position when received. The synchronization wire must be removed after lock installation and synchronization for proper lock operation.

1. Lower lock (95).
2. Bolts/screws (140).

⌚ Tighten

- Bolts/screws (140) to 8 N.m (71 lb. in.).
3. Electrical connector to end gate ajar switch lead-in wire on lower lock (95).
 4. Manually latch right upper lock.

CAUTION: With end gate open in the door position and the right upper and lower locks manually engaged, the end gate has been placed in a vulnerable position and could drop from the left upper lock if the synchronization locking rod is activated by pulling it inboard. When making swivel nut adjustment on left upper hinge gate side lock rod, do not pull on rod as personal injury and/or damage to the end gate could result.

🔑 Adjust

- Swivel nut on upper-to-lower lock connector rod (96) until it aligns with hole in lower lock (95). Insert swivel end in hole in lower lock (95) and engage retaining clip.

5. Remove and discard synchronization wire from lower lock (95) and unlatch right upper and lower locks (95 and 98) by actuating end gate door release handle (177). Perform synchronization checks. Refer to "Lock Synchronization Checks" under "Two-Way End Gate Lock and Synchronization Check" in this section.
6. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
7. Trim panel. Refer to "Trim Panel" in this section.

Upper Hinge Gate Side Lock

LEFT SIDE

Figures 5, 6, 47, 49 and 50

↔ Remove or Disconnect

1. Open end gate as a gate and suitably support.
2. Trim panel. Refer to "Trim Panel" in this section.
3. Left inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
4. Upper hinge gate side lock rod (180) from upper hinge gate side lock (82).
 - Pull upper hinge gate side lock rod (180) from clips (160) on end gate inner panel, if necessary.
5. Lock upper lock (98) with locking rod knob (173).
6. Mark a line around outer edge of upper hinge gate side lock (82).

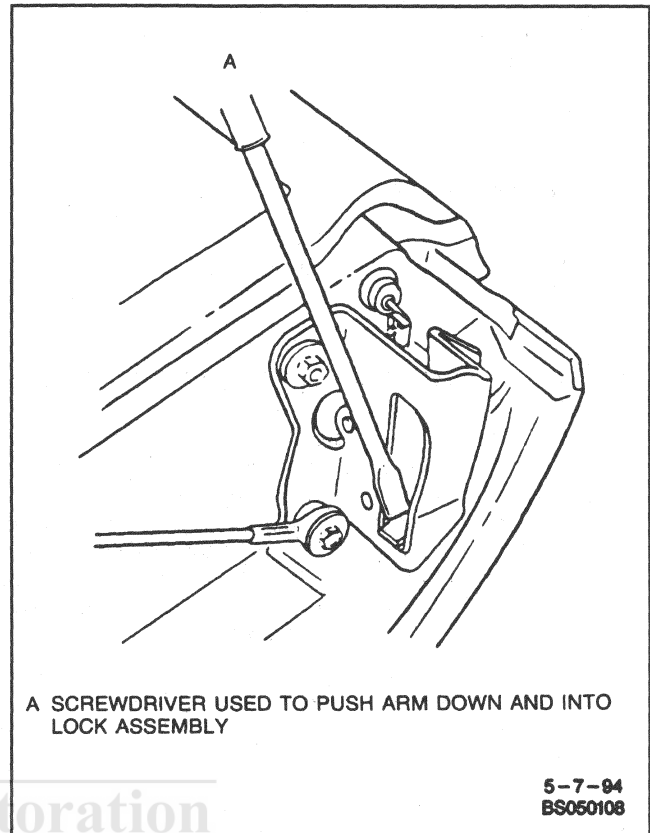


Figure 50 - Manually Latching Upper Hinge Gate Side Lock-(Left Side)

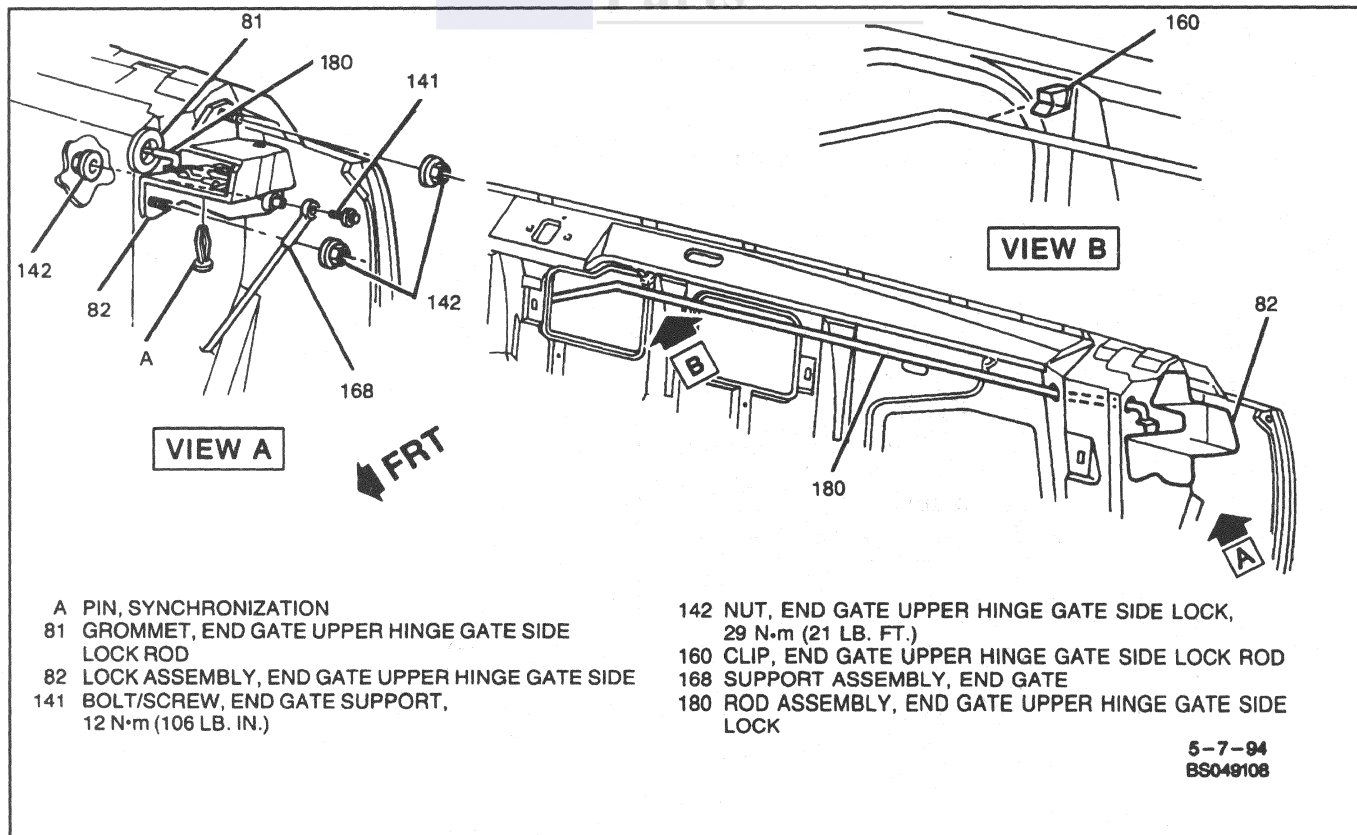


Figure 49 - Upper Hinge Gate Side Lock-(Left Side)

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7. Manually latch upper lock (98) and upper hinge gate side lock (82).
8. Bolt/screw (141).
9. Support (168).
10. Nuts (142).
11. Upper hinge gate side lock (82).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

Important

- The upper hinge gate side lock (82) must be installed in the latched position for proper lock synchronization. Service upper hinge gate side locks (82) will have a plastic synchronization pin installed when received. This synchronization pin must be removed after upper hinge gate side lock (82) is installed and end gate has been synchronized.

1. Align upper hinge gate side lock (82) to lines marked on end gate (59).
2. Nuts (142).

Tighten

- Nuts (142) to 29 N·m (21 lb. ft.).
3. Support (168).
 4. Bolt/screw (141).
 - Bolt/screw (141) to 12 N·m (106 lb. in.).
 5. Disconnect upper hinge gate side lock rod (180) from bellcrank (85) by removing retaining clip.
 - Reinstall retaining clip on bellcrank (85).
 6. Upper hinge gate side lock rod (180) to upper hinge gate side lock (82).

Adjust

- Swivel nut on upper hinge gate side lock rod (180) until it aligns with hole in bellcrank (85).
7. Upper hinge gate side lock rod (180) to bellcrank (85) and engage retaining clip.
 - Install upper hinge gate side lock rod (180) to clips (160) in end gate inner panel, if removed.
 8. Remove and discard synchronization pin.
 9. Operate end gate handle. Perform synchronization checks. Refer to "Lock Synchronization Checks" under "Two-Way End Gate Lock and Synchronization Check" in this section.
 10. Left inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
 11. Trim panel. Refer to "Trim Panel" in this section.

Upper Hinge Striker

LEFT SIDE

Figure 51

Remove or Disconnect

1. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.
2. Open end gate as a gate and suitably support.
3. Bolt/screw (141).
4. Support (168) and support spring (67).
5. Mark location of upper hinge striker (169) on body.
6. Nuts (145).
7. Upper hinge striker (169).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Upper hinge striker (169).
 - Align upper hinge striker (169) to location marked on body.
2. Nuts (145).

Tighten

- Nuts (145) to 50 N·m (37 lb. ft.).

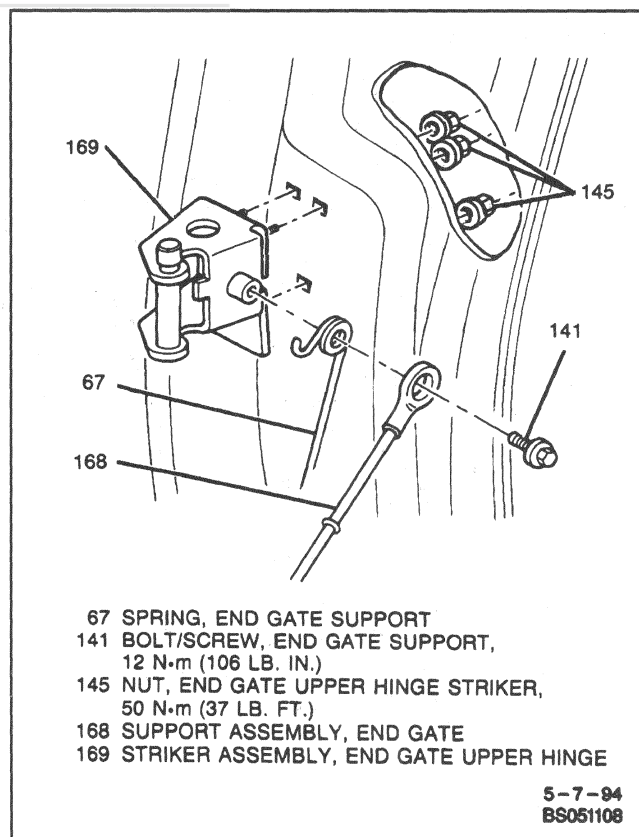


Figure 51 - Upper Hinge Striker-(Left Side)

3. Support spring (67) and support (168).
4. Bolt/screw (141).

 Tighten

- Bolt/screw (141) to 12 N.m (106 lb. in.).
5. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.

Latch Strikers

RIGHT SIDE

Figure 52

 Remove or Disconnect

1. Open end gate as a door.
2. Latch striker (49).
3. Washer (50), if necessary.

 Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Washer (50), if removed, to latch striker (49).
2. Latch striker (49).

 Tighten

- Latch striker (49) to 53 N.m (39 lb. ft.).

 Adjust

- Latch striker (49), as necessary, to engage with right upper or lower locks.

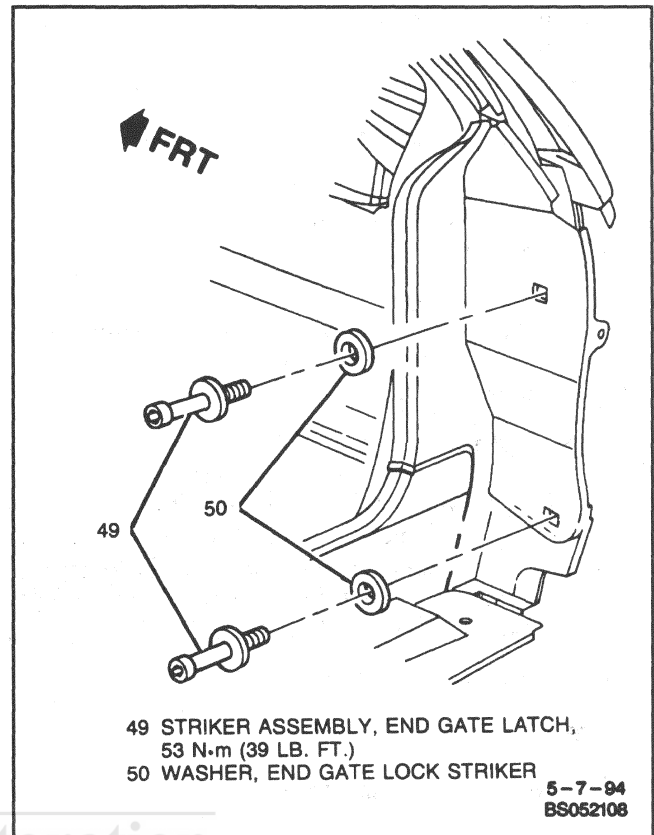


Figure 52 - Latch Strikers-(Right Side)

Lock Switch

Figure 53

 Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.

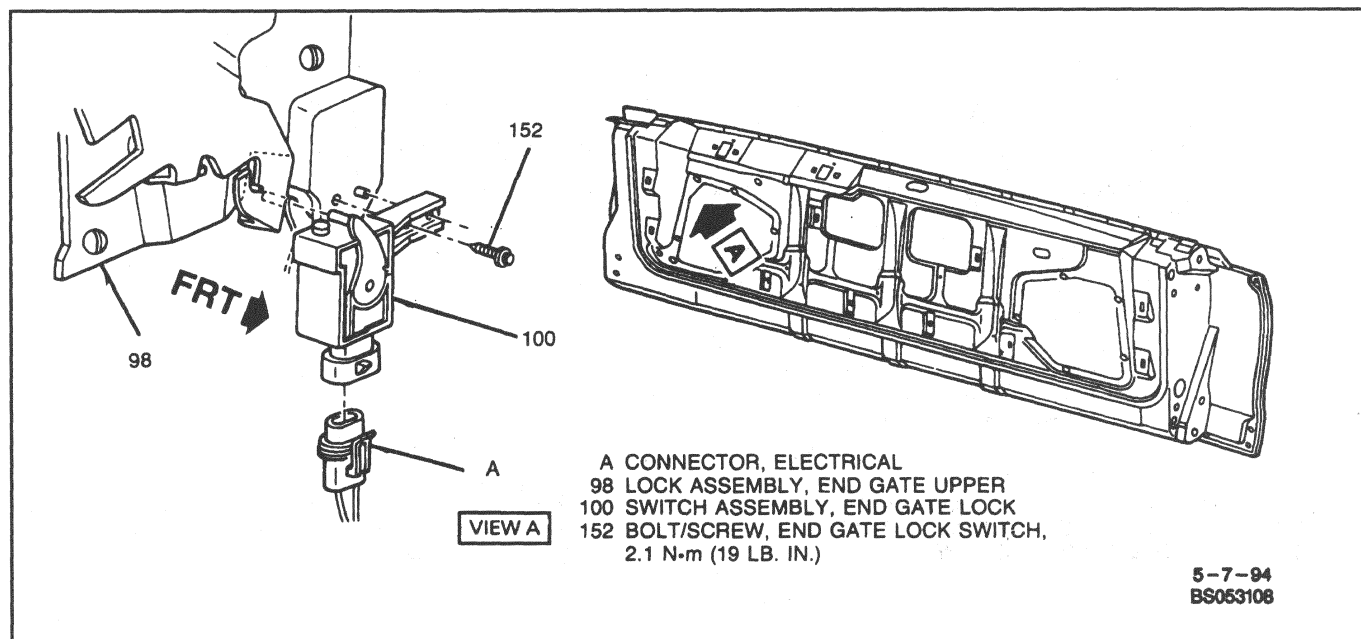


Figure 53 - Lock Switch

10-8-44 BODY REAR END

3. Electrical connector.
4. Bolt/screw (152).
5. Lock switch (100).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Lock switch (100).
 - Make sure lock switch (100) is behind lock lever of upper lock (98).
2. Bolt/screw (152).

⌚ Tighten

- Bolt/screw (152) to 2.1 N.m (19 lb. in.).
3. Electrical connector.
 4. Right inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
 5. Trim panel. Refer to "Trim Panel" in this section.

Lock Actuator

Figure 54

↔ Remove or Disconnect

1. Right upper lock. Refer to "Upper Lock (Right Side)" in this section.
2. Lock actuator rod (97) from lock actuator (94).

↔ Install or Connect

1. Lock actuator rod (97) to lock actuator (94).
2. Right upper lock. Refer to "Upper Lock (Right Side)" in this section.

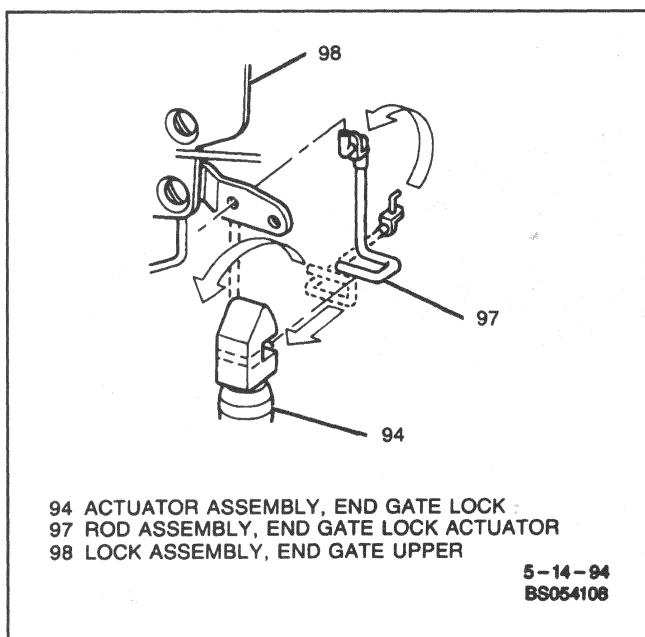


Figure 54 - Installing Lock Actuator and Lock Actuator Rod

Bellcrank

Figures 49 and 55

↔ Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Left inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
3. Handle rod from end gate release handle.
4. Upper hinge gate side lock rod (180) from clips (160) on end gate inner panel.
5. Upper hinge gate side lock rod (180) at bellcrank (85).
 - Reinstall retaining clip on bellcrank (85).
6. Upper lock rod (78) at bellcrank (85).
7. Rivets (135) using drill and 5/16-inch drill bit.
8. Bellcrank (85).

↔ Install or Connect

1. Bellcrank (85).
2. Rivets (135).
3. Upper lock rod (78) at bellcrank (85).
4. Upper hinge gate side lock rod (180) at bellcrank (85).
 - Spin nut on threaded upper hinge gate side lock rod (180) to align nut to hole in bellcrank (85) and engage retaining clip.
5. Upper hinge gate side lock rod (180) to clips (160) on end gate inner panel.

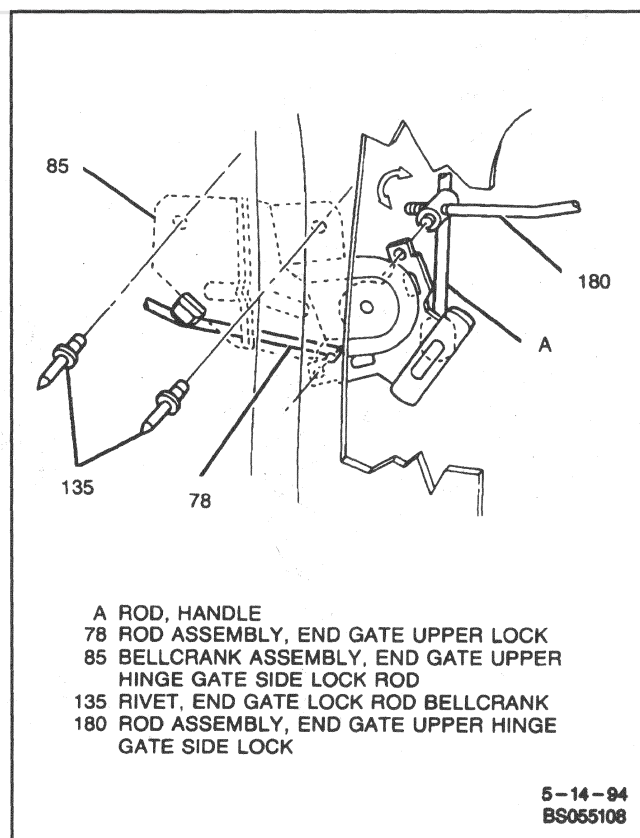


Figure 55 - Bellcrank

6. Handle rod to end gate handle.
7. Synchronize left and right upper locks. Refer to "Lock Synchronization Procedure" under "Two-Way End Gate Lock and Synchronization Check" in this section.
8. Left inner panel access hole cover. Refer to "Inner Panel Access Hole Covers" in this section.
9. Trim panel. Refer to "Trim Panel" in this section.

Two-Way End Gate Lock and Synchronization Check

The lock system on the two-way end gate is designed to perform the following blockout functions:

- Allow the end gate to be opened and closed as a door with glass opened and, at the same time, prevent accidental operation of the left upper hinge gate side lock (which allows the end gate to be opened as a gate).
- Allow the end gate to be opened and closed as a gate with glass opened and, at the same time, prevent accidental operation of the right lower lock (which allows the end gate to be opened as a door).

These blockout functions are accomplished by levers in the right upper lock. To assure that the right lock levers perform the blockout functions properly, the right upper lock and locking rod system must be synchronized with the rest of the end gate lock system (right lower lock and left upper hinge gate side lock). This synchronization is required to prevent accidental operation of the left upper hinge gate side lock when the end gate is opened as a door and to prevent accidental operation of the right lower lock when the end gate is opened as a gate.

LOCK SYNCHRONIZATION CHECKS

1. Synchronization check for right lower lock.

NOTICE: Place a protective support beneath the end gate to prevent damage if the end gate becomes disengaged from the right latch striker.

- A. Open end gate as a gate.
 - B. Allow end gate to open about halfway. Actuate end gate door release handle with moderate pressure rearward. Let go of release handle and close end gate. Open and close end gate as a door.
 - C. Repeat above two procedures five times. If right lower lock does not become disengaged, synchronization of the right lower lock is correct. If end gate becomes disengaged at right lower lock, reinstall end gate on right lower lock and proceed with Synchronization Procedure. Refer to "Lock Synchronization Procedure" below.
2. Synchronization check for right upper lock and left upper hinge gate side lock.

NOTICE: Place a protective support under the right side of the end gate to prevent damage in the event that the end gate becomes disengaged from the left upper hinge gate side lock.

- A. Open end gate as a door.
- B. Actuate end gate handle with moderate pressure. Let go of release handle and close end gate. Open and close end gate as a gate.
- C. Repeat above two procedures five times. If left upper hinge gate side lock does not become disengaged, the right upper lock and left upper hinge gate side lock are synchronized. If end gate becomes disengaged at the left upper hinge gate side lock, reinstall end gate on left upper hinge gate side lock and proceed with Synchronization Procedure. Refer to "Lock Synchronization Procedure" below.

LOCK SYNCHRONIZATION PROCEDURE

Figures 5, 6, 48 and 49

Remove or Disconnect

1. Open end gate (59) as a gate, then close securely.
2. Open end gate (59) as a door.
3. Trim panel. Refer to "Trim Panel" in this section.
4. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
5. Upper hinge gate side lock rod (180) from hole in bellcrank (85) by removing retaining clip.
 - A. Reinstall retaining clip on bellcrank (85).
 - B. Pull upper hinge gate side lock rod (180) from clip (160) on end gate inner panel, if necessary.
6. Upper-to-lower lock connector rod (96) from lower lock (95) by removing retaining clip.
 - Reinstall retaining clip on lower lock (95).

Install or Connect

CAUTION: With end gate open in the door position and the right upper and lower locks manually engaged, the end gate has been placed in a vulnerable position and could drop from the left upper hinge striker if the left upper hinge gate side lock rod is activated by pulling it inboard. When making swivel nut adjustment on left upper hinge gate side lock rod, do not pull on rod as personal injury and/or damage to the end gate could result.

1. Manually latch lower and upper locks (95 and 98) on end gate (59) using a wide blade screwdriver. Locks (95 and 98) must be fully engaged.
2. Align swivel nut on upper hinge gate side lock rod (180) with hole in bellcrank (85). Insert swivel end through hole in bellcrank (85) and engage retaining clip.

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3. Reinstall upper hinge gate side lock rod (180) to clips (160) on end gate inner panel, if removed.
4. Align swivel nut on upper to lower lock connector rod (96) with hole in lower lock (95). Insert swivel end through hole in lower lock (95) and engage retaining clip.
5. Unlatch upper and lower locks (98 and 95) by actuating end gate door release handle (177).
6. Perform "Lock Synchronization Checks" under "Two-Way End Gate Lock and Synchronization Check" in this section.
7. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
8. Trim panel. Refer to "Trim Panel" in this section.

TWO-WAY END GATE HINGES

Lower Hinge

(Left Side)

Figure 56

Remove or Disconnect

1. End gate. Refer to "Two-Way End Gate" in this section.
2. Trim panel. Refer to "Trim Panel" in this section.
3. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
4. Nuts (143).
5. Lower hinge (72).
 - Mark location of lower hinge (72).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

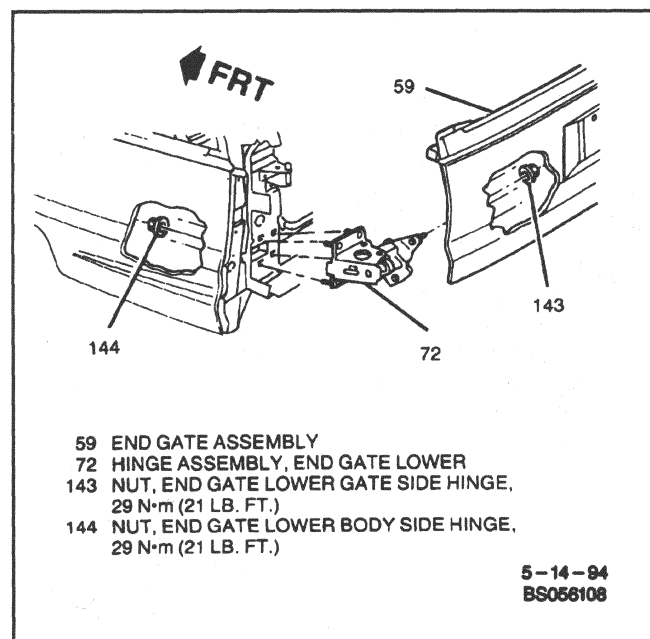


Figure 56 - Lower Hinge-(Left Side)

1. Lower hinge (72).
 - Align lower hinge (72) to lines marked on body.
2. Nuts (143).

Tighten

- Nuts (143) to 29 N·m (21 lb. ft.).
3. Inner panel access hole covers. Refer to "Inner Panel Access Hole Covers" in this section.
 4. Trim panel. Refer to "Trim Panel" in this section.
 5. End gate. Refer to "Two-Way End Gate" in this section.

TORQUE ROD AND TORQUE ROD LINK

Figure 57

Remove or Disconnect

1. End gate. Refer to "Two-Way End Gate" in this section.
2. Trim panel. Refer to "Trim Panel" in this section.
3. Place end gate on a covered work bench to protect painted surface.
4. Bolt/screw (147) and torque rod retainer (88) from right side of end gate.
5. Drill out rivet (148) using a 1/4-inch drill bit.
6. Torque rod grommet (90).
7. Torque rod (89) from end gate.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Torque rod (89) to end gate.
2. Torque rod grommet (90) and rivet (148).
3. Torque rod retainer (88) and bolt/screw (147) to right side of end gate.

Adjust

- Bolt/screw (147) to 12 N·m (106 lb. in.).
4. Trim panel. Refer to "Trim Panel" in this section.
 5. End gate. Refer to "Two-Way End Gate" in this section.

TWO-WAY END GATE

Figures 5, 6, 51, 56 and 57

Remove or Disconnect

1. Open end gate as a door until tension on torque rod (89) has been relieved.
2. Torque rod link bolts/screws (146).
3. Torque rod link (171) and torque rod link retainer (170).
4. Disengage torque rod link (171) from torque rod (89).

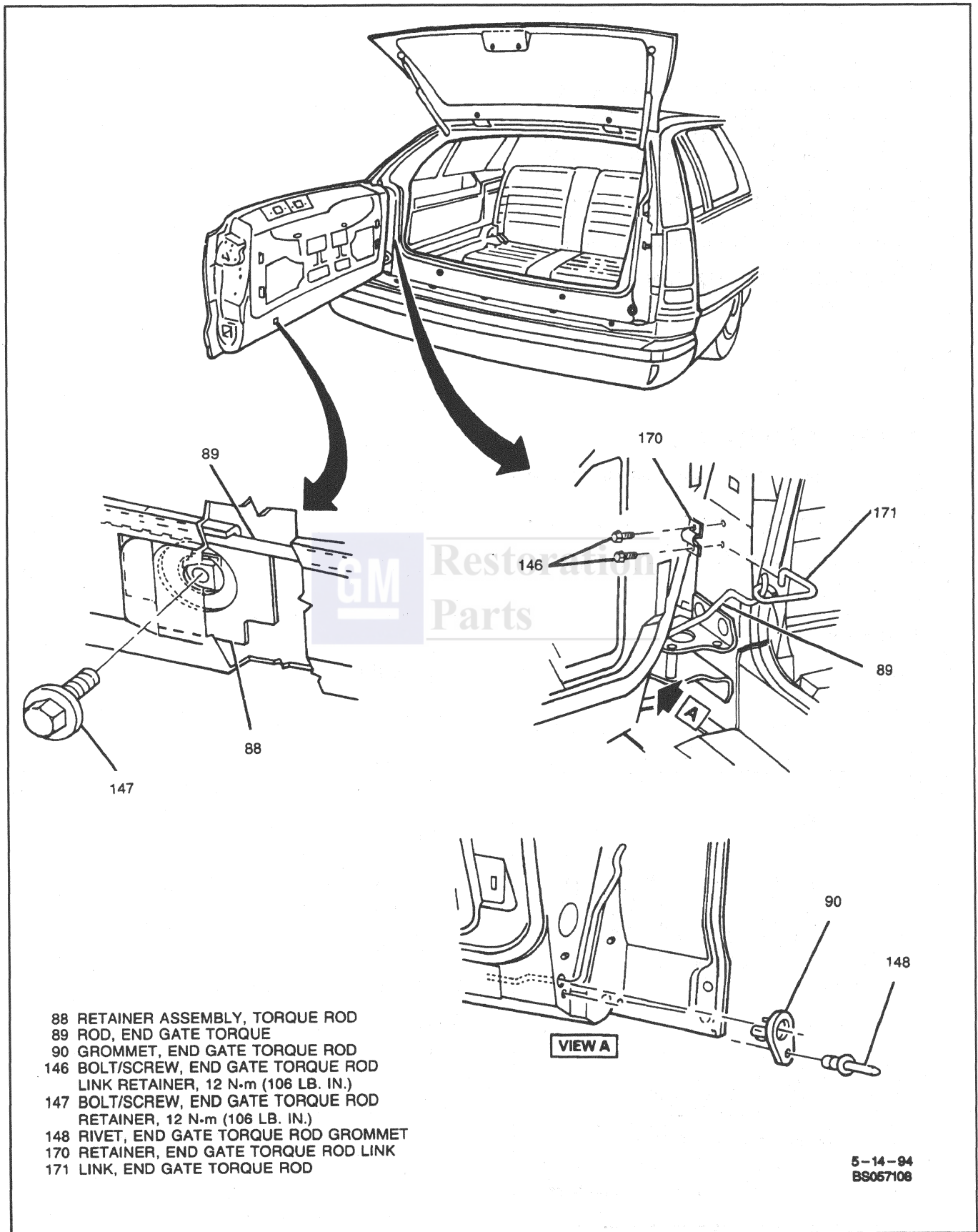


Figure 57 - Torque Rod and Torque Rod Link

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5. Close end gate.
6. Open end gate as a gate and suitably support.
7. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.
8. Electrical connectors.
9. Bolts/screws retaining wiring harness to body.

CAUTION: With end gate open in the gate position and the left upper hinge gate side lock manually engaged, the end gate has been placed in a vulnerable position and could drop from the right lower lock if the locking rod and/or end gate door release handle is activated. Do not pull on rod or activate end gate door release handle as personal injury and/or damage to the end gate could result.

10. Manually latch upper hinge gate side lock (82).

Important

- The aid of a helper will be required to help support the end gate.
11. Bolt/screw (141), support (168) and support spring (67).
 12. Lower body side hinge nuts (144).
 - Mark location of lower hinge (72).
 13. End gate from lower right latch striker (49) by activating the end gate door release handle (177) and lifting upward and rearward.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. End gate to lower right latch striker (49).
2. Lower body side hinge nuts (144).

Tighten

- Nuts (144) to 29 N.m (21 lb. ft.).
3. Support spring (67), support (168), and bolt/screw (141).

Tighten

- Bolt/screw (141) to 12 N.m (106 lb. in.).
4. Wiring harness and bolts/screws to body.
 5. Electrical connectors.
 6. Left quarter inner rear trim finish panel. Refer to SECTION 10-7.
 7. Close end gate.
 8. Open end gate as a door so that torque rod (89) will not be under tension.
 9. Engage torque rod (89) and torque rod link (171).
 10. Torque rod link (171) to torque rod link retainer (170).
 11. Torque rod link bolts/screws (146).

Tighten

- Torque rod link bolts/screws (146) to 12 N.m (106 lb. in.).

TWO-WAY END GATE ADJUSTMENTS

Figures 5, 6, 49 and 56

Before performing any adjustments, mark the original position of the hinge, lock or striker to be adjusted.

Proper diagnosis of a misaligned condition can eliminate performing unnecessary adjustments. To properly evaluate a misaligned end gate, remove the upper right latch striker (49). If the end gate, when opened as a door, rides up or is pulled down by the lower right latch striker (49), the lower right latch striker (49) should be adjusted.

The left hinges allow adjustment of the end gate's position in the body opening, flush alignment of the end gate (59) with adjacent panels, and proper lock operation.

Important

- The right upper and lower latch strikers (49) should be removed before performing any other hinge or lock adjustment. Refer to "Latch Strikers (Right Side)" in this section.
- Improper adjustment of right lower latch striker (49) may cause "GATE AJAR" lamp and roof rail courtesy and reading lamps to illuminate.

Adjust

1. Left lower hinge (72) at the body attachment up or down and from side to side.
 - A. To gain access to lower body side hinge nuts (144), remove left quarter inner rear trim finish panel. Refer to SECTION 10-7. Loosen lower body side hinge nuts (144) and adjust lower hinge (72) up, down, sideways, or rotate as required.
 - B. Rotating the lower hinge (72) slightly will raise or lower the right side of the end gate. This can be accomplished by loosening the lower body side hinge nuts (144). Then, with the end gate open as a door, support the right side of the end gate in the desired position and tighten the lower body side hinge nuts (144) to 29 N.m (21 lb. ft.). If this adjustment is performed or if the end gate is moved sideways, it may be necessary to also adjust the upper hinge striker (169).
 - C. If the lower hinge (72) is adjusted upward or downward, clearance between the upper hinge gate side lock (82) on the end gate and the upper hinge striker (169) on the body pillar should be checked. Clearance should be 8 mm (5/16-inch). The upper hinge gate side lock (82) should be adjusted as needed to meet this specification.

2. Lower hinge (72) at end gate attachment forward or rearward.
 - A. Forward and rearward adjustment of lower hinge (72) at the end gate attachment is primarily for flush alignment of the end gate (59) with adjacent panels in the area of the lower hinge (72).
 - B. The lower gate side hinge nuts (143) are located inside the end gate (59). To loosen nuts (143) for adjustment of end gate (59) on lower hinge (72), remove trim panel and left inner panel access hole cover to gain access to lower gate side hinge nuts. Refer to "Trim Panel" and "Inner Panel Access Hole Covers" in this section. Adjust end gate (59) on lower hinge (72) as required, then tighten nuts (143) to 29 N.m (21 lb. ft.) and replace previously removed parts.
3. Upper hinge gate side lock (82) forward and rearward.
 - A. The forward and rearward adjustment of the upper hinge gate side lock (82) is available to provide a flush alignment of the end gate (59) with adjacent body panels in the area of the upper hinge gate side lock (82).
 - B. Before adjusting upper hinge gate side lock (82), mark original position of lock on end gate (59). Two of the upper hinge gate side lock nuts (142) are located outside the end gate (59), one inside. To loosen inside nut (142), remove trim panel and inner panel access hole cover. Refer to "Trim Panel" and "Inner Panel Access Hole Covers" in this section. Then loosen nuts (142). Adjust lock as required, replace all previously removed parts, and tighten nuts (142) to 29 N.m (21 lb. ft.).
 - C. After any adjustment of the upper hinge gate side lock (82), synchronization of the lock system should be checked and, where required, the lock system should be synchronized, as described in "Two-Way End Gate Lock and Synchronization Check" in this section.
4. Upper hinge striker (169) up or down, and side to side. The up or down adjustment is to provide 8 mm (5/16-inch) clearance between the bottom of the upper hinge gate side lock (82) (on end gate) and the top of the upper hinge striker (169).
 - A. To check clearance, open end gate as a door and measure distance between the upper surface of the left upper hinge pin and upper hinge striker (169) and the lower surface of the upper hinge gate side lock (82).
 - B. To make necessary adjustment, remove left quarter inner rear trim finish panel to gain access to attachments. Refer to SECTION 10-7 for trim removal. Loosen striker nuts and reposition upper hinge striker (169) as required.

! Important

- A. This adjustment allows proper engagement of the upper hinge striker (169) with the upper hinge gate side lock (82). This adjustment is

not intended as a means of raising or lowering the left or right side of the end gate (59).

- B. To find the correct adjustment, open the end gate as a gate; then, while closing the end gate, carefully observe how the left upper striker pin engages in the slot in the bottom surface of the upper hinge gate side lock (82). The striker pin should enter into the slot with side pressure.
5. Upper and lower latch strikers (49) forward or rearward, up or down, and side to side by using spacers.

! Important

- A. Do not use upper and lower latch strikers (49) to align right side of end gate (59) up or down in body opening.
- B. The upper and lower lock strikers (49) should be removed before performing any other hinge or lock adjustment.
- C. To adjust the upper or lower latch strikers (49), open the end gate as a door and remove latch striker (49). Check alignment of end gate in body opening. The end gate (59) should be aligned with the upper hinge gate side lock (82) before adjustment of latch strikers (49). Install latch striker (49) slightly more than finger tight. Then carefully close end gate to allow latch striker (49) to self-align. Carefully open end gate and tighten latch striker (49) to 53 N.m (39 lb. ft.).
- D. Operate end gate both as a door and a gate and check flush alignment of outer panels in area of latch striker (49). If any further minor adjustment is required, mark position of latch striker (49) on body pillar, loosen latch striker (49) and make required adjustment from marked position and tighten latch striker (49) to 53 N.m (39 lb. ft.).

TWO-WAY END GATE WINDOW

Window

Figures 5, 6, 58 and 59

↔ Remove or Disconnect

1. Open and raise window (105).

! Important

- The aid of a helper will be required to support the window (105) while removing window struts (104 and 107).
2. Electrical connectors, if equipped.
 3. Window struts (104 and 107) from window strut window side studs (108) by unsnapping.
 4. Lower window (105) but do not engage window latch (84).
 5. Trim panel molding. Refer to SECTION 10-9.
 6. Nuts (149).

10-8-50 BODY REAR END

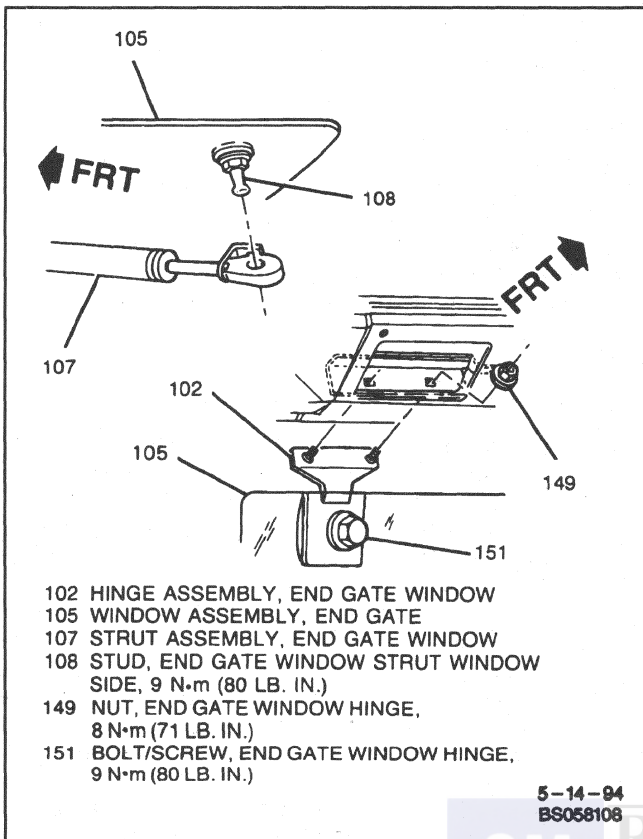


Figure 58 - Removing Window

7. Window (105).
8. High-mount stoplamp, if necessary. Refer to "End Gate High-Mount Stop-lamp" in this section.
9. Window strut window side stud (108), if necessary.
 - Unscrew to remove window strut window side stud (108), window strut spacer (109) and window strut nut (110).
10. Wiper blade stop (106), if necessary.
 - Unscrew nut (150) to remove wiper blade stop (106).
11. Window hinge (102), if necessary.
 - Unscrew bolt/screw (151) to remove window hinge (102) and window side hinge gasket (103).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Window side hinge gasket (103), window hinge (102) and bolt/screw (151), if removed.

Tighten

- Bolt/screw (151) to 9 N·m (80 lb. in.).
2. Wiper blade stop (106) and nut (150), if removed.

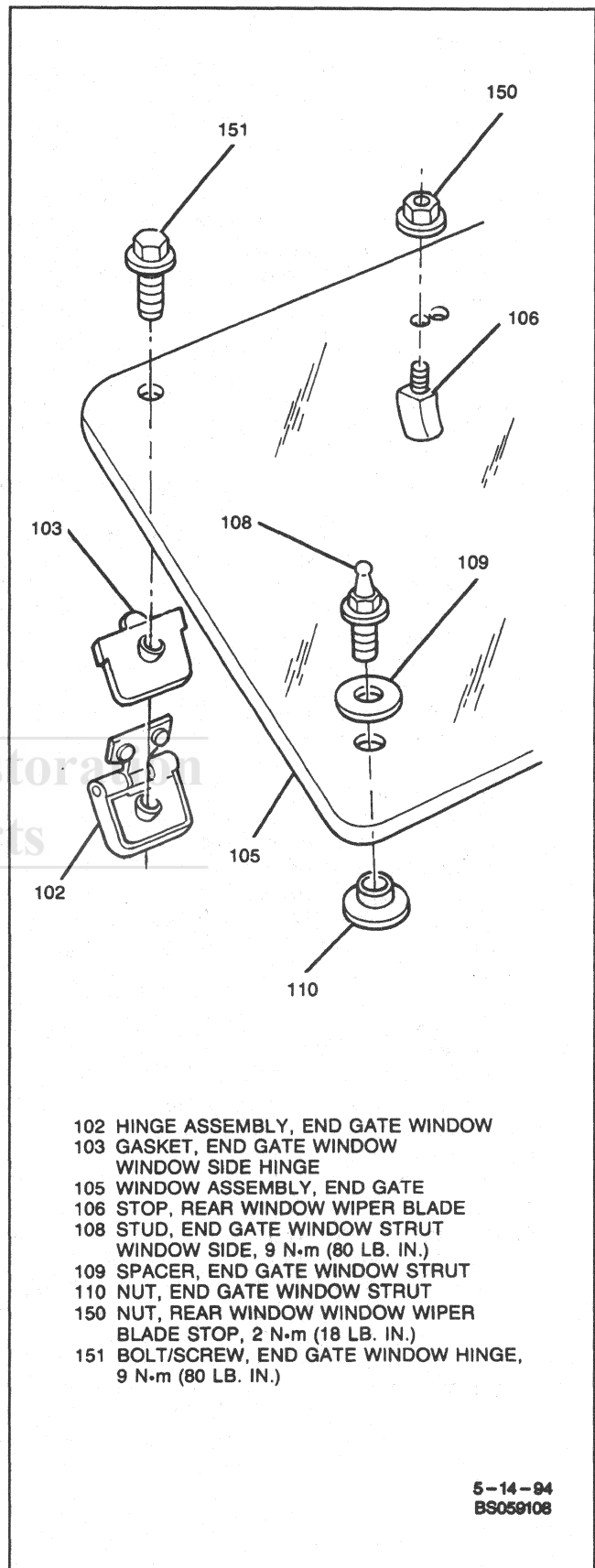


Figure 59 - Disassembling Window

Tighten

- Nut (150) to 2 N.m (18 lb. in.).
- 3. Window strut spacer (109), window strut nut (110) and window strut window side stud (108), if removed.

Tighten

- Window strut window side stud (108) to 9 N.m (80 lb. in.).
- 4. High-mount stoplamp, if removed. Refer to "End Gate High-Mount Stop-lamp" in this section.
- 5. Window (105).
- 6. Nuts (149).
- 7. Close window (105) gently.

Inspect

- Engagement of high-mount stoplamp pin and loop to locator (83) and window latch (84). Adjust as necessary. Refer to "Window Latch Adjustment" in this section.

Tighten

- Nuts (149) to 8 N.m (71 lb. in.).
- 8. Trim panel molding. Refer to SECTION 10-9.
- 9. Open window (105).
- 10. Window struts (104 and 107) to window (105).
 - Snap window struts (104 and 107) on to window strut window side studs (108) to secure.
- 11. Electrical connectors, if equipped.

Window Struts

Figures 5 through 6 and 60

Remove or Disconnect

1. Open window (105).
2. Electrical connectors, if equipped.
3. Window strut (104 or 107) from window strut body side stud (48).
4. Window strut (104 or 107) from window strut window side stud (108) by unsnapping.
5. Window strut body side stud (48), if necessary.
 - Unscrew.

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Open window (105) and support.
2. Window strut body side stud (48), if removed.

Tighten

- Window strut body side stud (48) to 12 N.m (106 lb. in.).

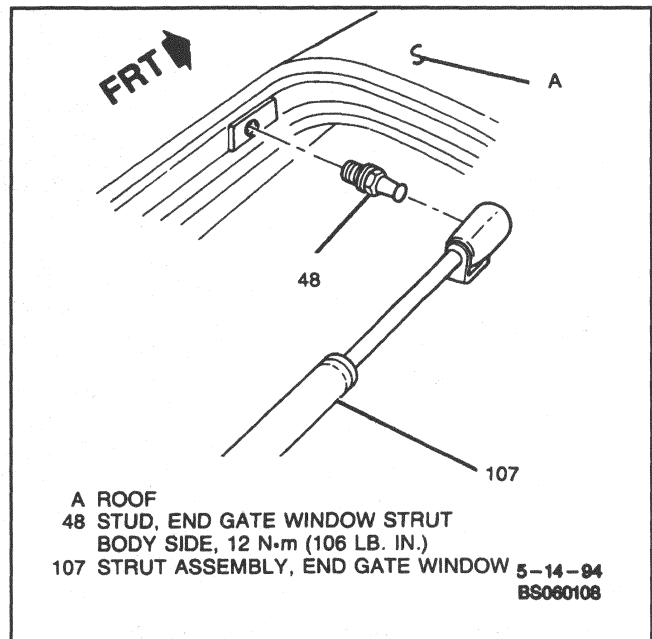


Figure 60 - Window Struts

3. Window strut (104 or 107) to window strut window side stud (108).
 - Snap window strut (104 or 107) on to window strut window side stud (108) to secure.
4. Window strut (104 or 107) to window strut body side stud (48).
5. Electrical connectors, if equipped.
6. Close window (105).

Window Latch

Figures 5, 6 and 61

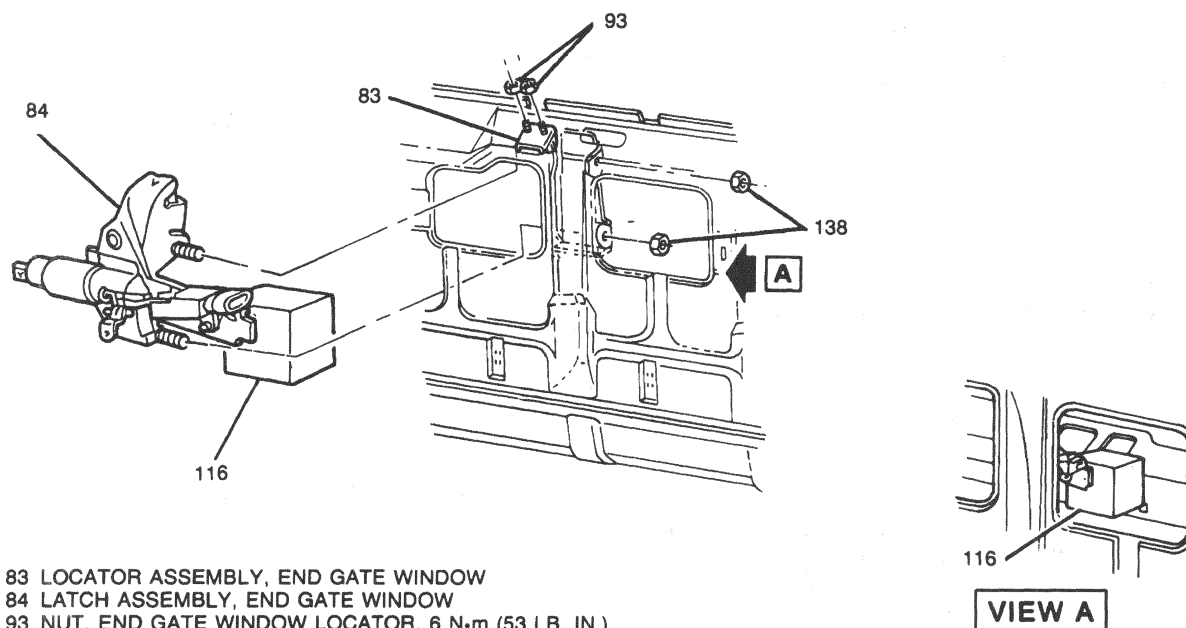
Remove or Disconnect

1. Lock cylinder. Refer to "Lock Cylinder" in this section.
2. Actuator bumper (116).
3. Electrical connectors.
4. Loosen nuts (93) on locator (83) and slide locator (83) out of way.
5. Nuts (138).
6. Window latch (84).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Window latch (84).
2. Nuts (138) finger tight.
3. Electrical connectors.
4. Close window (105) gently.
5. Slide locator (83) left or right to accept pin on high-mount stoplamp (111).
6. Slide window latch (84) left or right to accept loop on high-mount stoplamp (111).



83 LOCATOR ASSEMBLY, END GATE WINDOW
84 LATCH ASSEMBLY, END GATE WINDOW
93 NUT, END GATE WINDOW LOCATOR, 6 N·m (53 LB. IN.)
116 BUMPER, END GATE WINDOW RELEASE ACTUATOR
138 NUT, END GATE WINDOW LOCK, 6 N·m (53 LB. IN.)

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Figure 61 - Window Latch

7. Latch the window (105).
8. Move window latch (84) forward until window (105) is tightly sealed.

Tighten

- Nuts (93) to 6 N·m (53 lb. in.).
 - Nuts (138) to 6 N·m (53 lb. in.).
9. Actuator bumper (116).
 - Remove adhesive backing from actuator bumper (116) and insert between window latch (84) and inner reinforcement.
 - Make sure actuator bumper (116) does not interfere with window latch moving parts or hole for license plate attachment.
 10. Lock cylinder. Refer to "Lock Cylinder" in this section.

Window Latch Adjustment

Figures 61 and 62

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Loosen nuts (93).
3. Close window (105) gently.

Adjust

1. Slide locator (83) left or right to accept pin on high-mount stoplamp (111).

2. Slide window latch (84) left or right to accept loop on high-mount stoplamp (111).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Latch the window (105).
2. Move window latch (84) forward until window (105) is tightly sealed.

Tighten

- Nuts (93) to 6 N·m (53 lb. in.).
3. Trim panel. Refer to "Trim Panel" in this section.

Window Striker Bezel

Figures 5 and 6

To remove the window striker bezel (57), pull from opening on end gate (59).

END GATE HIGH-MOUNT STOP-LAMP

Figure 62

Remove or Disconnect

1. Open window (105).
2. Bolts/screws (153).

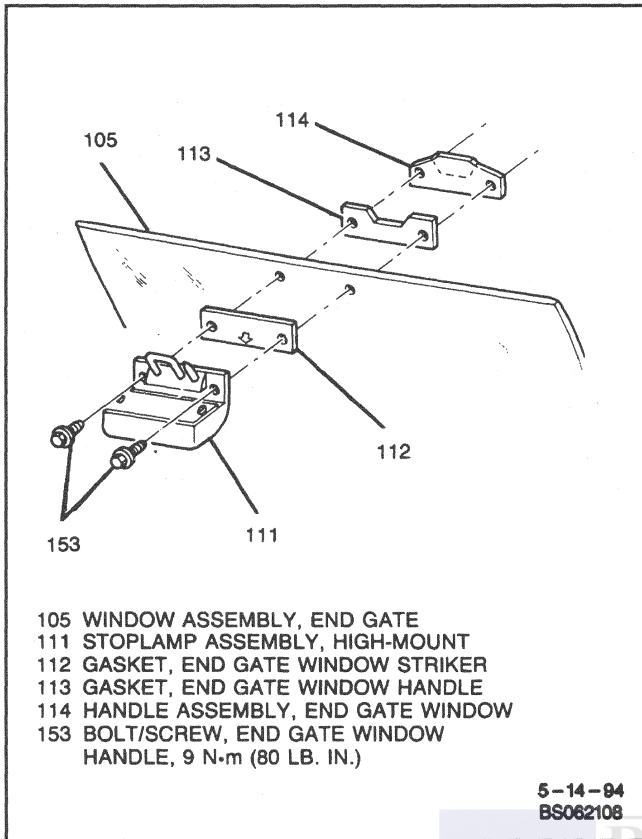


Figure 62 - High-Mount Stop-lamp

3. High-mount stoplamp (111).
4. Window striker gasket (112), window handle (114), and window handle gasket (113).

Install or Connect

NOTICE: Refer to "Notice" on page 10-8-1 of this section.

1. Window striker gasket (112) and high-mount stoplamp (111) to window (105).
 - Make sure arrow on window striker gasket (112) points toward top of window (105).
2. Window handle gasket (113) and window handle (114) to window (105).
3. Bolts/screws (153).

Tighten

- Bolts/screws (153) to 9 N-m (80 lb. in.).

Adjust

- Window latch to accept high-mount stoplamp loop and pin, if necessary. Refer to "Window Latch" in this section.

High-Mount Stop-lamp Contact

Figures 5 and 6

Remove or Disconnect

1. Trim panel. Refer to "Trim Panel" in this section.
2. Electrical connectors.
3. Rivets using 1/4-inch drill bit and drill.
4. High-mount stoplamp contact (161) from end gate (59).

Install or Connect

1. High-mount stoplamp contact (161) to end gate (59).
2. Rivets.
3. Electrical connectors.
4. Trim panel. Refer to "Trim Panel" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

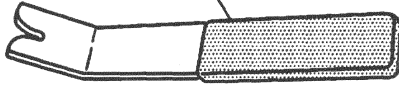
Convenience Net Retainer.....	2.5 N-m (22 lb. in.)
End Gate Door Release Handle Bolt/Screw.....	10 N-m (89 lb. in.)
End Gate Door Release Handle Trim Cover Bolt/Screw.....	1.9 N-m (17 lb. in.)
End Gate Handle Bolt/Screw.....	10 N-m (89 lb. in.)
End Gate Handle Trim Cover Bolt/Screw.....	1.9 N-m (17 lb. in.)
End Gate Inner Panel Access Hole Cover Bolt/Screw.....	1.5 N-m (13 lb. in.)
End Gate Latch Striker.....	53 N-m (39 lb. ft.)
End Gate Lock Switch Bolt/Screw.....	2.1 N-m (19 lb. in.)
End Gate Lower Body Side Hinge Nut.....	29 N-m (21 lb. ft.)
End Gate Lower Gate Side Hinge Nut.....	29 N-m (21 lb. ft.)
End Gate Lower Lock Bolt/Screw.....	8 N-m (71 lb. in.)
End Gate Support Bolt/Screw.....	12 N-m (106 lb. in.)
End Gate Torque Rod Link Retainer Bolt/ Screw.....	12 N-m (106 lb. in.)

10-8-54 BODY REAR END

End Gate Torque Rod Retainer Bolt/Screw.....	12 N-m (106 lb. in.)
End Gate Transfer Lower Finish Molding Bolt/Screw.....	1.3 N-m (12 lb. in.)
End Gate Transfer Upper Finish Molding Bolt/Screw	1.3 N-m (12 lb. in.)
End Gate Trim Panel Bolt/Screw.....	1.3 N-m (12 lb. in.)
End Gate Upper Hinge Gate Side Lock Nut.....	29 N-m (21 lb. ft.)
End Gate Upper Hinge Striker Nut.....	50 N-m (37 lb. ft.)
End Gate Upper Lock Bolt/Screw	8 N-m (71 lb. in.)
End Gate Upper Outer Finishing Molding Bolt/Screw	1.3 N-m (12 lb. in.)
End Gate Weatherstrip Bolt/Screw	1.3 N-m (12 lb. in.)
End Gate Window Handle Bolt/Screw	9 N-m (80 lb. in.)
End Gate Window Hinge Bolt/Screw	9 N-m (80 lb. in.)
End Gate Window Hinge Nut.....	8 N-m (71 lb. in.)
End Gate Window Locator Nut.....	6 N-m (53 lb. in.)
End Gate Window Lock Nut.....	6 N-m (53 lb. in.)
End Gate Window Strut Body Side Stud.....	12 N-m (106 lb. in.)
End Gate Window Strut Window Side Stud.....	9 N-m (80 lb. in.)
End Gate Window Weatherstrip Bolt/Screw.....	1.3 N-m (12 lb. in.)
Fuel Tank Filler Door Inner Cover Bolt/Screw.....	10 N-m (89 lb. in.)
High-Mount Stoplamp Bolt/Screw	1.5 N-m (13 lb. in.)
High-Mount Stoplamp Support Nut.....	6 N-m (53 lb. in.)
Luggage Shade Support Bolt/Screw.....	1.9 N-m (17 lb. in.)
Radio Rear Speaker Bolt/Screw	1.9 N-m (17 lb. in.)
Rear Compartment Lid Hinge Lid Side Bolt/Screw.....	29 N-m (21 lb. ft.)
Rear Compartment Lid Lock Bolt/Screw.....	4 N-m (35 lb. in.)
Rear Compartment Lid Lock Release Actuator Bolt/Screw.....	2.5 N-m (22 lb. in.)
Rear Compartment Lid Lock Striker Nut.....	10 N-m (89 lb. in.)
Rear Compartment Lid Lower Molding Bolt/Screw.....	1.3 N-m (12 lb. in.)
Rear Compartment Lid Lower Molding Nut.....	4 N-m (35 lb. in.)
Rear Compartment Lid Pull-Down Actuator Nut.....	10 N-m (89 lb. in.)
Rear Compartment Lid Pull-Down Switch Bolt/Screw	1.6 N-m (14 lb. in.)
Rear Compartment Lid Spoiler Nut.....	6 N-m (53 lb. in.)
Rear License Lamp Molding Nut.....	6 N-m (53 lb. in.)
Rear Quarter Taillamp Upper Molding Bolt/Screw	1.3 N-m (12 lb. in.)
Rear Window-to-Rear Compartment Lid Filler Bolt/Screw	1.9 N-m (17 lb. in.)
Rear Window Wiper Blade Stop Nut.....	2 N-m (18 lb. in.)

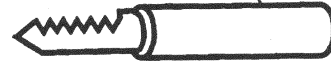
SPECIAL TOOLS

J 24595-C



1 DOOR TRIM PAD AND GARNISH CLIP REMOVER

BT 8401B



2 SHUTTER CAP RETAINER KEY

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SECTION 10-9

ROOF

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

ROOF

Figures 1 through 6

The information in this section provides service procedures that apply to all roof components.

ON-VEHICLE SERVICE

HEADLINING PANEL

Figures 7 through 9

The headlining panel is partially held in place with retainers (2). When the interior moldings and bolts/screws, sunshade brackets, dome lamp base, assist straps, coat hooks, roof rail courtesy and reading lamps are installed, the headlining panel is completely held in place.

Remove or Disconnect

1. Dome lamp (Chevrolet). Refer to "Dome Lamp" in this section.
2. Sunshades. Refer to "Sunshade" in this section.
3. Roof rail assist straps, if sedan. Refer to "Roof Rail Assist Strap" in this section.
4. Coat hook or roof rail courtesy and reading lamp. Refer to "Coat Hook and Roof Rail Courtesy and Reading Lamp" in this section.
5. Quarter window garnish moldings or quarter upper trim, if sedan. Refer to SECTION 10-7.
6. Body lock pillar trim finish panel and back body pillar finish panel, if wagon. Refer to SECTION 10-7.
7. Windshield garnish moldings. Refer to "Windshield Garnish Molding" in this section.
8. Center pillar upper trim finish panels. Refer to SECTION 10-6.
9. Endgate trim panel molding, if wagon. Refer to "Endgate Trim Panel Molding" in this section.
10. Roof stationary window garnish molding, if Buick wagon. Refer to "Roof Stationary Window Garnish Molding and Sunshade" in this section.

10-9-2 ROOF

11. Retainer (47), if wagon.
12. Headlining panel (83, 3 or 4).
 - A. Recline front seats, if sedan.
 - B. Unfasten headlining panel (83, 3 or 4) from retainers (2).
 - C. Remove headlining panel (83, 3 or 4) from vehicle through passenger door, if sedan or endgate opening if wagon.
13. Sunshade rod retainer nut (50) from hole in windshield header, if necessary.

Install or Connect

1. Sunshade rod retainer nut (50) to hole in windshield header, if removed.
2. Headlining panel (83, 3 or 4).
 - A. Recline front seats, if sedan.
 - B. Place headlining panel (83, 3 or 4) in vehicle through passenger door, if sedan or endgate opening if wagon.
 - C. Pull electrical connectors through openings.
 - Make sure rearview mirror wiring harness connector will extend beyond front edge of headlining panel (83, 3 or 4).
 - D. Align headlining panel (83, 3 or 4) to retainers (2) and door openings.
 - E. Press headlining panel (83, 3 or 4) to secure.
3. Retainer (47), if wagon.
4. Roof stationary window garnish molding, if Buick wagon. Refer to "Roof Stationary Window Garnish Molding and Sunshade" in this section.
5. Endgate trim panel molding, if wagon. Refer to "Endgate Trim Panel Molding" in this section.
6. Center pillar upper trim finish panels. Refer to SECTION 10-6.
7. Windshield garnish moldings. Refer to "Windshield Garnish Molding" in this section.
8. Body lock pillar trim finish panel and back body pillar finish panel, if wagon. Refer to SECTION 10-7.
9. Quarter window garnish moldings or quarter upper trim, if sedan. Refer to SECTION 10-7.
10. Coat hook or roof rail courtesy and reading lamps. Refer to "Coat Hook and Roof Rail Courtesy and Reading Lamp" in this section.
11. Roof rail assist straps, if sedan. Refer to "Roof Rail Assist Strap" in this section.
12. Sunshades. Refer to "Sunshade" in this section.

SUNSHADE AND VANITY MIRRORS

Sunshade

Figure 10

Remove or Disconnect

1. Bolts/screws (8).
2. Sunshade (13).
3. Electrical connector from sunshade connector, if equipped.

Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Electrical connector to sunshade connector, if equipped.
2. Sunshade (13).
 - Position sunshade support bracket to hole in headlining panel (83, 3 or 4).
3. Bolts/screws (8).

Tighten

- Bolts/screws (8) to 2.8 N.m (25 lb. in.).

Vanity Mirror

Figure 10

Remove or Disconnect

1. Lower sunshade (13) and raise mirror door.
2. Vanity mirror (12).
 - A. Using small screwdriver, unsnap bottom edge of vanity mirror (12).
 - B. Pull to unsnap upper edge of vanity mirror (12).

Install or Connect

1. Vanity mirror (12).
 - A. Snap in upper edge of vanity mirror (12).
 - B. Snap in lower edge of vanity mirror (12).
2. Lower mirror door and raise sunshade (13).

Bulb Replacement

Remove or Disconnect

1. Lens (11).
 - Insert small screwdriver at bottom edge of lens (11) to unsnap.
2. Bulb (10).

Install or Connect

1. Bulb (10).
2. Lens (11).
 - Insert top of lens (11) and snap in bottom.

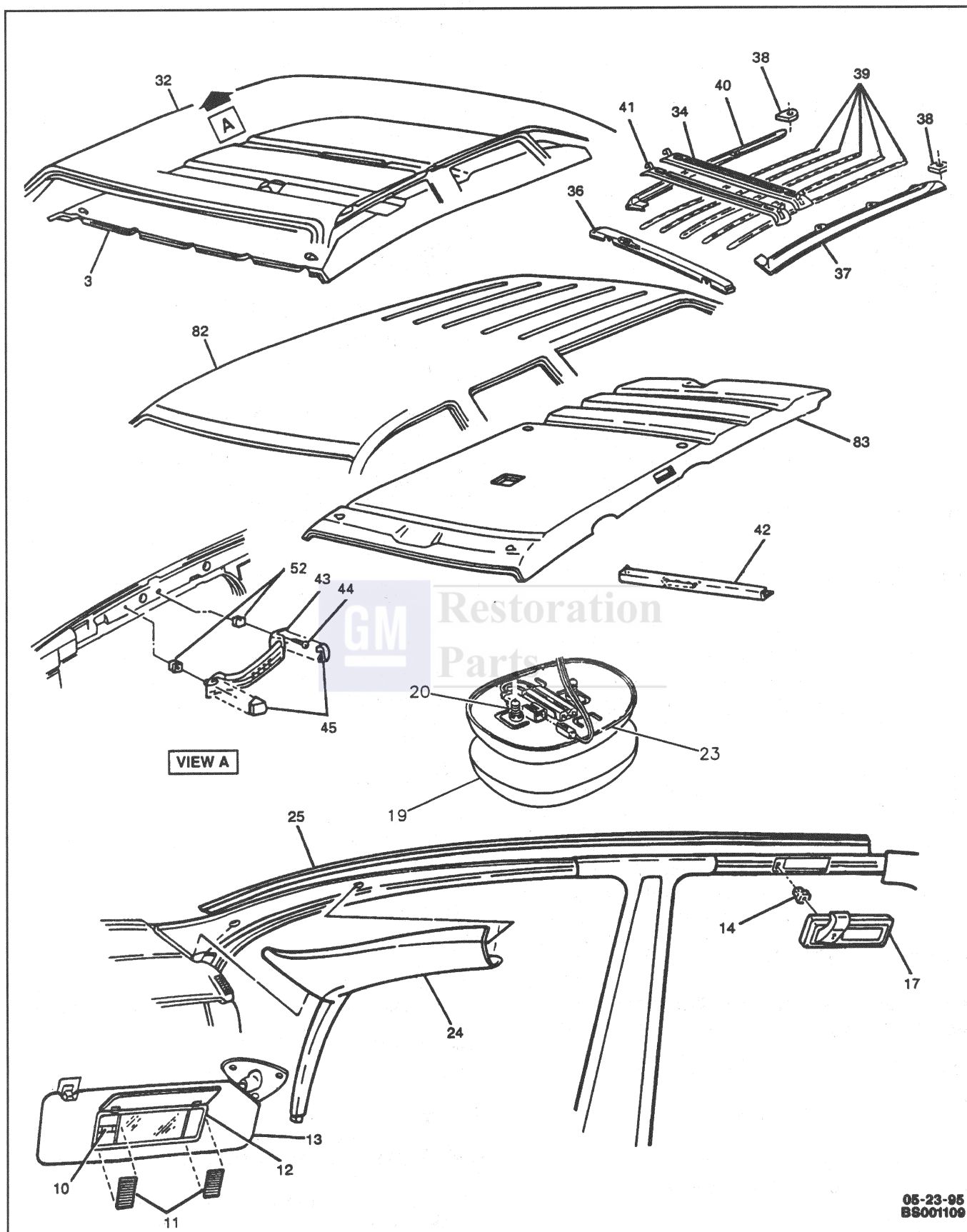
ROOF RAIL ASSIST STRAP

SEDAN

Figures 11 and 12

Remove or Disconnect

1. Cover (45) from roof rail assist strap (43) (Chevrolet).
2. Bolts/screws (44 or 53).
3. Roof rail assist strap (43) or (51).
4. Nuts (52), if necessary.



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Figure 1 - Roof Components - (Chevrolet)

10-9-4 ROOF

3 PANEL, HEADLINING TRIM FINISH
10 BULB, VANITY MIRROR
11 LENS, VANITY MIRROR
12 MIRROR, VANITY
13 SUNSHADE
14 NUT, COAT HOOK
17 HOOK, COAT
19 LENS, DOME LAMP
20 RETAINER, DOME LAMP
23 HOUSING, DOME LAMP
24 MOLDING, WINDSHIELD GARNISH
25 WEATHERSTRIP, ROOF SIDE RAIL
AUXILIARY
32 PANEL, ROOF (SEDAN)

34 RAIL, LUGGAGE CARRIER FRONT
36 DEFLECTOR, END GATE WINDOW AIR
37 RAIL, LUGGAGE CARRIER SIDE
38 CAP, LUGGAGE CARRIER OUTER SLAT
39 SLAT, LUGGAGE CARRIER CENTER
40 RAIL, LUGGAGE CARRIER SIDE
41 RAIL, LUGGAGE CARRIER REAR
42 MOLDING, END GATE TRIM PANEL
43 STRAP, ROOF RAIL REAR ASSIST
44 BOLT/SCREW, ROOF RAIL REAR ASSIST STRAP
3.8 N·m (34 LB. IN.)
45 COVER, ROOF RAIL REAR ASSIST STRAP
ESCUTCHEON
52 NUT, ROOF RAIL REAR ASSIST STRAP
82 PANEL, ROOF
83 PANEL, HEADLINING TRIM FINISH

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Figure 2 - Roof Components - (Chevrolet) -Legend



Install or Connect

NOTICE: Refer to “Notice” on page 10-9-1 of this section.

1. Nuts (52), if removed.
 - Snap into place to secure.
2. Roof rail assist strap (43) or (51) to nuts (52) in roof rail inner panel.
3. Bolts/screws (44 or 53).



Tighten

- Bolts/screws (44) to 3.8 N·m (34 lb. in.).
 - Bolts/screws (53) to 1.9 N·m (17 lb. in.).
4. Covers (45) to roof rail assist strap (43) (Chevrolet). Snap in place to secure.

INTERIOR LIGHTING

Coat Hook and Roof Rail Courtesy and Reading Lamp

Figure 13



Remove or Disconnect

1. Bolt/screw (16).
2. Coat hook or roof rail courtesy and reading lamp (15).
3. Electrical connector.
4. Nut (14), if necessary.



Install or Connect

NOTICE: Refer to “Notice” on page 10-9-1 of this section.

1. Nut (14), if removed.
2. Electrical connector.
3. Coat hook or roof rail courtesy and reading lamp (15).
4. Bolt/screw (16).



Tighten

- Bolt/screw (16) to 1.3 N·m (12 lb. in.).

LAMP

Dome Lamp

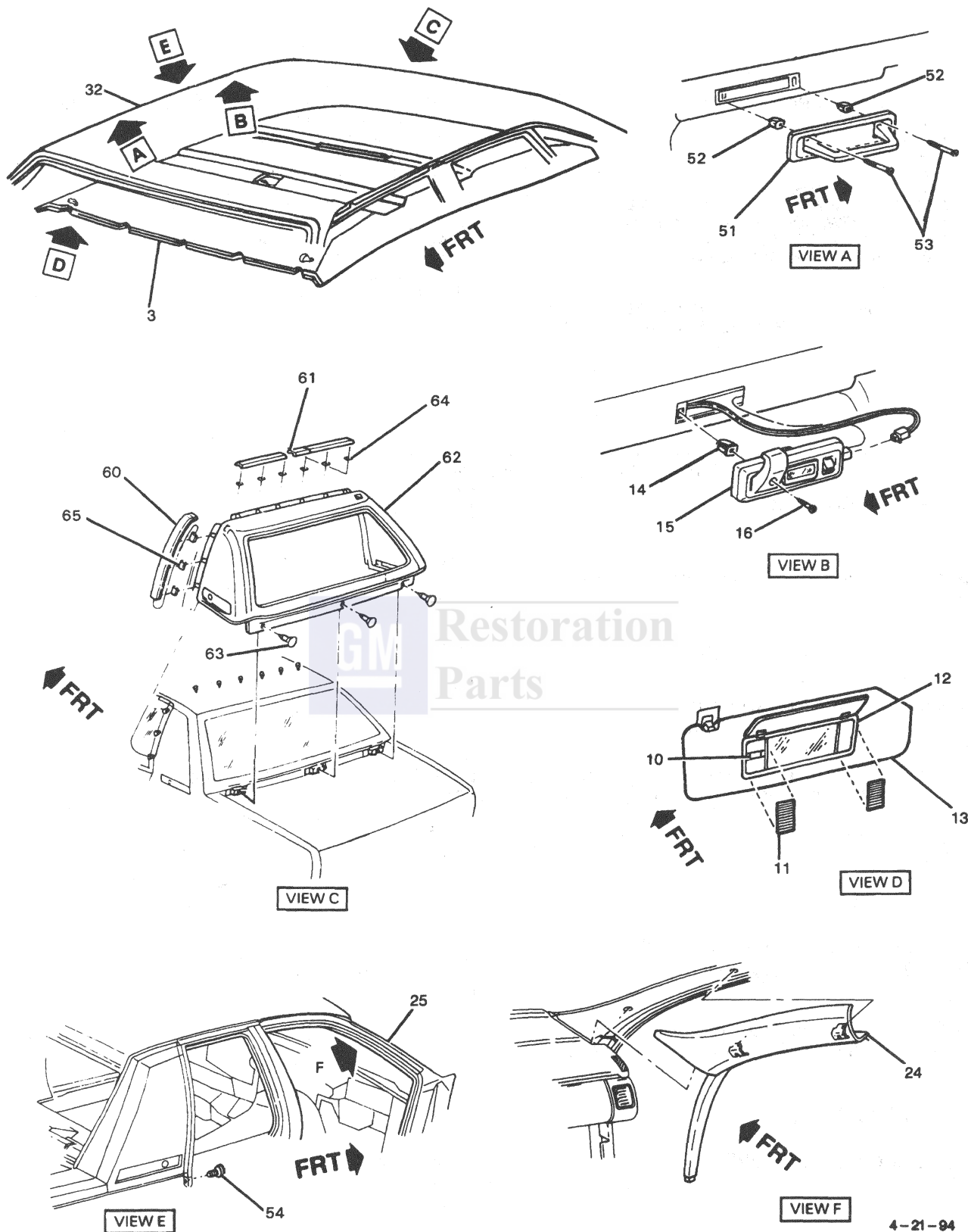
Figure 14

Some police and taxi vehicles have an extra dome lamp located in the center of the headlining panel between the sunshades.



Remove or Disconnect

1. Lens 66
 - Carefully squeeze lens 66 at front and rear, or at sides if police and taxi vehicle, to disengage and remove.
2. Bulb 69 from terminal socket or clips.
3. Retainers (20) or bolts/screws (67), if police or taxi vehicle.
4. Electrical connector.
5. Dome lamp housing (23 or 68).



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Figure 3 - Roof Components - (Buick Sedan)

3 PANEL, HEADLINING TRIM FINISH
 10 BULB, VANITY MIRROR
 11 LENS, VANITY MIRROR
 12 MIRROR, VANITY
 13 SUNSHADE
 14 NUT, COAT HOOK
 15 LAMP, ROOF RAIL COURTESY AND READING
 16 BOLT/SCREW, COAT HOOK, 1.3 N·m (12 LB. IN.)
 24 MOLDING, WINDSHIELD GARNISH
 25 WEATHERSTRIP, ROOF SIDE RAIL
 AUXILIARY
 32 PANEL, ROOF
 51 STRAP, ROOF RAIL FRONT OR REAR ASSIST
 52 NUT, ROOF RAIL FRONT OR REAR ASSIST STRAP

53 BOLT/SCREW, ROOF RAIL FRONT OR REAR ASSIST
 STRAP, 1.9 N·m (17 LB. IN.)
 54 BOLT/SCREW, ROOF SIDE RAIL AUXILIARY
 WEATHERSTRIP, 1.3 N·m (12 LB. IN.)
 60 MOLDING, ROOF PANEL COVER
 QUARTER UPPER FRONT FINISH
 61 MOLDING, ROOF PANEL COVER UPPER FINISH
 62 COVER, ROOF PANEL
 63 BOLT/SCREW, ROOF PANEL COVER,
 1.9 N·m (17 LB. IN.)
 64 CLIP, ROOF PANEL COVER UPPER FINISH MOLDING
 65 CLIP, ROOF PANEL COVER, QUARTER UPPER FRONT
 FINISH MOLDING

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Figure 4 - Roof Components - (Buick Sedan) - Legend



Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Dome lamp housing (23 or 68).
2. Electrical connector.
3. Ground wire and bolt/screw (67) to dome lamp housing (68) and secure with retainer (46), if police or taxi vehicle.
4. Retainers (20) if gap appears between domelamp and headliner push domelamp to fully seats and gap is gone.
5. Retainers (20) or bolts/screws (67), if police or taxi vehicle.



Tighten

- Bolt/screw (67) to 1.5 N·m (13 lb. in.).
6. Bulb 69 to terminal socket or clips.
 7. Lens 66.
- Carefully squeeze sides of lens (66) to engage edge of lens to (68) housing, if police or taxi vehicle.

INTERIOR MOLDINGS

Windshield Garnish Molding

Figure 15



Remove or Disconnect

1. Spotlamp, if equipped. Refer to SECTION 8B.
2. Windshield garnish molding (24) by disengaging clips from slots in pillar.



Install or Connect

1. Windshield garnish molding (24).
 - A. Engage clips to slots in pillar.
 - B. Apply pressure to secure.
2. Spotlamp, if removed. Refer to SECTION 8B.

Endgate Trim Panel Molding

Figure 16



Remove or Disconnect

1. Retainers (48).
2. Endgate trim panel molding (42).
 - Bow endgate trim panel molding (42) enough to disengage tabs from back body pillar panels.



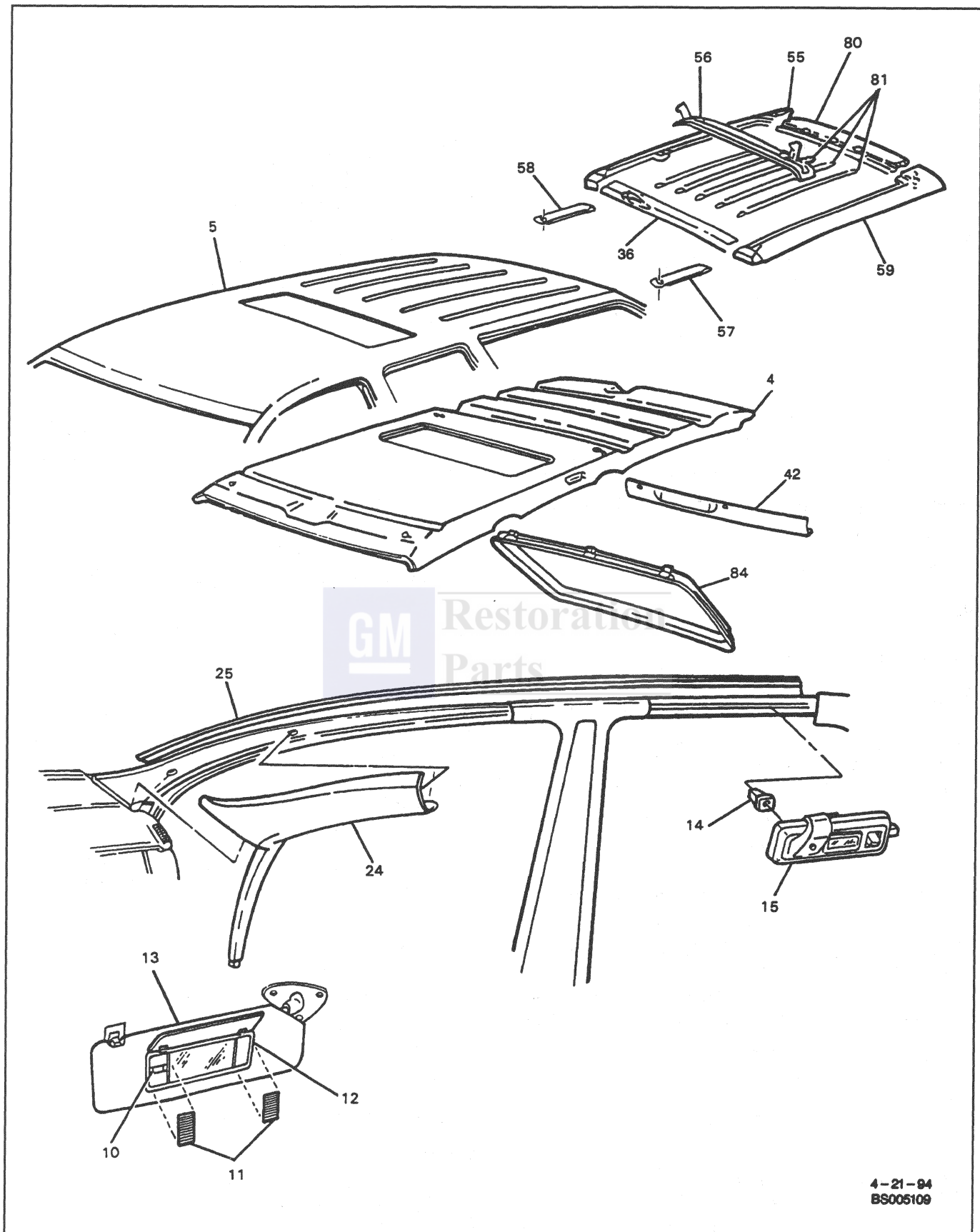
Install or Connect

1. Endgate trim panel molding (42).
 - Bow endgate trim panel molding (42) enough to interlock tabs with back body pillar panels.
2. Retainers (48).

Roof Stationary Window

BUICK

For roof stationary window, refer to SECTION 10-2.



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Figure 5 - Roof Components - (Buick Wagon)

- | | |
|--|--|
| 4 PANEL, HEADLINING TRIM FINISH | 36 DEFLECTOR, END GATE WINDOW AIR |
| 5 PANEL, ROOF | 42 MOLDING, END GATE TRIM PANEL |
| 10 BULB, VANITY MIRROR | 55 RAIL, LUGGAGE CARRIER SIDE |
| 11 LENS, VANITY MIRROR | 56 RAIL, LUGGAGE CARRIER REAR |
| 12 MIRROR, VANITY | 57 CAP, LUGGAGE CARRIER OUTER SLAT |
| 13 SUNSHADE | 58 CAP, LUGGAGE CARRIER OUTER SLAT |
| 14 NUT, COAT HOOK | 59 RAIL, LUGGAGE CARRIER SIDE |
| 15 LAMP, ROOF RAIL COURTESY AND READING | 80 RAIL, LUGGAGE CARRIER FRONT |
| 24 MOLDING, WINDSHIELD GARNISH | 81 SLAT, LUGGAGE CARRIER CENTER |
| 25 WEATHERSTRIP, ROOF SIDE RAIL
AUXILIARY | 84 MOLDING, ROOF STATIONARY WINDOW GARNISH |

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Figure 6 - Roof Components - (Buick Wagon) - Legend

Roof Stationary Window Garnish Molding and Sunshade

(BUICK)

Figure 17

Remove or Disconnect

1. Roof stationary window garnish molding (84) by unseating retainers.
2. Sunshade from roof stationary window garnish molding (84), if necessary.
3. Hooks and bolts/screws from sunshade, if necessary.

Install or Connect

1. Hooks and bolts/screws to sunshade, if removed.
 - Tighten bolts/screws securely.
2. Sunshade by engaging hooks to clips on roof stationary window garnish molding (84).
3. Roof stationary window garnish molding (84) by engaging retainers.

NAMEPLATE AND OPERA LAMPS

BUICK

Figure 18

Remove or Disconnect

1. Reposition rear compartment trim to access one nut (30 or 31).
2. Quarter upper rear trim finish panel to access second nut (30 or 31). Refer to SECTION 10-7.

3. Nuts (30 or 31) from bezel studs.
4. Nameplate (28) or opera lamp (22) from body.
5. Washers (35 or 29) from bezel studs.
6. Nameplate (28) or opera lamp (22) from bezel (27 or 21).
7. Electrical connector, if equipped.

Important

- Tape opera lamp electrical connector to quarter panel to prevent connector from falling into the quarter panel.

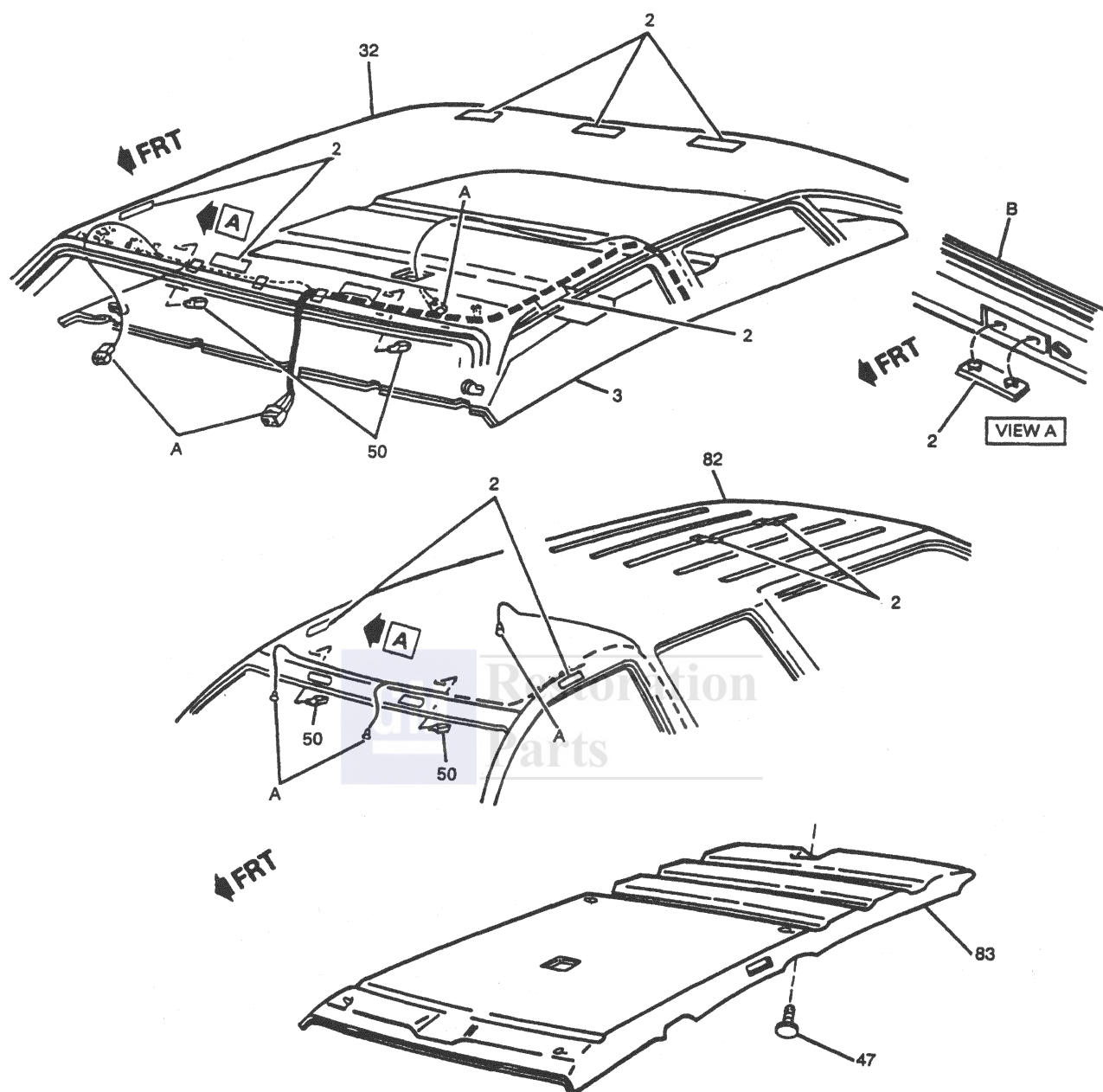
Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Electrical connector, if equipped.
2. Nameplate (28) or opera lamp (22) to bezel (27 or 21).
3. Washers (35 or 29) to bezel studs.
4. Nameplate (28) or opera lamp (22) to body.
5. Nuts (30 or 31) to bezel studs.

Tighten

- Nuts (30 or 31) to 3 N-m (27 lb. in.).
6. Quarter upper rear trim finish panel. Refer to SECTION 10-7.
 7. Position rear compartment trim.



- | | |
|--|---|
| A CONNECTOR, ELECTRICAL | 47 RETAINER, HEADLINING TRIM FINISH PANEL |
| B RAIL ROOF | 50 NUT, SUNSHADE ROD RETAINER |
| 2 RETAINER, HEADLINING TRIM FINISH PANEL MOLDING | 82 PANEL, ROOF (WAGON) |
| 3 PANEL, HEADLINING TRIM FINISH | 83 PANEL, HEADLINING TRIM FINISH |
| 32 PANEL, ROOF (SEDAN) | |

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Figure 7 - Installing Headlining Trim Finish Panel - (Chevrolet)

10-9-10 ROOF

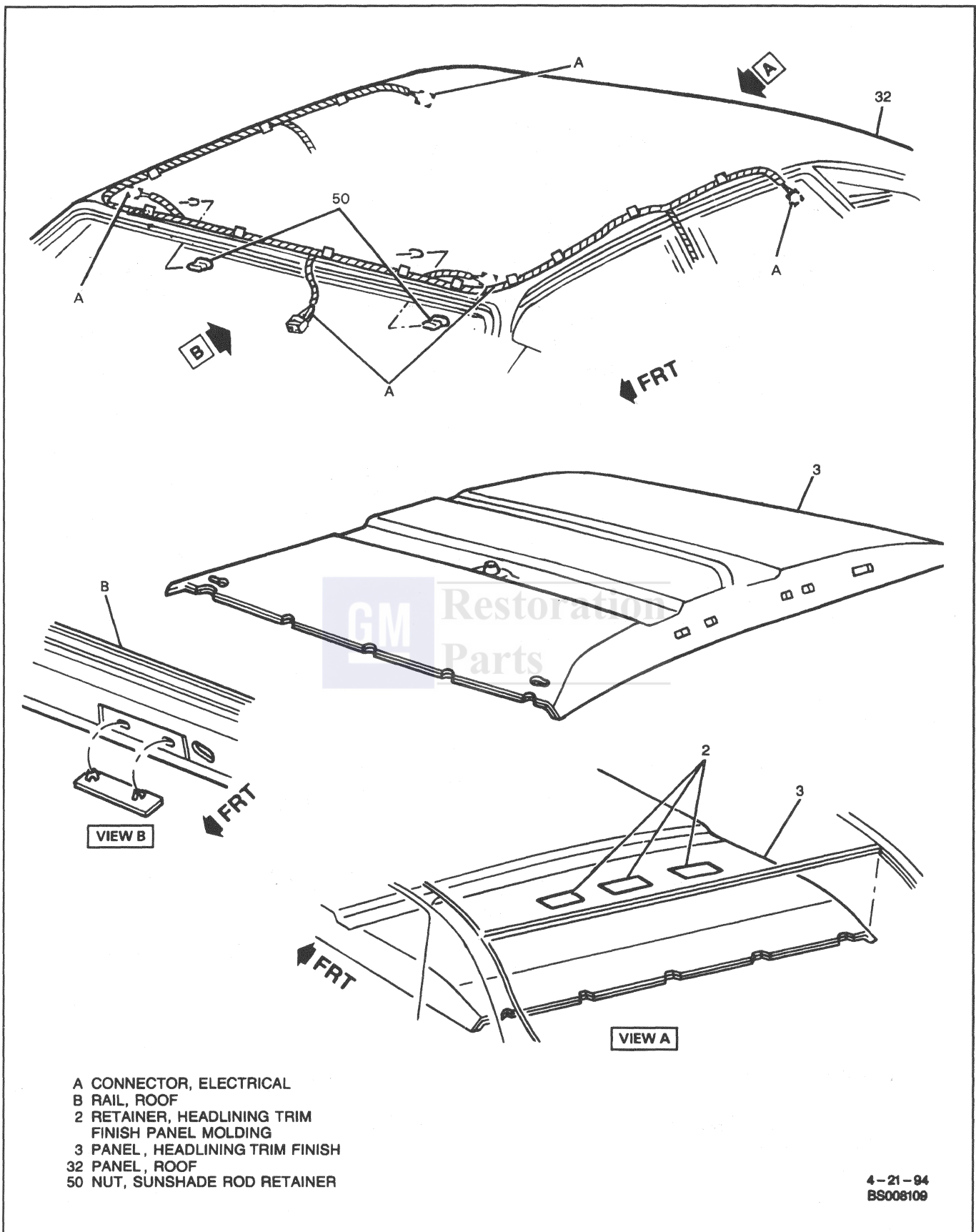


Figure 8 - Installing Headlining Trim Finish Panel - (Buick Sedan)

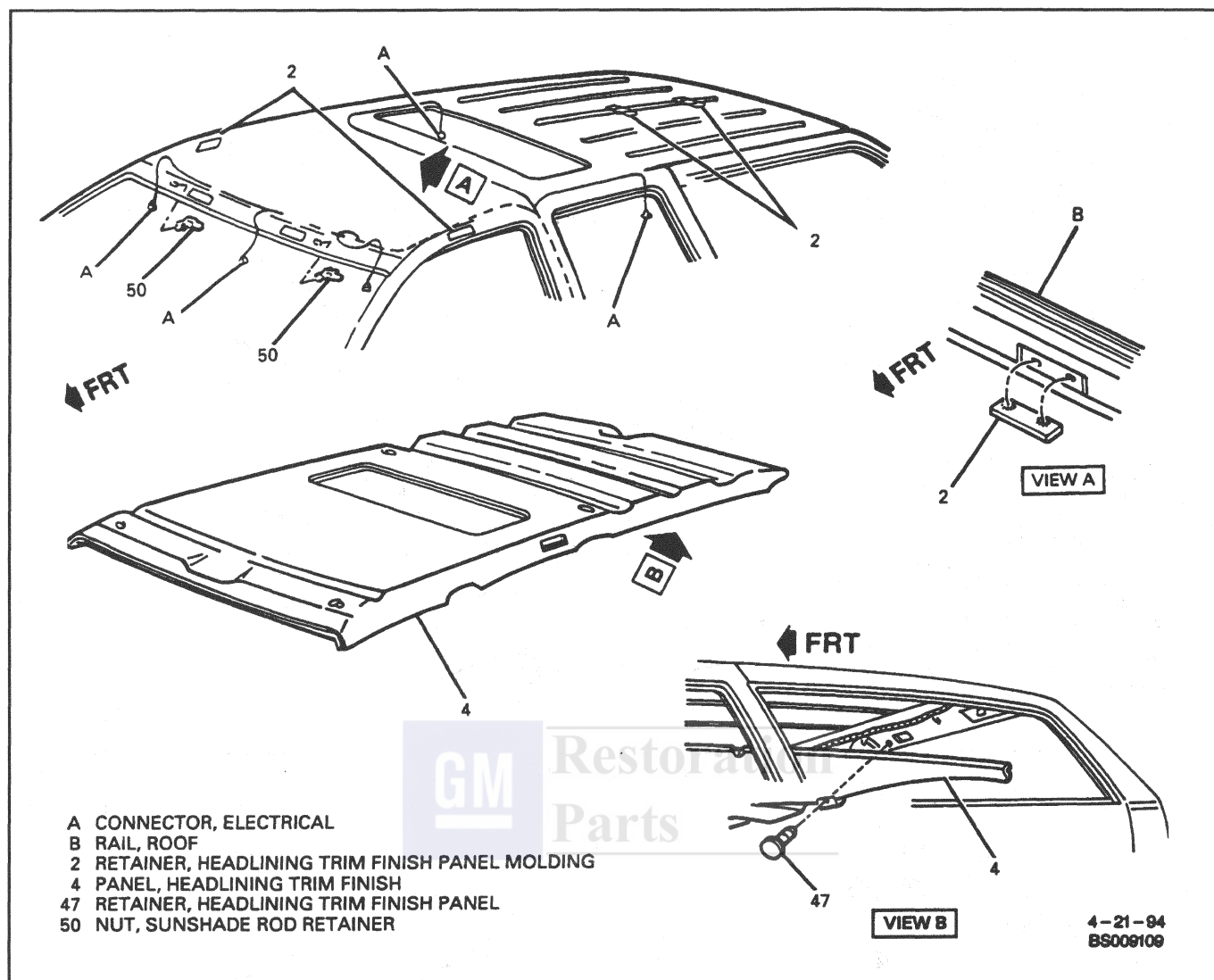


Figure 9 - Installing Headlining Trim Finish Panel - (Buick Wagon)

10-9-12 ROOF

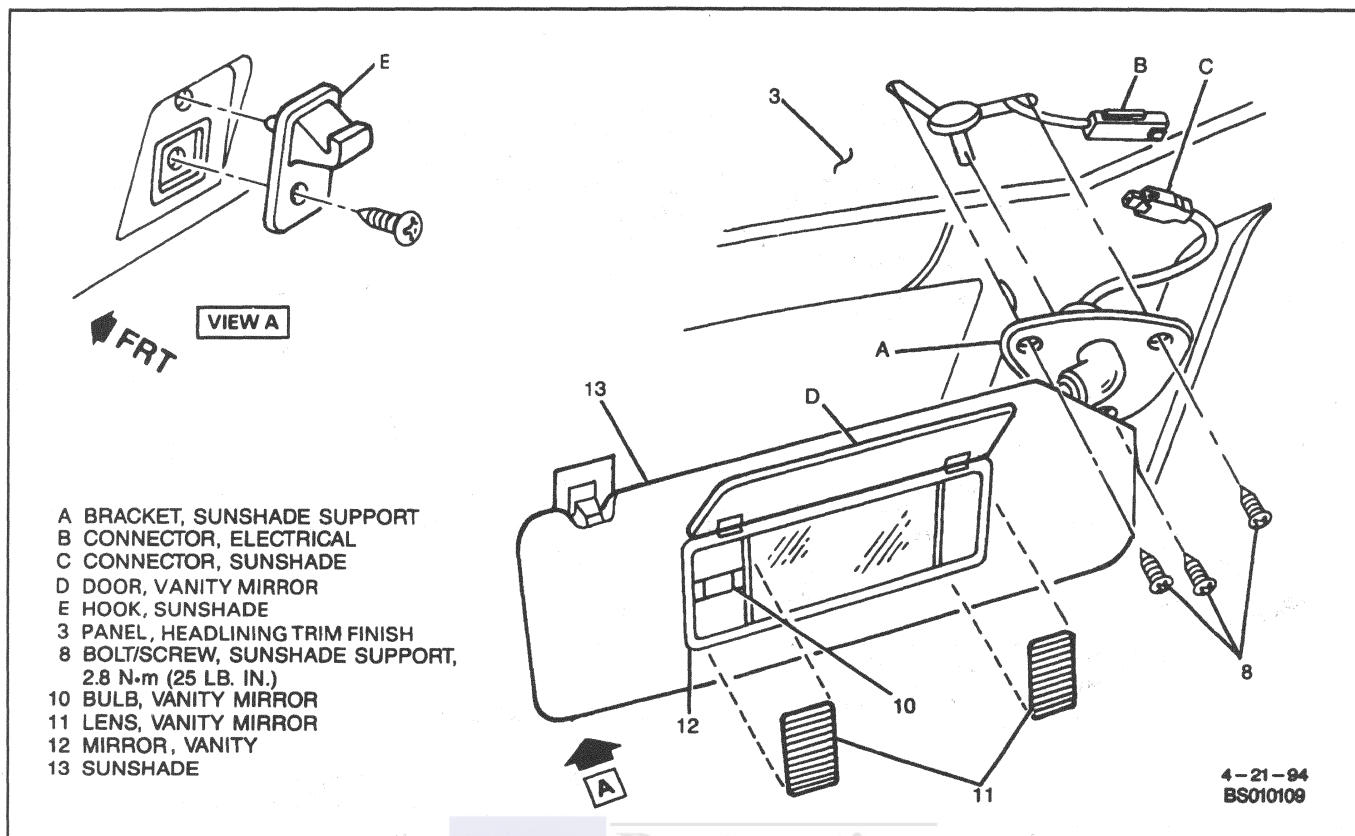


Figure 10 - Sunshade and Vanity Mirror

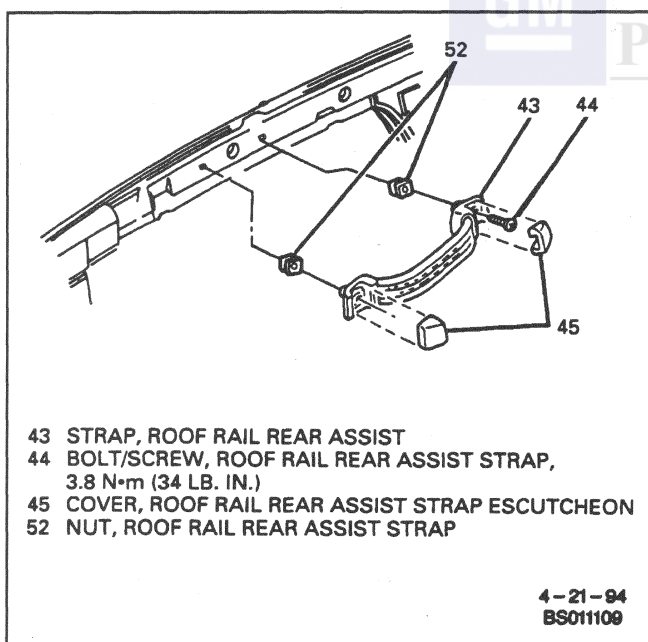


Figure 11 - Roof Rail Assist Strap - (Chevrolet Sedan)

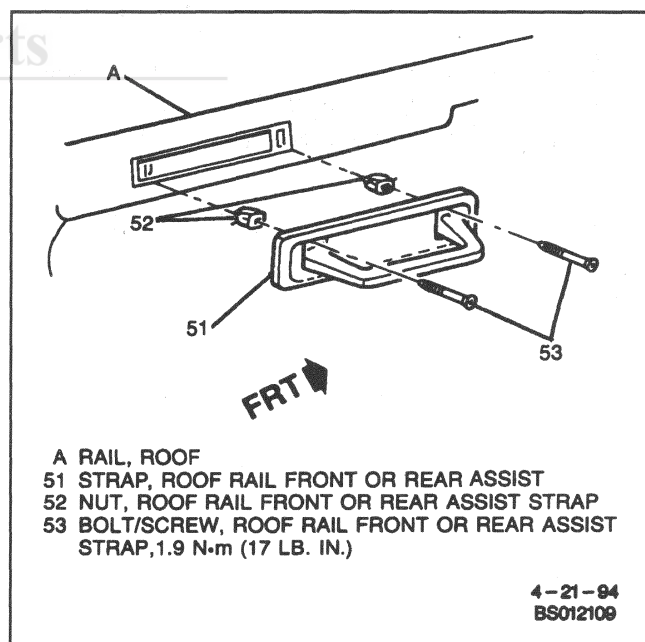


Figure 12 - Roof Rail Assist Strap - (Buick Sedan)

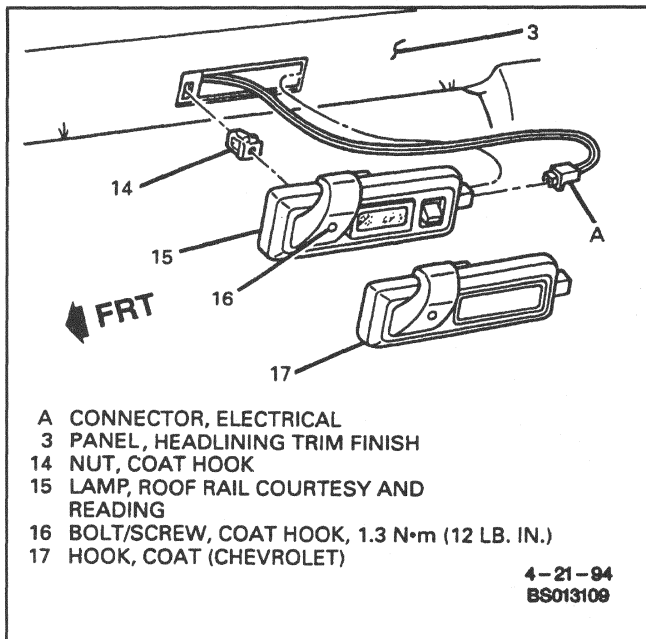


Figure 13 - Roof Rail Courtesy and Reading Lamp

ENDGATE WINDOW AIR DEFLECTOR

Figure 19

Remove or Disconnect

1. Rear window wiper and washer. Refer to SECTION 8E1.
2. Endgate trim panel molding. Refer to "Endgate Trim Panel Molding" in this section.
3. Right and left luggage carrier side rails. Refer to "Luggage Carrier" in this section.
4. Nuts (49).
5. Endgate window air deflector (36).

Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Endgate window air deflector (36).
2. Nuts (49).

Tighten

- Nuts (49) to 2.3 N·m (20 lb. in.).
3. Right and left luggage carrier side rails. Refer to "Luggage Carrier" in this section.
 4. Endgate trim panel molding. Refer to "Endgate Trim Panel Molding" in this section.
 5. Rear window wiper and washer. Refer to SECTION 8E1.

LUGGAGE CARRIER

Figures 20 and 21

Remove or Disconnect

1. Headlining panel. Refer to "Headlining Panel" in this section.
2. Bolts/screws (70) (Buick).
3. Luggage carrier outer slat caps (57 and 58) (Buick).
4. Luggage carrier rear rail (89 or 56).
 - Raise lever arms on luggage carrier rear rail (89 or 56) and slide rearward.
5. Bolts/screws (6 or 73).
6. Nuts (75).
7. Luggage carrier side rails (85 and 87 or 55 and 59).
8. Nuts (74), if necessary.
9. Nuts (79) (Buick).
10. Bolts/screws (88 or 77).
11. Luggage carrier outer slat cap (38) (Buick).
12. Luggage carrier front rail (34 or 80).
13. Nuts (76) (Buick), if necessary.
14. Bolts/screws (71).
15. Luggage carrier center slats (81).
16. Nuts (72), if necessary.

Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Nuts (72), if removed.
2. Luggage carrier center slats (81).
3. Bolts/screws (71).

Tighten

- Bolts/screws (71) to 1.2 N·m (11 lb. in.).
4. Nuts (76), if removed.
 5. Luggage carrier front rail (34 or 80).
 6. Bolts/screws (88 or 77).

Tighten

- Bolts/screws (88) to 1.5 N·m (13 lb. in.).
 - Bolts/screws (77) to 1.9 N·m (17 lb. in.).
7. Nuts (79), if removed.

Tighten

- Nuts (79) to 2.8 N·m (25 lb. in.).
8. Nuts (74), if removed.
 9. Luggage carrier side rails (85 and 87 or 55 and 59).
 10. Nuts (75).
 11. Bolts/screws (6 or 73).

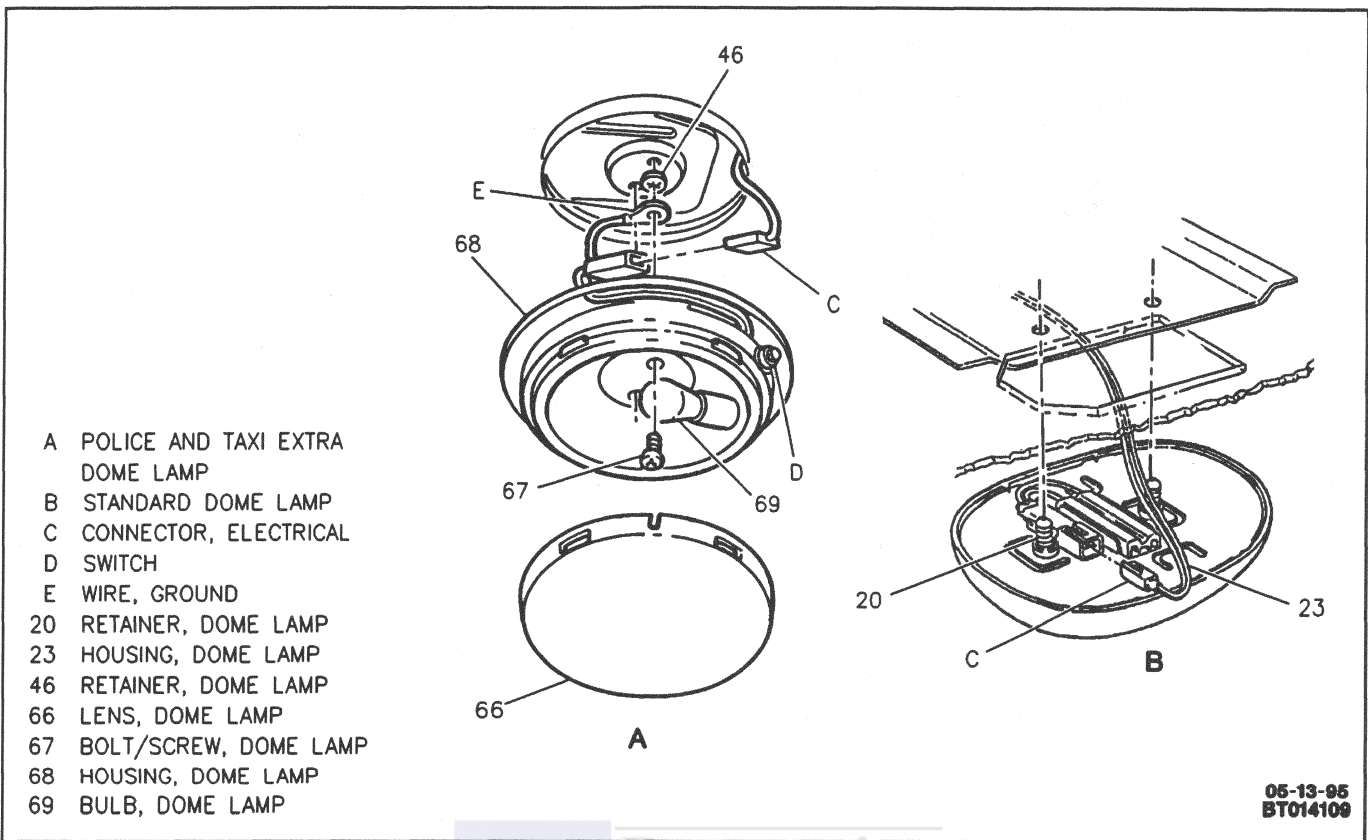


Figure 14 - Removing Dome Lamp - (Chevrolet)

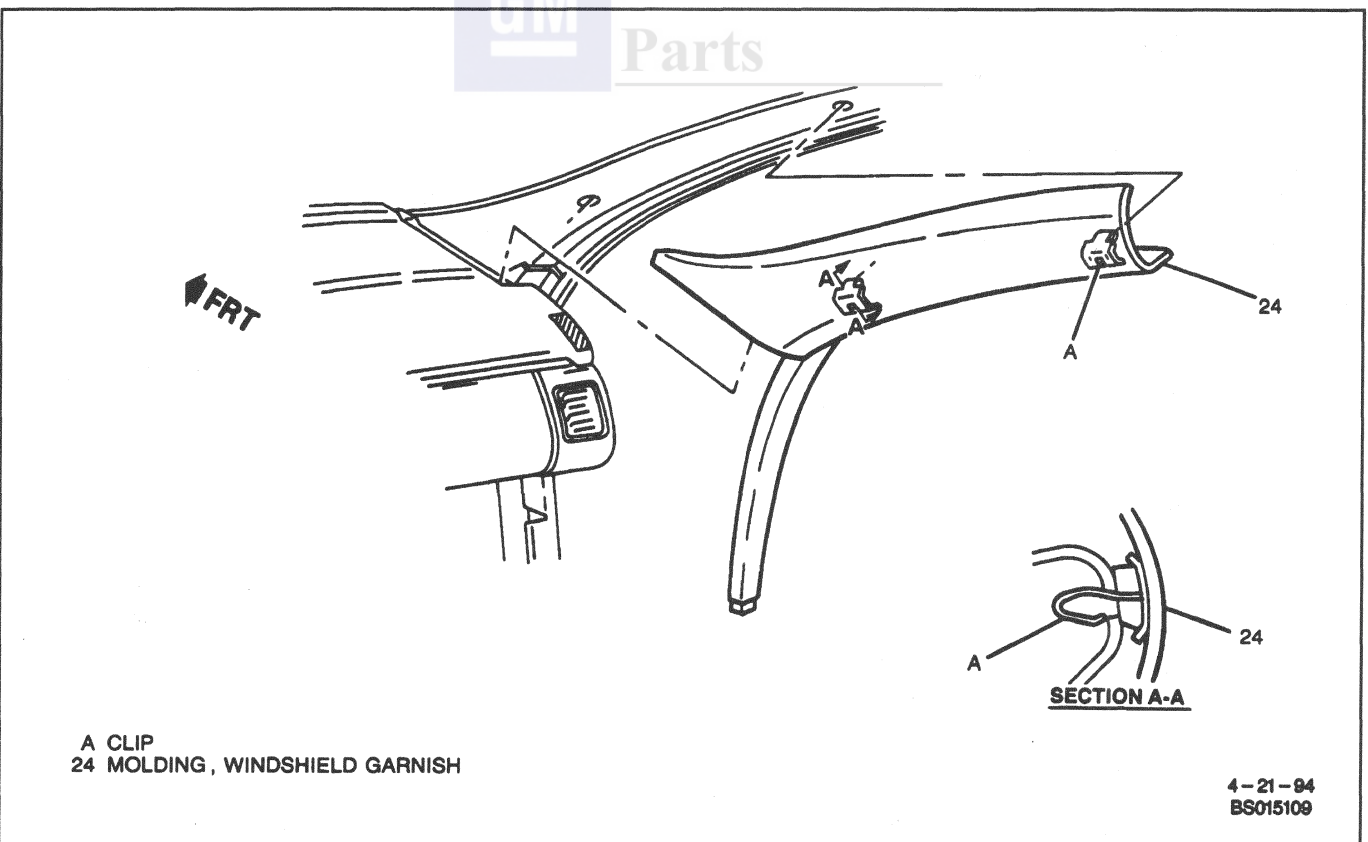


Figure 15 - Removing Windshield Garnish Molding

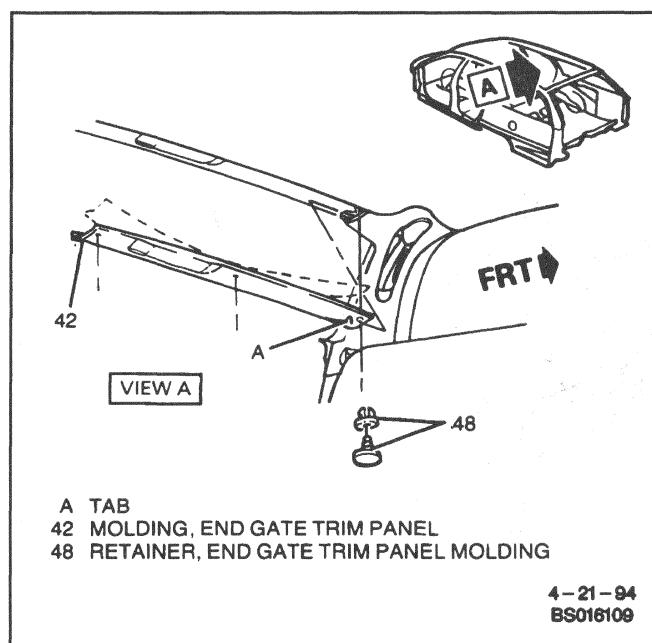


Figure 16 - Endgate Trim Panel Molding - (Wagon)

 Tighten

- Bolts/screws (6) to 6 N.m (53 lb. in.).
 - Bolts/screws (73) to 1.9 N.m (17 lb. in.).
12. Luggage carrier rear rail (89 or 56).
- Raise lever arms and align rollers on luggage carrier rear rail (89 or 56) and slide forward.

13. Luggage carrier outer slat caps (57 and 58) (Buick).
14. Bolts/screws (70), if removed.

 Tighten

- Bolts/screws (70) to 4.5 N.m (40 lb. in.).
15. Headlining panel. Refer to "Headlining Panel" in this section.

WEATHER-STRIP

Figures 22 and 23

 Remove or Disconnect

1. Bolt/screw (54), if Buick sedan.
 2. Weather-strip (25).
- Pull weather-strip (25) to remove from roof rail pinch-weld flange.

 Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Weather-strip (25).
- Position weather-strip center pillar cutout to center pillar.
2. Apply pressure to secure rear upper header of weather-strip (25) to roof rail pinch-weld flange.

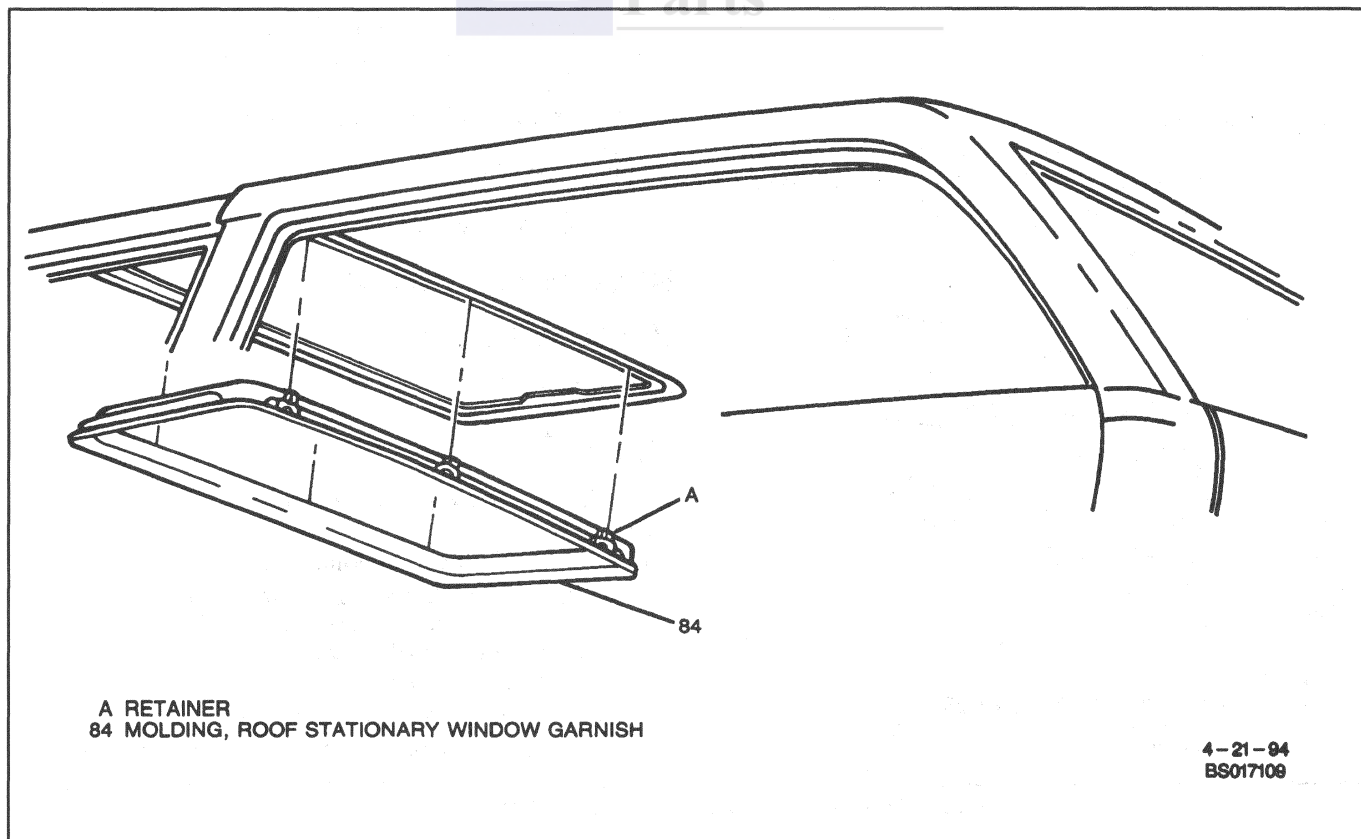


Figure 17 - Roof Stationary Window Garnish Molding - (Buick Wagon)

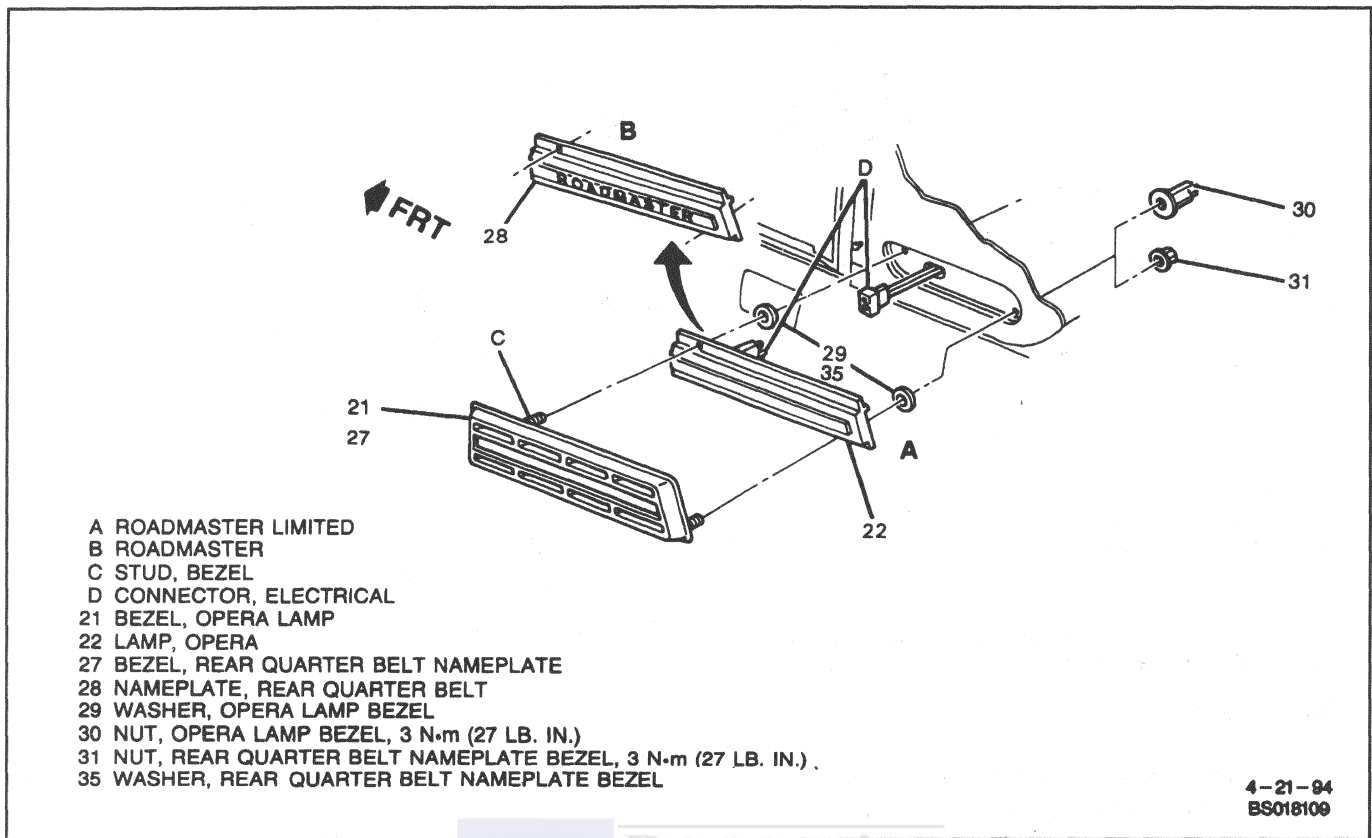


Figure 18 - Nameplate and Opera Lamps - (Buick Sedan)

3. Apply pressure to secure weather-strip (25) toward front of dash to roof rail pinch-weld flange.
4. It may be necessary to tap weather-strip (25) with rubber mallet.

Important

- Hit weather-strip (25) square to roof rail pinch-weld flange.

5. Use rolling tool to ensure proper engagement of weather-strip (25) to roof rail pinch-weld flange.

- Make sure bottom edge of weather-strip (25) extends underneath edge of door weather-strip (26).

6. Bolt/screw (54), if Buick sedan.

Tighten

- Bolt/screw (54) to 1.3 N·m (12 lb. in.).

ROOF PANEL COVER

Roof Panel Cover Moldings

BUICK SEDAN

Figure 24

Remove or Disconnect

1. Roof panel upper moldings (61).
 - A. Protect painted surface with tape.
 - B. Use a block of wood and rubber mallet to strike roof panel upper moldings (61) rearward at each clip location.
2. Roof panel quarter moldings (60).
 - Slide roof panel quarter moldings (60) upward to disengage from roof panel quarter molding clips (65).
3. Roof panel upper molding clips (64) and roof panel quarter molding clips (65).

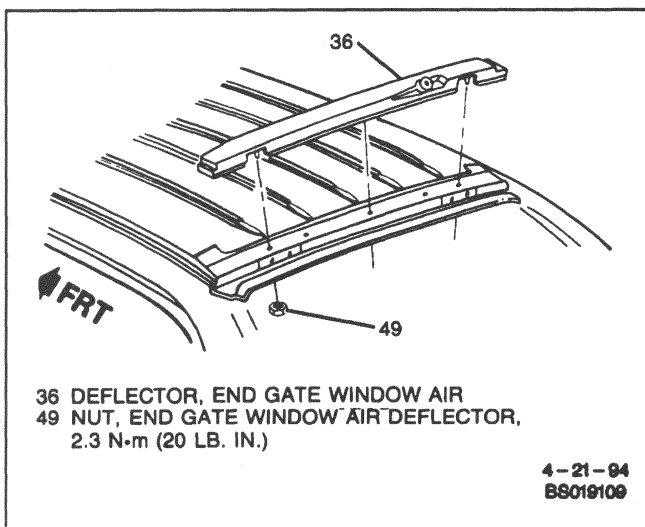


Figure 19 - Endgate Window Air Deflector - (Wagon)

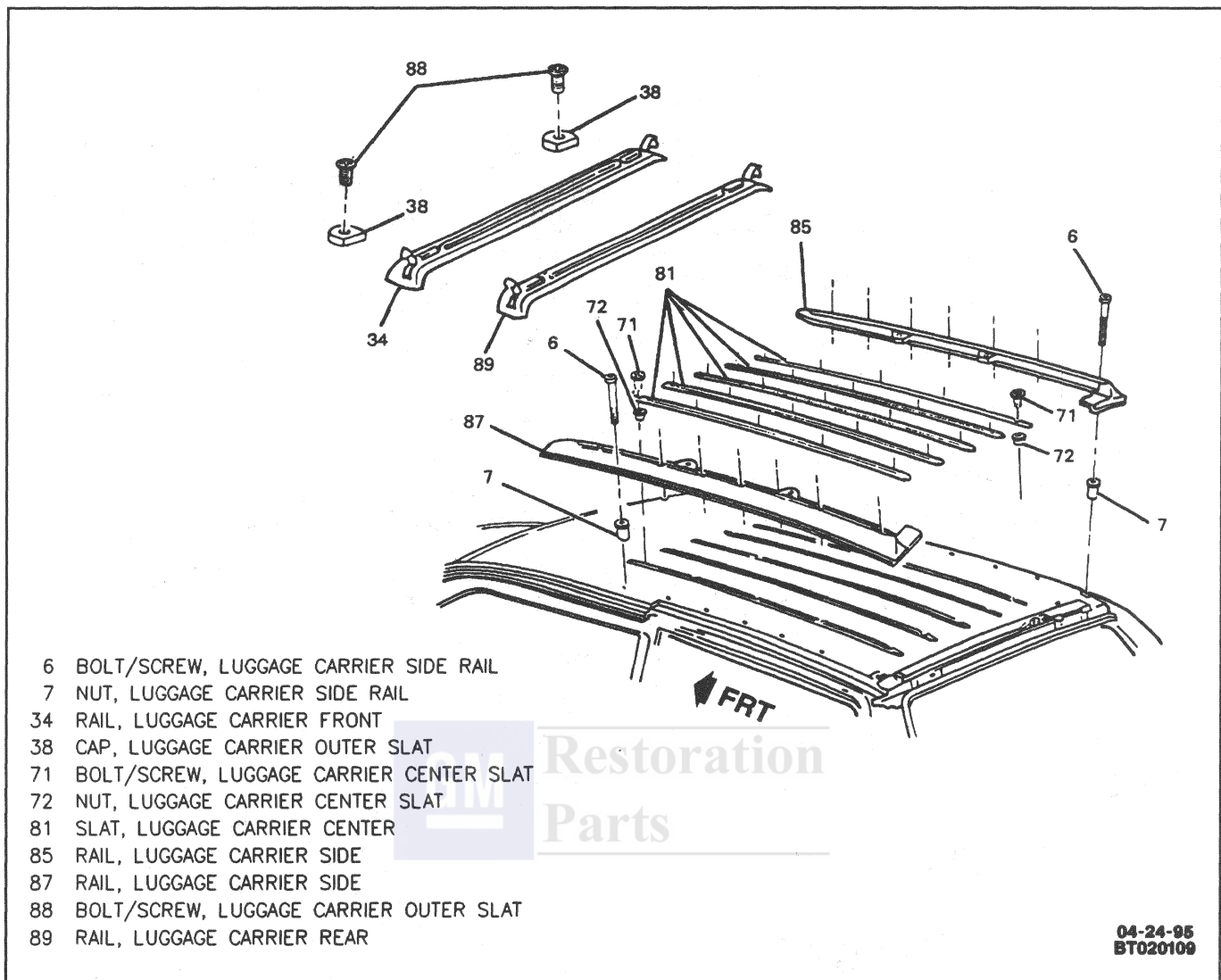


Figure 20 - Installing Luggage Carrier - (Chevrolet Wagon)

Install or Connect

1. Roof panel upper molding clips (64) and roof panel quarter molding clips (65).
2. Roof panel quarter moldings (60).
 - Insert bottom edge of roof panel quarter moldings (60) over top roof panel quarter molding clips (65) and slide down to secure.

NOTICE: Lower edges of roof panel quarter moldings (60) must lay on top of lower edge of roof panel cover material or damage to material may result.

3. Roof panel upper moldings (61).
 - Slide front edge of roof panel upper moldings (61) under front edge of roof panel upper molding clips (64) and roof panel quarter moldings (60). Then snap rear edge of roof panel upper moldings (61) over rear edge of roof panel upper molding clips (64) and roof panel quarter moldings (60).

Roof Panel Cover

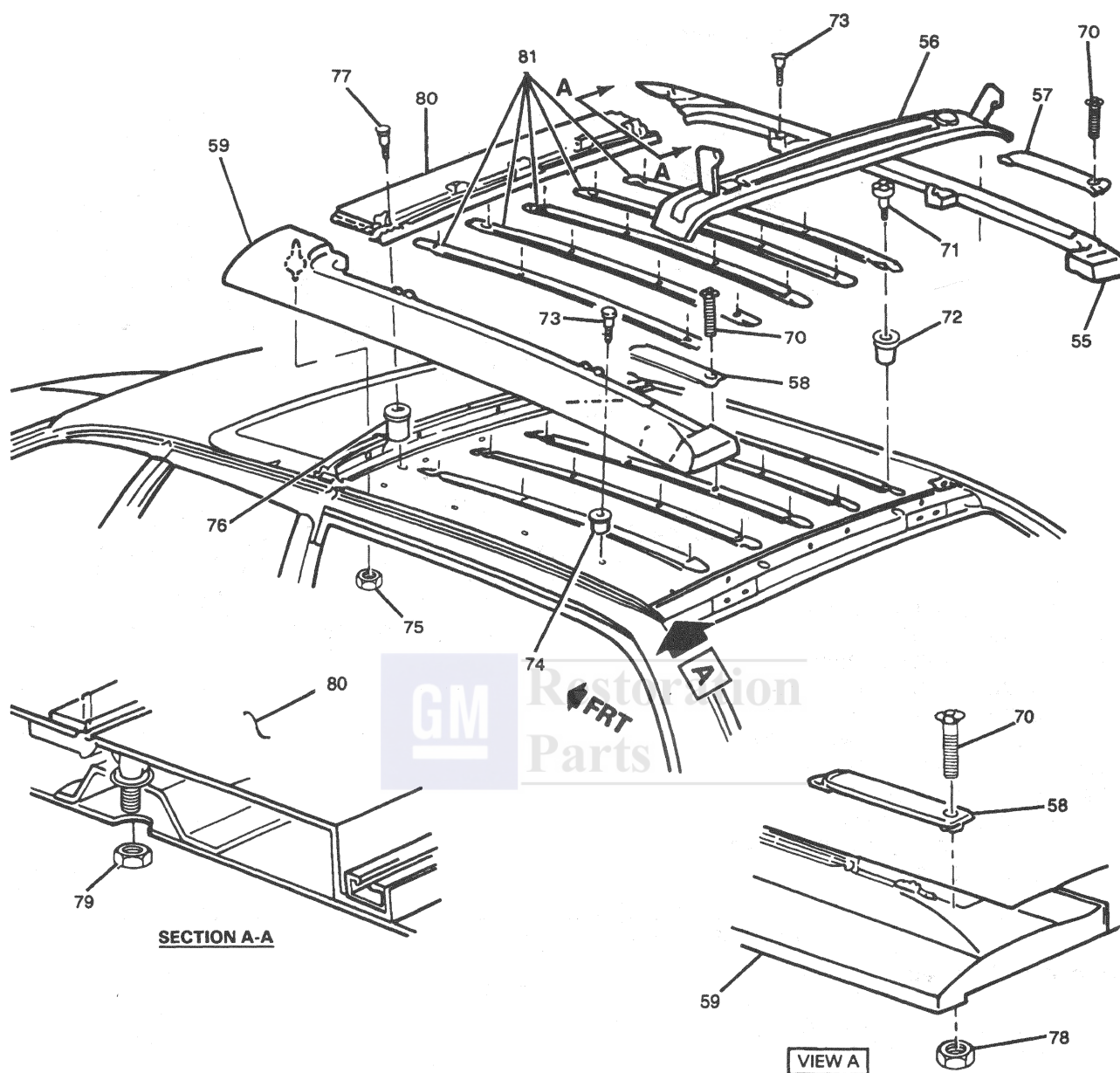
Figure 24

Remove or Disconnect

1. Roof panel upper and quarter moldings. Refer to "Roof Panel Cover Moldings" in this section.
2. Raise rear compartment lid.
3. Bolts/screws (63).
4. Nameplate or opera lamps. Refer to "Nameplate and Opera Lamps" in this section.
 - Tape opera lamp electrical connector to quarter panel to prevent connector from falling into the quarter panel.

NOTICE: Roof panel cover upper front corners are secured with adhesive. Be careful not to separate outer covering from pad during removal or damage will result.

5. Lift upper front corners of roof panel cover (62) just enough to allow removal of roof panel cover (62).



- 55 RAIL, LUGGAGE CARRIER SIDE
- 56 RAIL, LUGGAGE CARRIER REAR
- 57 CAP, LUGGAGE CARRIER OUTER SLAT
- 58 CAP, LUGGAGE CARRIER OUTER SLAT
- 59 RAIL, LUGGAGE CARRIER SIDE
- 70 BOLT/SCREW, LUGGAGE CARRIER OUTER SLAT CAP, 4.5 N·m (40 LB. IN.)
- 71 BOLT/SCREW, LUGGAGE CARRIER CENTER SLAT, 1.2 N·m (11 LB. IN.)
- 72 NUT, LUGGAGE CARRIER CENTER SLAT
- 73 BOLT/SCREW, LUGGAGE CARRIER SIDE RAIL, 1.9 N·m (17 LB. IN.)

- 74 NUT, LUGGAGE CARRIER SIDE RAIL
- 75 NUT, LUGGAGE CARRIER SIDE RAIL
- 76 NUT, LUGGAGE CARRIER FRONT RAIL
- 77 BOLT/SCREW, LUGGAGE CARRIER FRONT RAIL, 1.9 N·m (17 LB. IN.)
- 78 NUT, LUGGAGE CARRIER OUTER SLAT CAP
- 79 NUT, LUGGAGE CARRIER FRONT RAIL, 2.8 N·m (25 LB. IN.)
- 80 RAIL, LUGGAGE CARRIER FRONT
- 81 SLAT, LUGGAGE CARRIER CENTER

Figure 21 - Installing Luggage Carrier - (Buick Wagon)

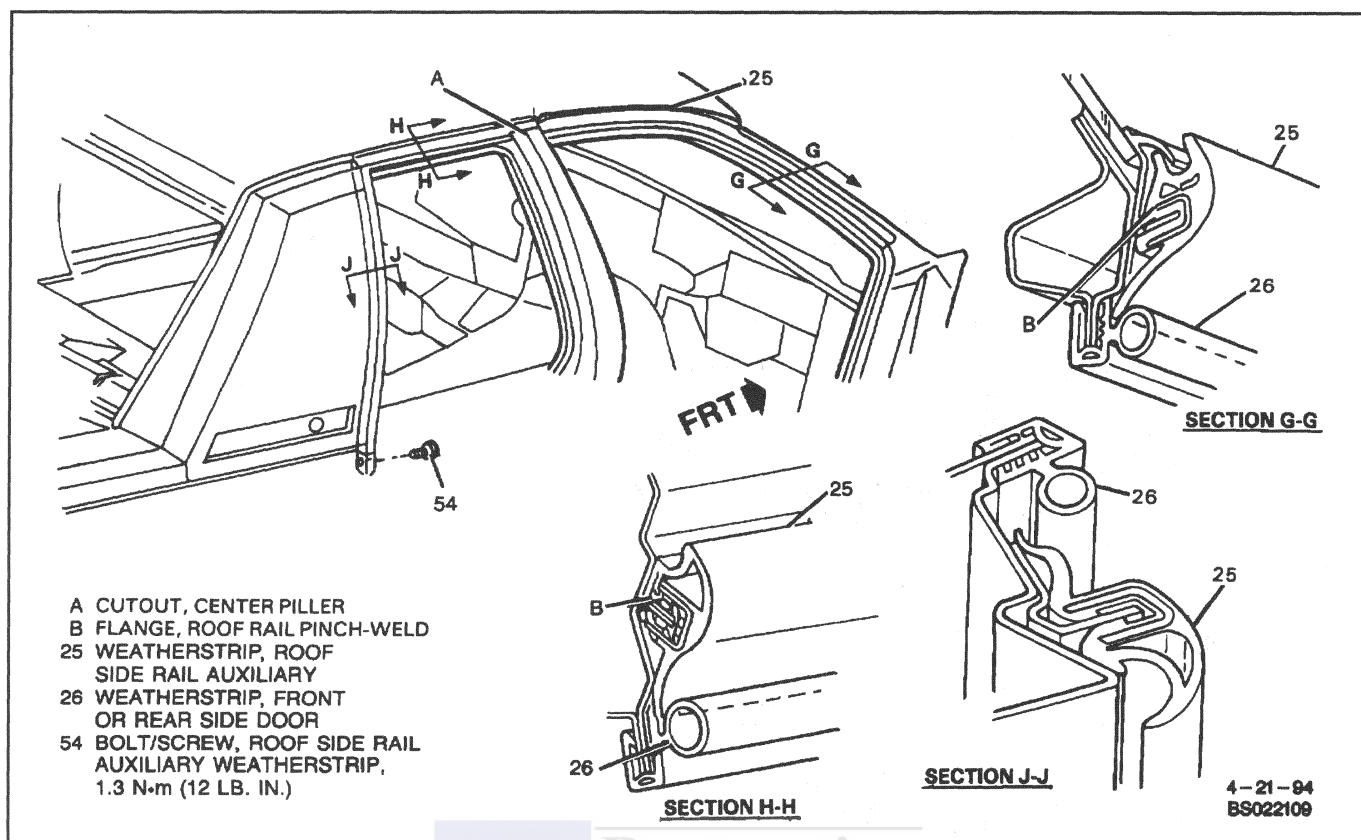


Figure 22 - Removing Weather-strip - (Buick Sedan)

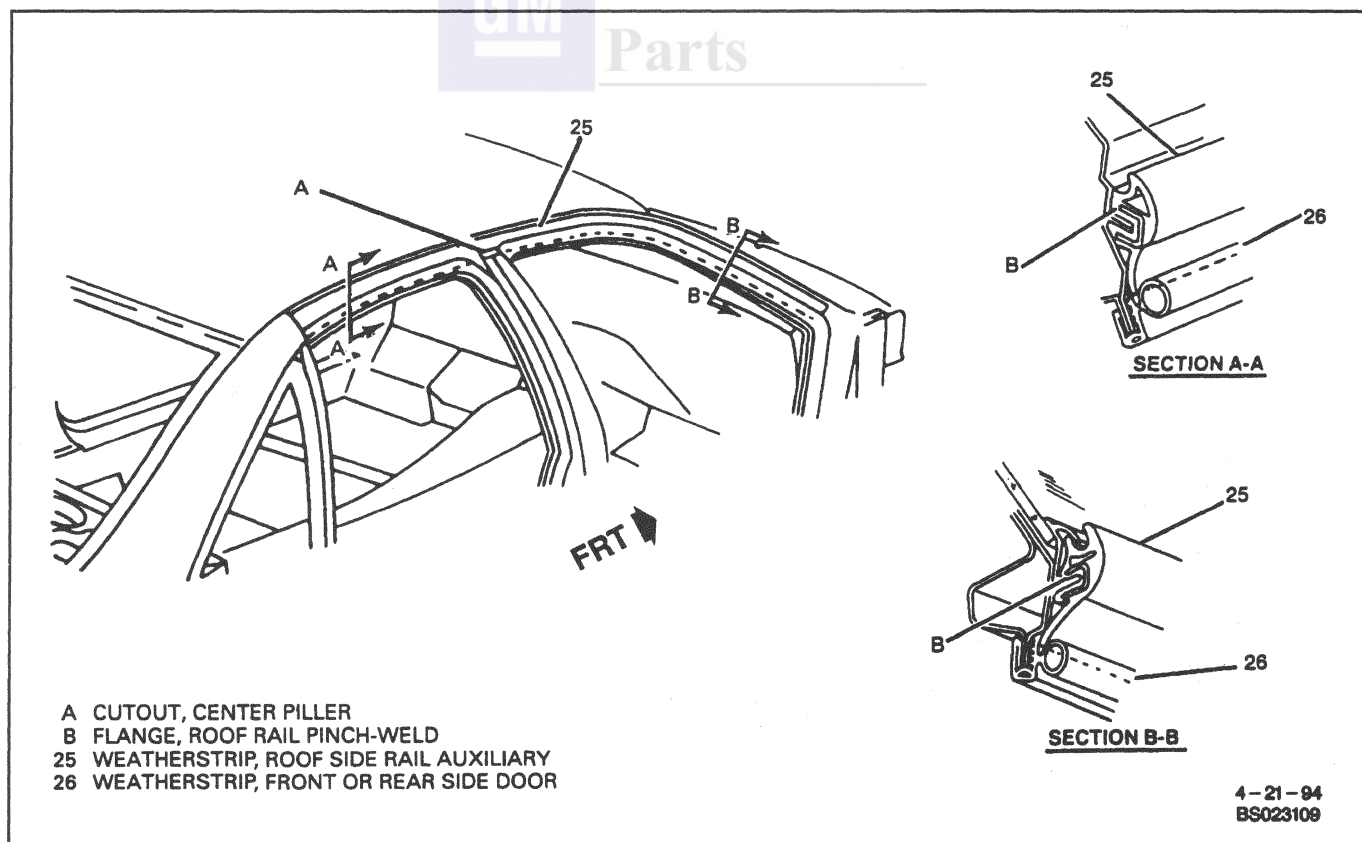
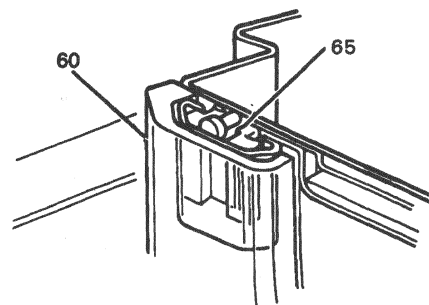
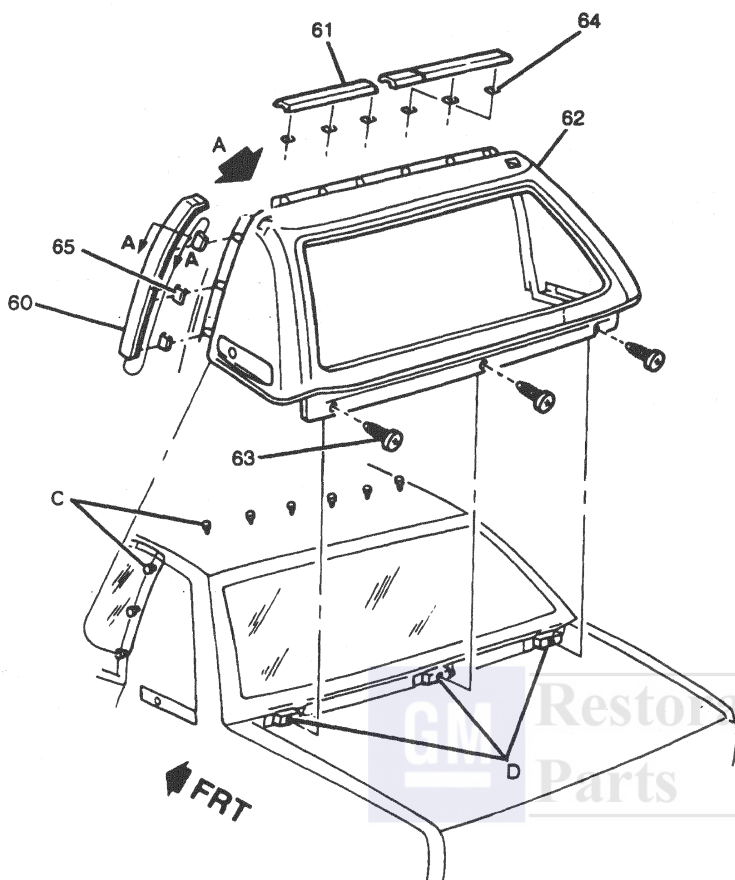
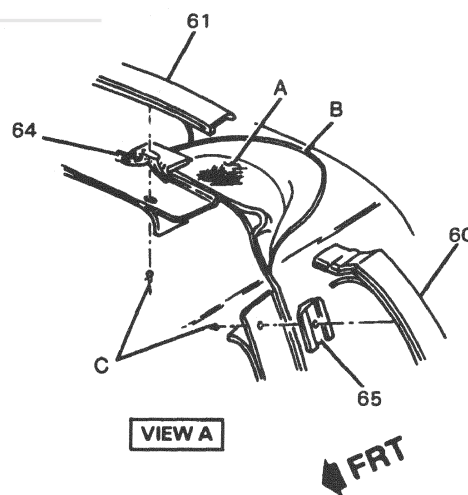


Figure 23 - Removing Weather-strip - (Chevrolet Sedan, Chevrolet and Buick Wagon)



SECTION A-A



VIEW A

- A PAD
- B CORNER, ROOF RAIL COVER
- C STUD
- D CLIP, SHELF PANEL
- 60 MOLDING, ROOF PANEL COVER QUARTER UPPER FRONT FINISH
- 61 MOLDING, ROOF PANEL COVER UPPER FINISH
- 62 COVER, ROOF PANEL
- 63 BOLT/SCREW, ROOF PANEL COVER, 1.9 N·m (17 LB. IN.)
- 64 CLIP, ROOF PANEL COVER UPPER FINISH MOLDING
- 65 CLIP, ROOF PANEL COVER QUARTER UPPER FRONT FINISH MOLDING

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Figure 24 - Installing Roof Panel Cover - (Buick Sedan)

6. Place protective covering over rear compartment lid to prevent possible damage to painted surface.
7. Roof panel cover (62) with aid of helper.



Install or Connect

NOTICE: Refer to "Notice" on page 10-9-1 of this section.

1. Roof panel cover (62) with aid of helper.
 - Position roof panel cover (62) to body, aligning holes on top and sides with studs.
2. Nameplate or opera lamps. Refer to "Nameplate and Opera Lamps" in this section.
3. Raise rear compartment lid.
4. Bolts/screws (63) on rear shelf panel clips.



Tighten

- Bolts/screws (63) to 1.9 N.m (17 lb. in.).
5. Apply vinyl trim adhesive to upper front corners of roof panel cover (62).
 6. Roof panel upper and quarter moldings. Refer to "Roof Panel Cover Moldings" in this section.

Weld Stud Replacement

Refer to SECTION 10-1 for weld stud replacement.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Coat Hook Bolt/Screw.....	1.3 N.m (12 lb. in.)
Dome Lamp Bolt/Screw.....	1.5 N.m (13 lb. in.)
Dome Lamp Stud.....	1.3 N.m (12 lb. in.)
Endgate Window Air Deflector Nut.....	2.3 N.m (20 lb. in.)
Luggage Carrier Center Slat Bolt/Screw.....	1.2 N.m (11 lb. in.)
Luggage Carrier Front Rail Bolt/Screw.....	1.9 N.m (17 lb. in.)
Luggage Carrier Front Rail Nut.....	2.8 N.m (25 lb. in.)
Luggage Carrier Outer Slat Cap Bolt/Screw (Buick).....	4.5 N.m (40 lb. in.)
Luggage Carrier Outer Slat Cap Bolt/Screw (Chevrolet).....	1.5 N.m (13 lb. in.)
Luggage Carrier Side Rail Bolt/Screw.....	6 N.m (53 lb. in.)
Opera Lamp Bezel Nut.....	3 N.m (27 lb. in.)
Rear Quarter Belt Nameplate Bezel Nut.....	3 N.m (27 lb. in.)
Roof Panel Cover Bolt/Screw.....	1.9 N.m (17 lb. in.)
Roof Rail Front or Rear Assist Strap Bolt/Screw (Buick).....	1.9 N.m (17 lb. in.)
Roof Rail Rear Assist Strap Bolt/Screw (Chevrolet).....	3.8 N.m (34 lb. in.)
Roof Side Rail Auxiliary Weather-strip Bolt/Screw.....	1.3 N.m (12 lb. in.)
Sunshade Support Bolt/Screw.....	2.8 N.m (25 lb. in.)
Sunshade Hook Bolt/Screw.....	2.5 N.m (22 lb. in.)

BLANK



SECTION 10-10

SEATS AND CARPET

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

FRONT SEAT

Chevrolet

Figure 1

There are two styles of Chevrolet front seats: 55-45 split bench and 45-45 split (for police and Impala SS vehicles). Seat covers may be cloth, leather, or vinyl (for police vehicles). All split style seats have manual recliners and either manual or power adjusters. Front seats may have armrests.

Buick

Figure 2

The Buick front seat is a 55-45 split style with head restraints on both sides and a driver's side armrest. On some vehicles the armrest may also function as a storage compartment. Seat covers may

be cloth or leather. Front seats are equipped with either manual or power recliners and either manual or power adjusters. Front seats may also be equipped with power lumbar supports.

REAR SEAT

Figures 3 and 4

The rear seat on the wagon was formerly called the second seat, and the second seat #2 was formerly called the third seat. The sedan and wagon rear seat are held by stops and hooks. The sedan rear seat may have a center armrest held onto the seat with attaching bolts/screws. The wagon has a folding rear (second) seat.

REAR SEAT #2

Figure 5

The rearward facing rear seat #2 has a remote seatback cushion latch at the lower right side of the seatback cushion. When the seatback cushion latch is

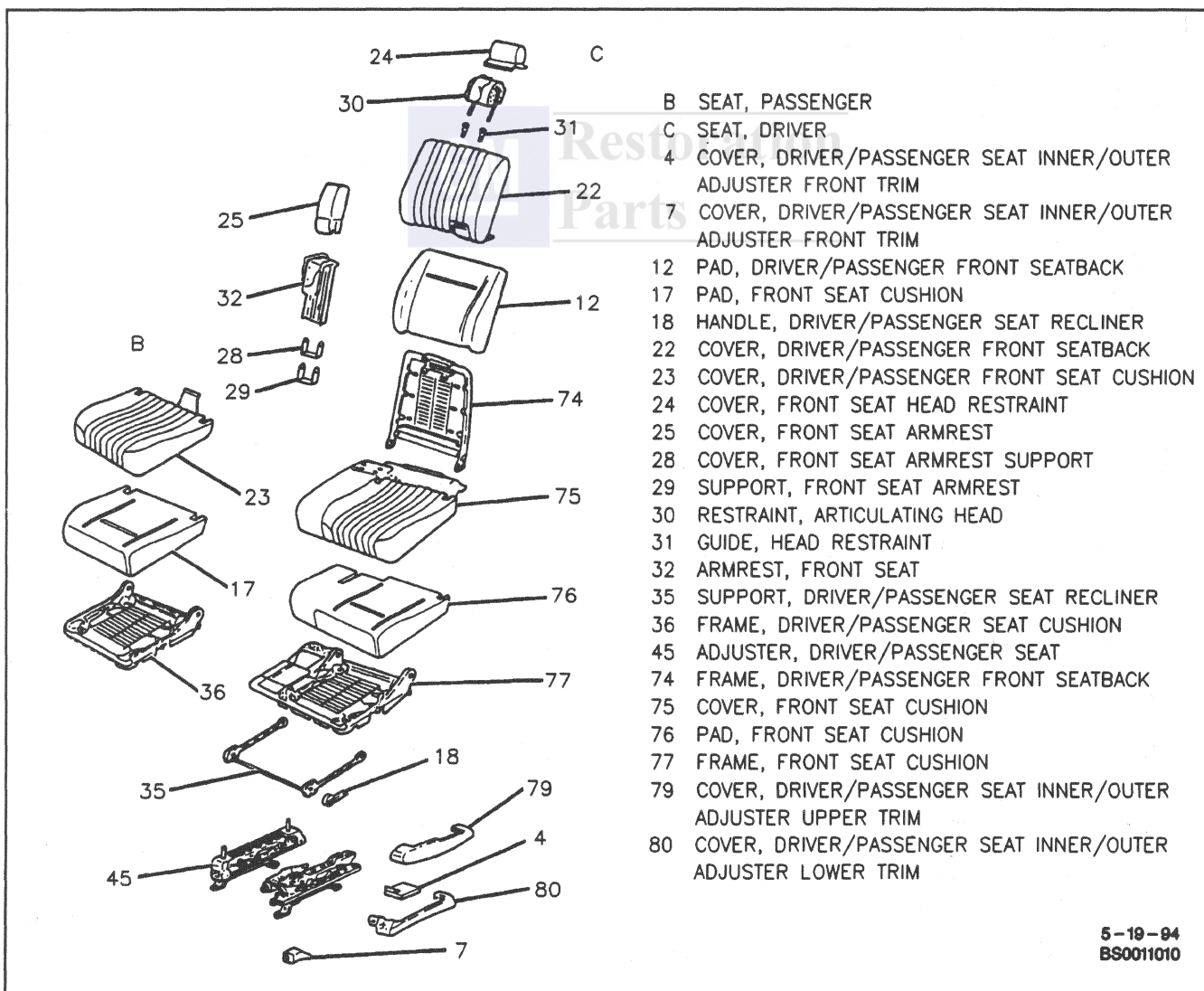
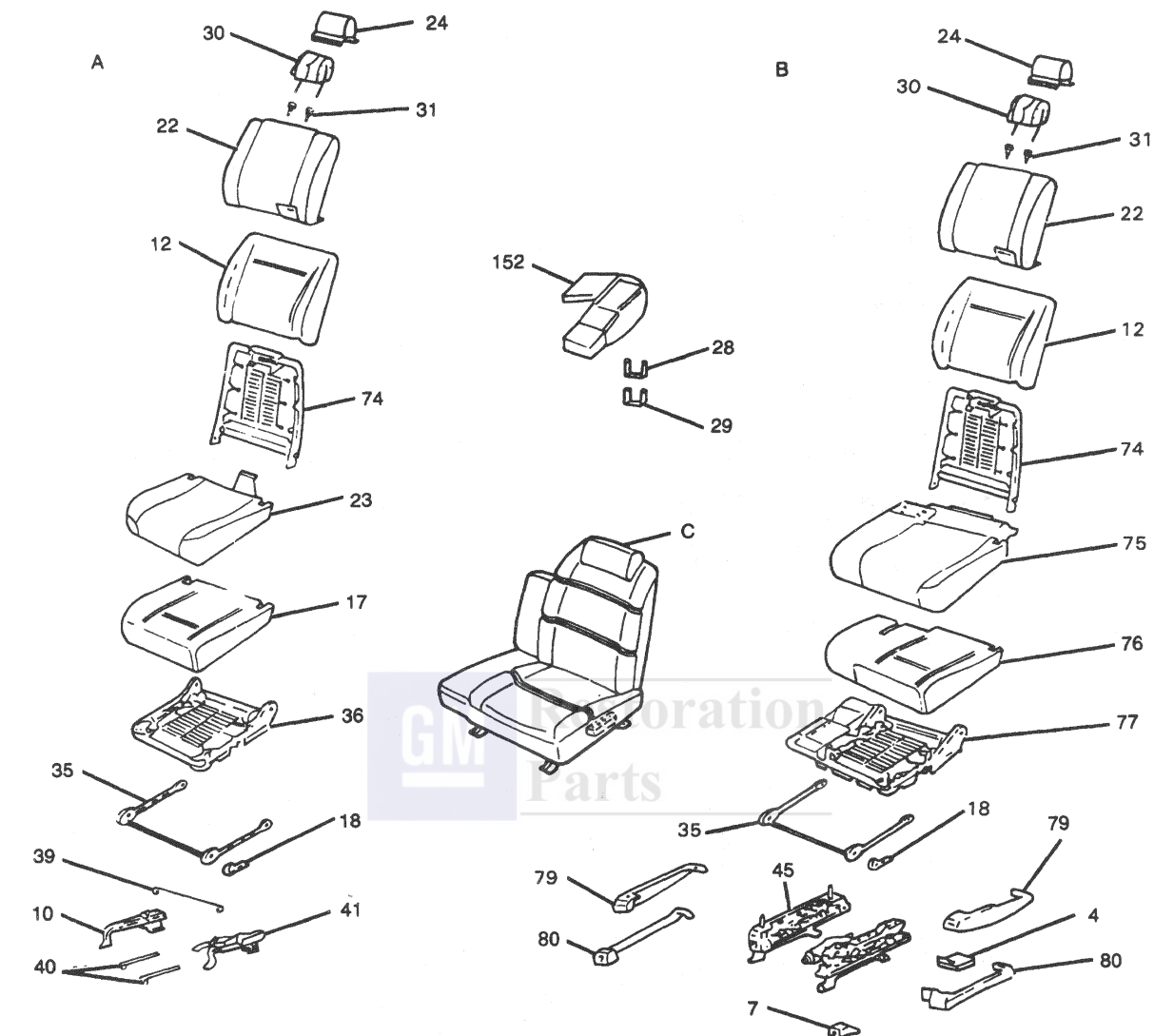


Figure 1 - Front Seat - (Chevrolet)

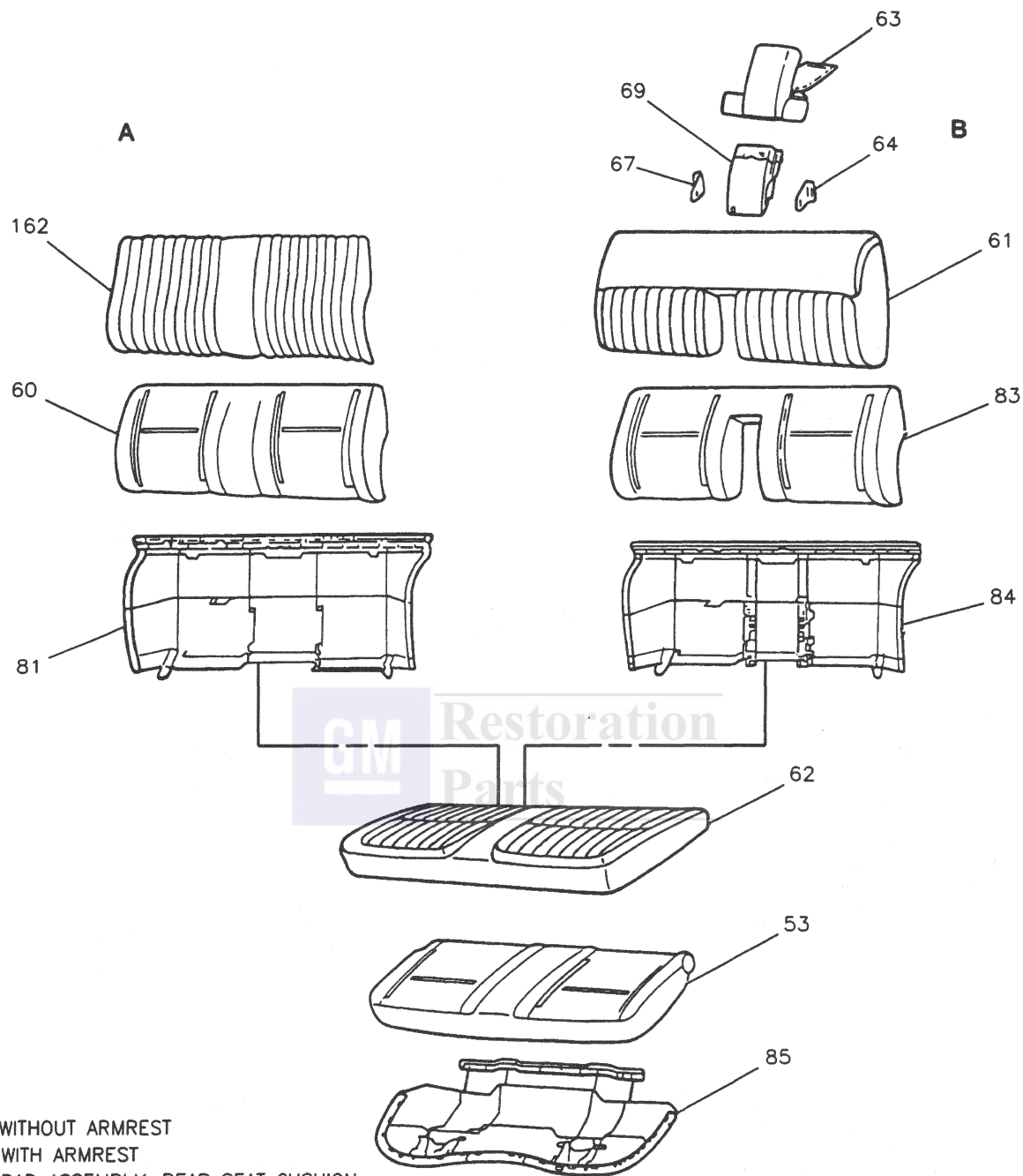


- | | |
|--|---|
| A SEAT, PASSENGER | 31 GUIDE, HEAD RESTRAINT |
| B SEAT, DRIVER | 35 SUPPORT, DRIVER/PASSENGER SEAT RECLINER |
| C SEAT WITH POWER RECLINE AND LUMBAR SUPPORT | 36 FRAME, DRIVER/PASSENGER SEAT CUSHION |
| 4 COVER, DRIVER/PASSENGER SEAT INNER/OUTER ADJUSTER REAR TRIM | 39 WIRE, DRIVER/PASSENGER SEAT ADJUSTER LINKING |
| 7 COVER, DRIVER/PASSENGER SEAT INNER/OUTER ADJUSTER FRONT TRIM | 40 SPRING, DRIVER/PASSENGER SEAT ADJUSTER RETURN |
| 10 ADJUSTER, DRIVER/PASSENGER SEAT | 41 KNOB, ADJUSTER ACTUATOR LEVER |
| 12 PAD, DRIVER/PASSENGER FRONT SEATBACK | 45 ADJUSTER, DRIVER/PASSENGER SEAT |
| 17 PAD, FRONT SEAT CUSHION | 74 FRAME, DRIVER/PASSENGER FRONT SEATBACK |
| 18 HANDLE, DRIVER/PASSENGER SEAT RECLINER | 75 COVER, FRONT SEAT CUSHION |
| 22 COVER, DRIVER/PASSENGER FRONT SEATBACK | 76 PAD, FRONT SEAT CUSHION |
| 23 COVER, DRIVER/PASSENGER FRONT SEAT CUSHION | 77 FRAME, FRONT SEAT CUSHION |
| 24 COVER, FRONT SEAT HEAD RESTRAINT | 79 COVER, DRIVER/PASSENGER SEAT INNER/OUTER ADJUSTER UPPER TRIM |
| 28 COVER, FRONT SEAT ARMREST SUPPORT | 80 COVER, DRIVER/PASSENGER SEAT INNER/OUTER ADJUSTER LOWER TRIM |
| 29 SUPPORT, FRONT SEAT ARMREST | |
| 30 RESTRAINT, DRIVER/PASSENGER HEAD | 152 ARMREST, FRONT SEAT |

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Figure 2 - Front Seat - (Buick)

10-10-4 SEATS AND CARPET



- A WITHOUT ARMREST
 B WITH ARMREST
 53 PAD ASSEMBLY, REAR SEAT CUSHION
 60 PAD ASSEMBLY, REAR SEATBACK
 61 COVER, REAR SEATBACK
 62 COVER, REAR SEAT CUSHION
 63 COVER, REAR SEAT ARMREST
 64 SUPPORT, REAR SEAT ARMREST BRACKET (RIGHT-HAND)
 67 SUPPORT, REAR SEAT ARMREST BRACKET (LEFT-HAND)
 81 FRAME, REAR SEATBACK
 83 PAD, REAR SEATBACK
 84 FRAME, REAR SEATBACK
 85 FRAME, REAR SEAT CUSHION
 162 COVER, REAR SEATBACK

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Figure 3 - Rear Seat

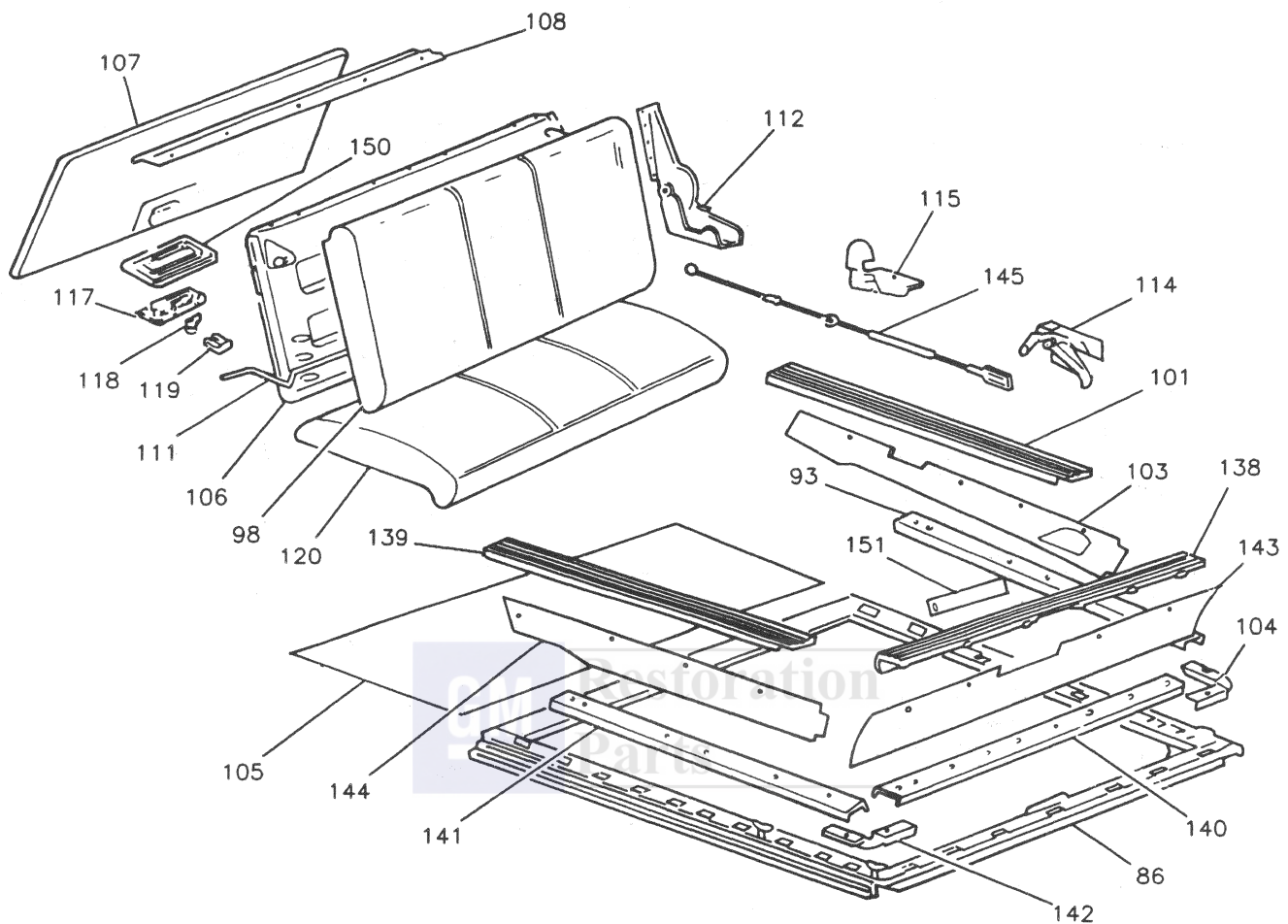


- 87 COVER, REAR SEATBACK CUSHION
88 COVER, REAR SEAT CUSHION
89 BUTTON, REAR SEATBACK LATCH RELEASE
90 LATCH, REAR SEATBACK CUSHION
121 PANEL, REAR SEATBACK CUSHION
128 SUPPORT, REAR SEATBACK CUSHION
130 CABLE, REAR SEATBACK LOAD FLOOR
131 LINK, REAR SEAT LOAD FLOOR FILLER PANEL
133 SUPPORT, REAR SEATBACK CUSHION
134 PANEL, REAR SEAT LOAD FLOOR FILLER
135 STRIKER, REAR SEATBACK CUSHION LATCH
146 FRAME, REAR SEATBACK CUSHION
147 PAD, REAR SEATBACK CUSHION
148 FRAME, REAR SEAT CUSHION
149 PAD, REAR SEAT CUSHION

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Figure 4 - Second Seat

10-10-6 SEATS AND CARPET



- | | | | |
|-----|---|-----|--|
| 86 | MODULE, LOAD FLOOR | 117 | HANDLE, LOAD FLOOR REAR PANEL |
| 93 | RAIL, LOAD FLOOR SIDE | 118 | CYLINDER, LOAD FLOOR LOCK |
| 98 | CUSHION, FOLDING THIRD SEATBACK | 119 | RETAINER, LOAD FLOOR LOCK CYLINDER |
| 101 | STRIP, LOAD FLOOR SIDE BUMPER | 120 | CUSHION, REAR SEAT #2 |
| 103 | PANEL, LOAD FLOOR SIDE | 138 | STRIP, LOAD FLOOR REAR BUMPER |
| 104 | REINFORCEMENT, LOAD FLOOR FRAME SIDE RAIL | 139 | STRIP, LOAD FLOOR SIDE BUMPER |
| 105 | PANEL, LOAD FLOOR STATIONARY | 140 | BAR, LOAD FLOOR FRAME REAR |
| 106 | PANEL, LOAD FLOOR FRONT | 141 | RAIL, LOAD FLOOR SIDE |
| 107 | PANEL, LOAD FLOOR REAR | 142 | REINFORCEMENT, LOAD FLOOR FRAME SIDE RAIL |
| 108 | HINGE, LOAD FLOOR REAR PANEL | 143 | PANEL, LOAD FLOOR REAR |
| 111 | ROD, REAR SEAT #2 BACK CUSHION TORQUE | 144 | PANEL, LOD FLOOR SIDE |
| 112 | LATCH, REAR SEATBACK CUSHION | 145 | CABLE, REAR SEAT #2 SEATBACK CUSHION LATCH RELEASE |
| 114 | HANDLE, REAR SEAT #2 BACK CUSHION LATCH RELEASE | 150 | RETAINER, LOAD FLOOR COMPARTMENT |
| 115 | LATCH, REAR SEAT #2 LOAD FLOOR | 151 | STRIKER, LOAD FLOOR REAR PANEL LOCK |

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Figure 5 - Rear Seat #2

released by lifting the seatback cushion latch release handle under the right side of the load floor rear panel, the third seatback can be lowered.

The folding rear seat #2 seatback is attached to a panel that becomes the load floor front panel when the seatback is folded down or when the rear seat #2 is absent. The seatback cushion is held onto the panel with wire loops on the lower seatback frame that hook through holes in the panel. The top of the seatback is held onto the panel with bolts/screws.

The luggage compartment front panel is attached to the luggage compartment rear panel through a hinge. The hinge is covered with vinyl trim.

The rear seat #2 module, or luggage compartment when the rear seat #2 is absent, has rails and rubber bumpers at the sides and rear. The rails are held with bolts/screws and rivets and the bumpers have retainers that snap into holes in the rails.

FLOOR CARPET

All floor carpets consist of a molded one-piece carpet over both front and rear floor panels.

DIAGNOSIS

MANUAL FRONT SEAT ADJUSTER

1. Adjusters will not lock or will not unlock.
 - Linking wire may be too loose, too tight or disconnected.
 - Return spring may be disconnected or damaged.
 - Lock bar may be sticking or damaged. Replace adjuster.
2. One adjuster locks and the other adjuster does not lock.
 - One adjuster may be forward or rearward of other adjuster. Make adjustments at the floor panel attachments.
3. Seat is hard to move forward or rearward.
 - Adjusters may be new. Move seat forward and rearward several times to work tightness out of channels.
 - Adjusters may not be properly lubricated.
 - Adjuster channels may be damaged. Replace adjuster.
 - Adjuster may not be parallel. Make adjustments at the floor pan attachments.

POWER FRONT SEAT ADJUSTER

Power Front Seat Adjuster without Power Recline

The following symptoms refer to mechanical operation of the power seat adjusters. For electrical diagnosis, refer to SECTION 8A.

1. One adjuster reaches maximum horizontal or vertical position before the other adjuster.
 - Adjusters may be out of phase.
2. Seat does not move smoothly.
 - Adjuster shoes and channels may not be properly lubricated.

- Adjuster horizontal actuator gear may be too tight.

3. One adjuster will not move forward and backward.
 - Horizontal drive cable may be disconnected or damaged.
 - Adjuster horizontal actuator may be damaged.
4. One adjuster will not move up or down.
 - Vertical drive cable may be disconnected or damaged.
 - Vertical actuator may be damaged.

Power Front Seat Adjuster with Power Recline

Buick

The following symptoms refer to mechanical operation of power seat adjusters with power recline. For electrical diagnosis, refer to SECTION 8A.

1. One adjuster reaches maximum horizontal position before the other adjuster.
 - Adjusters may be out of phase.
2. Seat does not move smoothly.
 - Adjusters may not be properly lubricated.
 - Drive shafts may not be inserted in motor or drives properly.
 - Drive shafts may be crimped.
3. One adjuster will not move forward and backward.
 - Drive shafts may be disconnected or damaged.

ON-VEHICLE SERVICE

FRONT SEAT

Figures 6, 7 and 8



Remove or Disconnect

NOTICE: Before removing the seat, place a protective shield over nearby paint and trim to avoid damage.

1. Operate seat to full-forward position.
2. Bolts/screws (3 or 5) from rear trim covers (1 or 4).
3. Rear trim covers (1 or 4).
4. Adjuster nuts (2) and washers (42) from rear anchor plate studs.
5. Operate seat to full-rearward position.
6. Bolts/screws (6 or 8) from front trim covers (7 or 9).
7. Front trim covers (7 or 9).
8. Adjuster nuts (2) and washers (42) from front anchor plate studs.
9. Electrical connectors from front seats with any electrical equipment, such as 6-way power adjusters, or power lumbar support.
10. Front seat with aid of a helper.

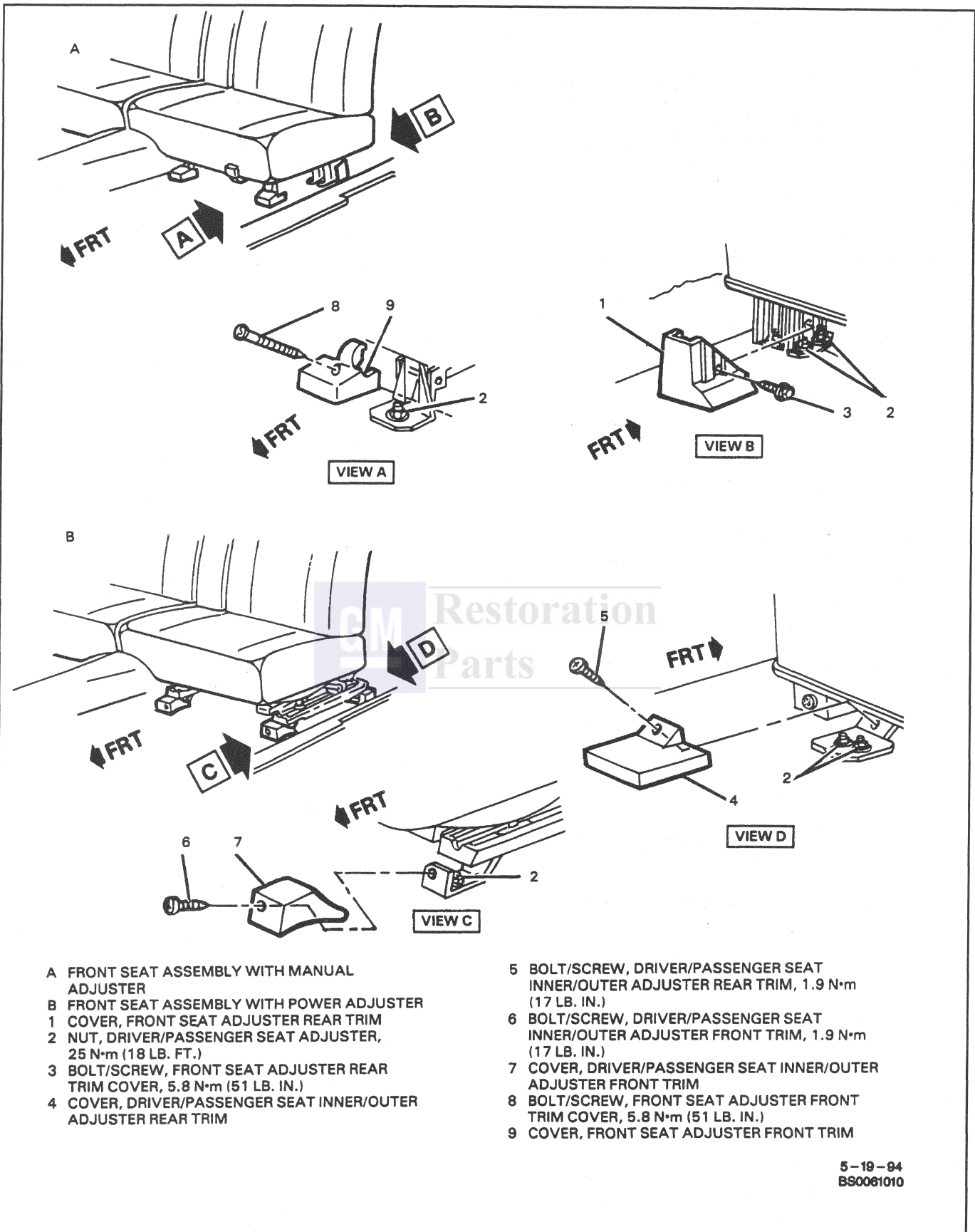


Figure 6 - Removing Front Seat Adjuster Trim Covers

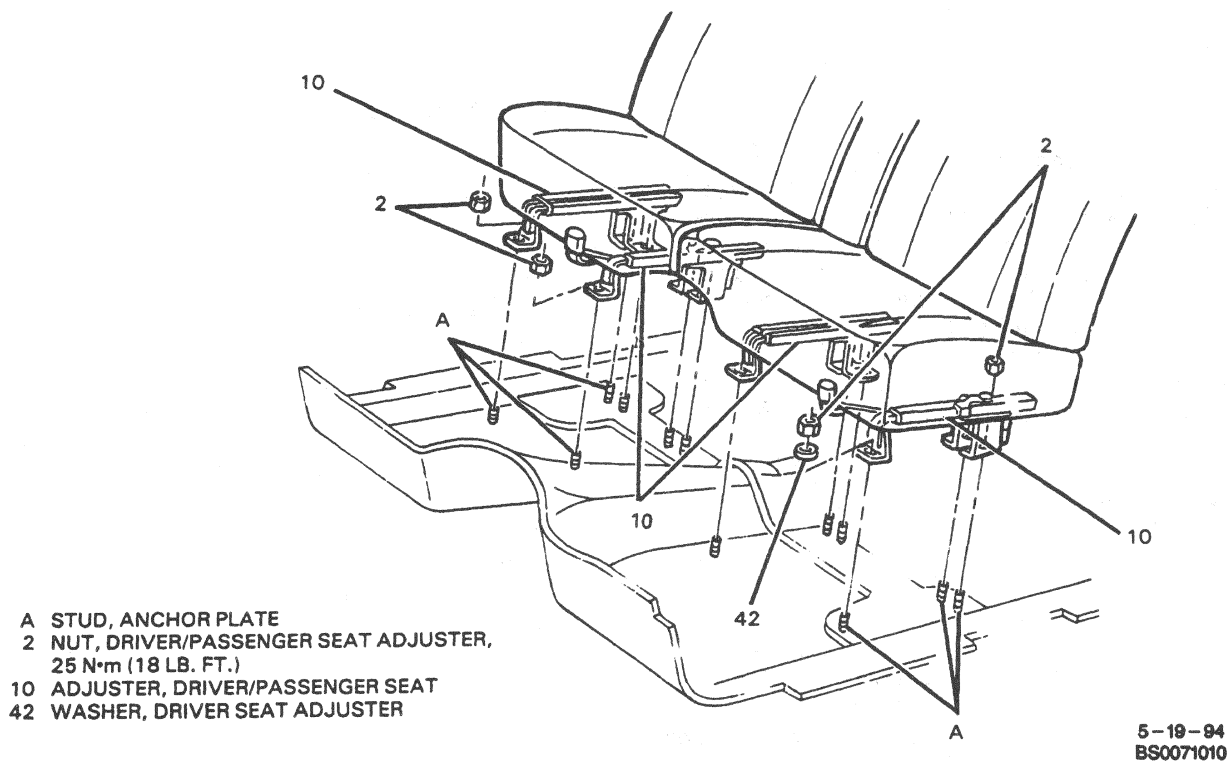


Figure 7 - Removing Front Seat - (Chevrolet)

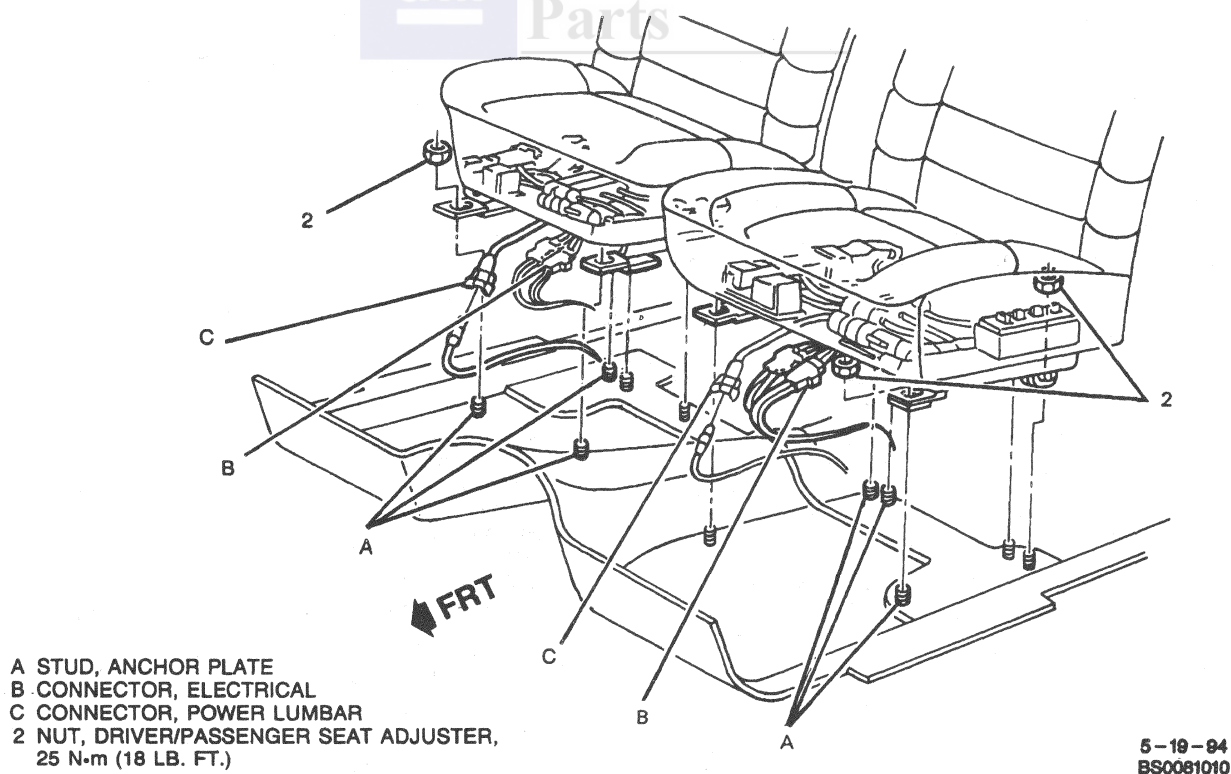


Figure 8 - Removing Front Seat - (Buick)

10-10-10 SEATS AND CARPET

- Guide seat belt through the slot in the seat cushion.

Install or Connect

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Front seat with aid of a helper.
 - Guide seat belt through slot in the seat cushion.
2. Electrical connectors on front seats with power seat adjusters or power lumbar support.
3. Adjuster nuts (2) and washers (42) to front anchor plate studs.

Tighten

- Adjuster nuts (2) to 25 N.m (18 lb. ft.).
4. Front trim covers (7 or 9).
 5. Bolts/screws (6 or 8) to front trim covers (7 or 9).

Tighten

- Bolts/screws (6) to 1.9 N.m (17 lb. in.).
 - Bolts/screws (8) to 5.8 N.m (51 lb. in.).
6. Move seat to full-forward position.
 7. Adjuster nuts (2) and washers (42) to rear anchor plate studs.

Tighten

- Adjuster nuts (2) to 25 N.m (18 lb. ft.).
8. Rear trim covers (1 or 4).
 9. Bolts/screws (3 or 5) to rear trim covers (1 or 4).

Tighten

- Bolts/screws (3) to 5.8 N.m (51 lb. in.).
- Bolts/screws (5) to 1.9 N.m (17 lb. in.).

COVERS AND PADS

Front seat and seatback cushions have formed foam pads that fit the contour of the seat cushion and seatback frames. The covers are either cloth or leather.

Front Seat Covers

MANUAL RECLINE

Figures 9 and 10

Tool Required:
J 9886-01 Door Handle Clip Remover

Remove or Disconnect

1. Head restraint. Refer to "Head Restraint" in this section.

Important

- If only the seatback cover is being removed, then the entire seat does not have to be removed. Skip steps 2 through 6 and 13.
2. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
 3. Front seat armrest with support. Refer to "Front Seat Armrest" in this section.

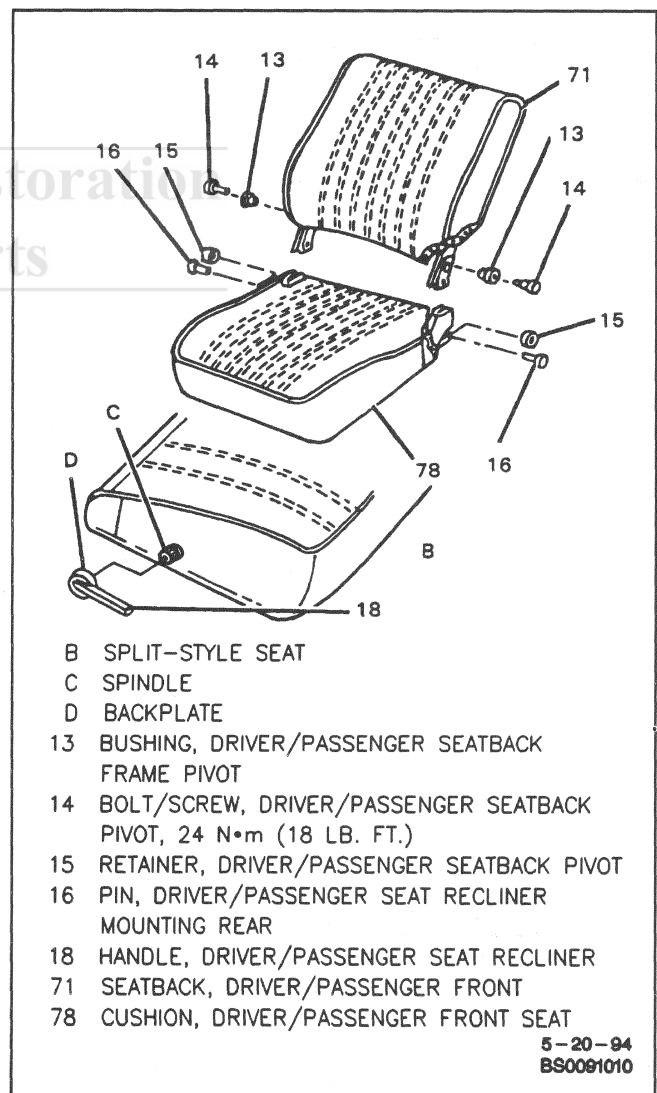


Figure 9 - Disassembling Manual Front Seats

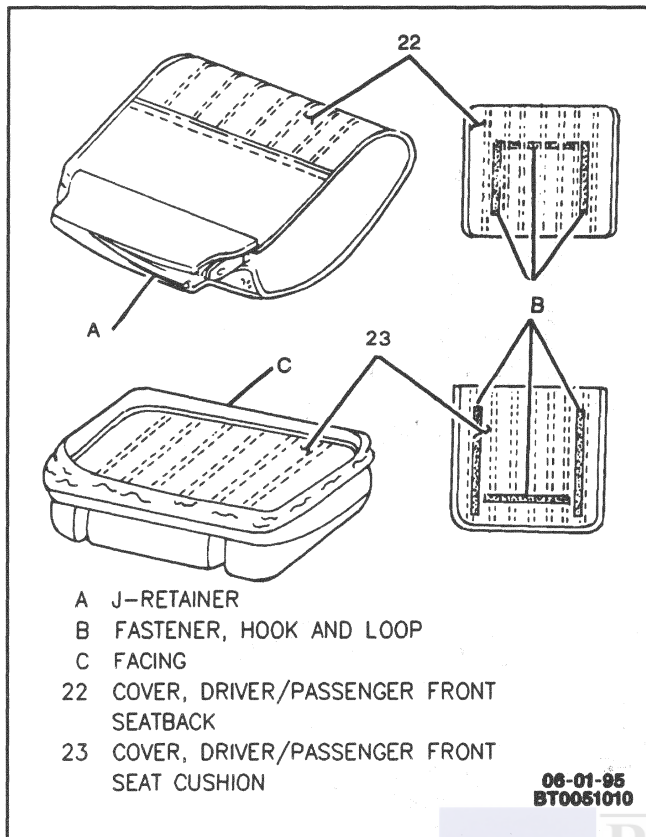


Figure 10 - Removing Front Seat and Seatback Covers (Typical)

4. Pull seat belt down through slot in seat cushion (78).
5. Recliner handle (18), using J 9886-01.
 - Use a screwdriver to unsnap back plate from recliner handle (18).
 - Release spring clip by pushing J 9886-01 between the recliner handle (18) and seat cushion (78).
6. Move seatback cushion cover (23) and foam enough to expose lock or support hardware.
7. Bolt/screw (14).
8. Bushing (13).
9. Retainer (15) from pin (16).
10. Pin (16) connecting seatback (71) to recliner.
11. Seatback (71).
12. Seatback cover (22).
 - A. Disengage J-retainers.
 - B. Disengage hook and loop fasteners.
 - C. Pull seatback cover (22) over pad.
13. Seat cushion cover (23).
 - A. Disengage J-retainers and push-in fasteners from bottom perimeter of seat frame.
 - B. Turn seat cushion cover facings up from pad.
 - C. Disengage hook and loop fasteners.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Seat cushion cover (23).
 - A. Turn seat cushion cover facings over edge of pad.
 - B. Engage J-retainers and push-in retainers around perimeter of seat frame.
 - C. Engage hook and loop fasteners from center to outer edges by pressing seat cushion cover (23) to pad to avoid wavy pattern.
2. Seatback cover (22).
 - A. Pull seatback cover (22) over foam pad.
 - B. Fold J-retainer into J-retainer and press to lock.
 - C. Engage hook and loop fasteners from center to outer edges by pressing seatback covers (22) to pad to avoid wavy pattern.
3. Seatback (71).
 - Align seatback (71) to seat cushion (78).
4. Move seat cushion cover (23) and pad enough to access lock or support hardware.
5. Pin (16) connecting seatback (71) to recliner.
6. Retainer (15).
 - Push onto pin (16).
7. Bushing (13).
8. Bolt/screw (14).



Tighten

- Bolt/screw (14) to 24 N.m (18 lb. ft.).
9. Move seat cushion cover (23) and foam back into place.
 10. Recliner handle (18).
 - Push recliner handle (18) with spring clip and back plate onto spindle to secure.
 11. Armrest and support. Refer to "Front Seat Armrest" in this section.
 12. Push seat belt back up through slot in seat cushion (78).
 13. Seat. Refer to "Front Seat" under "On-Vehicle Service and Unit Repair" in this section.
 14. Head restraint. Refer to "Head Restraint" in this section.

POWER RECLINE

Figures 11 and 12



Remove or Disconnect

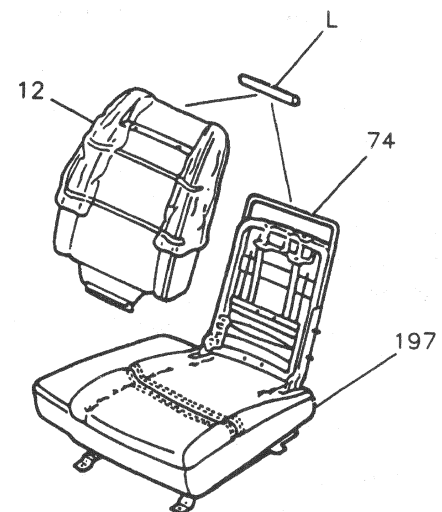
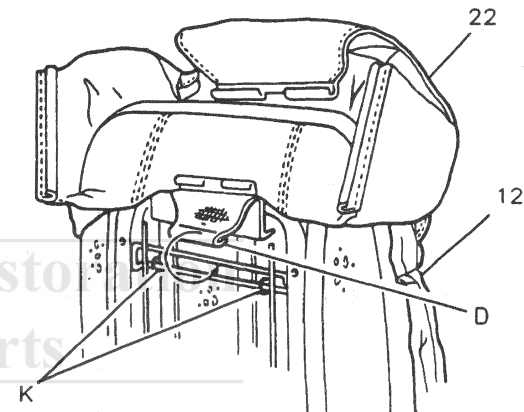
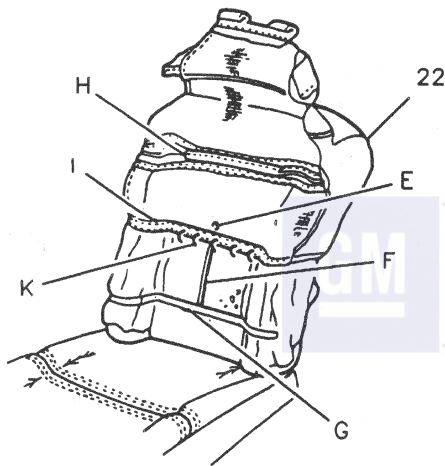
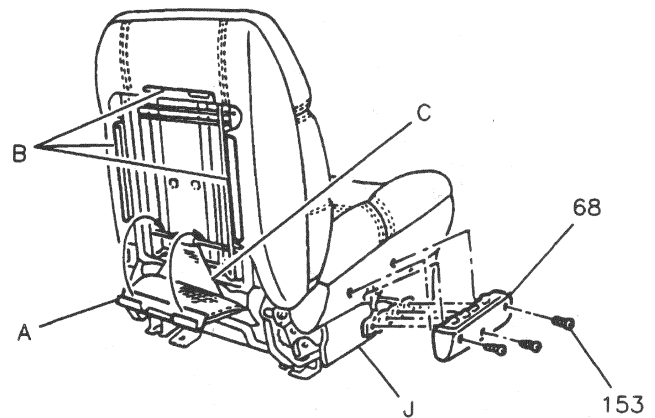
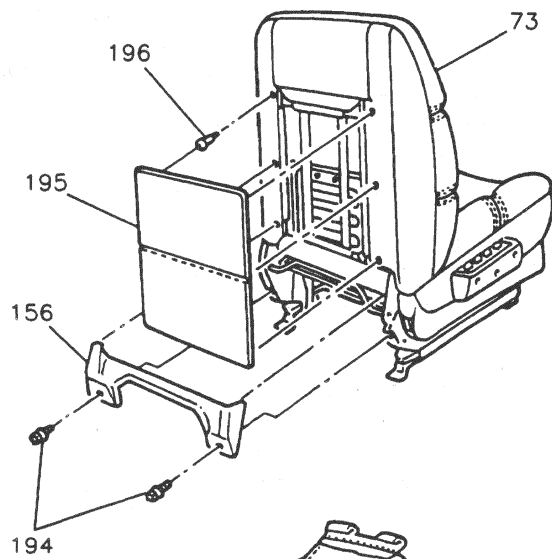
1. Armrest and support. Refer to "Front Seat Armrest" in this section.



Important

- If only the seatback cover and pads are being removed, then the entire seat does not have to be removed. Skip steps 3, 4 and 12 through 14.
2. Head restraint. Refer to "Head Restraint" in this section.
 3. Bolts/screws (194).
 4. Panel (156).

10-10-12 SEATS AND CARPET



- | | | | |
|-----|---|-----|---|
| A | J-RETAINER, REAR LOWER | 156 | PANEL, SEAT CUSHION FINISH |
| B | J-RETAINER, REAR UPPER | 194 | BOLT/SCREW, SEATBACK CUSHION FINISH PANEL |
| C | J-RETAINER, UPPER | 195 | PANEL, SEATBACK CUSHION FINISH |
| D | J-RETAINER | 196 | RETAINER, MAP POCKET PANEL |
| E | HOLE | 197 | CUSHION, DRIVER/PASSENGER FRONT SEAT |
| F | WORKLINE | | |
| G | TRENCH | | |
| H | RETAINER, TIE-DOWN | | |
| I | RETAINER, TIE-DOWN | | |
| J | CONNECTOR, ELECTRICAL | | |
| K | RING, RETAINING | | |
| L | EXTRUSION, FOAM | | |
| 12 | PAD, DRIVER/PASSENGER FRONT SEATBACK | | |
| 22 | COVER, DRIVER/PASSENGER FRONT SEATBACK | | |
| 68 | SWITCH, DRIVER SEAT LUMBAR SUPPORT | | |
| 73 | SEATBACK, DRIVER/PASSENGER FRONT | | |
| 74 | FRAME, DRIVER/PASSENGER FRONT SEATBACK | | |
| 153 | BOLT/SCREW, DRIVER SEAT LUMBAR SUPPORT SWITCH | | |

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Figure 11 - Power Recline Front Seatback Cover and Pads

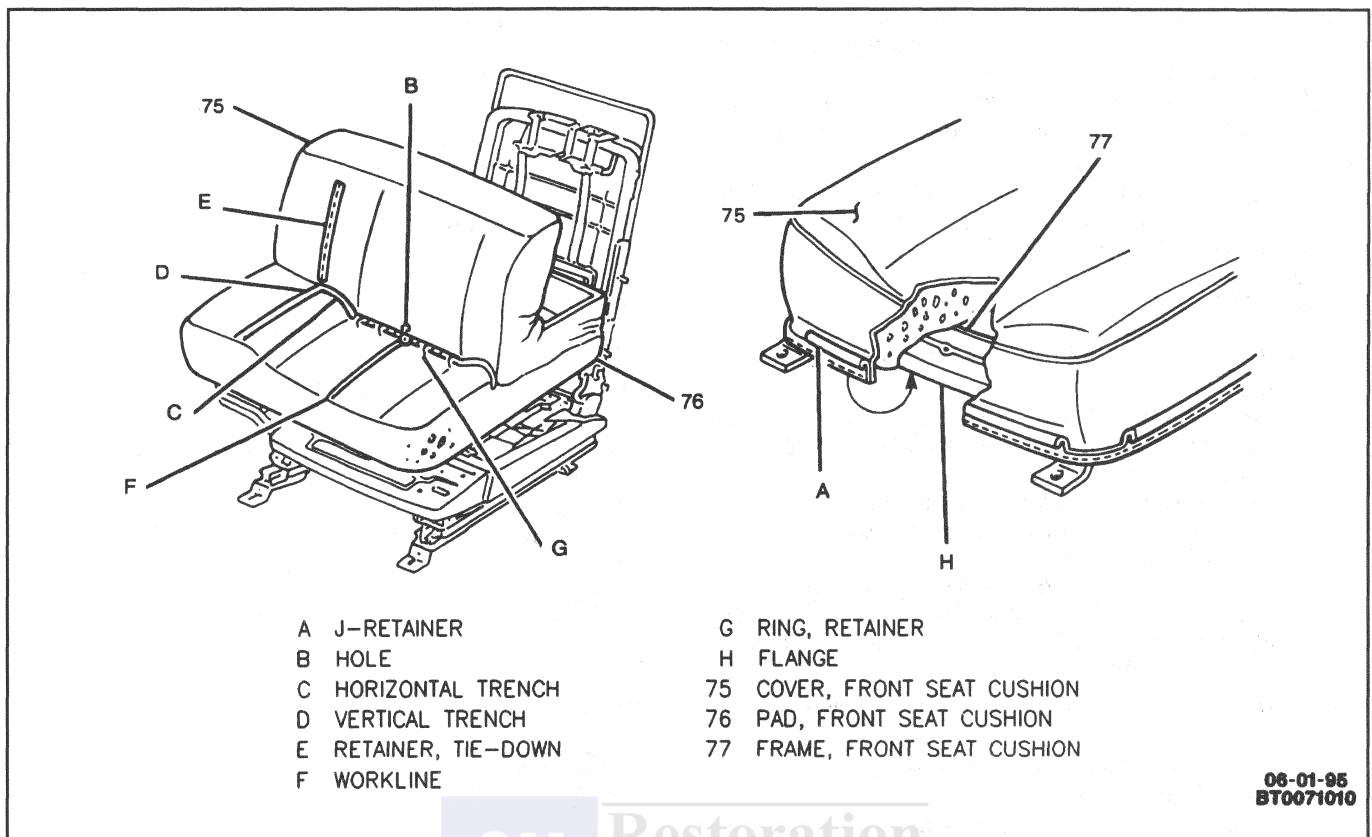


Figure 12 - Power Recline Front Seat Cushion Cover and Pads

5. Panel (195).
 - Disengage plastic retainers (196), using a flat-bladed tool to pry panel (195) away.
6. Pull seat belt down through slot in seat cushion (197).
7. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
8. Rear upper J-retainers.
9. Pull rear lower J-retainer under seatback and carefully pull seatback cover (22) upward until lower retaining rings on front of seatback are exposed.
10. Retaining rings.
11. Repeat steps 9 and 10 for upper retaining rings on front of seatback (73).
12. Continue pulling seatback cover (22) upward until J-retainer in seatback cover headrest opening is exposed, and remove J-retainer.
13. Pull seatback cover (22) free.
14. Seatback pad (12).
 - A. Remove foam extrusion from top of seatback and pull wire on top of split style seatback pad (12) away from wire on top of seatback frame (74).
 - B. Remove retaining rings on back of seatback frame (74).
 - C. Remove J-retainer.
15. Lumbar support switch (68).
 - A. Remove bolts/screws (153).
- B. Disconnect electrical connectors and push them back through holes in seat cushion cover (75).
16. J-retainers holding seat cushion cover (75) to flange of seat frame (77).
17. Seat cushion (197) from seat frame (77).
18. Seat cushion cover (75) from seat pad (76).
 - A. Pull back seat cushion cover (75) until retaining rings are exposed, and then remove them.
 - B. Pull seat cushion cover (75) free of seat pad (76).

**Install or Connect**

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Seat cushion cover (75).
 - A. Lay seat cushion cover (75) over seat pad (76) and fold seat cushion cover (75) back to expose a horizontal trench in the seat pad (76) on the passenger and driver sides, and a vertical trench on the driver side only. Locate tie-down retainer in seat cushion cover (75) to wire in trench, aligning hole in seat cushion cover (75) to workline in seat pad (76) and attach with retaining rings.
 - B. Pull seat cushion cover (75) over sides of seat pad (76).

10-10-14 SEATS AND CARPET

2. Seat cushion (197) to seat frame (77).
 - A. Place electrical connectors through holes in seat cushion covers (75).
 - B. Attach J-retainers on bottom of seat cushion cover (75) to flange around seat frame (77).
3. Lumbar support switch (68).
 - A. Connect electrical connectors to lumbar support switch (68).
 - B. Install bolts/screws (153).

Tighten

- Bolts/screws (153) to 10.5 N.m (93 lb. in.).
4. Seatback pad (12).
 - A. Place seatback pad (12) on seatback frame (74) and attach J-retainer to wire on back of seatback frame (74).
 - B. Secure seatback pad (12) to seatback frame (74) with retaining rings on the back of seatback frame (74).
 - C. Place wire on top of seatback pad (12) behind wire on top of seatback frame (74) and then place foam extrusion on top of both wire tops when assembled.
 5. Inside out seatback cover (22) over seatback pad (12).
 6. J-retainer from seatback cover headrest opening to seatback frame (74).
 7. Pull seatback cover (22) down over seatback pad (12) and position upper tie-down retainer to trench in seatback pad (12), aligning hole in seatback cover (22) to workline in seatback pad (12). Attach seatback cover (22) with retaining rings. Continue to pull seatback cover (22) down and do the same when lower tie-down retainer is positioned to trench.
 8. Rear upper J-retainers.
 9. Pull seat belt up through slot in seat cushion (197).
 10. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
 11. Panel (195).
 12. Panel (156).
 13. Bolts/screws (194).

Tighten

- Bolts/screws (194) to 11 N.m (97 lb. in.).
14. Head restraint. Refer to "Head Restraint" in this section.
 15. Armrest and support. Refer to "Front Seat Armrest" in this section.

Head Restraint Cover

Figure 13

Remove or Disconnect

1. Arrow retainer from J-retainer.
2. Head restraint cover (24).

Install or Connect

1. Head restraint cover (24) over pad.
 - Align cutouts to head restraint posts.
2. Fold arrow retainer into J-retainer.
 - Press to lock.

Armrest Cover

Figure 14

Remove or Disconnect

1. Armrest and support. Refer to "Front Seat Armrest" in this section.
2. Bolts/screws (27) from support (29) and support cover (28).
3. Armrest and washers (26) from support (29) and support cover (28).
4. Washers (26) from armrest.
5. Center armrest cover (25).
 - Unzip to remove.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Center armrest cover (25).
 - Zip closed.
2. Washers (26) to armrest.
3. Armrest and washers (26) to support (29) and support cover (28).
4. Bolts/screws (27).

Tighten

- Bolts/screws (27) to 11 N.m (97 lb. in.).

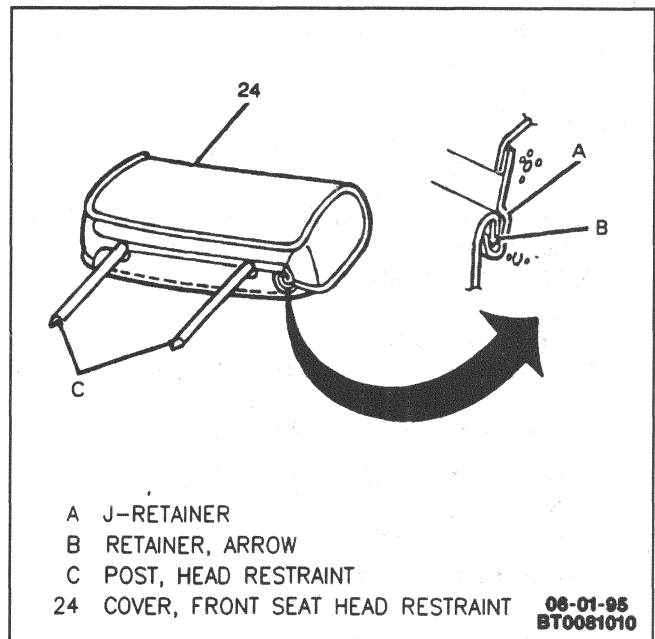


Figure 13 - Head Restraint Cover

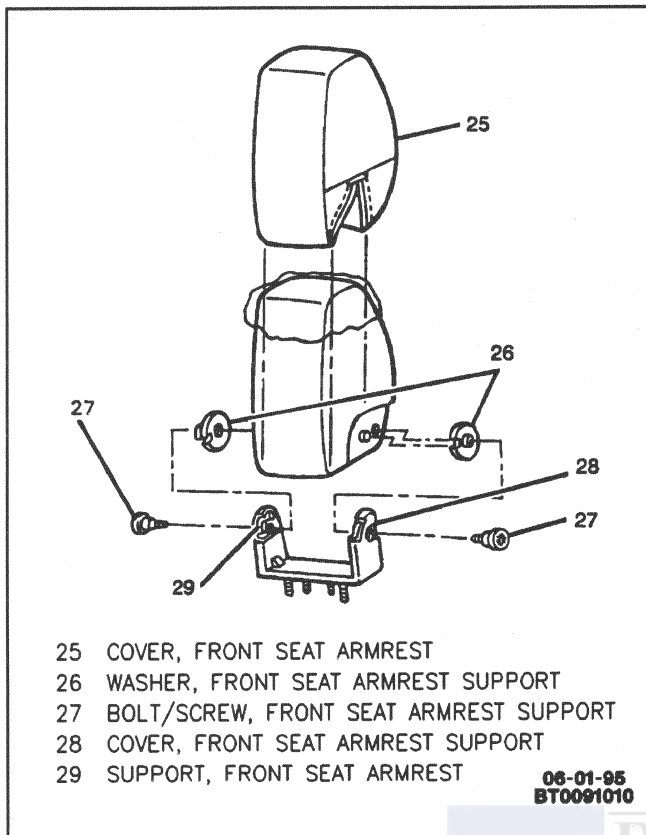


Figure 14 - Removing Front Seat Armrest Support and Cover (Typical)

5. Armrest and support to seat frame. Refer to "Front Seat Armrest" in this section.

Head Restraint

Figures 15 and 16

All front seats have head restraints. The head restraints are designed so they cannot be removed from the seatback without first inserting a flat tool inside the head restraint guides to release the lock clips. The head restraints can be raised or lowered for proper positioning.

Two head restraint lock-releasing tools must be fabricated locally from flexible steel strap (Figure 15). The flat surfaces of these tools will release the spring lock tab.

Remove or Disconnect

1. Raise head restraint (30) to full-up position.
2. Insert head restraint lock-releasing fabricated tools down left-hand side of both guides (31).
3. Push head restraint (30) and tools down simultaneously to disengage post detentes from tabs.
4. Lift head restraint (30) out.

Install or Connect

1. Posts into guides (31).

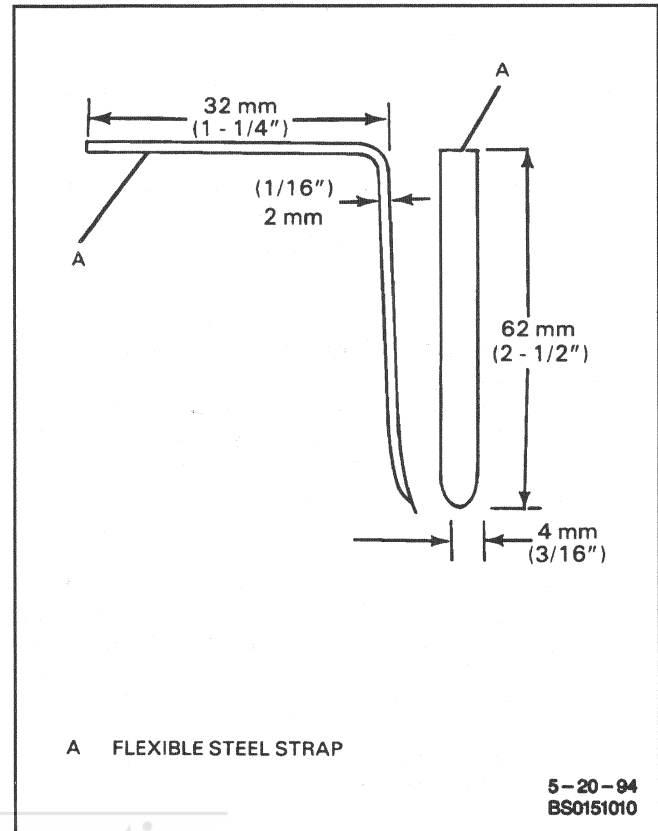


Figure 15 - Head Restraint Lock Releasing Fabricated Tool

2. Push head restraint (30) into full-down position.
3. Raise head restraint (30) to ensure head restraint (30) stops at post detents.

Front Seat Armrest

Figure 17

Both the standard armrest and the storage armrest are removed the same way. The storage armrest is not serviceable. If damaged it must be replaced.

Remove or Disconnect

1. Position seat in full-forward and full-up position.
2. J-retainer on front seat cushion cover from frame.
3. Nuts (34) from studs.
4. Armrest (32) and support from front seat.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Armrest (32) and support to front seat.
2. Nuts (34) onto studs.

Tighten

- Nuts (34) to 11 N.m (97 lb. in.).
3. J-retainer on front seat cushion cover to frame.

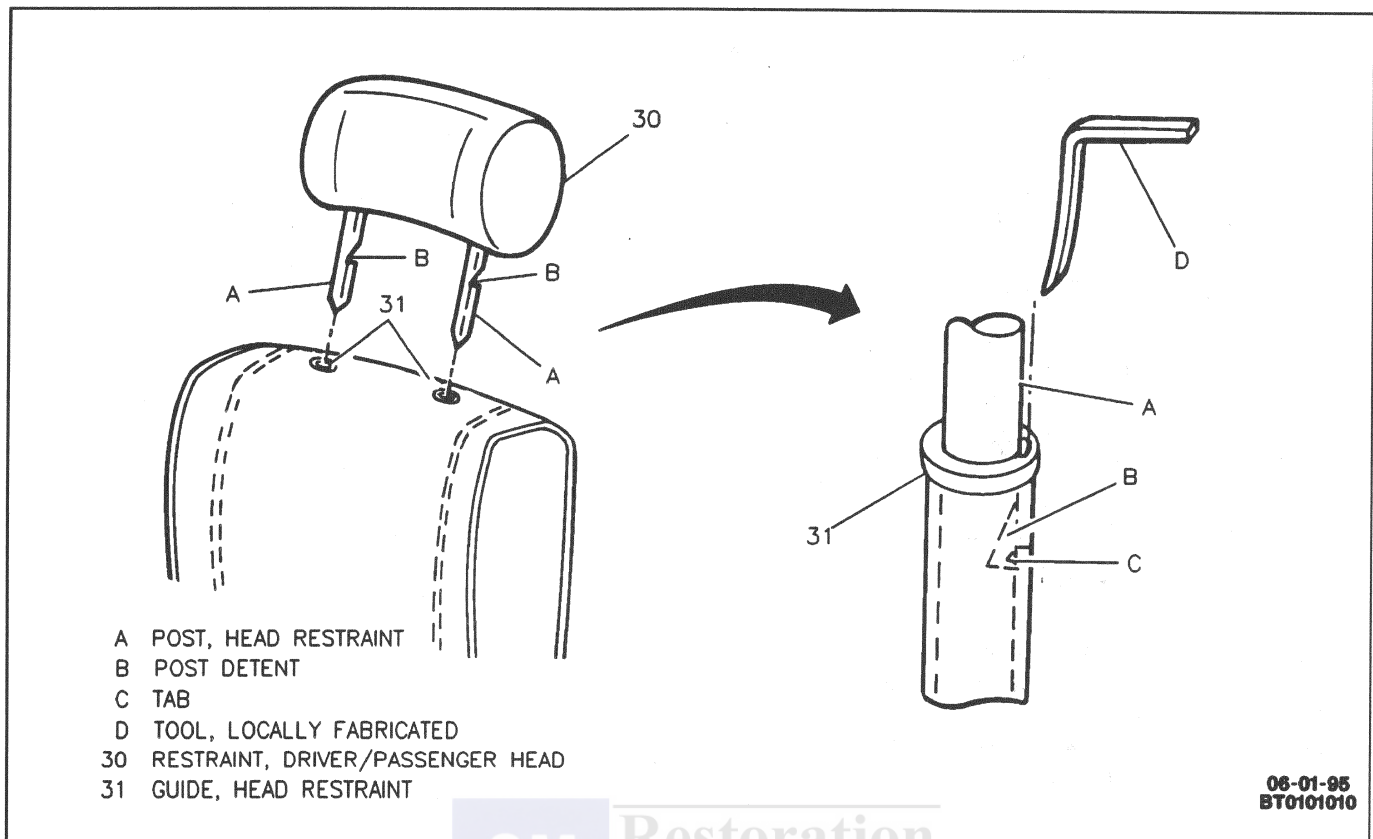


Figure 16 - Removing Head Restraint

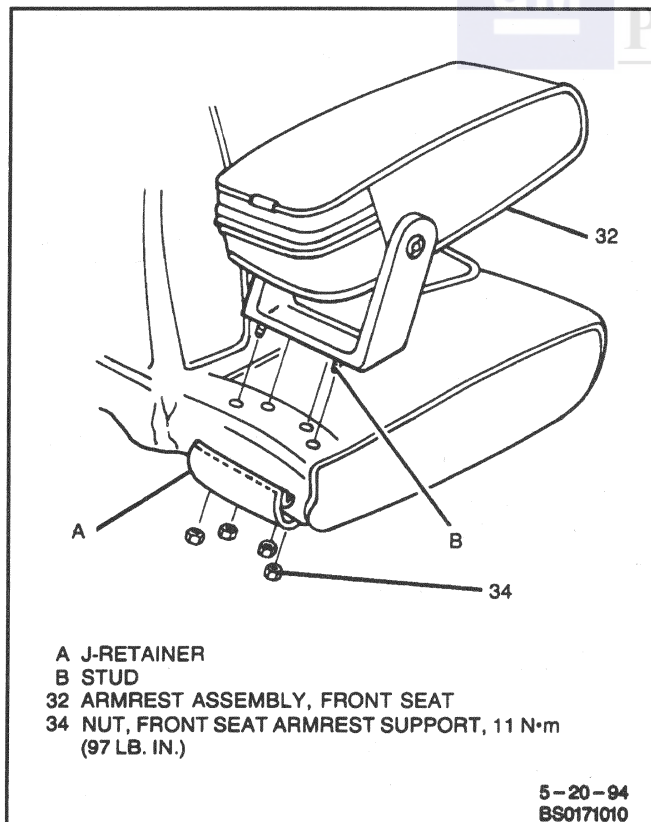


Figure 17 - Removing Front Seat Armrest - (Typical)

Manual Reclining Seatback

Some seats are equipped with driver and passenger manual reclining seatbacks. The seatbacks can be reclined to several positions by exerting slight pressure against the seatback and lifting the front of the recliner handle located at the front outboard side of the seat cushion. When the recliner handle is lifted, the spring-loaded recliner support is released, allowing the seatback to be pushed rearward. Lifting the recliner handle also allows the spring-loaded recliner support to bring the seatback forward from the reclined position.

The manual recliner is attached with pins to the outboard seat pivots. It is covered by the seat covers.

Manual Recliner Check

Inspect

1. Front seat manual recliner.
 - A. Pull upward on recliner handle and push seatback to rear. Move seatback into full-reclined position, checking ease of handle operation and seatback movement.
 - B. Release recliner handle and ensure it returns to normal position without assistance. Seatback should remain fully reclined.
 - C. Pull upward on recliner handle and allow seatback to move forward to a middle reclined position. Release recliner handle.
 - D. Push upper seatback to rear to check for recliner locking action.

- E. Pull upward on recliner handle and allow seatback to return to normal position, checking ease of handle operation and seatback full return. Release recliner handle.
 - F. Push upper seatback to rear to check for recliner locking action.
2. If recliner does not operate correctly, replace recliner support.

Manual Recliner Support

Figures 9, 10 and 18

Tool Required:
J 9886-01 Door Handle Clip Remover

↔ Remove or Disconnect

1. Front seat and place on clean, protected surface. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Recliner handle (18), using J 9886-01.
 - A. Use a screwdriver to unsnap back plate from recliner handle (18).
 - B. Release spring clip by pushing J 9886-01 between the recliner handle (18) and seat cushion (78).
3. Disengage J-retainers from side of seat cushion (78).
4. Push the seat cushion cover (23) and pad enough to gain access to the front and rear pins (16 and 20) and retainers (15 and 19).
5. Front and rear retainers (15 and 19).
6. Front and rear pins (16 and 20).
7. Recliner support (35) from seat cushion frame (36).

→→ Install or Connect

1. Recliner support (35) to seat cushion frame (36).
2. Front and rear pins (16 and 20).
 - Push the seat cushion cover (23) and foam pad enough to gain access to front and rear holes for pins (16 and 20).
3. Front and rear retainers (15 and 19) to front and rear pins (16 and 20).
4. Engage J-retainers to side of seat cushion (78).
5. Recliner handle (18).
 - Push recliner handle (18) with spring clip and back plate onto spindle to secure.
6. Front seat. Refer to "Front Seat" under "On-Vehicle Service and Unit Repair" in this section.

Power Reclining Seatback

Buick

Some front seats may be equipped with a power reclining seatback feature. The controls are located on the side of both seat cushions.

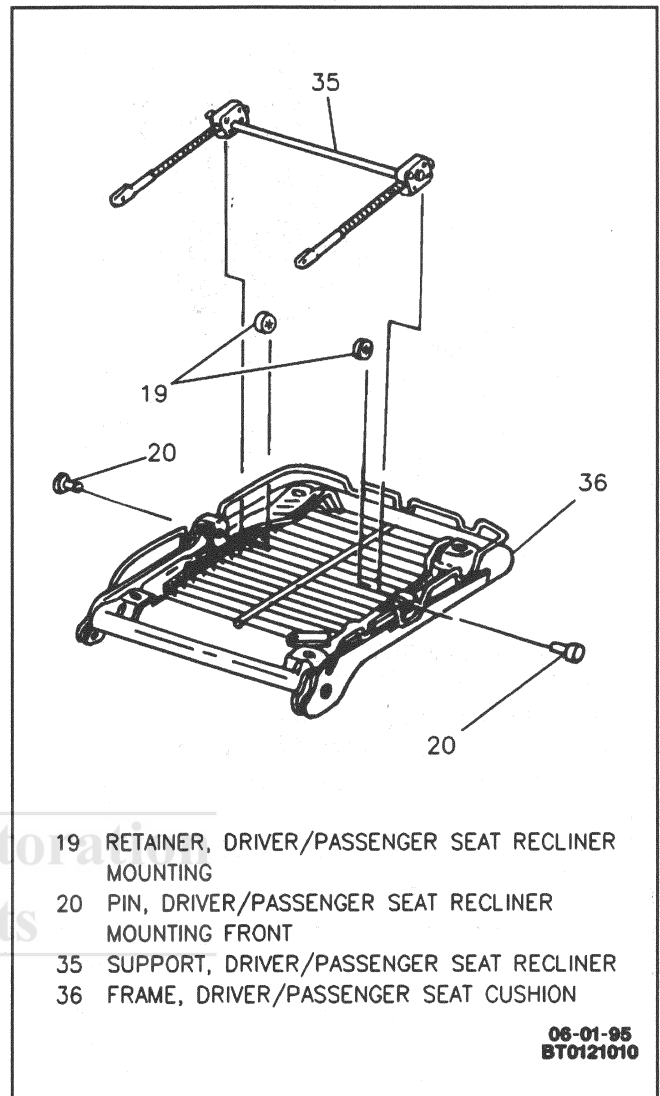


Figure 18 - Removing Manual Recliner Support

Seatback Frame Removal

Figure 19

↔ Remove or Disconnect

1. Seatback cover and pads from seatback frame. Refer to "Power Recline Seat Cushion and Seatback Cover and Pads" under "Cover and Pads" in this section.
2. Seatback lumbar. Refer to "Seatback Lumbar" in this section.
3. Bolts/screws (159).
4. Bolt/screw (160).
5. Seatback frame (74).

→→ Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Seatback frame (74).
2. Bolt/screw (160).

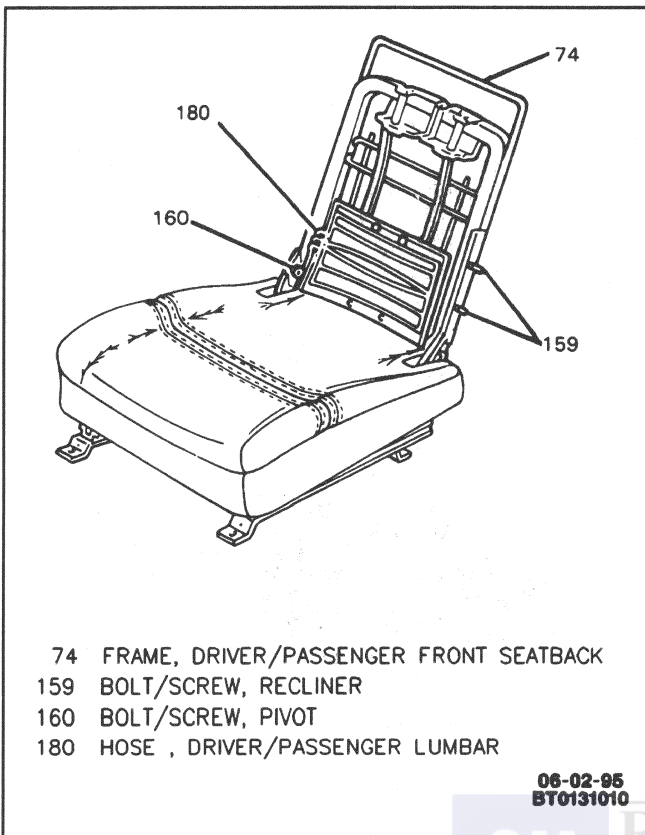


Figure 19 - Power Reclining Seatback - (Buick)

3. Bolts/screws (159).



Tighten

- Bolt/screw (160) to 29 N.m (21 lb. ft.).
- Bolts/screws (159) to 32 N.m (24 lb. ft.).

4. Seatback Lumbar support. Refer to "Seatback Lumbar Support" in this section.

5. Seatback pad and covers to seatback frame. Refer to "Power Recline Seat Cushion and Seatback Cover Pads" under "Cover and Pads" in this section.

Power Recliner

Figure 20



Remove or Disconnect



Important

- To remove recliner motor or cable housings only, it is not necessary to remove entire recliner. Skip steps 3 through 5.

1. Operate seat to full-up position.
2. Seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
3. Electrical connector.
4. Seatback cover and pads. Refer to "Power Recline Seat Cushion and Seatback Cover and Pads" under "Cover and Pads" in this section.

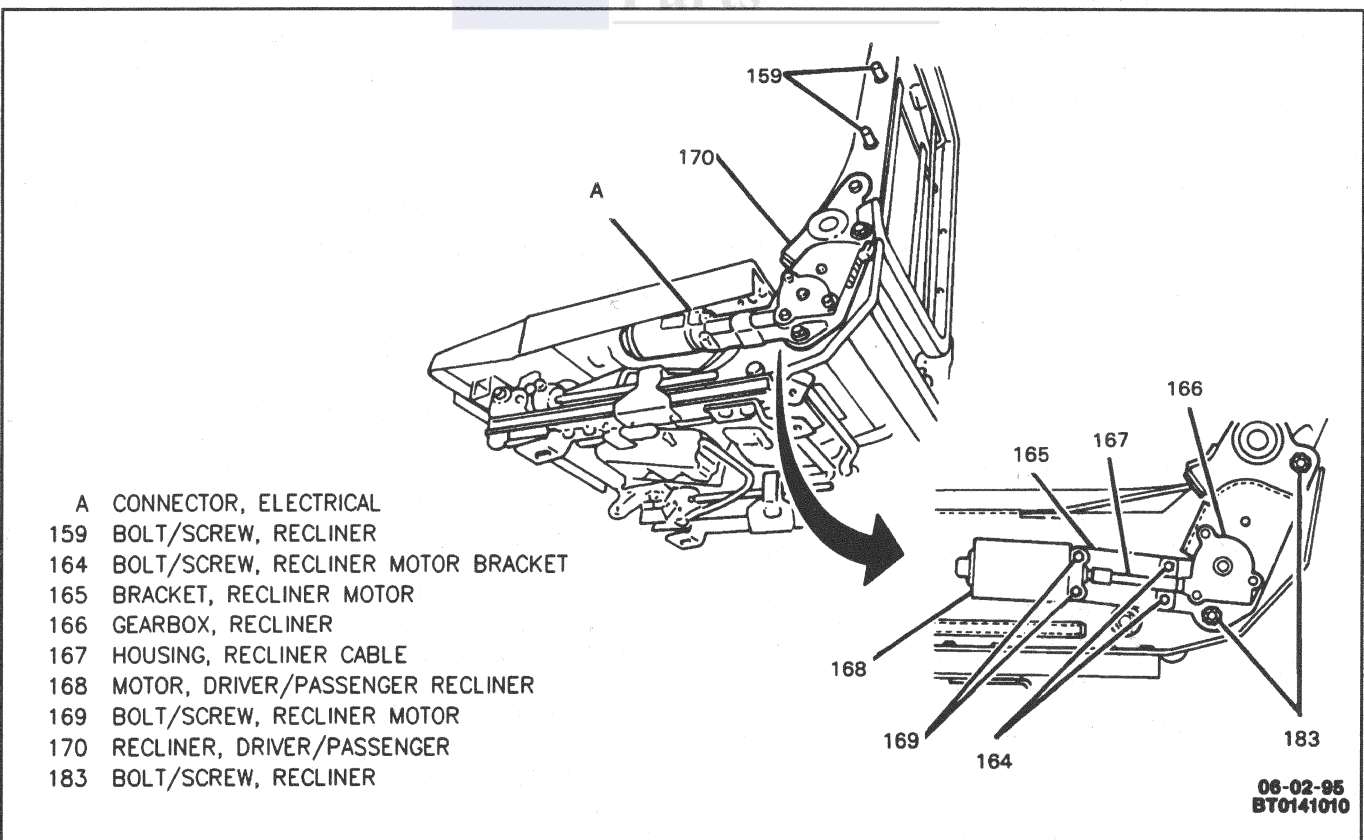


Figure 20 - Power Recliner - (Buick)

5. Bolts/screws (183).
6. Bolts/screws (159).
7. Power recliner (170).
8. Bolts/screws (164) attaching bracket (165) to gearbox (166), note bracket (165) attachment to gearbox (166).
9. Cable housing (167) from gearbox (166), being careful not to crimp cable housing (167).
10. Bolts/screws (169), if replacing motor (168).
11. Motor (168) from bracket (165), if replacing motor (168).

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Motor (168) to bracket (165), if removed.
2. Bolts/screws (169), if removed.
 - Tighten securely.
3. Cable housing (167) to gearbox (166), being careful that cable housing (167) fits correctly and does not crimp.
4. Bracket (165) to gearbox (166), being careful to attach bracket (165) properly.
5. Bolts/screws (164).
 - Tighten securely.
6. Recliner (170).
7. Bolts/screws (183).
8. Bolts/screws (159).



Tighten

- Bolts/screws (183 and 159) to 32 N.m (24 lb. ft.).
9. Seatback cover and pads. Refer to "Power Recline Seat Cushion and Seatback Cover and Pads" under "Cover and Pads" in this section.
 10. Electrical connector.
 11. Front seat. Refer to "Front Seat" under "On-Vehicle Service and Unit Repair" in this section.

MANUAL FRONT SEAT ADJUSTER

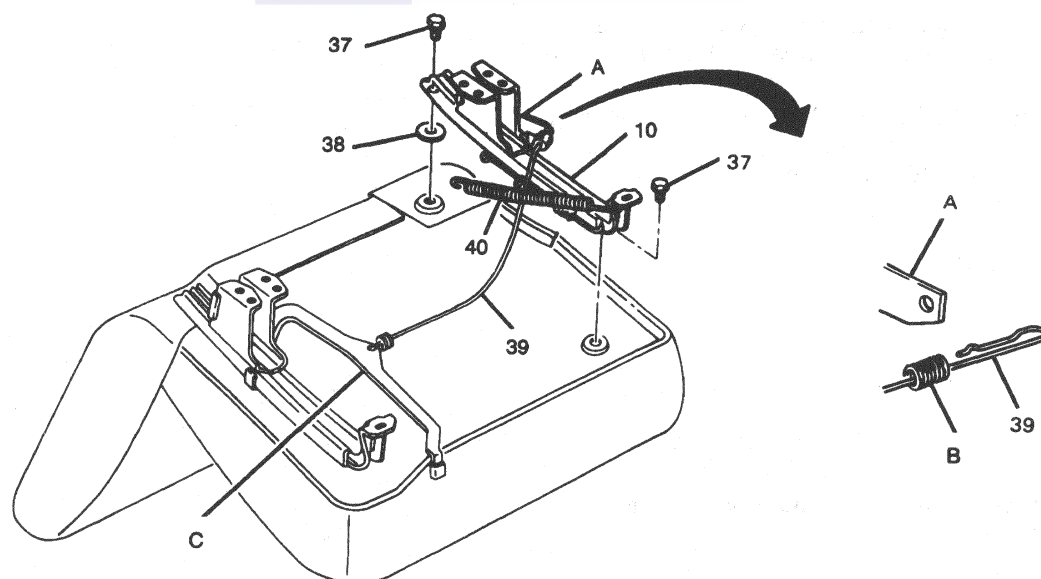
Front seats may have manual seat adjuster attached to the seat cushion. An adjuster actuator lever is located at the lower front edge of the seat cushion. When the lever is moved to the left, the seat adjusters unlock. The seat can then be moved forward and backward. The seat locks in place when the lever is released.

The seat adjusters are held onto the seat cushion frame with bolts/screws and to the floor pan with nuts and washers installed over studs.

Floor Pan Attachment Adjustment

Figures 6 and 21

A small amount of forward and rearward or side adjustment is possible at the seat adjuster floor pan attaching points. The adjustment can be used to align the seat adjusters with each other.



A LOCK BAR
 B SPRING, RETAINER
 C LEVER, ADJUSTER ACTUATOR
 10 ADJUSTER, DRIVER/PASSENGER SEAT
 37 BOLT/SCREW, DRIVER/PASSENGER SEAT ADJUSTER-TO-SEAT FRAME, 24 N.m (18 LB. FT.)

38 SPACER, DRIVER/PASSENGER SEAT ADJUSTER
 39 WIRE, DRIVER/PASSENGER SEAT ADJUSTER LINKING
 40 SPRING, DRIVER/PASSENGER SEAT ADJUSTER RETURN

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Figure 21 - Removing Manual Adjuster

10-10-20 SEATS AND CARPET

↔ Remove or Disconnect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Bolts/screws (3, 5, 6 or 8) from adjuster rear or front trim covers (1, 4, 7 or 9).
2. Adjuster rear or front trim covers (1, 4, 7 or 9).

🔑 Adjust

1. Loosen adjuster nuts (2).
2. Align seat adjusters (10).
 - A. Make sure seat adjusters (10) are lined up front to rear.
 - B. Make sure seat adjusters (10) are parallel to each other.

🔩 Tighten

- Adjuster nuts (2) to 25 N.m (18 lb. ft.).

↔ Install or Connect

1. Adjuster rear or front trim covers (1, 4, 7 or 9).
2. Bolts/screws (3, 5, 6 or 8) to adjuster rear or front trim covers (1, 4, 7 or 9).

🔍 Inspect

- Floor pan attachment by moving seat all the way forward and rearward, locking it in several positions.
 - A. Both seat adjusters (10) should lock at each position.
 - B. Seat should move easily forward and rearward.

Adjuster Replacement

Figure 21

↔ Remove or Disconnect

1. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Return spring (40) from the seat adjuster (10) being removed.
3. Linking wire (39).

- Slide retainer spring back to reveal end of linking wire (39).

4. Bolts/screws (37).
5. Seat adjuster (10) from seat.
6. Spacers (38), if necessary.

- If spacers (38) are installed between the adjuster (10) and the seat frame, note the location of the spacers (38).

↔ Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Spacers (38), if necessary.
2. Seat adjuster (10) to seat.
3. Bolts/screws (37).

🔩 Tighten

- Bolts/screws (37) to 24 N.m (18 lb. ft.).
4. Linking wire (39).
 - A. Hook ends of linking wire (39) through hole in lock bar and adjuster actuator lever.
 - B. Slide retainer spring over end of linking wire (39).
 5. Return spring (40) to the seat adjuster (10).
 6. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

Adjuster Actuator Lever Knob Replacement

Figure 22

Adjuster actuator lever knob fits over the end of the adjuster actuator lever that comes out from under the seat cushion. The knob can generally be removed and reinstalled several times without becoming too loose.

↔ Remove or Disconnect

- Knob (41) from adjuster actuator lever.
 - A. Place a protective covering over the nearby trim.

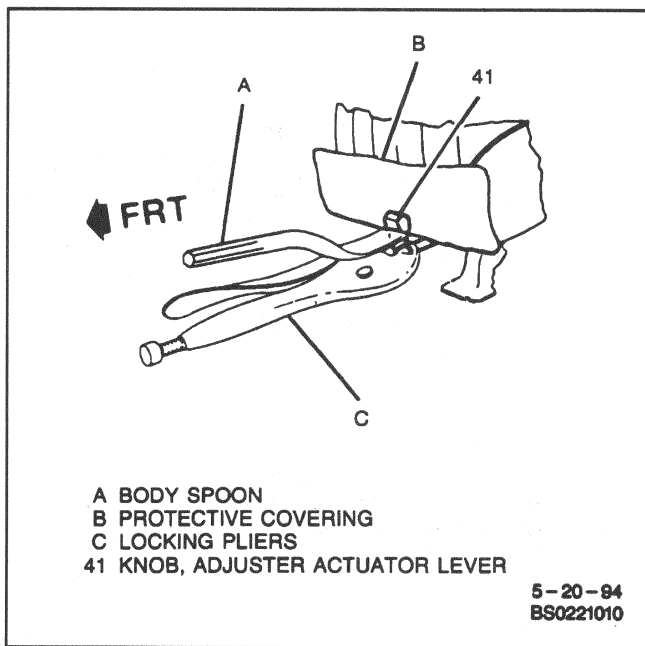


Figure 22 - Adjuster Actuator Lever Knob

- B. Draw a pencil line on the adjuster actuator lever 25 mm (1 inch) from the end as a guide for full-depth fit of the knob (41).
- C. Clamp locking pliers on to adjuster actuator lever below the pencil line.
- D. Using a body spoon, pry downward to remove the knob (41).

Install or Connect

- Knob (41) onto the adjuster actuator lever. Gate marks on the knob (41) must face to the rear. Press the knob (41) firmly onto the adjuster actuator lever. Use a rubber mallet, if necessary.

Important

- While installing the knob, take care not to bend the adjuster actuator lever.

POWER FRONT SEAT ADJUSTER

Six-way power seat adjusters are available on front seats. The adjusters use three 12-volt, reversible, permanent-magnet motors controlled by a switch on the door trim. The motors are held on to the adjusters with a support. Drive cables connect the motors to the vertical and horizontal actuators. The seats can be moved forward and backward by one motor, up and down in the front with the second, and up and down in the rear with the third.

Adjuster Horizontal Actuator Adjustment

Figure 23

With seat adjuster installed, chucking or jerking can be corrected by tightening or loosening the adjuster horizontal actuator and pinion gear to the adjuster lower track rack gear.

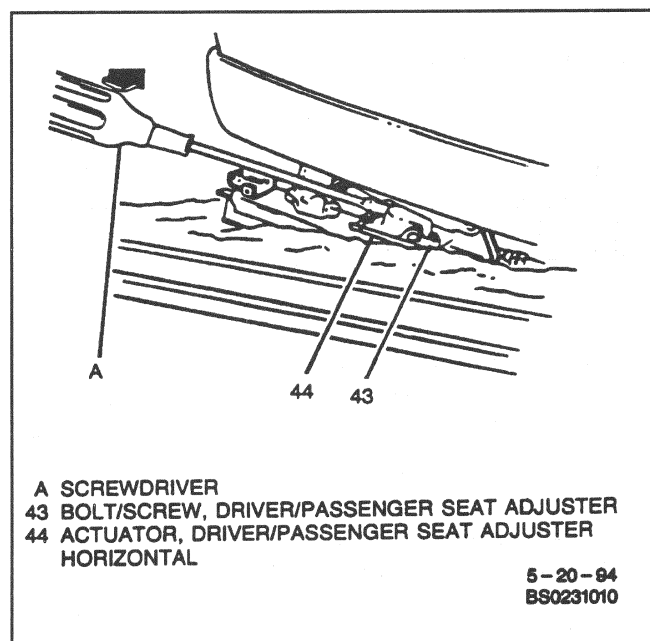


Figure 23 - Adjuster Horizontal Actuator



Adjust

- Adjuster horizontal actuator (44).
 - A. Operate seat to full-up position and about 3/4-forward position.
 - B. Loosen bolts/screws (43).
 - C. Using a large screwdriver, apply 67 to 111 N (15 to 25 pounds) of outward pressure on adjuster horizontal actuator (44). At the same time, use the horizontal switch to move seat slightly forward and backward, helping to tightly fit the adjuster horizontal actuator pinion gear teeth to the lower track rack gear teeth to eliminate any free play between gear teeth.
 - D. While maintaining pressure against adjuster horizontal actuator (44), tighten bolts/screws (43).

Adjuster Phase Adjustment

When one adjuster reaches either maximum horizontal or maximum vertical travel before the other, the adjusters are out of phase. Out-of-phase adjusters can occur over time or when the seats are serviced.



Adjust

1. Horizontal phase.
 - A. Operate horizontal switch until one adjuster reaches full-forward position.
 - B. Detach horizontal drive cable from the full-forward adjuster.
 - C. Operate horizontal switch until the other adjuster reaches full-forward position.
 - D. Connect horizontal drive cable.



Inspect

- Horizontal travel.
2. Vertical phase.
 - A. Operate vertical switch until one adjuster has reached fully raised position at both the front and rear.
 - B. Disconnect both front and rear vertical drive cables from the fully raised adjuster.
 - C. Operate vertical switch until the other adjuster reaches fully raised position at both front and rear.
 - D. Connect vertical drive cables.



Inspect

- Vertical travel.

Adjuster Replacement

Figures 1, 2, 24 and 25



Remove or Disconnect

1. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Drive cables (49).

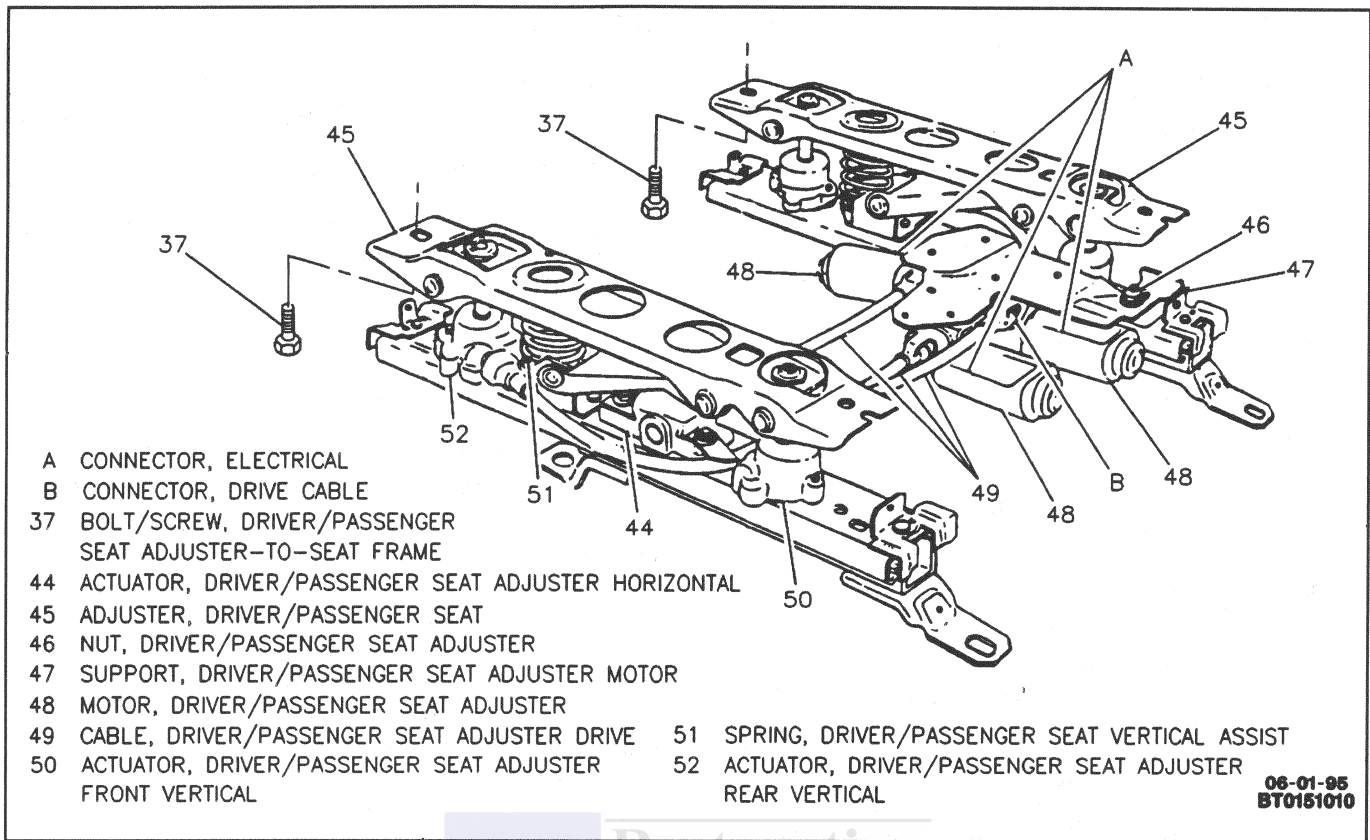


Figure 24 - Power Adjuster Components

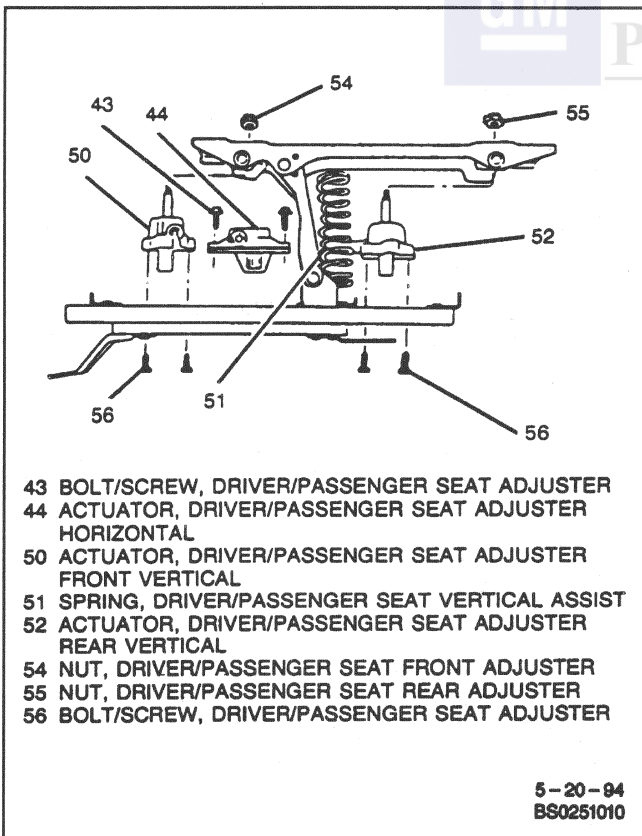


Figure 25 - Adjuster Horizontal and Vertical Actuator

3. Nut (46) securing motor support (47) with motors (48) attached.
4. Motor support (47) with motors (48) attached.
5. Bolts/screws (37).
6. Adjuster (45).
7. Upper and lower adjuster cover bolts/screws, if necessary.
8. Upper and lower adjuster covers (79 and 80), if necessary.



Disassemble

CAUTION: Failure to place the power adjuster in a bench vise before removing the rear vertical actuator will cause ejection of the compressed assist spring and possible personal injury.

1. Rear adjuster nut (55).
 - A. Place adjuster (45) in a bench vise and remove the rear adjuster nut (55).
 - B. Open the vise slowly to relieve assist spring compression and remove the adjuster (45) from the vise.
2. Vertical assist spring (51).
3. Front adjuster nut (54).
4. Bolts/screws (43) from adjuster horizontal actuator (44).
5. Adjuster horizontal actuator (44).
6. Adjuster bolts/screws (56).

7. Rear vertical actuator (52).
8. Front vertical actuator (50).

Assemble

1. Front vertical actuator (50).
2. Rear vertical actuator (52).
3. Adjuster bolts/screws (56).
4. Adjuster horizontal actuator (44).
5. Bolts/screws (43) to adjuster horizontal actuator (44).
6. Front adjuster nut (54).
7. Vertical assist spring (51).
8. Rear adjuster nut (55).
 - A. Place adjuster (45) into a bench vise.
 - B. Carefully compress the vertical assist spring (51) and install the rear adjuster nut (55).
 - C. Remove power adjuster (45) from the bench vise.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Upper and lower adjuster covers (79 and 80), if removed.
2. Upper and lower adjuster cover bolts/screws, if removed.

Tighten

- Upper and lower adjuster cover bolts/screws to 1.5 N.m (13 lb. in.).
3. Adjuster (45).
 4. Bolts/screws (37).

Tighten

- Bolts/screws (37) to 24 N.m (18 lb. ft.).
5. Motor support (47) with motors (48) attached.
 6. Nut (46) securing motor support (47).
 7. Drive cables (49).
 8. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

Motor Replacement

Figure 24

Remove or Disconnect

1. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Drive cables (49).
3. Nut (46).
4. Motor support (47) with motors (48) attached.
5. Electrical connectors from motors (48).
6. Motors (48) from motor support (47).
 - Grind off ends of grommet to separate the motors (48) from the motor support (47).

Install or Connect

1. Motors (48) to the motor support (47).
 - A. Drill out top end of grommet, using a 3/16-inch drill bit.
 - B. Secure motors (48) to motor support (47) with 3/16-inch rivets.
2. Electrical connectors to motors (48).
3. Motor support (47) with motors (48) attached.
4. Nut (46).
5. Drive cables (49).
6. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

Seat Track and Seat Track Motors

Figures 11, 19, 20 and 26 through 28

Remove or Disconnect

Important

- If only the motor (172) is being removed, skip steps 3 through 10.

1. Operate seat to full-up position.
2. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
3. Bolts/screws (194).
4. Panel (156).
5. Electrical connectors from motor (172).
6. Bolts/screws (160).
7. Bolts/screws (159).
8. Hitch pins from pivot pins (184).
9. Pivot pins (184).
10. Seat track (185).
11. Place seat track (185) facing up (as installed in vehicle).
12. Motor (172) and bracket (178).
 - A. Remove bolts/screws (173 and 186).
 - B. Remove motor (172) by carefully pulling up. Be careful not to crimp flex shafts and cable housings as motor (172) is pulled away from them.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Motor (172) and bracket (178).
 - A. Lower motor (172) into seat track (185), being careful to properly insert cable housings and flex shafts into motor (172).
 - B. Install bolts/screws (173 and 186).
 - Tighten securely.
2. Frame (77) to seat track (185).
3. Pivot pins (184).
4. Hitch pins to pivot pins (184).
5. Seatback (73) to seat cushion (197).

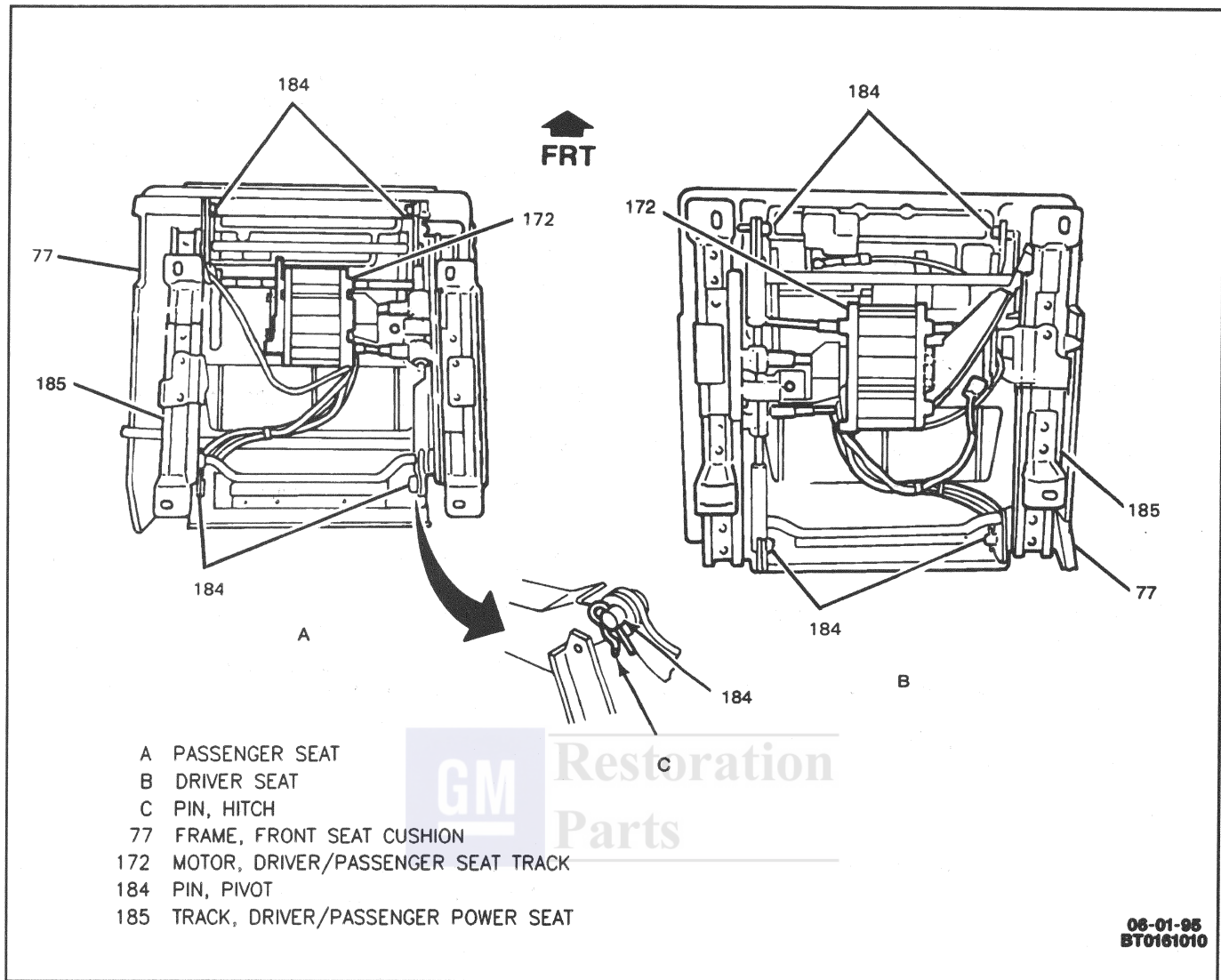


Figure 26 - Power Reclining Seat Track and Seat Track Motor

6. Bolts/screws (159).

7. Bolts/screws (160).



Tighten

• Bolts/screws (159) to 32 N.m (24 lb. ft.).

• Bolts/screws (160) to 29 N.m (21 lb. ft.).

8. Recliner motor electrical connectors to motor (172).

9. Panel (156).

10. Bolts/screws (194).



Tighten

• Bolts/screws (194) to 11 N.m (97 lb. in.).

11. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

POWER LUMBAR COMPONENTS

The power lumbar unit consists of a motor, cable assembly and a strap. The power lumbar unit can only be serviced as a complete assembly.

Seatback Lumbar

Figure 28



Remove or Disconnect

1. Make seatback lumbar support is in full back (relaxed) position before removal.
2. Head restraint. Refer to "Headrest Restraint" under "Front Seat" in this section.
3. Seatback. Refer to "Power Reclining Seatback" under "Front Seat" in this section.
4. Seatback cover and pad. Refer to "Power Recline Seat Cushion and Seatback Cover and Pad" under "Cover and Pad" in this section.
5. Disconnect lumbar strap (179) from seatback frame (74).
 - A. Pull center of strap forward until the end is oriented 90° from frame bracket.
 - B. Slide strap ends from frame bracket, one at a time.
6. Electrical connector.
 - Cut straps from frame to release.

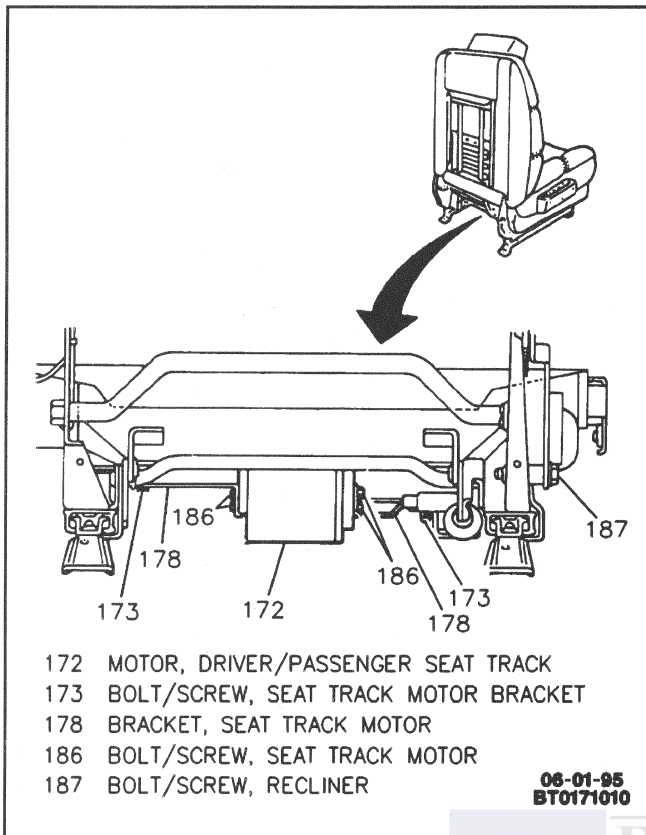


Figure 27 - Seat Track Motor Mounting

7. Bolts/screws and washers from motor and gear (180).
8. Seatback lumbar.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Seatback lumbar.
2. Bolts/screws and washers from motor and gear (180).
3. Electrical connector.
4. Lumbar strap (179) to seatback frame (74).
 - A. Orient end of strap so that it is 90° from seatback bracket.
 - B. Slide end of strap into bracket.
 - C. Repeat for opposite side.
5. Seatback cover and pad. Refer to "Power Recline Seatback Cushion and Seatback Cover and Pad" under "Cover and Pad" in this section.
6. Seatback. Refer to "Power Reclining Seatback" under "Front Seat" in this section.
7. Head restraint. Refer to "Headrest Restraint" under "Front Seat" in this section.

MEMORY SEAT COMPONENTS

Memory Module

Figure 29

Remove or Disconnect

1. Operate seat to full-up position.
2. Driver seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
3. Electrical connector from memory module (60).
4. Retaining bolt from memory module (60).
5. Memory module (60).

Install or Connect

1. Memory module (60).
2. Retaining bolt to memory module (60).
 - Tighten securely.
3. Electrical connector to memory module (60).
4. Driver seat. Refer to "Front Seat" in this section.

HEATED SEAT COMPONENTS

Heating Element

Figures 2 and 30

Important

- When replacing heating elements, the attached pads must also be replaced.

Remove or Disconnect

1. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Seat cushion cover (23 or 75). Refer to "Power Recline Seat Cushion and Seatback Cover and Pads" under "Cover and Pads" in this section.
3. Electrical connectors from heating element (8 or 13).
4. Heating element (8 or 13) with attached pad (9 or 14) from seat cushion frame (36 or 77).

Install or Connect

1. Heating element (8 or 13).
 - A. Peel backing paper from new heating element (8 or 13) and attach to new pad (9 or 14).
 - B. Align cutout in heating element (8 or 13) to hook and loop strip on new pad (9 or 14).
2. Heating element (8 or 13) with attached pad (9 or 14) to seat cushion frame (36 or 77).
3. Electrical connectors to heating element (8 or 13).
4. Seat cushion cover (23 or 75). Refer to "Power Recline Seat Cushion and Seatback Cover and Pads" under "Cover and Pads" in this section.
5. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

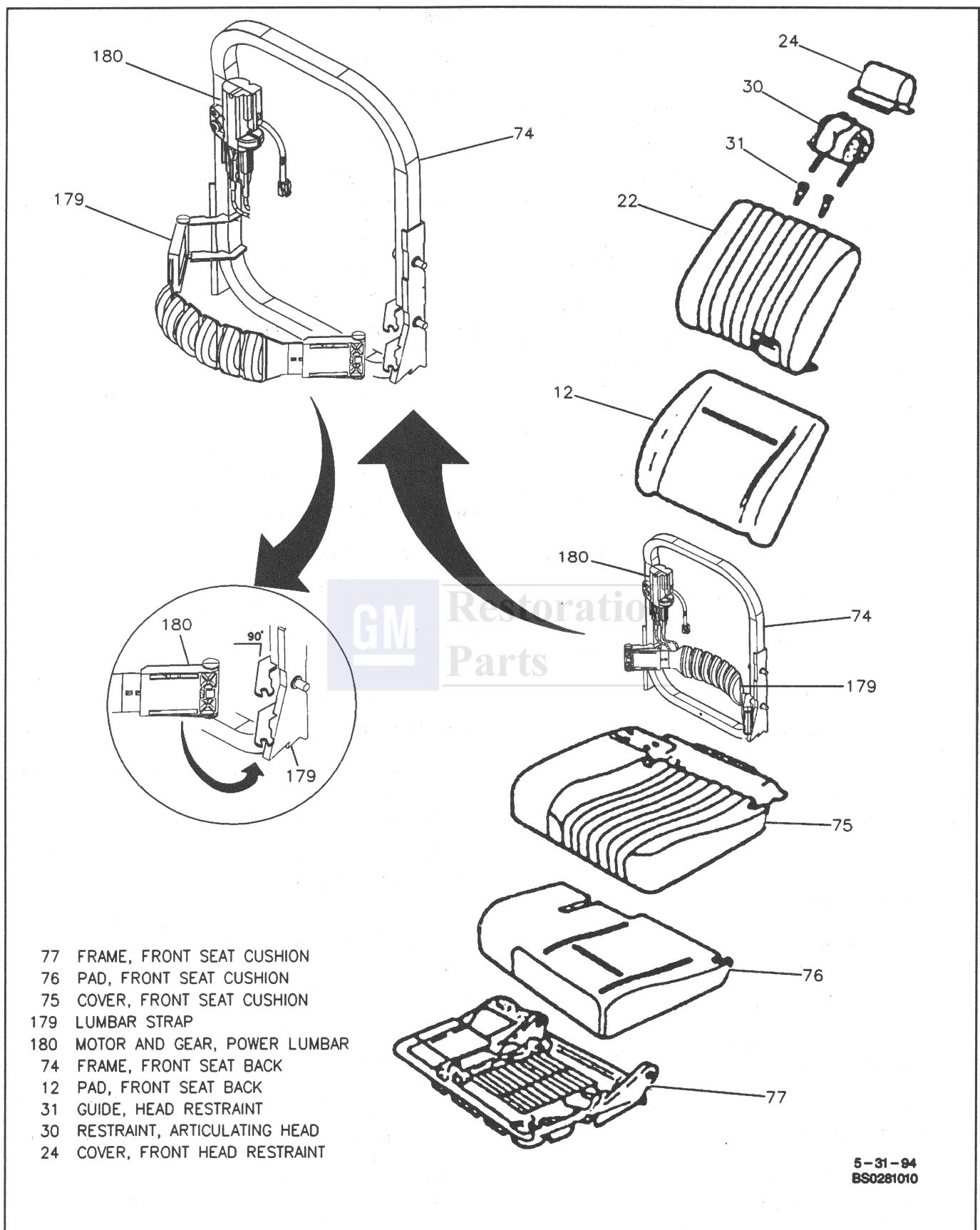


Figure 28 - Power Lumbar Components

Heater Module**Figures 11 and 29 and 30****↔ Remove or Disconnect**

1. Operate seat to full-up position.
2. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
3. Switch bolts/screws (68).
 - Pull switch (68) outward to access electrical connectors.
4. Electrical connector from heater switch.
5. Electrical connectors from heating elements (8 or 13).
6. Retainers.
7. Module (61).

→ Install or Connect

1. Module (61).
2. Retainers.

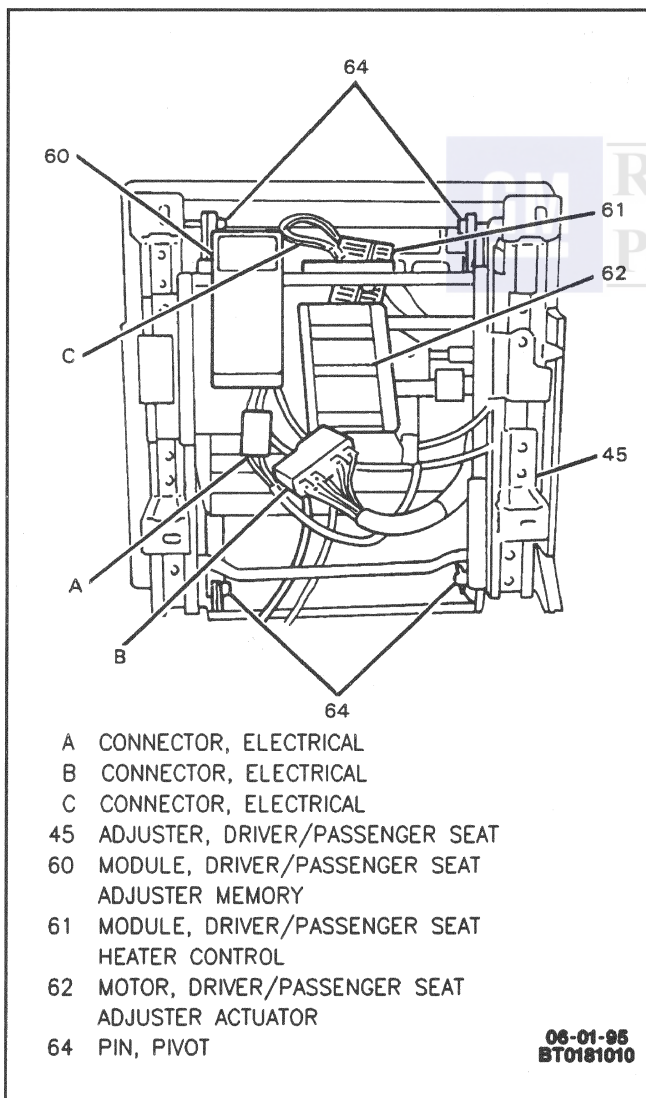


Figure 29 - Seat Track and Seat Track Motors

3. Electrical connectors to heating elements (8 or 13).
4. Electrical connector to heater switch.
 - Position switch (68) against seat.
5. Switch bolts/screws (68).

⌚ Tighten

- Bolts/screws (68) to 10.5 N·m (93 lb. in.).
6. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

REAR SEAT**Figures 31 and 32**

The middle or second seat on the wagon is known as the "Rear Seat". The last or third seat on the wagon is known as the "Rear Seat #2". For service procedure on the third seat, refer to "Rear Seat #2" under "On-Vehicle Service" in this section.

The sedan and wagon rear seat cushions are held in place by dome stops on the floor pan. The dome stops hook over frame wires on the seat cushion.

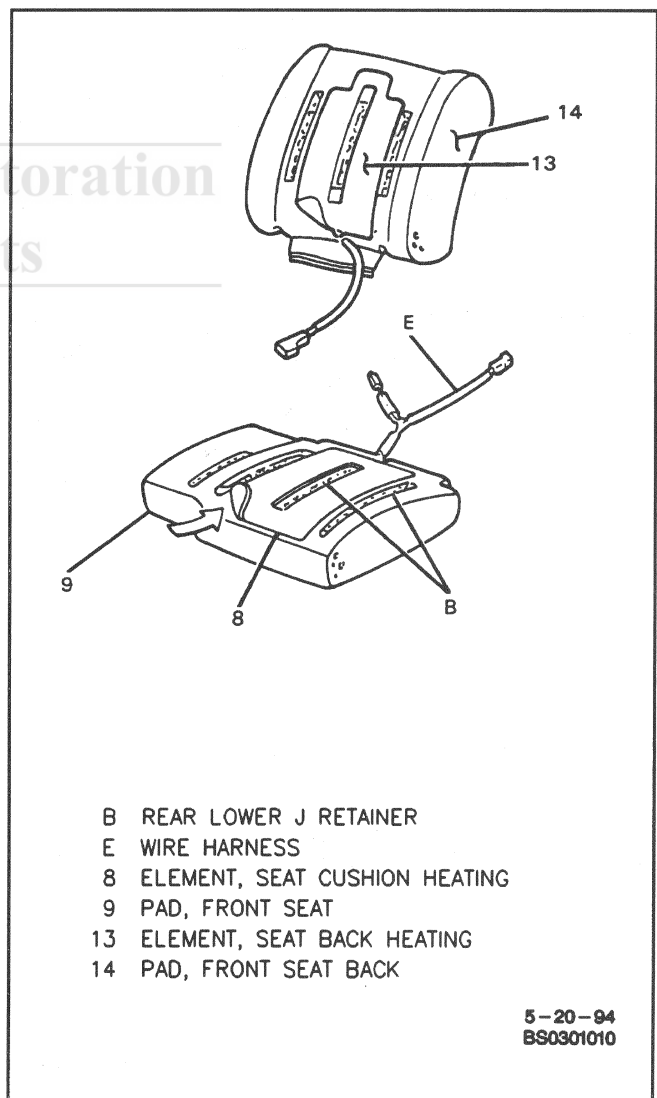
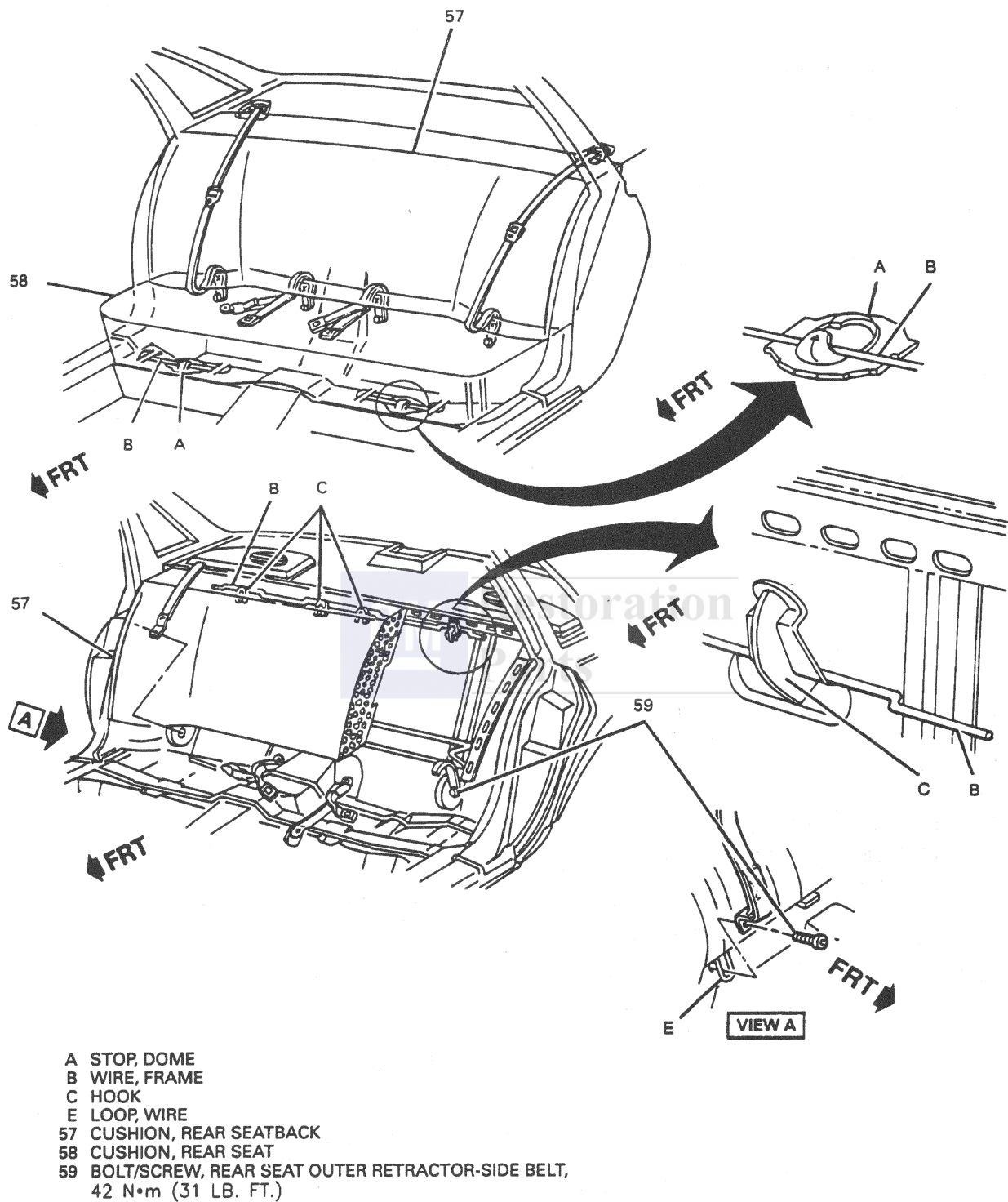


Figure 30 - Heating Element



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Figure 31 - Removing Rear Seat (Typical)

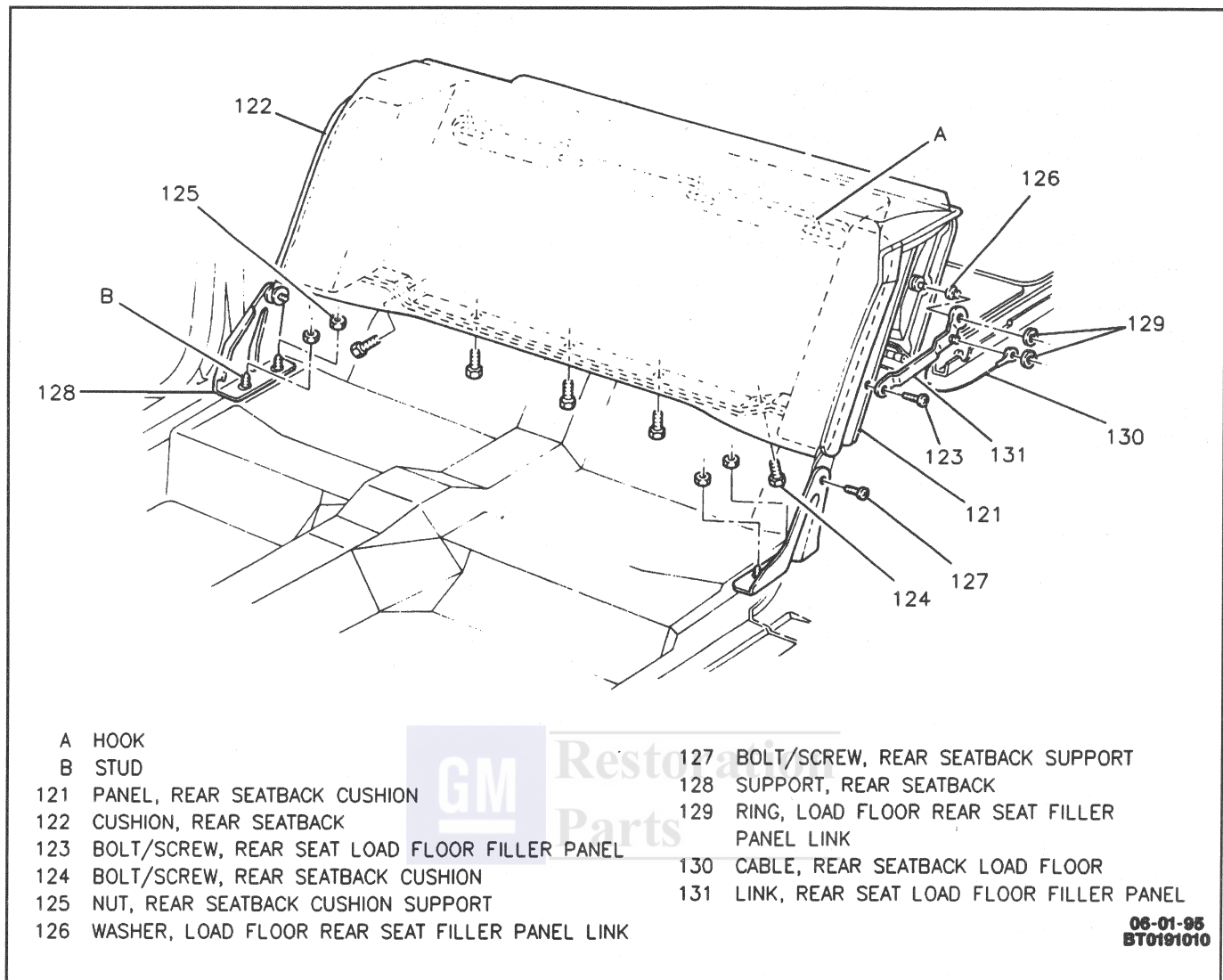


Figure 32 - Second Seatback

The sedan rear seatback is held by hooks on the seatback panel. Frame wires in the seatback cushion hang over the hooks. The bottom of the seatback cushion is held by the rear seat retractor-side belt bolts/screws.

The wagon rear seat #2 seatback is held by a link at the back and at the floor pan by seatback supports on the seatback panel. The seatback panel is attached to the seatback with hooks at the upper edge and bolts/screws at the lower edge.



Remove or Disconnect

1. Push lower front edge of seat cushion (58) rearward.
2. Frame wire from the dome stops by lifting upward and pulling forward on frame.
3. Seat cushion (58).

4. Rear seatback cushion (57 or 122).

- Sedan rear seatback cushion (57).
 - A. Remove bolts/screws (59).
 - B. Lift rear seatback cushion (57) off the hooks on seatback panel.
- Wagon rear seatback cushion (122).
 - A. Lower rear seatback cushion (122).
 - B. Remove bolts/screws (123) from each side of rear seatback cushion (122).
 - C. Remove bolts/screws (124) from bottom edge of rear seatback cushion (122).
 - D. Raise rear seatback cushion (122) enough to pull lower edge forward.
 - E. Lift upward to release upper edge of rear seatback cushion (122) from the hooks on seatback cushion panel (121) and remove rear seatback cushion (122).

 Install or Connect

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: Refer to “Notice” on page 10-10-1 of this section.

1. Rear seatback cushion (57 or 122).
 - Sedan rear seatback cushion (57).
 - A. Hang seatback cushion (57) over the hooks on the seatback panel.
 - B. Install bolts/screws (59) through seat belt anchor plate and wire loop in bottom of seat frame.

 Tighten

- Bolts/screws (59) to 48 N.m (35 lb. ft.).
- Wagon rear seatback cushion (122).
- A. Hang rear seatback cushion (122) over the hooks on the seatback cushion panel (121).
- B. Install bolts/screws (123 and 124).

 Tighten

- Bolts/screws (123) to 29 N.m (21 lb. ft.).
 - C. Raise rear seatback cushion (122).
2. Seat cushion (58) by sliding it rearward, pressing down.
 - The frame wire in the seat cushion (58) should slide into the dome stops.

TRIM AND COVERS

Rear Seatback Panel (Wagon)

Figure 32

 Remove or Disconnect

1. Rear seatback cushion. Refer to “Rear Seats” under “On-Vehicle Service” in this section.
2. Bolts/screws (123).
3. Nuts (125) from studs.
4. Seatback cushion panel (121).

 Disassemble

- Support bolt/screw (127) and support (128) from seatback cushion panel (121).

 Install or Connect

NOTICE: Refer to “Notice” on page 10-10-1 of this section.

- Support (128) and support bolt/screw (127) to seatback cushion panel (121).

 Tighten

- Support bolt/screw (127) to 29 N.m (21 lb. ft.).

 Install or Connect

NOTICE: Refer to “Notice” on page 10-10-1 of this section.

1. Seatback cushion panel (121).
2. Nuts (125) to studs.

 Tighten

- Nuts (125) to 34 N.m (25 lb. ft.).
3. Bolts/screws (123).

 Tighten

- Bolts/screws (123) to 29 N.m (21 lb. ft.).
4. Rear seatback cushion. Refer to “Rear Seats” under “On-Vehicle Service” in this section.

Rear Seat Covers

Figures 33 and 34

Rear seat and seatback cushions have formed foam pads that fit the contour of the seat frames. The covers are either vinyl, cloth or leather and are held by trim retainer rings.

 Remove or Disconnect

1. Rear Seats. Refer to “Rear Seats” under “On-Vehicle Service” in this section.
2. Rear seatback panel, if necessary. Refer to “Rear Seatback Panel (Wagon)” in preceding procedure.
3. Armrest and support, if equipped. Refer to “Rear Seat Armrest” in this section.
4. Trim retainer rings.
 - Note position of trim retainer rings.
5. Rear seatback cover (61) and rear seat cushion cover (62) for sedan, or rear seatback cover (87) and rear seat cushion cover (88) for wagon.
 - Pull to disengage hook and loop fastener on front face, if sedan.

 Install or Connect

1. Rear seatback cover (61) and rear seat cushion cover (62) for sedan, or rear seatback cover (87) and rear seat cushion cover (88) for wagon.

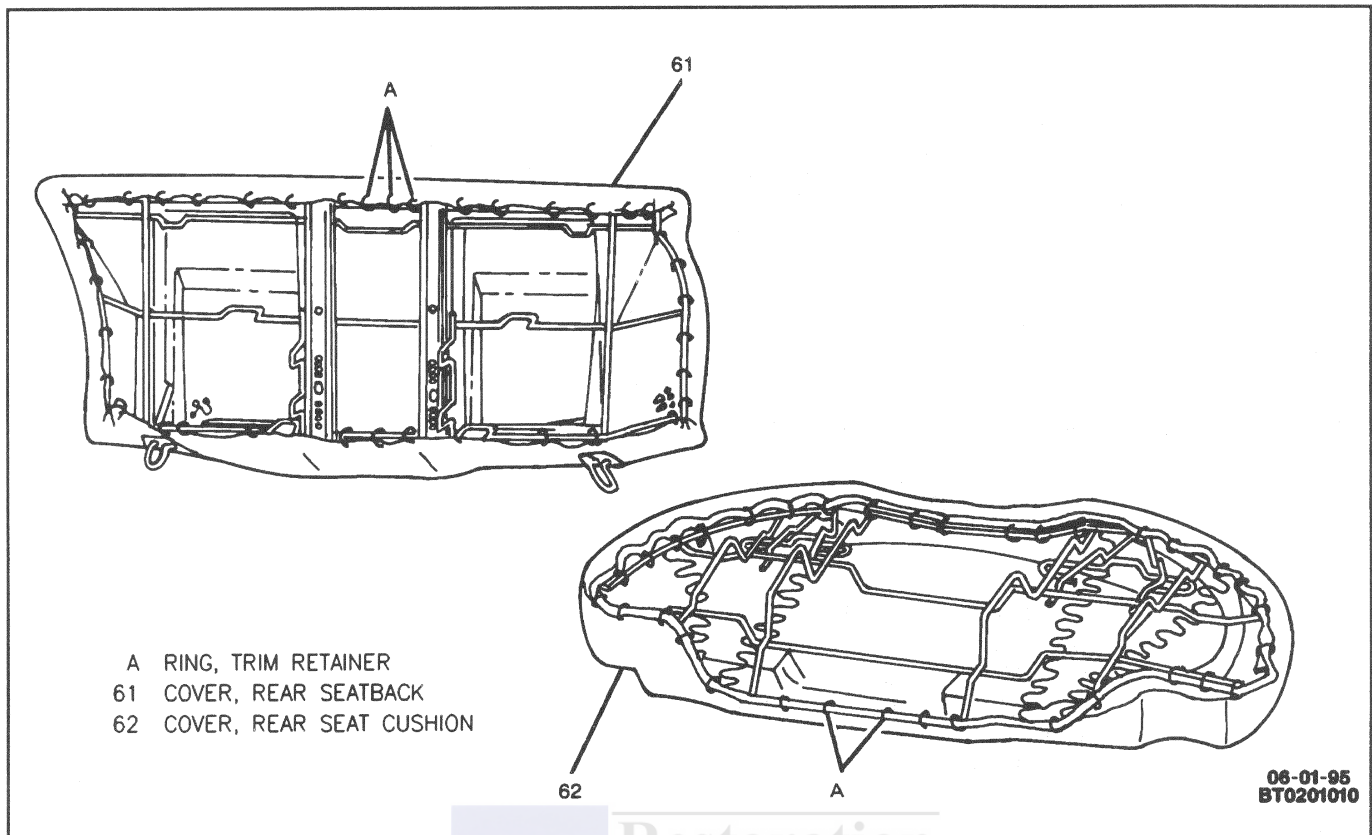


Figure 33 - Installing Rear Seat Cushion and Seatback Covers (Sedan)

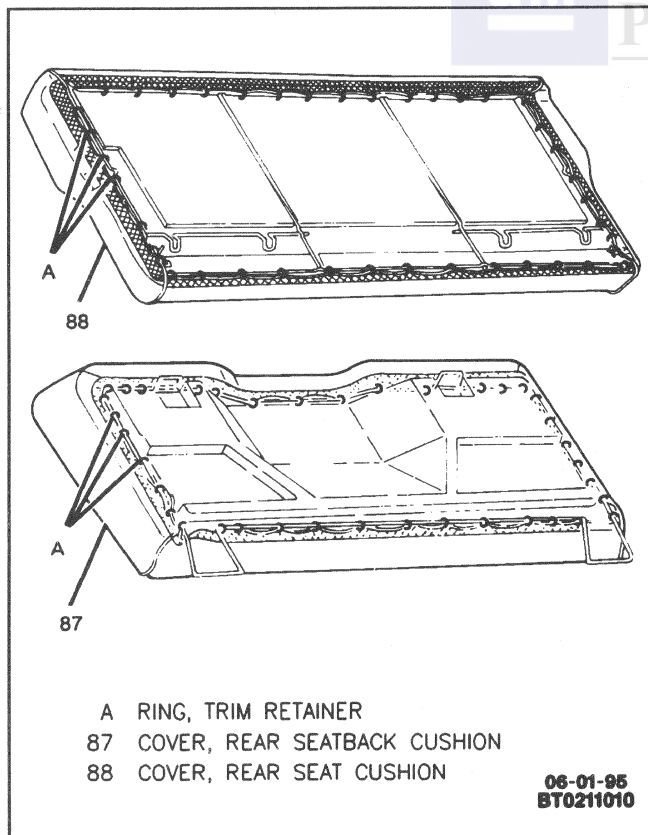


Figure 34 - Rear Seat and Seatback Covers (Wagon)

- Press to engage hook and loop fastener on front face, if sedan.

- Trim retainer rings.
- Armrest and support, if equipped. Refer to "Rear Seat Armrest" in this section.
- Rear seatback panel. Refer to "Rear Seatback Panel (Wagon)" in preceding procedure.
- Rear Seats. Refer to "Rear Seats" under "On-Vehicle Service" in this section.

Rear Seat Armrest Cover

Figure 35

↔ Remove or Disconnect

- Armrest and support. Refer to "Rear Seat Armrest" in this section.
- Bolts/screws (65).
- Supports (64 and 67).
- Washers (66).
- Trim retainer ring connecting rear side flaps.
- Trim retainer rings connecting rear forward and rear flaps.
- Rear seat armrest cover (63).

→→ Install or Connect

- Rear seat armrest cover (63) over foam pad.
- Trim retainer rings joining rear forward and rear flaps.

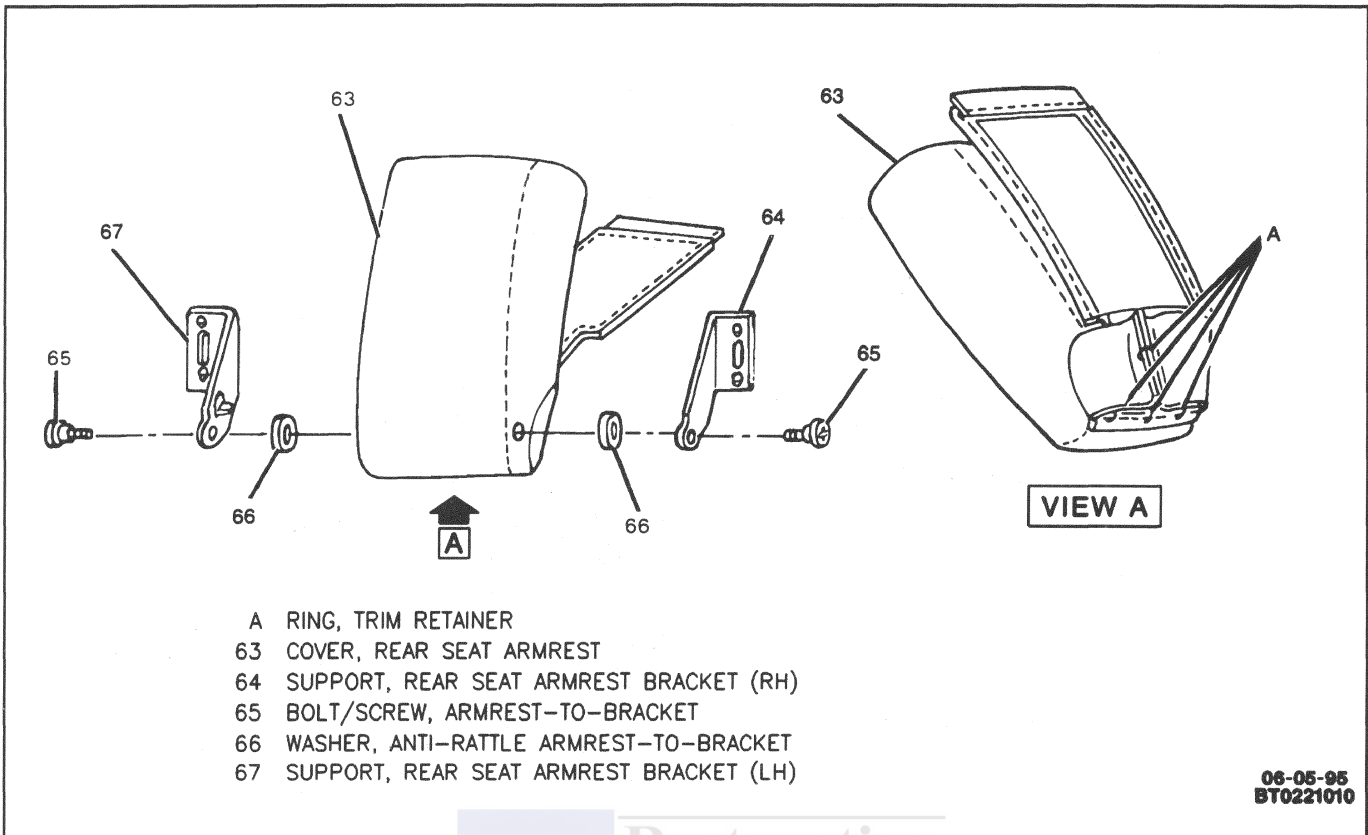


Figure 35 - Removing Rear Seat Armrest Cover

3. Trim retainer ring joining rear side flaps.
4. Washers (66).
5. Supports (64 and 67).
6. Bolts/screws (65).
2. Bolts/screws (68) securing supports (64 and 67) to frame.



Tighten

- Bolts/screws (65) to 11 N.m (97 lb. in.).
7. Armrest and support. Refer to "Rear Seat Armrest" in this section.

Rear Seat Armrest

Figure 36



Remove or Disconnect

1. Rear seatback cushion. Refer to "Rear Seats" under "On-Vehicle Service" in this section.
2. Trim retainer rings.
3. Armrest curtain from upper wire.
4. Bolts/screws (68).
5. Rear seat armrest (69).



Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Rear seat armrest (69).



Tighten

- Bolts/screws (68) to 4 N.m (35 lb. in.).
3. Armrest curtain.
 - Install over front of middle wire and attach to upper wire.
 4. Trim retainer rings.
 5. Rear seatback cushion. Refer to "Rear Seats" under "On-Vehicle Service" in this section.

REAR SEAT LINKAGES AND LATCHES (WAGON)

Rear Seatback Filler Panel Link

Figure 32



Remove or Disconnect

1. Place rear seatback cushion (122) in an unlocked position.
2. Bolt/screw (123).
3. Lower rear seatback cushion (122).
4. Link rings (129).
5. Cable (130) from filler panel link (131).
6. Filler panel link (131).

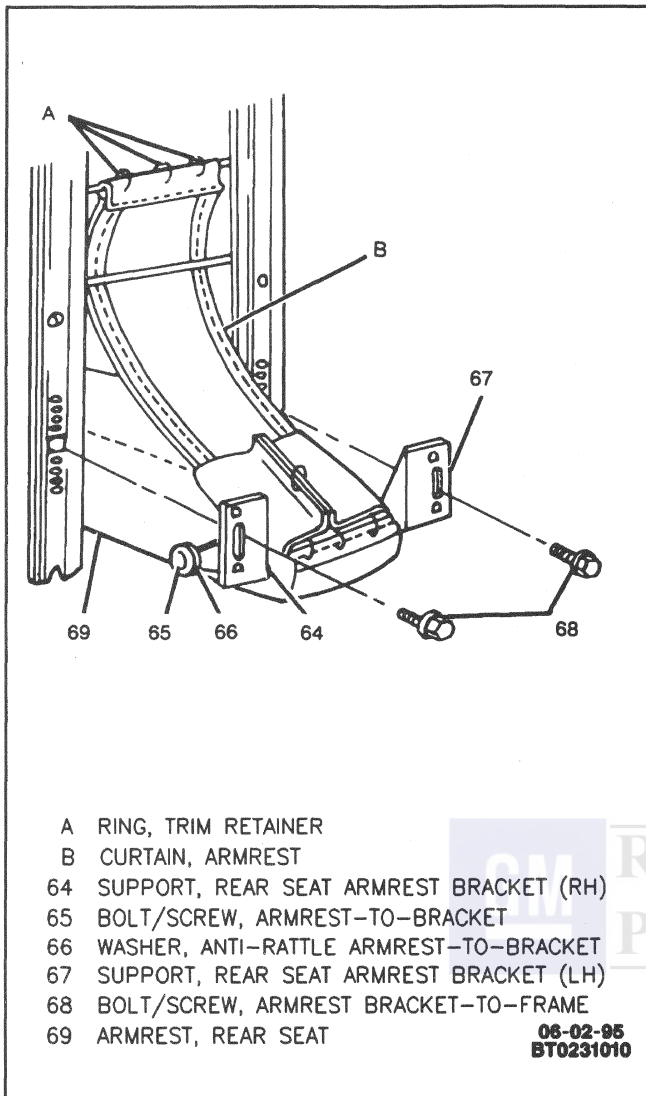


Figure 36 - Removing Rear Seat Armrest

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Filler panel link (131).
 - Be sure washer (126) is installed before filler panel link (131), if necessary.
2. Cable (130) to filler panel link (131).
3. Link rings (129).
4. Raise rear seatback cushion (122) part way.
5. Bolt/screw (123).

Tighten

- Bolt/screw (123) to 29 N.m (21 lb. ft.).
6. Lock rear seatback cushion (122) in position.

Rear Seatback Latch

Figure 37

The wagon rear seat has a seatback latch located on the upper right side of the wheelhouse. The rear seatback cushion can be folded down by pushing the lock button rearward and pulling the seatback cushion down.

Remove or Disconnect

1. Lower rear seatback cushion.
2. Unscrew button (89).
3. Body lock pillar trim finish panel. Refer to SECTION 10-7.
4. Mark position of the seatback latch (90).
5. Bolts/screws (91).
6. Seatback latch (90).

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Seatback latch (90) to position marked during removal.

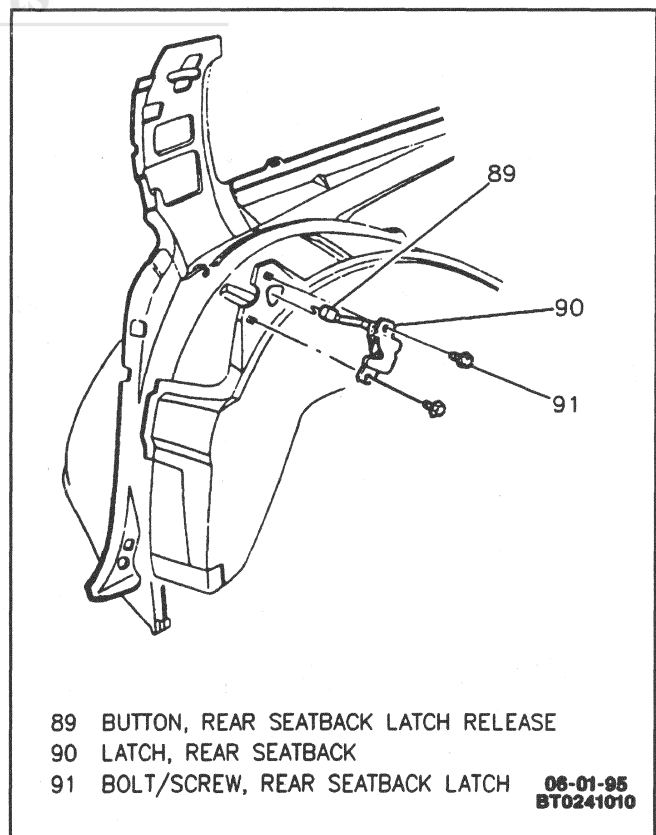


Figure 37 - Rear Seatback Latch (Wagon)

10-10-34 SEATS AND CARPET

2. Bolts/screws (91).



Tighten

- Bolts/screws (91) to 24 N.m (18 lb. ft.).
3. Body lock pillar trim finish panel. Refer to SECTION 10-7.
 4. Hand tighten button (89).

Rear Seatback Latch Striker

Figure 4



Remove or Disconnect

1. Unlatch rear seatback cushion.
2. Latch striker (135).



Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Latch striker (135).



Tighten

- Latch striker (135) to 60 N.m (44 lb. ft.).

Rear Seatback Cable

Figure 38



Remove or Disconnect

1. Unlock and lower rear seatback cushion.
2. Link ring (129).
3. Cable (130) from stud.
4. Cable (130) from cable pin (92) by unscrewing cable (130).



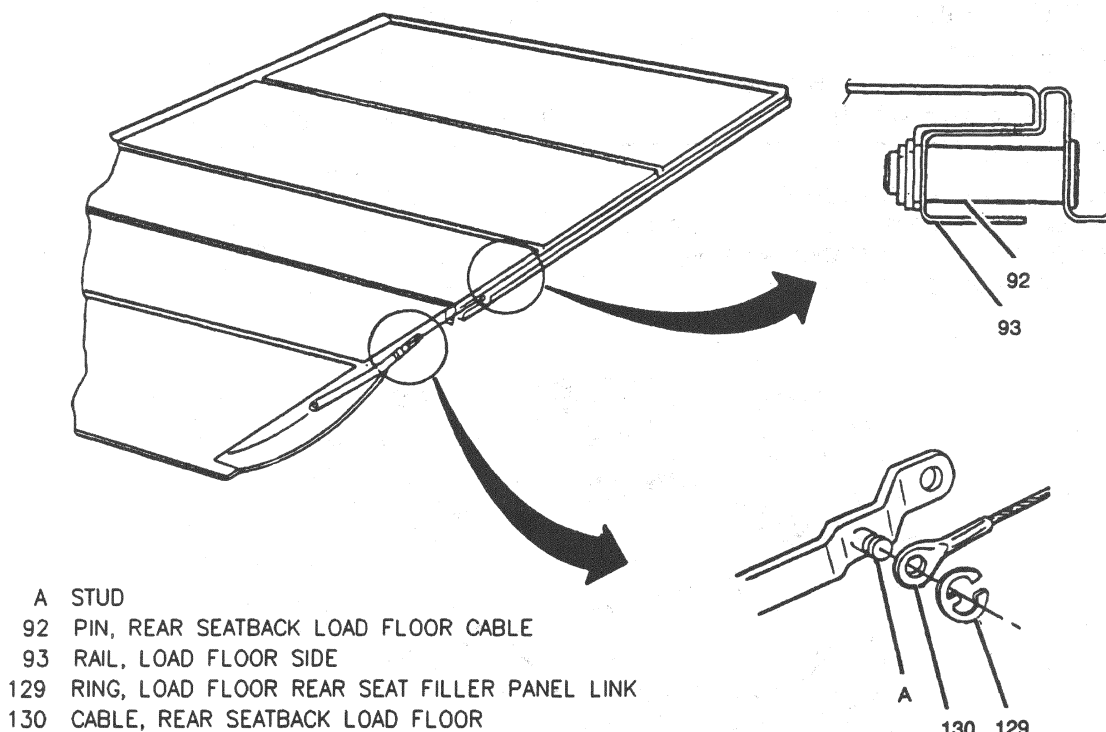
Install or Connect

1. Cable (130) to cable pin (92) by screwing cable (130) into cable pin (92).
 - If installing new cable (130), measure 167 mm (6 9/16 inches) from the end of the luggage compartment rail to the center of the cable loop.
2. Cable (130) to stud.
3. Link ring (129).

REAR SEAT #2

The rearward facing rear seat #2 has a remote seatback latch at the lower right side of the seatback. When the rear seat #2 seatback latch is released by lifting the seat latch release handle under the right side of the luggage compartment rear panel, the seatback cushion can be lowered.

The rear seat #2 seatback cushion is attached to a panel that becomes the load floor front panel when the seatback cushion is folded down or when the seat



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Figure 38 - Rear Seatback Load Floor Cable (Wagon)

is absent. The seatback cushion is held onto the panel with wire loops on the lower seatback frame that hook through holes in the panel. The top of the seatback cushion is held onto the panel with bolts/screws.

The load floor front panel is attached to the load floor rear panel through a hinge. The hinge is covered with vinyl trim.

The rear seat #2 module, or load floor when the seat is absent, has side rails, a rear bar, and rubber bumper strips at the sides and rear. The rails are held with bolts/screws and rivets and the bumper strips have retainers that snap into holes in the rails.

Rear Seat #2 Module

Figures 32 and 39

Remove or Disconnect

1. Retract luggage shade, if necessary.
2. Unhook convenience net if necessary.
3. Filler panel link bolts/screws (123).
4. Body lock pillar trim finish panels. Refer to SECTION 10-7.
5. Stationary panel bolts/screws (97) along front flange of filler and stationary panels.
6. Load floor bumper strips and panels. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
7. Position seatback cushion in unlatched position by releasing the rear seat #2 seatback cushion latch.
8. Bolts/screws (96).
9. Release cable from handle. Refer to "Rear Seat #2 Seatback Cable" in this section.
10. Open end gate as a gate.
11. Bolts/screws (95) along side and rear rails.
12. Rear seat #2 module from vehicle.

Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Rear seat #2 module into vehicle.
2. Bolts/screws (95) along side and rear rails.

Tighten

- Bolts/screws (95) to 1.3 N.m (12 lb. in.).
3. Release cable to handle. Refer to "Rear Seat #2 Seatback Cable" in this section.
 4. Bolts/screws (96).

Tighten

- Bolts/screws (96) to 12 N.m (106 lb. in.).
5. Latch seatback cushion.
 6. Bumper strips and panels. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
 7. Stationary panel bolts/screws (97).

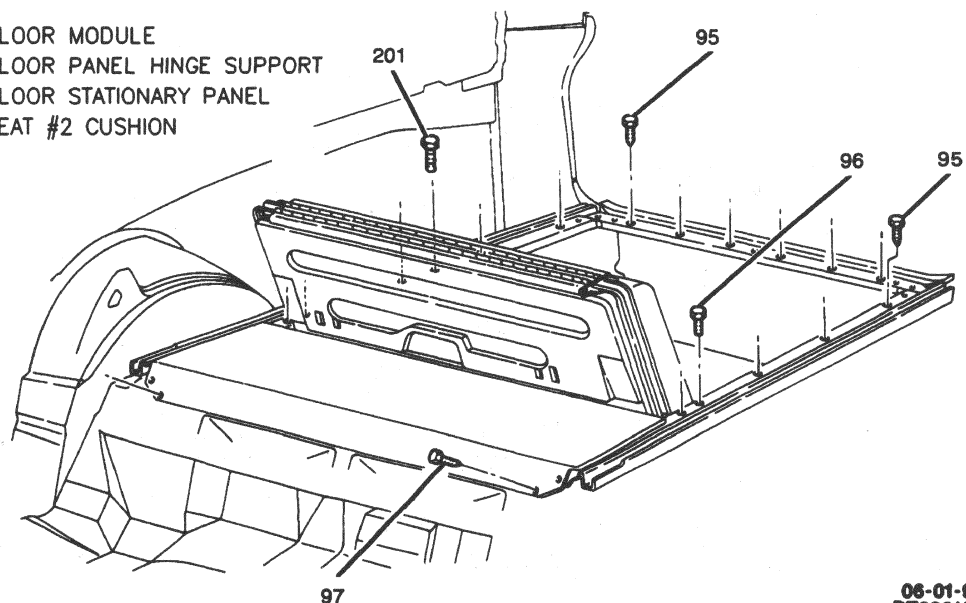
Tighten

- Stationary panel bolts/screws (97) to 1.3 N.m (12 lb. in.).
8. Body lock pillar trim finish panels. Refer to SECTION 10-7.
 9. Filler panel link bolts/screws (123).

Tighten

- Filler panel link bolts/screws (123) to 29 N.m (21 lb. ft.).
10. Convenience net, if removed.

- 95 BOLT/SCREW, LOAD FLOOR MODULE
 96 BOLT/SCREW, LOAD FLOOR PANEL HINGE SUPPORT
 97 BOLT/SCREW, LOAD FLOOR STATIONARY PANEL
 201 BOLT/SCREW, REAR SEAT #2 CUSHION



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Figure 39 - Rear Seat #2 Module

Rear Seat #2 Seatback Cushion

Figure 40

Remove or Disconnect

1. Curtain retainers (99).
2. Bolts/screws (100).
3. Lift and pull on seatback cushion (98) to release the wire loops from the holes in the seatback panel.

Install or Connect

1. Hang seatback cushion (98) by inserting the wire loops into the holes in the seatback panel.
2. Bolts/screws (100).

Tighten

- Bolts/screws (100) to 3 N.m (27 lb. in.).
- 3. Curtain retainers (99).

Rear Seat #2 Seat Cushion

The seat cushion is held in place and removed the same way as other rear seat cushions. Refer to "Rear Seats" under "On-Vehicle Service" in this section.

Trim and Covers

Rear seat #2 seat covers are serviced the same way as rear seat covers. Refer to "Rear Seat #2 Seatback" and "Rear Seat #2 Seat Cushion" for seat removal, and "Trim and Covers" under "Rear Seats" for seat cover replacement.

Strips, Rails, Bar and Panels

Figures 5 and 41

Remove or Disconnect

Tool Required:

J 24595-C Door Trim Pad and Garnish Clip Remover

1. Bumper strip (101, 138 or 139) using J 24595-C.
2. Rear Seat #2 module. Refer to "Rear Seat #2 Module" in this section.
 - To remove only the rear bar (140), do not remove module.
3. Drill out rivets (102) using 1/4-inch drill bit.
4. Rail (93 or 141) or bar (140) and reinforcement (104 or 142).
5. Panel (103, 143 or 144) using J 24595-C.

Install or Connect

1. Panel (103, 143 or 144).
2. Reinforcement (104 or 142) and rail (93 or 141) or bar (140).
3. Rivets (102).

4. Rear Seat #2 module. Refer to "Rear Seat #2 Module" in this section.

5. Bumper strip (101, 138 or 139).

Torque Rod

Figure 42

Remove or Disconnect

1. Rear seat #2 seatback panel. Refer to "Load Floor Panels" in this section.
2. Drill out rivets (72) from torque rod retainers (109) using 1/4-inch drill bit.
3. Torque rod retainers (109).
4. Pivot support anchor plate (132) from torque rod (111).
5. Torque rod (111) by sliding it from front panel pivot support (110).

Install or Connect

1. Torque rod (111) by sliding it into front panel pivot support (110).
2. Pivot support anchor plate (132) over torque rod (111) and position against front panel pivot support (110).
3. Torque rod retainers (109).
4. Rivets (72) to torque rod retainers (109).
5. Rear seat #2 seatback panel. Refer to "Load Floor Panels" in this section.

REAR SEAT #2 LINKAGE AND LATCHES

Rear Seat #2 Seatback Cushion Latch

Figure 43

Remove or Disconnect

1. Rear seat #2 seatback panel. Refer to "Load Floor Panels" in this section.
2. Drill out rivets using 1/4-inch drill bit.
3. Rear seat #2 seatback cushion latch (112).

Install or Connect

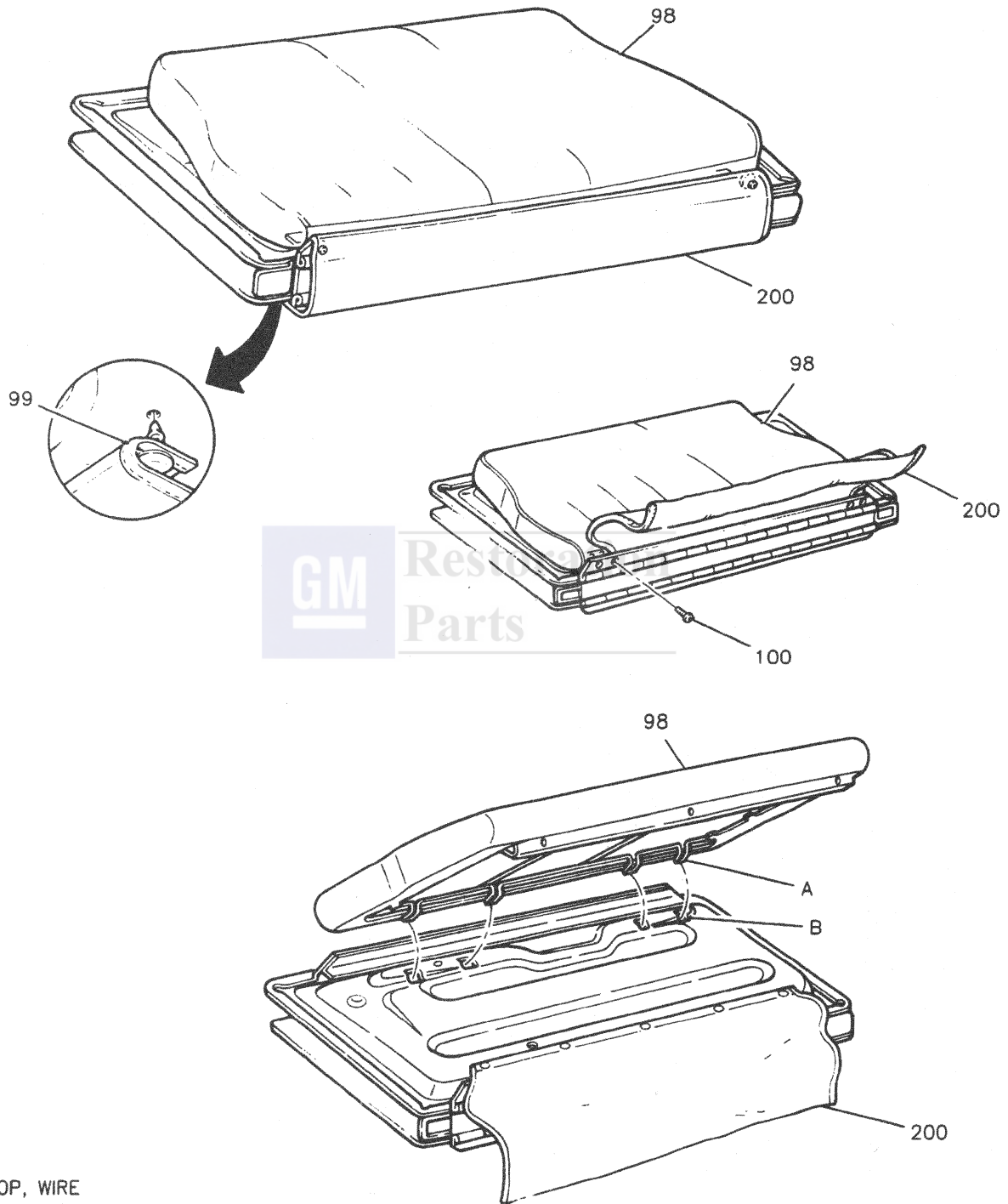
1. Rear seat #2 seatback cushion latch (112).
2. Rivets.
3. Rear seat #2 seatback panel. Refer to "Load Floor Panels" in this section.

Rear Seat #2 Seatback Load Floor Latch

Figure 43

Remove or Disconnect

1. Rear seat #2 module. Refer to "Rear Seat #2 Module" in this section.
2. Raise rear seat #2 seatback cushion.



- A LOOP, WIRE
 B HOLE
 98 CUSHION, REAR SEAT #2 SEATBACK
 99 RETAINER, REAR SEAT #2 SEATBACK CUSHION CURTAIN
 100 BOLT/SCREW, REAR SEAT #2 SEATBACK CUSHION PANEL
 200 CURTAIN, REAR SEAT #2 SEATBACK CUSHION

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Figure 40 - Removing Rear Seat #2 Seatback Cushion

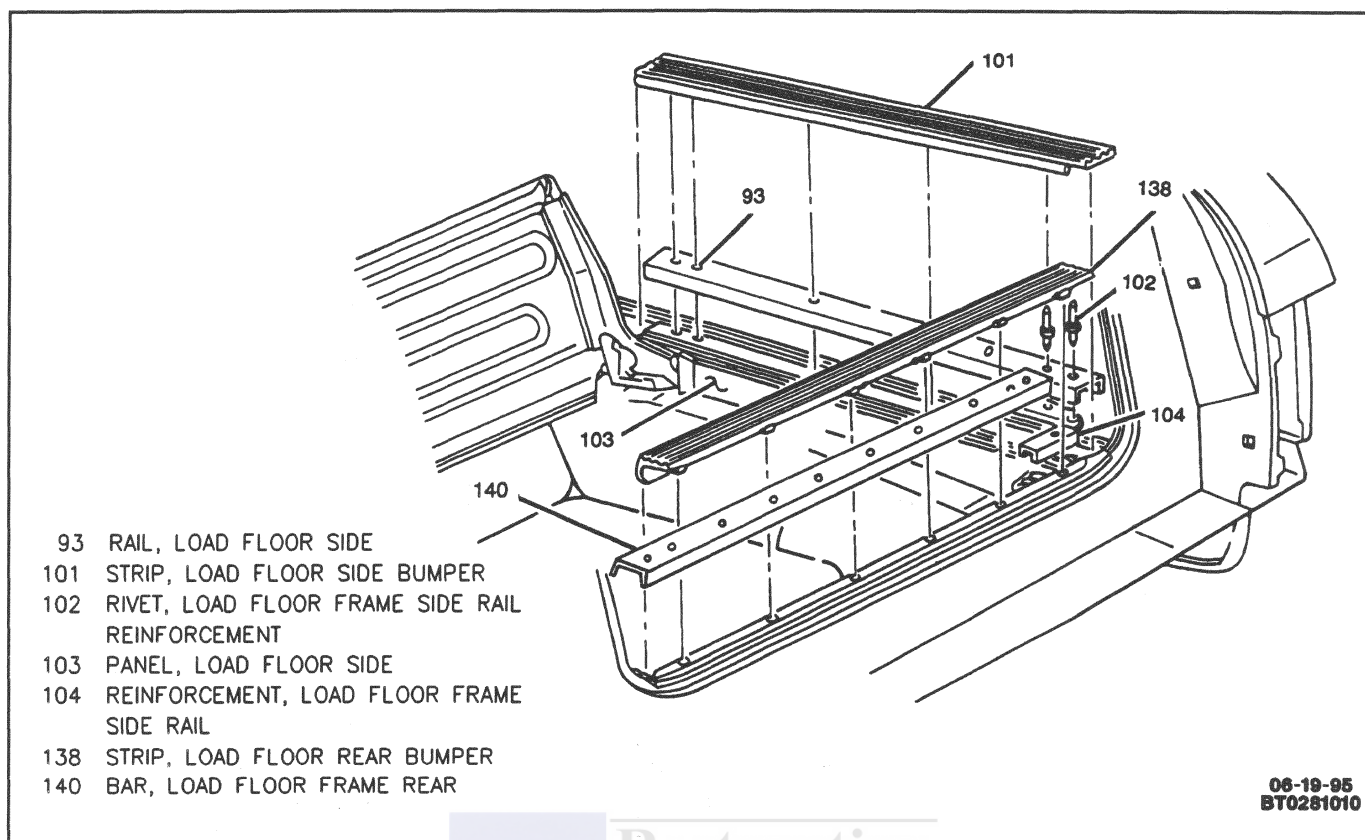


Figure 41 - Strips, Rails, Bar and Panels

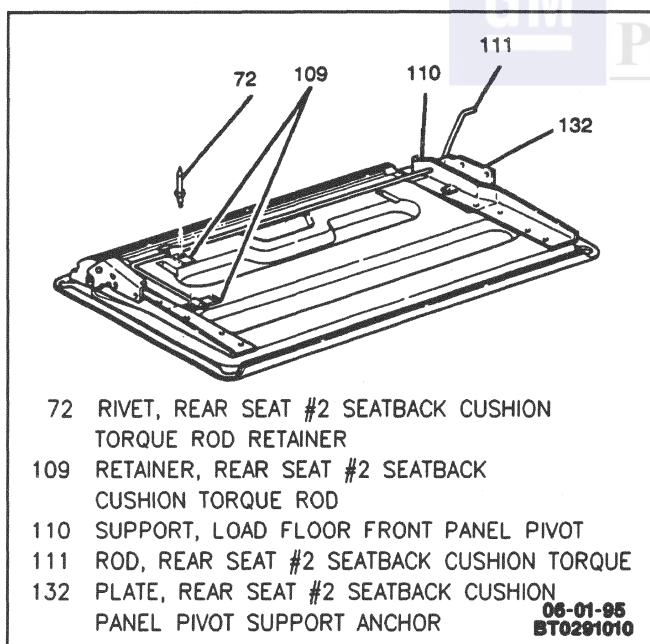


Figure 42 - Torque Rod

3. Cable retainer from seatback load floor latch (115).
4. Rivets using a 1/4-inch drill bit and drill.
5. Rear seat #2 seatback load floor latch (115).



Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.

1. Rear seat #2 seatback load floor latch (115).
2. Rivets.
3. Cable retainer to seatback load floor latch (115).
4. Rear seat #2 module. Refer to "Rear Seat #2 Module" in this section.

Rear Seat #2 Seatback Latch Release Handle

Figure 43



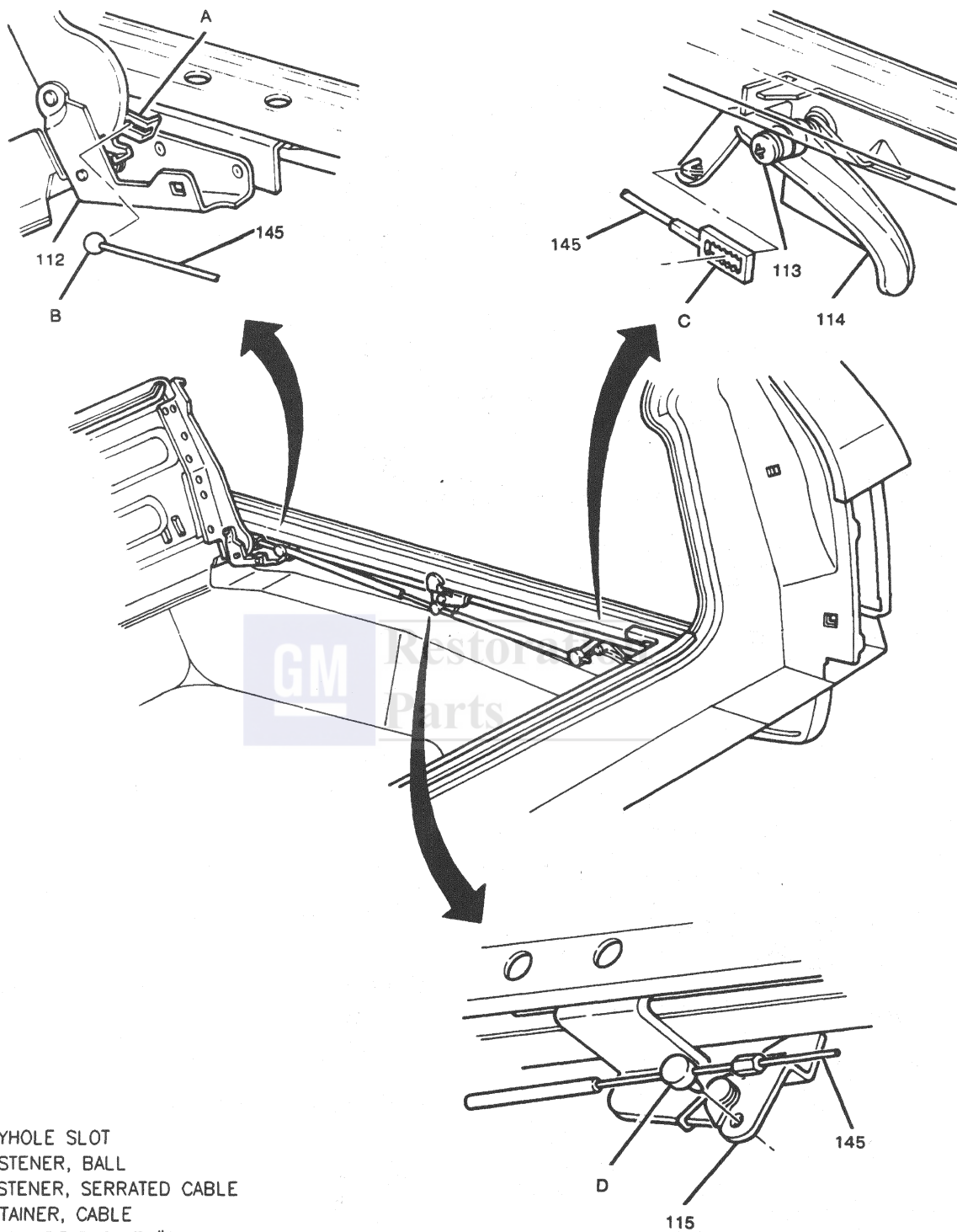
Remove or Disconnect

1. Right side bumper strip and side panel. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
2. Latch release handle bolt/screw (113).
3. Serrated cable fastener from latch release handle (114).
4. Latch release handle (114).



Install or Connect

NOTICE: Refer to "Notice" on page 10-10-1 of this section.



- A KEYHOLE SLOT
- B FASTENER, BALL
- C FASTENER, SERRATED CABLE
- D RETAINER, CABLE
- 112 LATCH, REAR SEAT #2 SEATBACK CUSHION
- 113 BOLT/SCREW, REAR SEAT #2 SEATBACK CUSHION LATCH RELEASE HANDLE
- 114 HANDLE, REAR SEAT #2 SEATBACK CUSHION LATCH RELEASE
- 115 LATCH, REAR SEAT #2 SEAT LOAD FLOOR
- 145 CABLE, REAR SEAT #2 SEATBACK CUSHION LATCH RELEASE

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Figure 43 - Rear Seat #2 Seatback Load Floor Latch, Cable and Latch Release Handles

10-10-40 SEATS AND CARPET

1. Latch release handle (114).
2. Serrated cable fastener to latch release handle (114).
3. Latch release handle bolt/screw (113).



Tighten

- Latch release handle bolt/screw (113) to 28 N.m (21 lb. ft.).
4. Right side bumper strip and side panel. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.

Rear Seat #2 Seatback Cable

Figure 43



Remove or Disconnect

1. Right side bumper strip and side panel. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
2. Seatback cable (145).
 - A. Serrated cable fastener from latch release handle (114).
 - B. Cable retainer from third seatback load floor latch (115) by putting a screwdriver between fastener and seatback load floor latch (115) and twisting.
 - C. Ball fastener from seatback latch (112) through keyhole slot with aid of screwdriver.



Install or Connect

1. Seatback cable (145).
 - A. Ball fastener to seatback latch (112) through keyhole slot.
 - B. Cable retainer to seatback load floor latch (115).
 - C. Serrated cable fastener to latch release handle (114).
2. Bumper strip and side panel. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.

LOAD FLOOR

Load Floor Panels

Figures 4, 5, 40 and 44

Stationary Panel



Remove or Disconnect

1. Rear seat #2 module. Refer to "Rear Seat #2 Module" in this section.
2. Drill out rivets (102) at side rails (93 and 141) and filler panel (134) using 1/4-inch drill bit.
3. Stationary panel (105).

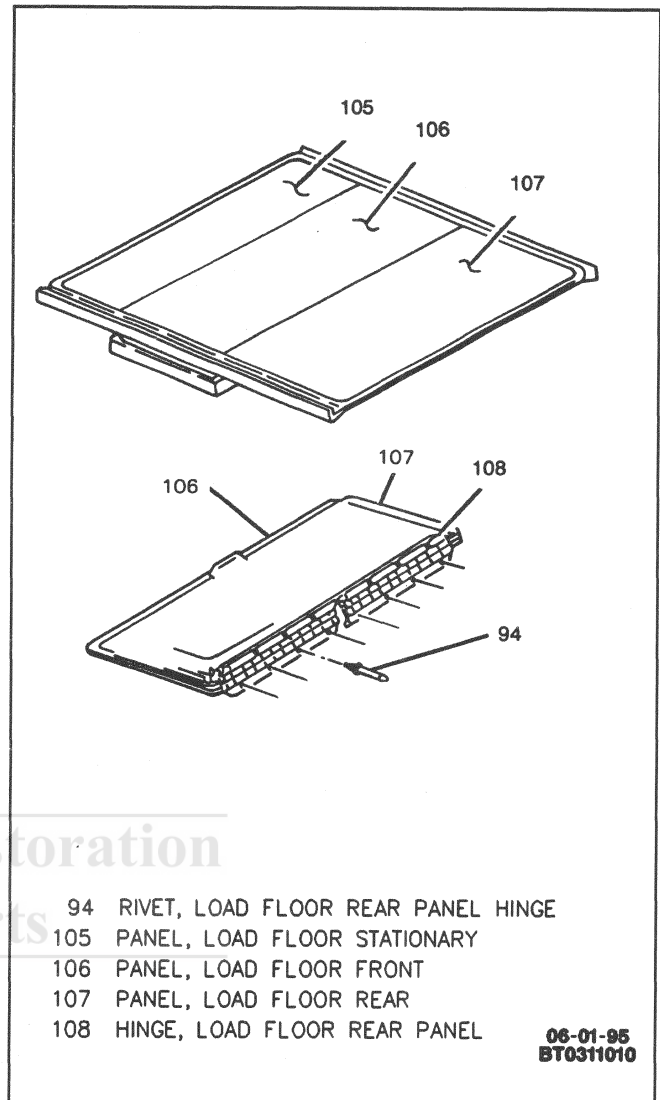


Figure 44 - Load Floor Panels



Install or Connect

1. Stationary panel (105).
2. Rivets (102) at side rails (93 and 141) and filler panel (134).
3. Rear seat #2 module. Refer to "Rear Seat #2 Module" in this section.

Load Floor Front Panel

Figures 5 and 44



Remove or Disconnect

1. Rear Seat #2 module. Refer to "Rear Seat #2 Module" in this section.
2. Side rails. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
3. Torque rod. Refer to "Torque Rod" in this section.
4. Rear seat #2 seatback. Refer to "Rear Seat #2" under "On-Vehicle Service" in this section.

5. Drill out rivets (94) at hinge (108) using 1/4-inch drill bit.
6. Load floor front panel (106).

Install or Connect

1. Load floor front panel (106).
2. Rivets (94) to hinge (108).
3. Rear seat #2 seatback. Refer to "Rear Seat #2" under "On-Vehicle Service" in this section.
4. Torque rod. Refer to "Torque Rod" in this section.
5. Side rails. Refer to "Strips, Rails, Bar and Panels" under "Trim and Covers" in this section.
6. Rear seat #2 module. Refer to "Rear Seat #2 Module" in this section.

Load Floor Rear Panel

Figure 44

Remove or Disconnect

- Load floor rear panel (107) by drilling out rivets (94) at hinge (108) using 1/4-inch drill bit.

Install or Connect

1. Load floor rear panel (107).
2. Rivets (94) at hinge (108).

Load Floor Lock Cylinder and Rear Panel Handle

Figure 45

Remove or Disconnect

1. Open load floor rear panel.
2. Lock cylinder arm retainer.
3. Lock cylinder arm.
4. Retainer (119).
5. Lock cylinder (118).
6. Nuts (116) from rear panel handle (117).
7. Rear panel handle (117).

Install or Connect

1. Rear panel handle (117).
2. Nuts (116) to rear panel handle (117).

Tighten

- Nuts (116) to 1.3 N·m (12 lb. in.).
3. Lock cylinder (118).
 4. Retainer (119).
 5. Lock cylinder arm.
 6. Lock cylinder arm retainer.

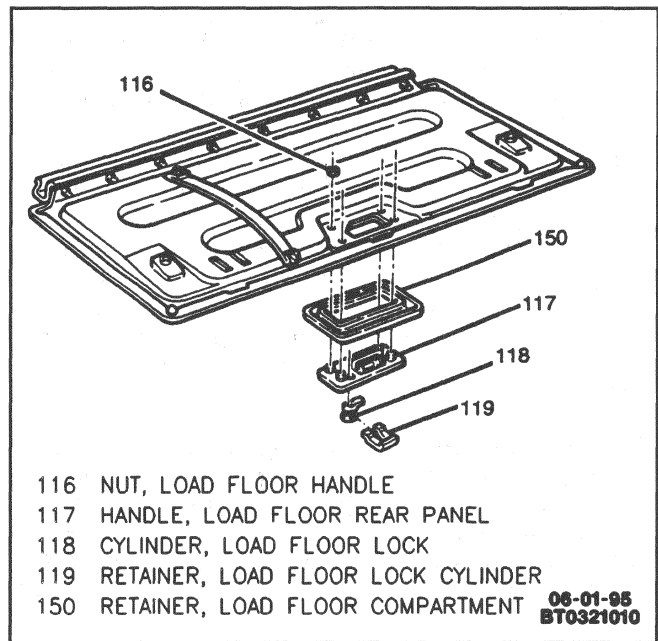


Figure 45 - Lock Cylinder

Load Floor Lock Striker

Figure 5

Remove or Disconnect

1. Open load floor rear panel.
2. Bolts/screws.
3. Load floor lock striker (151).

Install or Connect

1. Load floor lock striker (151).
2. Bolts/screws.

Adjust

- Load floor lock striker (151) to accept rear panel handle (117).

Tighten

- Bolts/screws to 6 N·m (53 lb. in.).

FLOOR PANEL INSULATORS

Floor panel insulators have been designed for the high floor panel temperatures caused by the catalytic converter in the exhaust system. When servicing a vehicle in the field, it is essential that any floor panel insulators that have been disturbed or removed be reinstalled in the original sequence and location. If replacement of a floor panel insulator is necessary, the material specified for that particular location on the floor panel must be used. The types of materials are listed below. Types 1 and 2 are rolled stock, and are ordered by linear foot and cut to fit. Type 3 is sheet stock and also cut to fit.

10-10-42 SEATS AND CARPET

CAUTION: All of the materials below must meet Motor Vehicle Safety Standard No. 302 for flammability or vehicle damage and personal injury could result.

- Floor panel insulator (cerma blanket thermal) - consists of 10 mm (3/8-inch) thick aluminum silica (type 1).
- Floor panel insulator (amberlite) - consists of 10 mm thick (3/8-inch) thick resinated fibers (type 2).
- Floor panel insulator sheet (phenolic bonded fiberglass) 305 mm x 457 mm (12 inches x 18 inches) cut to size (type 3).

CAUTION: Any insulator service repair or replacement should be the same thickness, size and location as the original installation in the vehicle or vehicle damage and personal injury could result.

When servicing or replacing interior insulators, the following instructions must be observed:

- Insulators must be installed in original position and sequence. Pieces should be butted together to avoid gapping or overlapping.
- If it is necessary to replace an insulator, specified material must be used.
- Use original part to determine the amount of replacement material and as a template for cutting and fitting new piece to floor panel.
- When installing an insulator, do not enlarge cutouts or holes used for attachment of interior components such as seats or seat belts.
- Crossbody harness for interior components such as power seats, seat belt warning lamp and alarm or rear speakers must be routed over floor panel insulators in the original location and clipped in place.
- Spray-on deadeners and trim adhesives should not be applied to the top of the floor panel at the area directly over the Three Way + Oxidation catalytic converters or mufflers.

Floor Carpet

All floor carpets consist of a molded one-piece carpet over both front and rear floor panel.



Remove or Disconnect

1. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.
2. Front seat belts. Refer to SECTION 10-11.
3. Center pillar upper trim finish panel. Refer to SECTION 10-6.
4. Rear seat cushion. Refer to "Rear Seats" under "On-Vehicle Service" in this section.
5. Body hinge pillar trim panels. Refer to SECTION 10-5.
6. Rear side door lock pillar garnish molding. Refer to SECTION 10-7.
7. Floor carpet retainers. Refer to SECTION 10-6.
8. Floor air outlet. Refer to SECTION 8C.
9. Floor carpet.



Install or Connect

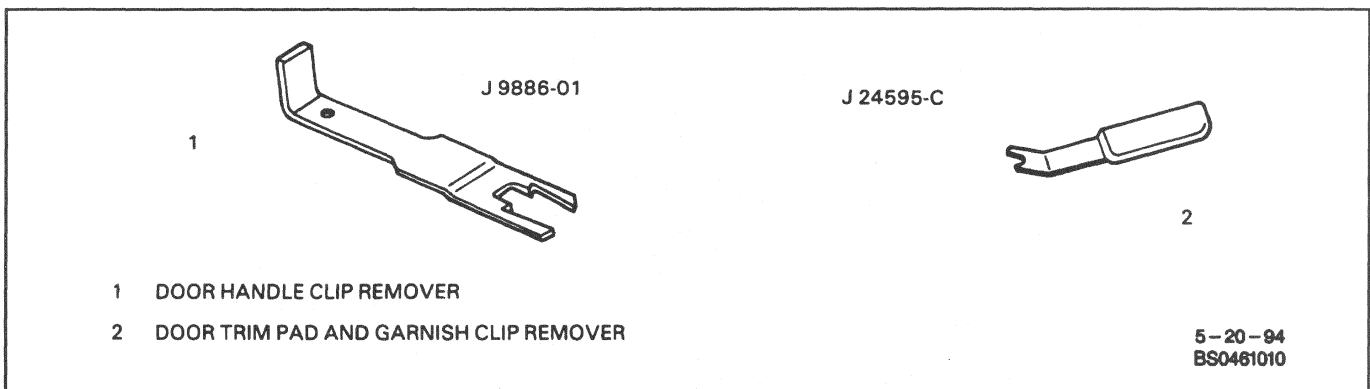
1. Floor carpet.
2. Floor air outlet. Refer to SECTION 8C.
3. Floor carpet retainers. Refer to SECTION 10-6.
4. Rear side door lock pillar garnish molding. Refer to SECTION 10-7.
5. Body hinge pillar trim panels. Refer to SECTION 10-5.
6. Rear seat cushion. Refer to "Rear Seats" under "On-Vehicle Service" in this section.
7. Center pillar upper trim finish panel. Refer to SECTION 10-6.
8. Front seat belts. Refer to SECTION 10-11.
9. Front seat. Refer to "Front Seat" under "On-Vehicle Service" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Armrest Bracket-to-Frame Bolt/Screw	4 N.m (35 lb. in.)
Armrest-to-Bracket Bolt/Screw	11 N.m (97 lb. in.)
Driver/Passenger Seat Adjuster Nut	25 N.m (18 lb. ft.)
Driver/Passenger Seat Adjuster-to-Seat Frame Bolt/Screw	24 N.m (18 lb. ft.)
Driver/Passenger Seat Inner/Outer Adjuster Front Trim Cover Bolt/Screw	1.9 N.m (17 lb. in.)
Driver/Passenger Seat Inner/Outer Adjuster Rear Trim Cover Bolt/Screw	1.9 N.m (17 lb. in.)
Driver/Passenger Seatback Pivot Bolt/Screw	24 N.m (18 lb. ft.)
Driver Seat Lumbar Control Switch Bolt/Screw	10.5 N.m (93 lb. in.)
Folding Second Seatback Cushion Support Nut	34 N.m (25 lb. ft.)
Folding Second Seatback Latch Bolt/Screw	24 N.m (18 lb. ft.)
Folding Second Seatback Latch Striker	60 N.m (44 lb. ft.)
Folding Second Seatback Support Bolt/Screw	29 N.m (21 lb. ft.)
Folding Third Seat Cushion Bolt/Screw	14 N.m (124 lb. in.)
Folding Third Seatback Cushion Latch Release Handle Bolt/Screw	28 N.m (21 lb. ft.)
Folding Third Seatback Cushion Panel Bolt/Screw	3 N.m (27 lb. in.)
Front Seat Adjuster Front Trim Cover Bolt/Screw	5.8 N.m (51 lb. in.)
Front Seat Adjuster Rear Trim Cover Bolt/Screw	5.8 N.m (51 lb. in.)
Front Seat Armrest Support Bolt/Screw	11 N.m (97 lb. in.)
Front Seat Armrest Support Nut	11 N.m (97 lb. in.)
Front Seatback Pivot Bolt/Screw	24 N.m (18 lb. ft.)
Load Floor Folding Second Seat Filler Panel Link Bolt/Screw	29 N.m (21 lb. ft.)
Load Floor Handle Nut	1.3 N.m (12 lb. in.)
Load Floor Module Bolt/Screw	1.3 N.m (12 lb. in.)
Load Floor Panel Hinge Support Bolt/Screw	12 N.m (106 lb. in.)
Load Floor Stationary Panel Bolt/Screw	1.3 N.m (12 lb. in.)
Pivot Bolt/Screw	29 N.m (21 lb. ft.)
Rear Seat Outer Retractor-Side Belt Bolt/Screw	42 N.m (31 lb. ft.)
Recliner Bolt/Screw	32 N.m (24 lb. ft.)
Toe Kick Panel Bolt/Screw	11 N.m (97 lb. in.)

SPECIAL TOOLS





SECTION 10-11

SEAT BELTS

CAUTION: Replace belts, retractors, and hardware in use in all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

RESTRAINT SYSTEM

Seat belts are the primary means of occupant restraint. Seat belts help keep the occupant inside the passenger compartment and ride down the crash forces more gradually during the following events:

- Frontal impact type crashes.
- Rear impact type crashes.
- Side impact type crashes.
- Roll-over type crashes.

All seat belts with retractors have emergency locks in the retractors. During normal operation, the retractors remain unlocked to allow free movement of the occupant's upper body under normal driving conditions. The seat belt webbing is locked into

position by pendulum that causes a locking bar to engage a cog on the spool of the retractor mechanism under the following conditions:

- The rapid extraction of the seat belt webbing from the retractor.
- The speed of the vehicle changes abruptly.
- The direction of the vehicle changes abruptly.
- The vehicle is on a steep upgrade or a downgrade.

The front and rear seat belts are also equipped with a dual-mode latchplate that has the ability to lock or cinch itself along the webbing. This feature eliminates the need for a locking clip when securing a child seat.

In conjunction with the seat belts, this vehicle is equipped with a Supplemental Inflatable Restraint (SIR) System. Refer to SECTION 9J for more information about the SIR (air bag) system.

10-11-2 SEAT BELT

Front Seat Belt System

SEDAN OR WAGON

The front seat belt system includes the following components.

- The driver and passenger seat retractor side belts are attached to center lock pillar.
- The driver and passenger seat buckle side belts are attached to floor panel at center of bench seat.
- The front seat center belts are attached to floor panel at center of bench seat.

The driver's seat belt system includes a seat belt switch in the driver seat buckle side belt which controls a reminder lamp and a tone alarm. When the driver seat belt is buckled, the driver's door is closed, and the ignition switch is turned "ON," the following events will occur:

- The tone alarm will not operate.
- The reminder lamp will not operate.

When the driver's seat belt is not buckled, the driver's door is closed, and the ignition switch is in "RUN," the following events will occur:

- The tone alarm will operate for 4 to 8 seconds and then go "OFF".
- The reminder lamp will operate until the driver seat belt is buckled.

To diagnose a failure of the reminder lamp or tone alarm, refer to SECTION 8A-76.

Rear Seat Belt System

SEDAN

The rear seat belt system includes the following components:

- The rear seat center and buckle side belts are attached to the floor panel inboard of the rear seat.
- The rear seat outer retractor side belts are attached to the rear window panel under a trim cover, which is also shared with rear speaker grille covers.

WAGON

The rear seat belt system includes the following components:

- The rear seat center and buckle side belts are attached to the floor panel inboard of the rear seat.
- The rear seat outer retractor side belts are attached to the quarter panel lock pillar which is under the rear the quarter inner finish trim.

Rear Seat #2 Belt System

WAGON

The rear seat #2 belt system includes the following components:

- The rear seat #2 buckle/latch belts are attached to the floor panel under seat.

Child Seat Restraint System Belt

CHILD SEAT

CAUTION: A child in a rear facing child restraint, can be seriously injured if the right front passenger's air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. It is always better to secure a child restraint in the rear seat. If a forward facing child seat is suitable for your child, ALWAYS move front passenger seat as far back as it will go and then install the child restraint. Be sure the child restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instructions that came with the child restraint.

The child seat may only be used in a forward facing seating location. The child seat should be installed and secured according to the manufacturer's directions. If the child seat has a top strap it will need to be anchored, refer to "ON-VEHICLE SERVICE" in this section. Passenger should not be allowed to sit at locations where the seat belts are being used to secure the child seat.

ON-VEHICLE SERVICE

CAUTION: Replace belts, retractors, and hardware when used in all but a minor collision. Also, restraint systems should be replaced and anchorage's properly repaired if they were in area damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

GENERAL SERVICE INSTRUCTIONS

- Do not bleach or dye seat belts webbing. Clean only with a mild soap and water solution and a soft brush or cloth.
- Keep sharp edges and damaging objects away from seat belts. Avoid bending or damaging any part of the seat belt buckle or latch plate. Replace any seat belts which are cut or damaged in any way.
- Use only the correct seat belt anchor bolts/screws and tighten to the correct torque value, refer to "SPECIFICATIONS" in this section. When installing seat belt anchor bolts, start the bolt by hand to ensure that the bolt is threaded straight.
- Front Seat Center Belts, Rear Seat Center Belts, and Rear Seat #2 Belts are to be serviced as a set with service replacement parts only. Do not attempt to make repairs to the individual components which are only serviced as a set.

- Verify that the replacement part number is correct for the vehicle at that seating position. Do not substitute a seat belt from a different seating position.

OPERATIONAL AND FUNCTIONAL CHECKS

Seat Belt System

1. Begin in the driver seat. Turn the ignition switch to "RUN" and verify proper operation of the seat belt reminder lamp with the belt buckled and unbuckled, refer to "General Description" Front Seat Belt System.
2. Inspect the shoulder belt guide. Check that the guide swivels freely, the seat webbing is seated flat in the guide slot that the webbing doesn't bind.
3. Check that seat belt buckle faces inboard and is accessible.
4. Check that the seat belt retractor units are securely attached.
5. Check the seat belt anchor bolts to verify that they are secure.
6. Fully extend the seat belt webbing and check that there are no twists or tears in the webbing.
7. Allow the seat belt webbing to retract and check that the webbing returns freely and completely back in the retractor.
8. Snap seat belt latch plate into buckle.
9. Tug sharply on the seat belt latch plate and buckle, check that it remains locked.
10. Push the button on buckle. The seat belt latch plate must release from the buckle easily and the button must return to its original position.
11. Repeat steps 2 through 10 for the front passenger seat.
12. Check that center belts are accessible and that there are no twists or tears in the webbing.
13. Snap seat belt latch plate into buckle.
14. Tug sharply on the seat belt latch and buckle, check that it remains locked.
15. Push the button on buckle. The seat belt latch plate must release from buckle easily and the button must return to its original position.
16. Repeat steps 2 through 10 for the rear seats, for (Sedan and Wagon). To remove seats or seat cushions, refer to SECTION 10-10.
17. Repeat steps 12 through 15 for the rear seat center belts. To remove seats or seat cushions, refer to SECTION 10-10.
18. Repeat steps 12 through 15 for the rear seat #2 belts (Wagon). To remove seats or seat cushions, refer to SECTION 10-10.

Emergency Locking Retractors

Figure 1

CAUTION: Perform this test in an area clear of other vehicles or obstructions. Do not conduct this test on open road. A large, empty parking lot is suitable. Failure to observe this precaution may result in damage to the vehicle and possible personal injury.

1. Fasten the seat belts. An assistant is needed when the retractor under test is not part of the driver seat belt.
2. Accelerate the vehicle slowly to 16 km/h (10 mph) and apply the brakes firmly.
3. Verify that the seat belt webbing locks when braking firmly.
4. If the seat belt doesn't lock, proceed with steps 5 through 8.
5. Remove seat belt assembly from vehicle.
6. Tilt the seat belt retractor slowly.
7. Check that the seat belt webbing can be pulled from the retractor at an inclination of 15 degrees or less and cannot be pulled from retractor at an inclination of 45 degrees or more. Refer to Figure 1.
8. If the seat belt retractor doesn't operate as described, replace the seat belt.

FRONT SEAT BELTS

Driver and Passenger Seat Retractor Side Belts

Figure 2 and 3

↔ Remove or Disconnect

1. Bolt/screw (1) from center pillar (2).
2. Floor carpet retainer and center pillar upper trim finish panel. Refer to SECTION 10-6.

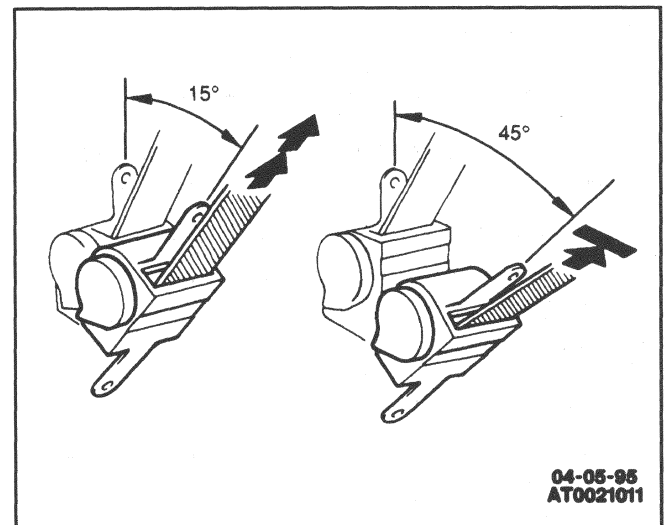


Figure 1-Seat Belt Retractor (Typical)

10-11-4 SEAT BELT

3. Driver and passenger seat retractor side belts.
 - Pull driver and passenger seat retractor side belts anti-rotation tab up and out from center pillar tee slot.
 - Retractor tab will indicate "RIGHT" for right-hand side and "LEFT" for left-hand side. Verify part replacement is correct.
4. Driver and passenger seat retractor side belt from vehicle.

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Driver and passenger seat retractor side belt to vehicle (24).
2. Driver and passenger seat retractor side belt.
 - Ensure that retractor tab marked "RIGHT" is installed on right-hand side and retractor tab marked "LEFT" is installed on left-hand side.
 - Insert anti-rotation tab into center pillar tee slot and pull down on retractor.
3. Bolt/screw (1) tab and center pillar (2).

Tighten

- Bolt/screw (1 and 14) to 42 N.m (31 lb. ft.).
4. Floor carpet retainer and center pillar upper trim finish panel. Refer to SECTION 10-6.

Front Seat Center and Buckle Side Belts (SEDAN AND WAGON)

Figure 4

Remove or Disconnect

1. Move front seat full forward for access.
2. Sleeve plug (4).
 - Remove by twisting out.
3. Bolt/screw (3).
4. Electrical connector, when removing driver side front seat center belt (7) or driver's seat buckle side belt (5).
5. Front seat center belts (7 and 8) or buckle side belts (5 and 6).

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Front seat center belts (7 and 8) or buckle side belts (5 and 6).
2. Electrical connector, when installing driver side front seat center belt (7) or driver's seat buckle side belt (5).
3. Bolt/screw (3).

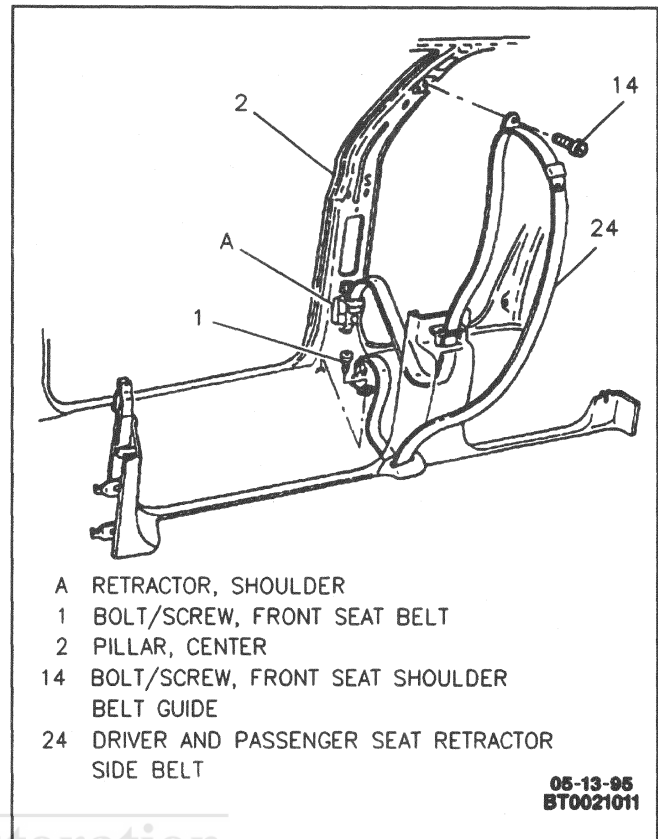


Figure 2-Driver and Passenger Seat Retractor Side Belts (Sedan)

Tighten

- Bolt/screw (3) to 42 N.m (31 lb. ft.).
4. Sleeve plug (4).

REAR SEAT BELTS

Rear Seat Center and Buckle Side Belts (SEDAN AND WAGON)

Figure 5 and 8

Remove or Disconnect

1. Rear seat cushion. Refer to SECTION 10-10.
 - Rear seat center belts must be removed from slots in rear seat cushion.
2. Bolt/screw (15) from rear seat center belts. (Sedan.)
3. Bolt/screw (28) from rear seat center belts. (Wagon.)

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Bolt/screw (28) to rear seat center belts. (Wagon)
2. Bolt/screw (15) to rear seat center belts. (Sedan)

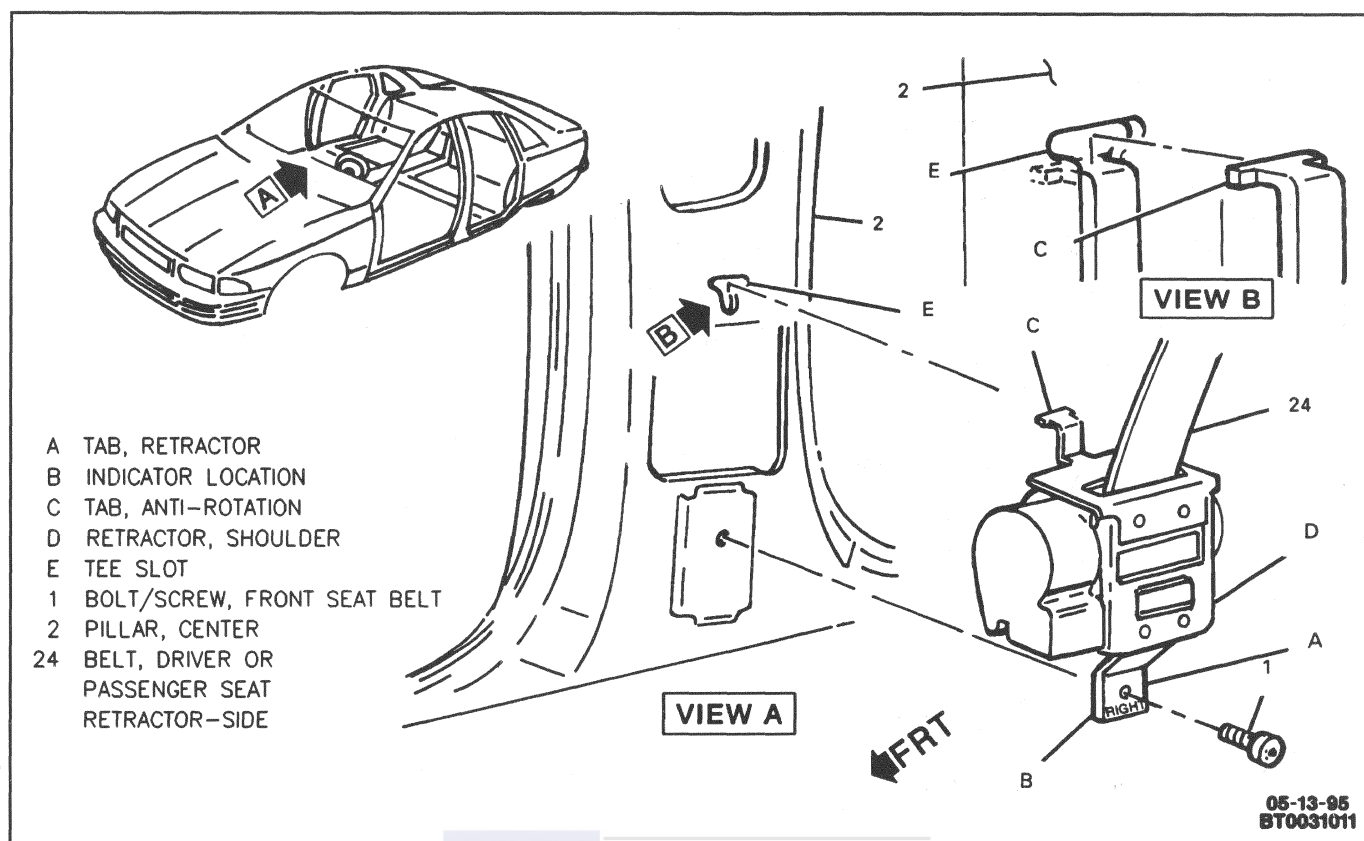


Figure 3-Driver and Passenger Seat Retractor Side (Center Pillar Typical)

**Tighten**

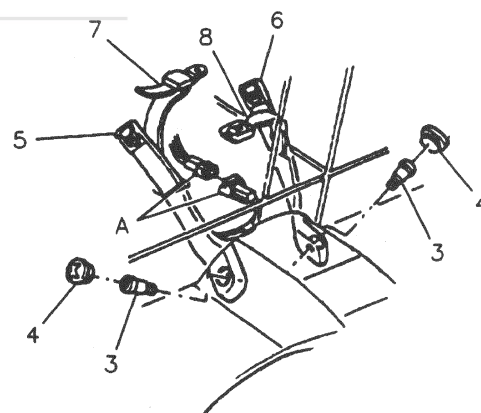
- Bolt/screw (15 or 28) to 42 N·m (31 lb. ft.).
- 3. Rear seat cushion. Refer to SECTION 10-10.
- Rear seat center belts must be routed through slots in rear seat cushion.

Rear Seat Outer Retractor Side Belts

(SEDAN)

Figure 6**Remove or Disconnect**

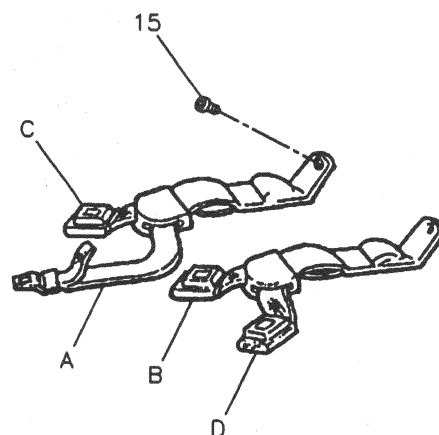
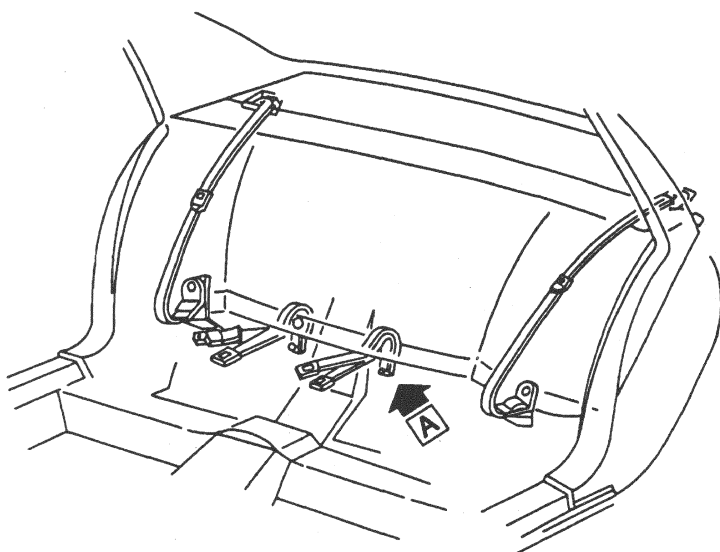
1. Rear seat cushion. Refer to SECTION 10-10.
 - Rear seat center belts must be removed from slots in rear seat cushion.
2. Bolt/screw (15) from anchor plate end of belt and rear seatback lower attachment loop.
3. Rear speaker grille (18) (Chevrolet only).
 - Pull up on rear speaker grille (18) to disengage from rear window panel trim (19).
4. Quarter upper trim and rear window panel trim, if necessary. Refer to SECTION 10-8.
5. Bolt/screw (16) rear seat outer retractor.
6. Rear seat outer retractor side belt located at rear window panel (40). Refer to Figure 6.
7. Rear seat outer retractor side belt (17).



- A CONNECTOR, ELECTRICAL
- 3 BOLT/SCREW, DRIVER OR PASSENGER SEAT BUCKLE-SIDE BELT
- 4 PLUG, FRONT SEAT BELT SLEEVE
- 5 BELT, DRIVER'S SEAT BUCKLE-SIDE
- 6 BELT, PASSENGER SEAT BUCKLE-SIDE
- 7 BELT, DRIVER'S SIDE FRONT SEAT CENTER
- 8 BELT, FRONT SEAT CENTER

Figure 4-Front Seat Center and Buckle Side Belts (Sedan and Wagon)

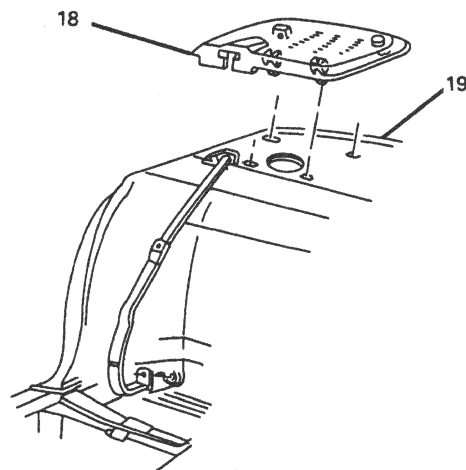
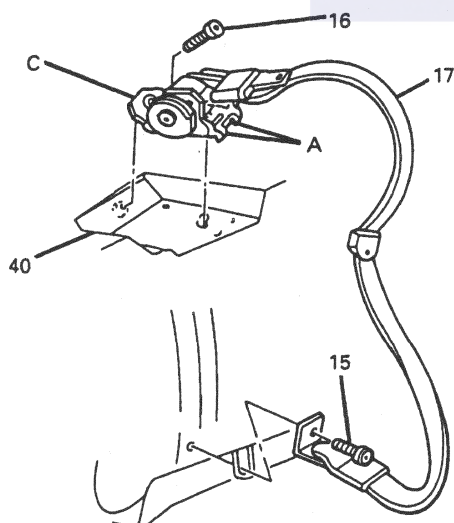
10-11-6 SEAT BELT



- A BELT, REAR SEAT CENTER LATCH SIDE
- B BELT, REAR SEAT CENTER BUCKLE SIDE
- C BELT, REAR SEAT PASSENGER BUCKLE SIDE
- D BELT, REAR SEAT DRIVER BUCKLE SIDE
- 15 BOLT/SCREW, REAR SEAT CENTER BELT

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Figure 5-Rear Seat Center and Buckle Side Belts (Sedan and Wagon)



- A PIN, LOCATOR
- C RETRACTOR, SHOULDER
- 15 BOLT/SCREW, REAR SEAT OUTER RETRACTOR-SIDE BELT
- 16 BOLT/SCREW, REAR SEAT BELT RETRACTOR

- 17 BELT, REAR SEAT OUTER RETRACTOR-SIDE
- 18 GRILLE, RADIO REAR SPEAKER (CHEVROLET ONLY)
- 19 TRIM, REAR WINDOW PANEL
- 40 PANEL, REAR WINDOW

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Figure 6-Rear Seat Outer Retractor Side Belts (Sedan)

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Rear seat outer retractor side belt (17).
2. Rear seat outer retractor side belt to rear window panel (40).
 - Use locator pin on bottom of retractor as a guide.
3. Bolt/screw (16) to retractor and rear window panel (40).

Tighten

- Bolt/screw (16) to 42 N.m (31 lb. ft.).
4. Quarter upper trim and rear window panel trim, if removed. Refer to SECTION 10-8.
 5. Rear speaker grille (18).
 - Push down on rear speaker grille (18) to engage clips to rear window panel trim (19).
 6. Bolt/screw (15) to anchor plate end of belt and rear seatback lower attachment loop.

Tighten

- Bolt/screw (15) to 42 N.m (31 lb. ft.).
7. Rear seat cushion. Refer to SECTION 10-10.
 - Rear seat center and buckle side belts must be routed through slots in rear seat cushion.

Rear Seat Outer Retractor Side Belts (WAGON)

Figure 7

Remove or Disconnect

1. Folding rear seat-back cushion. Refer to SECTION 10-10.
2. Radio quarter speaker grille (wagon) and body lock pillar trim finish panel. Refer to SECTION 10-7.
3. Bolt/screw (33) connecting rear seat outer retractor side belt (34) to floor of vehicle.
4. Lift up guide loop cover to access bolt/screw (37).
5. Bolt/screw (37) and guide bracket trim cover (38) from rear seat belt bracket on body lock pillar.
6. Nuts (36) connecting rear seat outer retractor to studs.
7. Washers (41) from studs.
8. Rear seat outer retractor-side belt (34).

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Rear seat outer retractor-side belt (34).
 - Position rear seat retractor belt on studs.

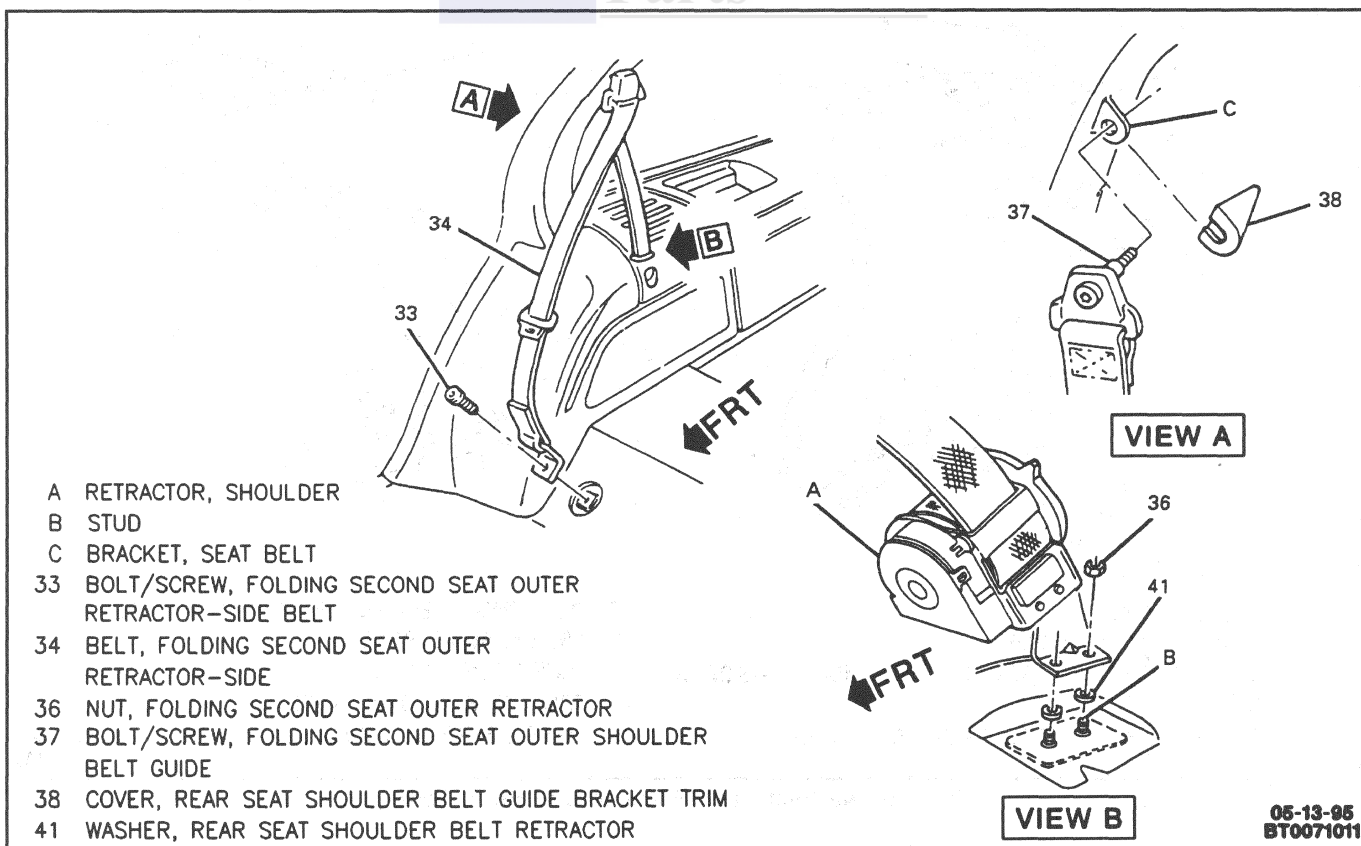


Figure 7-Rear Seat Outer Retractor Side Belts (Wagon)

10-11-8 SEAT BELT

2. Washers (41) on studs.
3. Nuts (36) connecting rear seat outer retractor belts to studs.

Tighten

- Nuts (36) to 25 N.m (18 lb. ft.).
4. Bolt/screw (37) and guide bracket trim cover (38) to seat belt bracket on body lock pillar.
 - Close guide bracket trim cover (38) over bolt/screw (37).

Tighten

- Bolt/screw (37) to 42 N.m (31 lb. ft.).
5. Bolt/screw (33) connecting rear seat outer retractor-side belt (34) to floor of vehicle.

Tighten

- Bolt/screw (33) to 42 N.m (31 lb. ft.).
6. Body lock pillar trim panel and radio quarter speaker grille. Refer to SECTION 10-7.
 7. Folding rear seatback cushion. Refer to SECTION 10-10.

Rear Seat #2 Belts

FOLDING THIRD SEAT-(WAGON)

Figure 8

Remove or Disconnect

1. Rear seat #2 cushion. Refer to SECTION 10-10.
2. Anchor plate bolts/screws (28) attaching rear seat #2 belts (27) and retainers (26) to load floor.
3. Rear seat #2 belts (27) and retainers (26).

Install or Connect

NOTICE: Refer to "Notice" on page 10-11-1 of this section.

1. Retainers (26) and rear seat #2 belts (27).
2. Anchor plate bolts/screws (28) attaching rear seat #2 belts (27) and retainers (26) to load floor.

Tighten

- Anchor plate bolts/screws (28) to 42 N.m (31 lb. ft.).
3. Rear seat #2 cushion. Refer to SECTION 10-10.

CHILD SEAT RESTRAINT SYSTEM BELT

CHILD SEAT (WAGON)

Figure 8

The child seat should be used only in a forward facing seating location. When the child seat is used in the front seat location, it is easily installed by connecting the child seat tether to the center seat belt. The child seat can use the latch of the rear seat center belts or the outboard belt latches if they are fully extended. Occupants should not be allowed to sit at locations where the seat belts are being used for the child seat.

CAUTION: The child seat tether anchor is intended for use only on the left or right outboard rear seat or rear seat #2 seat. Installation at any other seating position could result in system failure, leading to injury in the event of a collision.

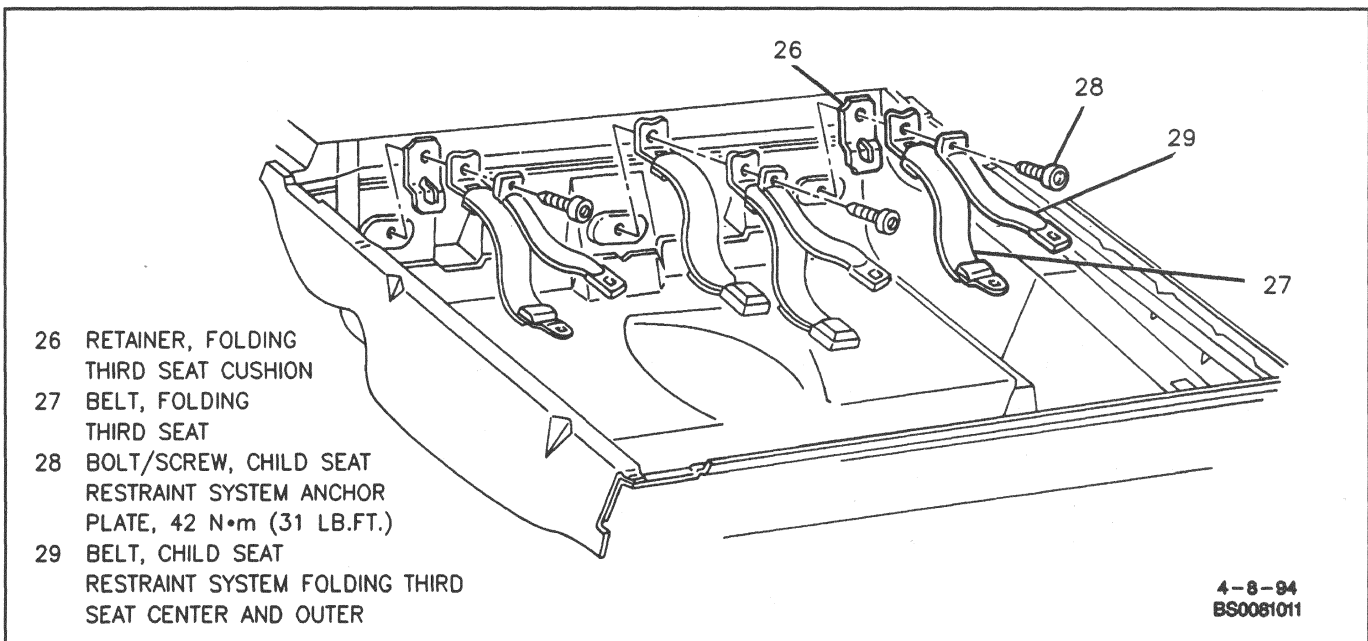


Figure 8-Rear Seat #2 Belts (Folding Third Seat)

CHILD SEAT TETHER ANCHOR**(SEDAN)**

If a child seat that requires a top strap is to be used in the rear seat position on the sedan, a special dealer installed anchor must be used to anchor the child tether to the rear window panel. In order to assure the correct child seat tether angle, the child seat is only to be used at the seating position for which the anchor is installed.

If an anchor bracket is being installed for the first time, use the following procedure.

Child Seat Restraint System Belt Installation**TOP STRAP ANCHOR INITIAL INSTALLATION****Figure 9****Install or Connect**

1. From inside rear compartment, select desired rear seat installation position and locate appropriate existing 10 mm (13/32-inch) hole on underside of rear window panel (40).
2. From inside passenger compartment, locate existing 10 mm (13/32-inch) hole in rear window panel trim backing by running fingers across rear window panel trim (19).
3. Once the 10 mm (13/32-inch) hole is located, cut an "X" spanning a 20 mm (25/32-inch) circle in trim (19) at marked spot.
4. Insert child seat tether bolt/screw (20) through anchor bracket (21) and spacer (22). Push through "X" cut in trim (19) and hole in rear window panel (40) and thread into J-clip (23).

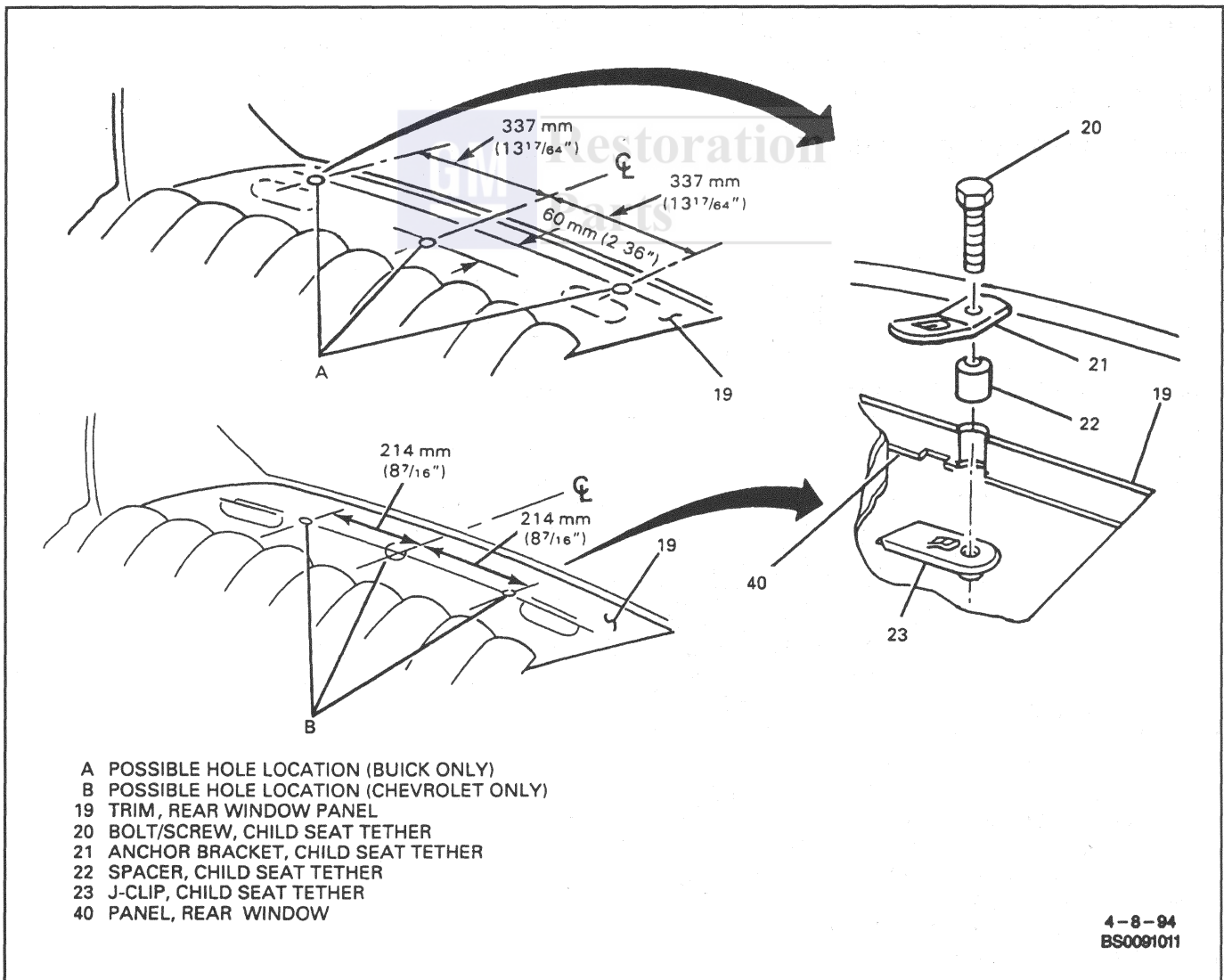


Figure 9-Child Seat Tether Anchorage Installation (Sedan)



Tighten

- Bolt/screw (20) to 42 N.m (31 lb. ft.).

CHILD SEAT TETHER ANCHOR REPLACEMENT

If the anchor bracket (21) becomes damaged, it must be replaced.



Remove or Disconnect

1. Bolt/screw (20), anchor bracket (21) and spacer (22).
2. J-clip (23) from inside rear compartment, if damaged or if permanently removing child seat top strap anchor bracket (21).

CAUTION: All bolt/screw holes to the exterior of the vehicle must be sealed completely to prevent carbon monoxide from entering the vehicle. Apply a sealant between the anchor bolt/screw washer and sheet metal to prevent carbon monoxide from entering the vehicle. In the event that the child seat anchorage assembly is removed, all bolt/screw holes penetrating to the exterior of the vehicle must be resealed. Breathing carbon monoxide can cause carbon monoxide poisoning and may be fatal.

3. Seal hole if permanently removing anchor bracket (21).

CHILD SEAT TETHER ANCHORAGE

(SEDAN)

Figure 9



Remove or Disconnect

1. Assembled bolt/screw (20), anchor bracket (21) and spacer (22).
2. J-clip (23) from inside rear compartment, if damaged or if permanently removing child seat top strap anchor bracket (21).
3. Seal hole if permanently removing anchor bracket (21).



Install or Connect

NOTICE: Refer to “Notice” on page 10-11-1 of this section.

1. J-clip (23) from inside rear compartment, if removed.
2. Bolt/screw (20), anchor bracket (21) and spacer (22).



Tighten

- Bolt/screw (20) to 42 N.m (31 lb. ft.).

CHILD SEAT BELT

(WAGON)

Figure 8

If a child seat with a tether is installed in the rear seat #2, child seat belts should be installed to the anchor plate bolts/screws, attached to the load floor.

CAUTION: When installing child seat belt in the rear seat #2 of a wagon do not use existing anchor plate bolts/screws. Installation anchor bolts/screws must be six millimeters longer than existing anchor bolts/screws to secure seat belts to vehicle load floor. Use of existing anchor bolts/screws may cause seat belts to work loose. This could result in personal injury.



Remove or Disconnect

1. Rear seat #2 cushion. Refer to SECTION 10-10.
2. Anchor plate bolts/screws (28).
3. Child seat belts (29) and rear seat #2 belts (27).
4. Retainers (26) in outside positions.



Install or Connect

NOTICE: Refer to “Notice” on page 10-11-1 of this section.

1. Retainers (26) in outside positions.
2. Rear Seat #2 belts (27) and child seat belts (29).
3. Anchor plate bolts/screws (28).



Tighten

- Anchor plate bolts/screws (28) to 42 N.m (31 lb. ft.).
4. Rear seat #2 cushion. Refer to SECTION 10-10.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Child Seat Tether Bolt/Screw.....	42 N.m (31 lb. ft.)
Driver or Passenger Seat Retractor Side Belt Bolt/Screw	42 N.m (31 lb. ft.)
Front Seat Center and Buckle Side Belt (Sedan or Wagon)	42 N.m (31 lb. ft.)
Front Seat Shoulder Belt Guide (Sedan or Wagon) Bolt/Screw.....	42 N.m (31 lb. ft.)
Rear Seat Center and Buckle Side Belt (Sedan and Wagon) Bolt/Screw.....	42 N.m (31 lb. ft.)
Rear Seat Outer Retractor Side Belt (Sedan) Bolt/Screw.....	25 N.m (18 lb. ft.)
Rear Seat Outer Retractor Side Belt (Wagon) Bolt/Screw.....	42 N.m (31 lb. ft.)
Rear Seat #2 Outer Buckle Side Belts Bolt/Screw	42 N.m (31 lb. ft.)
Rear Seat #2 Center and Buckle Side Belts Bolt/Screw.....	42 N.m (31 lb. ft.)



BLANK



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1996 Chevrolet Caprice, Impala SS/Buick Roadmaster/ Chevrolet Wagon and Buick Wagon Service Manual

Book 2

Foreword

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 1996 Chevrolet Caprice, Impala SS/Buick Roadmaster/Chevrolet Wagon and Buick Wagon.

BOOK 1 contains all sections EXCEPT Engine Controls (Section 6E), Automatic Transaxle Diagnosis (Section 7A) and Electrical Diagnosis (Section 8A).

BOOK 2 contains Engine Controls (Section 6E), Automatic Transaxle Diagnosis (Section 7A) and Electrical Diagnosis (Section 8A).

This service manual replaces the 1996 Caprice, Impala SS/Buick Roadmaster Preliminary Service Manual (GMP/96-B-2P).

Information on unit repair (overhaul) can be found in the 1996 Transmission/Transaxle/Transfer Case Unit Repair Manual (TURM), GMPT/96-TURM, available separately. The TURM manual contains information on automatic and manual transmissions and transaxles, and transfer cases for all GM passenger cars and light duty trucks, including the fluid flow and circuit description information.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better serve the vehicle owners.

When this manual refers to a brand name, a number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication approval. General Motors reserves the right to make changes at any time without notice.

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70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
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-40	-40	100700

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Engine Coolant Temperature (ECT) Sensor	23	17	—
EVAP Canister Solenoid Valve	5.8	—	52
Front Fuel Tank Retaining Strap Bolts	32	24	—
Fuel Filler Pipe Attaching Screws (Except Wagon)	6	—	53
Fuel Filler Pipe Attaching Screws (Wagon)	1.9	—	17

Engine Control System/Fuel System Torque Specs (cont'd)

Application	N-m	Lb Ft	Lb In
Fuel Filler Pipe Ground Strap Screw	4	—	35
Fuel Pressure Regulator Attaching Screw	10	—	89
Fuel Rail and Resonator Bracket Attaching Bolts	10	—	89
Fuel Sender Assembly Attaching Nuts	3	—	27
Fuel Tank Cross Strap Attaching Nut	15	11	—
Fuel Tube Bracket Attaching Screw	5	—	44
Heated Oxygen Sensor (HO2S)	41	30	—
IAC Valve Attaching Screws	3	—	27
IAC Valve/Coolant Cover Attaching Screws	3.2	—	28
Knock Sensor (KS)	19	14	—
Manifold Absolute Pressure (MAP) Sensor	6	—	50
Rear Fuel Tank Retaining Strap Nuts	25	18	—
Throttle Body Attaching Bolts	25	18	—
Throttle Position (TP) Sensor Attaching Screws	2	—	18

Engine Scan Tool Data List

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop				
Scan Tool Parameter	Vehicle Platform	Data List	Units Displayed	Typical Data Values
1-4 Shift Sol.	Y	Eng 1	Enable/Disabled	Disabled
A/C Clutch	B,D,F,Y	Eng 1,2	Off/On	Off
A/C Evap. $\pm$ Temp.	F	Eng 1	C°/F°	Varies
A/C High Side	B,D,F,Y	Eng 1	Volts/psi	Varies
A/C Request	B,D,F,Y	Eng 1, Misfire	No/Yes	No
A/C Status	B,D,F,Y	Eng 1, Misfire	Off/On	Off
A/T Perf. Mode	F	Eng 1	Normal/Perf.	Varies
A/T Perf. Switch	F	Eng 1	Active/Inactive	Varies
AIR Pump	B,D,F,Y	Eng 1, 2, FT	Disabled/Enabled	Disabled
ASR/TCS Spark Retard	D,F,Y	Eng 2	No/Yes	No
BARO	B,D,F,Y	Eng 1, 2	kPa/Volts	65-104/3.5-4.5 (Varies w/Altitude)
CKP Engine Speed	B,D,F,Y	Eng 2, Misfire	RPM	$\pm$ 75 RPM from engine speed
CKP: Lo Res Angle	B,D,F,Y	Eng 2 Misfire	° Dev (Deviation)	0° Dev (varies $\pm$ 3°)
Cold Start Up	B,D,F,Y	Eng 1, 2	No/Yes	Varies
Current Gear	B,D,F,Y	Eng 1	Gear position	1
Cycles Of Misfire Data	B,D,F,Y	Misfire	Counts	0-100
Cyl. Mode Misfire Index	B,D,F,Y	Misfire	Counts	Varies
Desired Idle	B,D,F,Y	Eng 1, 2	RPM	PCM Controlled
DTC	B,D,F,Y	FF, RR	Pxxxx	Varies
DTC Set This Ign.	B,D,F,Y	Eng 1, 2	No/Yes	No
ECT	B,D,F,Y	All	C°/F°	85°C-108°C (185°-226°)
EGR Duty Cycle	B,D,F,Y	Eng 1,2, FT	Percentage	0

Engine Scan Tool Data List (cont'd)

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop				
Scan Tool Parameter	Vehicle Platform	Data List	Units Displayed	Typical Data Values
Engine Load	B,D,F,Y	FF, FR, Misfire	Percentage	3% @ Idle 9% @ 2500 RPM
Engine Oil Temp.	Y	Engine 1	C°/F°	Varies
Engine Run Time	B,D,F,Y	Eng 1	C°/F°	Varies
Engine Speed	B,D,F,Y	All	RPM	± 100 RPM from desired
EVAP Purge	B,D,F,Y	Eng 1, 2, FT	Percentage	0
EVAP Vacuum Sw.	B,D,F,Y	Eng 1, 2, FT	No Purge/Purge	No Purge
Fail Counter	B,D,F,Y	FF, FR	Counts	Varise
FC Relay 1	B,D,F,Y	Eng 1, 2	Off/On	Depends on engine temperature and A/C Pressure
FC Relay 2	B,D,	Eng 1, 2	Off/On	Depends on engine temperature and A/C Pressure
FC Relay 2 and 3	F,Y	Eng 1, 2	Off/On	Depends on engine temperature and A/C Pressure
Fuel Trim Cell	B,D,F,Y	Eng 1, 2, FT	Cell Number	16
Fuel Trim Learn	B,D,F,Y	Eng 1, 2, FT	Disabled/Enable	Enable (may Toggle)
High Res. Signal	B,D,F,Y	Eng 1, 2	Inactive/Active	Active
HO2S Bn 1 Sen. 1	B,D,F,Y	Eng 1, 2, FT	Millivolts	10-1000 mV and Varying
HO2S Bn 1 Sen. 2	B,D,F,Y	Eng 1, 2, FT	Millivolts	10-1000 mV and Varying
HO2S Bn 2 Sen. 1	B,D,F,Y	Eng 1, 2	Millivolts	10-1000 mV and Varying
HO2S Bn 2 Sen. 2	B,D,F,Y	Eng 1, 2, FT	Millivolts	10-1000 mV and Varying
IAC Learned	B,D,F,Y	Eng 1, 2, FT	Counts	10-50
IAC Position	B,D,F,Y	Eng 1, 2, FT	Counts	10-50
IAT	B,D,F,Y	Eng 1, 2, FT	C°/F°	10°C-90°C (50°F-194°F)
Ignition Volts	B,D,F,Y	Eng 1, 2, FT	Volts	12.5-14.5
Inj Avg PWM Bn 1	B,D,F,Y	Eng 1, FT	Milliseconds	1-4
Inj Avg PWM Bn 2	B,D,F,Y	Eng 1, 2, FT	Milliseconds	1-4
Knock Retard	B,D,F,Y	Eng 1, 2	Degrees	0
KS Activity	B,D,F,Y	Eng 1, 2	No/Yes	No
Long Term FT Bn 1	B,D,F,Y	Eng 1, 2, FT	Percentage/Counts	—
Long Term FT Bn 2	B,D,F,Y	Eng 1, 2, FT, FF, FR	Percentage/Counts	—
Loop Status	B,D,F,Y	Eng 1, 2, FT	Open/Closed	Closed
Low Res. Signal	B,D,F,Y	Eng 1, 2	Milliseconds	Varies
LT FT Avg. Bn 1	B,D,F,Y	FT	Counts/Percentage	—
LT FT Avg. Bn 2	B,D,F,Y	Eng 1, 2	Counts/Percentage	—

Engine Scan Tool Data List (cont'd)

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop				
Scan Tool Parameter	Vehicle Platform	Data List	Units Displayed	Typical Data Values
MAF	B,D,F,Y	All	Grams Per Seconds (g/s)	5-9 @ Idle (depends on altitude) 20-26 @ 2500 RPM (depends on altitude)
MAP	B,D,F,Y	Eng 1, 2 FT	kPa/Volts	20-48/1.0-2.0 (varies w/altitude)
Mileage Since First Failure	B,D,F,Y	FF, FR	km/Miles	Varies
Mileage Since Last Failure	B,D,F,Y	FR	km/Miles	Varies
Mileage Since MIL Request	B,D,F,Y	FF	km/Miles	Varies
Misfire Cur. #1	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #2	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #3	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #4	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #5	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #6	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #7	B,D,F,Y	Misfire	Counts	Varies
Misfire Cur. #8	B,D,F,Y	Misfire	Counts	Varies
Misfire Failures	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #1	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #2	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #3	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #4	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #5	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #6	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #7	B,D,F,Y	Misfire	Counts	Varies
Misfire Hist. #8	B,D,F,Y	Misfire	Counts	Varies
Misfire Passes	B,D,F,Y	Misfire	Counts	Varies
Misfire Per Cycle Status	B,D,F,Y	Misfire	Prim. Cyl# 0-8, Sec. Cyl# 0-8	—
Msf. Rev. Status	B,D,F,Y	Misfire	Accept/Reject	Accept
MPH Km/h	B,D,F,Y	Eng 1	MPH km/h	0
Not Run Counter	B,D,F,Y	FF	Counts	0
Oil Level	B,D	Eng 1	Normal/Low	Normal
Pass Counter	B,D,F,Y	FF	Counts	Varies
Pass Key Fuel	B,D,F,Y	Eng 1,2	Disabled/OK	OK
PCM Reset	B,D,F,Y	Eng 1,2	Yes/No	No
PNP	B,D,F,Y	Eng 1	P-N—/—ROD21	P-N—
PSP Switch	B,D,F,Y	Eng 1	High Press./Normal	Normal
Reverse Inhibit	F	Eng 1	Enable/Disabled	Disabled
Revs w/Misfire	B,D,F,Y	Misfire	Counts	0

Engine Scan Tool Data List (cont'd)

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop				
Scan Tool Parameter	Vehicle Platform	Data List	Units Displayed	Typical Data Values
Shrt Term FT Bn 1	B,D,F,Y	Eng 1, 2, FT FF, FR	Percentage/Counts	—
Shrt Term FT Bn 2	B,D,F,Y	Eng 1, 2, FT FF, FR	Percentage/Counts	—
Skip Shift Sol.	F	Eng 1	Enable/Disabled	Disabled
Spark	B,D,F,Y	Eng 1, 2	Degrees	Varies
ST FT Avg. Bn 1	B,D,F,Y	FT	Counts/Percentage	—
ST FT Avg. Bn 2	B,D,F,Y	FT	Counts/Percentage	—
Start Up ECT	B,D,F,Y	Eng 1, 2	C°/F°	Varies
TCC Brake Switch	B,D,F,Y	Eng 1	Applied/Released	Released
TCC Duty Cycle	B,D,F,Y	Eng 1	Disabled/Enable	Disabled
TCC Enable	B,D,F,Y	Eng 1	Disabled/Enable	Disabled
TCC Stator Temp.	B,D	Eng 1	Normal/High	Normal
Total Misfire	B,D,F,Y	Misfire	Counts	0
TP Angle	B, D, F, Y	All	Percentage	0%
TP Sensor	B,D,F,Y	Eng 1	Volts	0.55-0.90
TR Switch	B,D,F,Y	Eng 1	Transmission Gear position	Park/Neut.
Traction Control	D,F,Y	Eng 1, 2	Inactive/Active	Inactive
Vehicle Speed	B,D,F,Y	Eng 1	MPH km/h	0
Warm Up Cycles w/o Emis. Faults	B,D,F,Y	Eng 2	Counts	0-40
Warm Up cycle w/o Non-Emis. Faults	B,D,F,Y	Eng 2	Counts	0-40

Engine Scan Tool Data Definitions

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

1-4 Shift Sol.: Scan Tool Displays Enabled or Disabled (Y Car Only). When the PCM enables the 1-4 shift solenoid, the scan tool will display Enabled.

A/C Clutch: Scan Tool Displays On or Off. Represents the commanded state of the A/C clutch control relay. The A/C clutch should be engaged when ON is indicated on the scan tool.

A/C Evap. Temp.: Scan Tool Range -18°C to 53°C (0°F to 128°F) (F Car Only). The scan tool will display the A/C evaporator temperature. This sensor is used by the PCM to cycle the A/C compressor clutch. This sensor is also used to prevent A/C evaporator freeze-up.

A/C High Side: Scan Tool Displays 15-452psi/0.00-5.00 Volts. Represents the A/C refrigerant pressure sensor signal. The amount of pressure indicates the amount of load that the A/C compressor is placing on the engine. The PCM uses this information to adjust idle and to control the cooling fans.

A/C Request: Scan Tool Displays Yes or No. Indicates the state of the A/C request input circuit from the HVAC controls. The PCM uses the A/C request signal to determine whether A/C compressor operation is being requested.

A/C Status: Scan Tool Displays On or Off. The scan tool will display ON when voltage is applied to the A/C compressor clutch.

A/T Perf. Mode: Scan Tool Displays Normal or Perf (F Car Only). This parameter is the actual state of the performance mode control program within the PCM. The scan tool will display Perf. when the performance mode is enabled (Performance Shift Calibration). The scan tool will display Normal when the performance mode is disabled (Normal Shift Calibration).

A/T Perf. Switch: Scan Tool Displays Inactive or Active (F Car Only). This parameter indicates the position of the performance mode switch. The scan tool will display Active when the switch is depressed and then Inactive when the switch is released.

AIR Pump: Scan Tool Displays Disabled or Enabled. When the PCM enables the Secondary Air Injection (AIR) pump the scan tool will indicate ENABLED. When the PCM turns the AIR pump off, the scan tool will indicate DISABLED.

ASR/TCS Spark Retard: Scan Tool Displays No or Yes (If so equipped). When the traction control system requires reduced engine torque, the PCM will retard the engines' timing. When this occurs, the scan tool will display Yes.

BARO: Scan Tool Range 10-105 kPa/0.00-5.00 Volts. The Barometric Pressure reading is determined from the MAP sensor signal monitored during key up and Wide-Open Throttle (WOT) conditions. The Barometric Pressure is used to compensate for altitude differences.

CKP Engine Speed: Scan Tool Range 0-9999 RPM. The crankshaft engine speed is computed by the PCM from the crankshaft position sensor signal. The CKP engine speed should remain close to actual engine speed.

CKP:Lo Res Angle: Scan Tool Range +60 to -30° Dev. This parameter is the actual timing relationship between the crankshaft and the camshaft in degrees. Ideally the value would be zero indicating that the cam is neither advanced or retarded relative to the crank. Under normal operation, this value can be expected to fluctuate slightly above or below zero. As timing chain wear increases, the deviation will increase.

Cold Start Up: Scan Tool Displays Yes or No. When the engine coolant temperature and intake air temperatures are less than 50°C (122°F) and are within 3°C (5°F) of each other at start-up, is consider a cold start-up. When these temperatures are in the range, the scan tool will indicate YES. When the scan tool displays YES, indicates a cold start-up was detected.

Current Gear: Scan Tool Displays 1, 2, 3, or 4. The PCM looks at Trans Range position and the gear commanded by the PCM. The actual forward gear that the transmission is in will be the lower of the two because the manual valve can override the PCM commanded gear.

Cycles of Misfire Data: Scan Tool Range 0-100. Counts the number of Misfire tests during 200 revolutions.

Cyl. Mode Misfire Index: Scan Tool Range 0-65535. This parameter displays the amount of crankshaft decelerations. When an engine is operating without a misfire, the scan tool will display less then 1000 counts. When an engine misfire occurs, the counter will be greater then 1000 counts.

Desired Idle: Scan Tool Range 0-3187 RPM. The idle speed that is commanded by the PCM. The PCM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

DTC: Scan Tool Range P0001-P1999. This parameter indicates what DTC is stored within freeze frame and/or Failure Records buffer.

DTC Set This Ign.: Scan Tool Displays Yes or No. This parameter indicates if a Diagnostic Trouble Code has set on the current ignition cycle.

ECT: Scan Tool Range -40°C to 151°C (-40°F to 304°F). The Engine Coolant Temperature (ECT) sensor is mounted in the coolant pump. The PCM applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the PCM will interpret the lower voltage as a warm engine.

EGR Duty Cycle: Scan Tool Range 0%–100% (L99 and LT1 Only). The PCM turns the EGR on and off. The ON time of the EGR solenoid valve is the duty cycle. This ON time is expressed as a percent. The amount of the percent is the amount of time the EGR valve is open.

Engine Load: Scan Tool Range 0%–100%. Engine load is calculated by the PCM from engine speed and MAF sensor readings. Engine Load should increase with an increase in RPM or airflow.

Engine Oil Temp.: Scan Tool Range -40°C to 164°C (-40°F to 327°F) (Y Car Only). The scan tool will display the Engine Oil Temperature. The engine oil temperature is used by the PCM to control the cooling fans.

Engine Run Time: Scan Tool Displays Seconds, Minutes, Hours. This indicates the amount of time the engine has been operating. When the ignition is cycled off the timer will be set to zero.

Engine Speed: Scan Tool Range 0–20000 RPM. Engine speed is computed by the PCM from the low resolution signal. It should remain close to desired idle under various engine loads with engine idling.

EVAP Purge: Scan Tool Range 0%–100%. Represents the PCM commanded PWM duty cycle of the EVAP Purge Solenoid valve. 0% displayed indicates no purge; 100% displayed indicates full purge.

EVAP Vacuum SW.: Scan Tool Displays Purge or No Purge. The EVAP purge vacuum switch is a normally closed switch positioned in the purge line between the canister and the EVAP purge solenoid. The EVAP purge vacuum switch will open when vacuum increases to greater than 5 inches of water in the purge line. The EVAP Purge Vacuum Switch is used by the PCM to monitor EVAP canister purge solenoid operation and purge system integrity. The EVAP Purge Vacuum Switch should be closed to ground with no vacuum present (0% EVAP Purge PWM). With EVAP Purge PWM at 25% or greater, the EVAP Purge Vacuum Switch should open and purge should be indicated.

Fail Counter: Scan Tool Range 0–255. When a MIL is requested or a history DTC is stored, the PCM will count and store the amount times a diagnostic test failed. This information will be stored in Freeze Frame or Failure records. Only one DTC can be stored in each Freeze Frame and/or Failure Records buffers.

FC Relay 1: Scan Tool Displays On or Off. When the PCM commands a coolant fan ON, the scan tool will indicate ON. Some vehicles are equipped with a three relay configuration. When the PCM commands the fan one relay control ON, both fans will be enabled on low speed.

FC Relay 2: Scan Tool Displays On or Off (B and D Car without Heavy Duty Cooling). When the PCM commands a coolant fan ON, the scan tool will indicate ON.

FC Relay 2 and 3: Scan Tool Displays On or Off (F and Y Car Only). When the PCM commands a coolant fan ON, the scan tool will indicate ON.

Fuel Trim Cell: Scan Tool Range 0–255. This parameter indicates what Fuel trim cell is currently active.

Fuel Trim Learn: Scan Tool Displays No or Yes. When conditions are appropriate for enabling long term fuel trim corrections, Fuel Trim Learn will display YES. This indicates that the long term fuel trim is responding to the short term fuel trim. If the Fuel Trim Learn displays NO, then long term fuel trim will not respond to changes in short term fuel trim.

High Res. Signal: Scan Tool Displays Inactive or Active. This signal is generated by the ignition control module. When the PCM detects a high resolution signal, the scan tool display will change from inactive to active.

HO2S Bn1 and Bn2 Sen. 1: Scan Tool Range 0–1107 mV. Represents the fuel control exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10 mV (lean exhaust) and 1000 mV (rich exhaust) while operating in 'Closed Loop.'

HO2S Bn1 and Bn2 Sen. 2: Scan Tool Range 0–1107 mV. Represents the fuel control exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10 mV (lean exhaust) and 1000 mV (rich exhaust) while operating in 'Closed Loop.'

IAC Learned: Scan Tool Range 0–255. IAC learned is an internal PCM parameter. Each time the vehicle is driven the IAC system learns how many counts is required to produce a given desired idle.

IAC Position: Scan Tool Range 0–255. Displays the commanded position of the idle air control pintle in counts. A larger number of counts means that more air is being commanded through the idle air passage. Idle air control should respond fairly quickly to changes in engine load to maintain desired idle RPM.

IAT: Scan Tool Range -40°C to 151°C (-40°F to 304°F). The PCM converts the resistance of the intake air temperature sensor to degrees. Intake Air Temperature (IAT) is used by the PCM to adjust fuel delivery and spark timing according to incoming air density.

Ignition Volts: Scan Tool Range 0.0–25.5 volts. This parameter is the battery ignition voltage input to the PCM.

Inj. Avg. PWM Bn1 and Bn2: Scan Tool Range 0–1000 m/sec. Indicates the amount of time the PCM is commanding each injector ON during each engine cycle. A longer injector pulse width will cause more fuel to be delivered. Injector Pulse Width should increase with increased engine load.

Knock Retard: Scan Tool Range 0.0°–16°. Indicates the amount of spark the PCM is removing from IC spark advance in response to the signal from the Knock sensors.

KS Activity: Scan Tool Displays Yes or No. Indicates whether or not a KS activity is being detected by the PCM. With the engine idling, the scan tool should indicate NO.

LT FT Avg. Bn1 and Bn2: Scan Tool Displays Counts/Percentage. This parameter indicates the average of all long term fuel trim cells. The short term fuel trim cells are rated (Weighted) for the amount of which they are used. For example, an idle cell will be rated higher than a wide open cell. If a fueling malfunction is occurring in the idle cell and the wide open cell, the average would be more affected by the idle cell than the wide open cell. A negative value significantly below 128/0% indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value significantly greater than 128/0% indicates that a lean condition exists and the PCM is compensating by adding fuel (increased injector pulse width). When the average of the cells reach a predetermined high or low, a fuel trim DTC will set.

Long Term FT Bn1 and Bn2: Scan Tool Displays Percentage/Counts. Long Term Fuel Trim is derived from the Short Term Fuel Trim value and represents a long-term correction of fuel delivery. A value of 0%/128 indicates that fuel delivery requires no compensation to maintain the PCM commanded air/fuel ratio. A negative value significantly below 0%/128 indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value significantly greater than 0%/128 indicates that a lean condition exists and the PCM is compensating by adding fuel (increased injector pulse width). Because Long Term Fuel Trim tends to follow Short Term Fuel Trim; a value in the negative range due to canister purge at idle should not be considered unusual. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Loop Status: Scan Tool Displays Open or Closed. Closed Loop indicates that the PCM is controlling fuel delivery according to oxygen sensor voltage. In Open Loop, the PCM ignores the oxygen sensor voltage and bases the amount of fuel to be delivered on TP sensor, engine coolant, and MAF sensor inputs only.

Low Res. Signal: Scan Tool Range 0.0–332.7 m/sec. This signal is generated by the ignition control module. This signal indicates the time between low resolution signal pulses. The PCM uses this signal to determine engine position and engine speed.

MAF: Scan Tool Range 0.0–655 gm/s. MAF (Mass Air Flow) is the MAF Input Frequency converted to grams of air per second. This indicates the amount of air entering the engine.

MAP: Scan Tool Range 10–105 kPa/0.00–5.0 Volts. The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure from engine load, EGR flow (L99 and LT1 only), and speed changes. As intake manifold pressure increases, intake vacuum decreases resulting in a higher MAP sensor voltage and kPa reading. The MAP sensor signal is used for the following: (1) To monitor intake manifold pressure changes during the EGR flow test (L99 and LT1 only); (2) To update the BARO reading; (3) Enabling factor for several of the diagnostics.

Mileage Since First Failure: Scan Tool Displays km and miles. This parameter indicates the mileage at which a emission Diagnostic Trouble Code failed for the first time. This mileage will be stored in the Freeze Frame and Failure records buffers.

Mileage Since Last Failure: Scan Tool Displays km and miles. This parameter indicates the mileage at the time the PCM detected the last test ran and failed for a DTC that is stored in the Failure Records buffer only.

Mileage Since MIL Request: Scan Tool Displays km and miles. The PCM will store the mileage of the vehicle at the time a MIL has been requested for an emission DTC. This mileage will be stored in the Freeze Frame buffer only.

Misfire Cur. #1 – Misfire Cur. #8: Scan Tool Range 0–255 Counts. The Misfire Current counters increment at a rate according to the number of possible misfires being detected on each cylinder during the last 200 cylinder firing events. The counters may normally display some activity, but the activity should be nearly equal for all the cylinders.

Misfire Failures: Scan Tool Range 0–65535 Counts. Indicates the number of 200 crankshaft revolution sample periods during which the level of misfire was sufficiently high to report a fail.

Misfire Hist. #1 – Misfire Hist. #8: Scan Tool Range 0–65535 Counts. The Misfire History counters display the total level of misfire that has been detected on each cylinder. The Misfire History counters will not update or show any activity until a misfire DTC (P0300) has become active. The Misfire History counters will update every 200 cylinder firing events.

Misfire Passes: Scan Tool Range 0–65535 Counts. Indicates the number of 200 crankshaft revolution sample periods during which the misfire diagnostic reported a pass.

Misfire Per Cycle Status: Scan Tool Displays Prim. Cyl # 0–8 and Sec. Cyl # 0–8. When a multiple misfire occurs, the scan tool will display the cylinder with the most significant misfire under Prim. Cyl. The scan tool will display the least significant misfire under Sec. Cyl.

MPH km/h: Scan Tool Range 0–255 km/h (0–158 mph). The vehicle speed sensor signal is converted into km/h and mph for display.

MSF Rev. Status: Scan Tool Displays Accept or Rejected. The scan tool will display Rejected when the PCM detects a misfire that is out of the normal misfire range. When rejected is displayed, indicates the PCM did not use the last 200 revolution test.

Not Run Counter: Scan Tool Range 0–255 Counts—When a MIL is requested or a history DTC is stored, the PCM will count and store the amount times a diagnostic test did not run. This information will be stored in Freeze Frame buffer only. Only one DTC can be stored in each Freeze Frame and/or Failure Records buffers.

Oil Level: Scan Tool Displays OK or Low (B and D Car Only). This parameter indicates when the engine oil level is low. The scan tool will display Low when the PCM detects the engine oil level is low.

Pass Counter: Scan Tool Range 0–255. When a MIL is requested or a history DTC is stored, the PCM will count and store the amount times a diagnostic test passed. This information will be stored in Freeze Frame buffer. Only one DTC can be stored in the Freeze Frame buffer.

Pass Key Fuel: Scan Tool Displays Disabled or OK (Except Y Car). The Theft Deterrent Fuel Enable circuit is an input from the Vehicle Theft Deterrent Control Module that signals the PCM to enable the injectors if the proper signal is received. The scan tool will normally display OK. If the Vehicle Theft Deterrent Control Module does not send the correct Theft Deterrent Fuel Enable signal to the PCM, the display will switch to DISABLED and the fuel system may be disabled.

PCM Reset: Scan Tool Displays Yes or No. This parameter indicates when an internal PCM reset has occurred. The scan tool will display YES when an internal PCM reset occurred.

PNP: Scan Tool Displays –ROD21 or P–N – – – –. This parameter will indicate if the transmission gear selector lever is in park or neutral, or the transmission gear selector is in reverse or any forward gear.

PSP Switch: Scan Tool Displays High Press or Normal (B and D Car Only). This parameter indicates when power steering load is present. The scan tool will display High Press when the PCM detects a power steering load is present (Parking Lot Maneuvers).

Reverse Inhibit: Scan Tool Displays Enabled or Disabled (F Car Only). When vehicle speed is below 4 mph, the PCM will enable the reverse inhibit solenoid and the scan tool will indicate Enabled.

Revs W/Misfire: Scan Tool Range 0–200 counts. This parameter displays the amount of misfire within 200 cycles.

ST FT Avg. Bn1 and Bn2: Scan Tool Displays Counts/Percentage. This parameter indicates the average of the short term fuel trim cells. The short term fuel trim cells are rated (Weighted) for the amount of which they are used. For example, an idle cell will be rated higher than a wide open cell. If a fueling malfunction is occurring in the idle cell and the wide open cell, the average would be more affected by the idle cell than the wide open cell. A negative value significantly below 128/0% indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value significantly greater than 128/0% indicates that a lean condition exists and the PCM is compensating by adding fuel (increased injector pulse width). When the average of the cells reach a predetermined high or low, a fuel trim DTC will set.

Shrt Term FT Bn1 and Bn2: Scan Tool Displays Percentage/Counts. Short Term Fuel Trim represents a short-term correction to fuel delivery by the PCM in response to the amount of time the fuel control oxygen sensor voltage spends above or below the 450 mV threshold. If the oxygen sensor voltage has mainly remained less than 450 mV, indicating a lean air/fuel mixture, short term fuel trim will increase into the positive range above 0%/128 and the PCM will add fuel. If the oxygen sensor voltage stays mainly above the threshold, short term fuel trim will decrease below 0%/128 into the negative range while the PCM reduces fuel delivery to compensate for the indicated rich condition. Under certain conditions such as extended idle and high ambient temperatures, canister purge may cause Short Term Fuel Trim to read in the negative range during normal operation. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Skip Shift Sol.: Scan Tool Displays Enabled or Disabled (F Car Only). When the PCM enables the skip shift solenoid, the scan tool will display Enabled.

Spark: Scan Tool Range -64° to 64°. Displays the amount of spark advance being commanded by the PCM on the IC circuit. The PCM computes the desired spark advance using the following: (1) Engine coolant temperature; (2) Engine speed (RPM); (3) Load; (4) Vehicle speed. This distributor ignition system is a net build distributor (No timing adjustment). All timing adjustments are completed by the PCM.

Start Up ECT: Scan Tool Range -40°C to 151°C (-40°F to 304°F). Indicates the Engine Coolant Temperature at the time that the vehicle was started. Used by the HO2S diagnostic to determine if the last startup was a cold start.

TCC Brake Switch: Scan Tool Displays Applied or Released. This parameter indicates the state of the TCC brake switch circuit input. Open indicates 0.0 voltage input (brake switch open, brake pedal applied). Closed indicates a B+ voltage input (brake switch closed, brake pedal released).

TCC Duty Cycle: Scan Tool Displays Disabled or Enabled. This parameter is the commanded state of the TCC PWM solenoid. The scan tool will indicate Enabled when the commanded state of the solenoid is ON. When the solenoid is not on the scan tool will display Disabled.

TCC Enable: Scan Tool Displays Engaged or Disengaged. Represents the PCM commanded state of the transmission torque converter clutch.

TCC Stator Temp.: Scan Tool Displays Normal or High (B and D Car with LT1). This parameter indicates the state of the TCC fluid temperature switch input. When the PCM detects the transmission temperature above a predetermined temperature, the scan tool will display High.

Total Misfire: Scan Tool Range 0–255. Indicates the total number of cylinder firing events that were detected as being misfires during the last 200 crankshaft revolution sample period.

TP Angle: Scan Tool Range 0%–100%. TP Angle is computed by the PCM from the TP Sensor voltage. TP Angle should display 0% at idle and 100% at wide open throttle.

TP Sensor: Scan Tool Range 0.00–5.00 Volts. This signal is used by the PCM to determine the amount of throttle demanded by the driver. The display should be between 0.36–0.96 volts at idle and greater than 4.0 volts at wide open throttle.

TR Switch: Scan Tool Displays INVALID, PARK/NEUTRAL, REVERSE, DRIVE 4/OD, DRIVE 3/D, DRIVE 2, or DRIVE 1. Trans Range represents the decoded status of the three transmission range pressure switch inputs from the Transmission Range Pressure Switch Assembly. The combination of transmission range inputs indicates the position of the transmission manual valve.

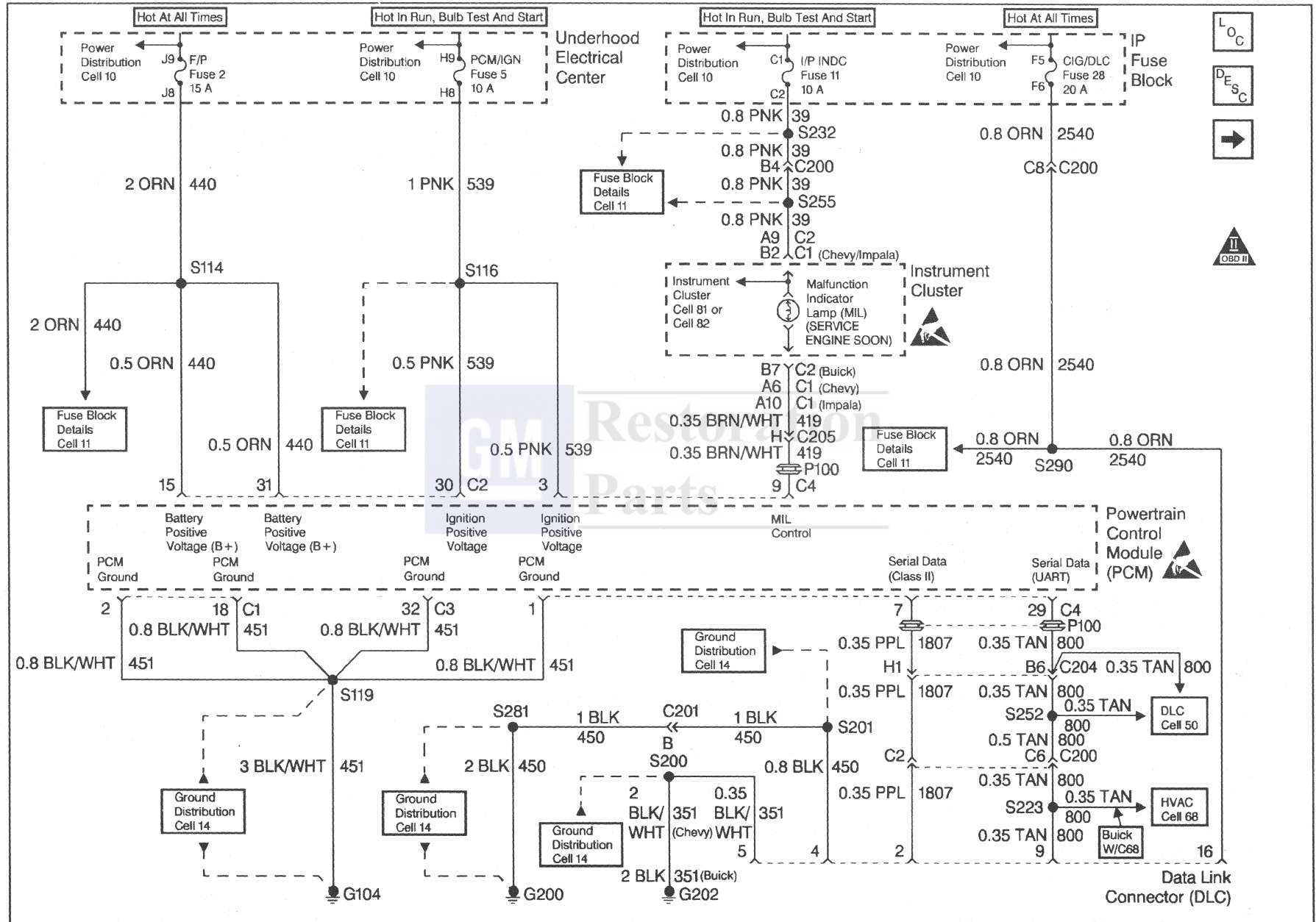
Traction Control: Scan Tool Displays Active or Inactive (If so equipped). When the traction control system is active the scan tool will display Active.

Warm Up Cycles w/o Emis. Faults: Scan Tool Range 0–40. This parameter counts the number of warm up cycles without an emission fault present. The counter will increment to 40 and roll back to 0 unless a fault occurs. If a fault occurs, the counter will revert back to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM will also reset the counter to 0.

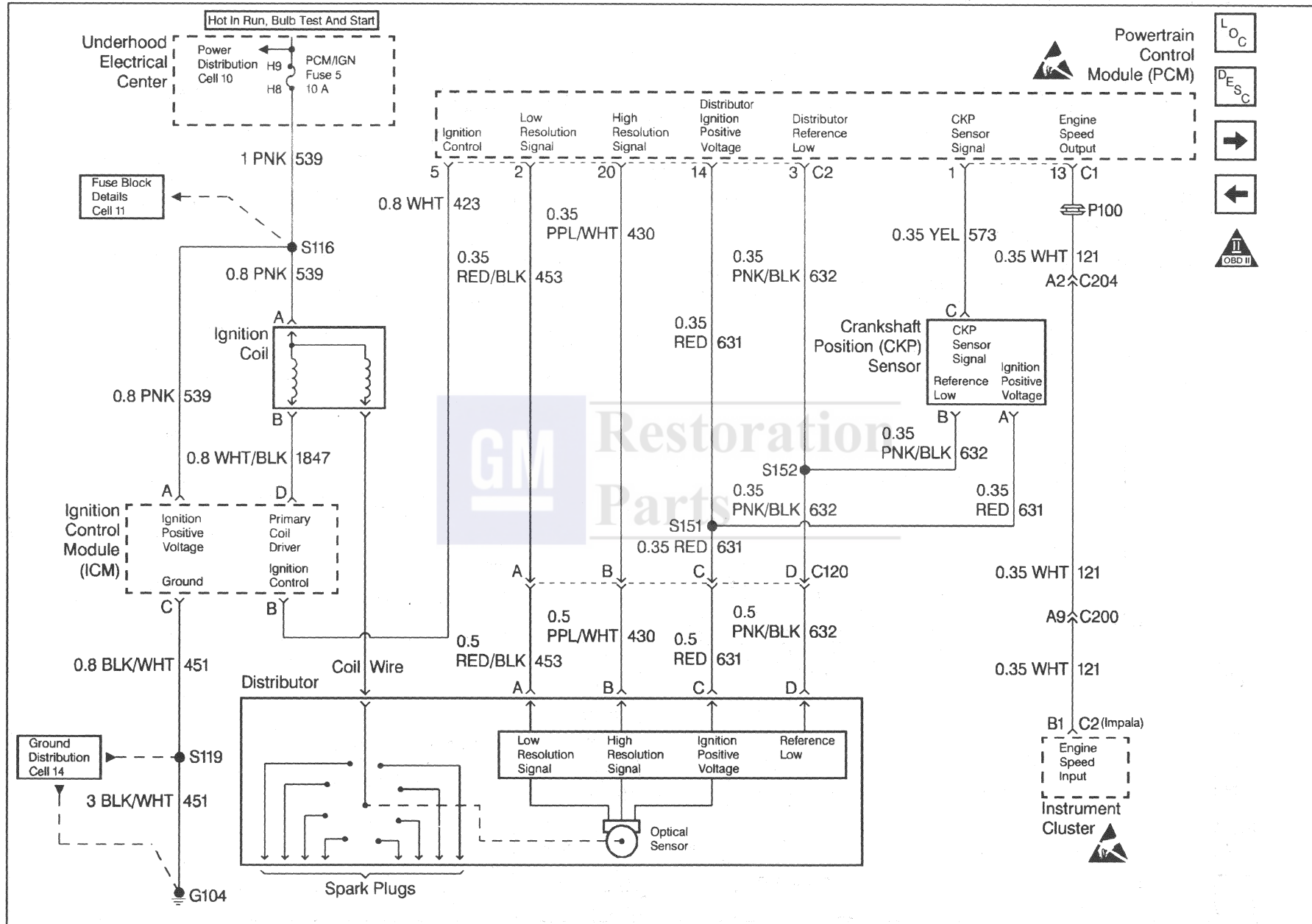
Warm Up Cycles w/o Non – Emis. Faults: Scan Tool Range 0–40. This parameter counts the number of warm up cycles without a non-emission fault present. The counter will increment to 40 and roll back to 0 unless a fault occurs. If a fault occurs, the counter will revert back to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM will also reset the counter to 0.

Restoration
Parts

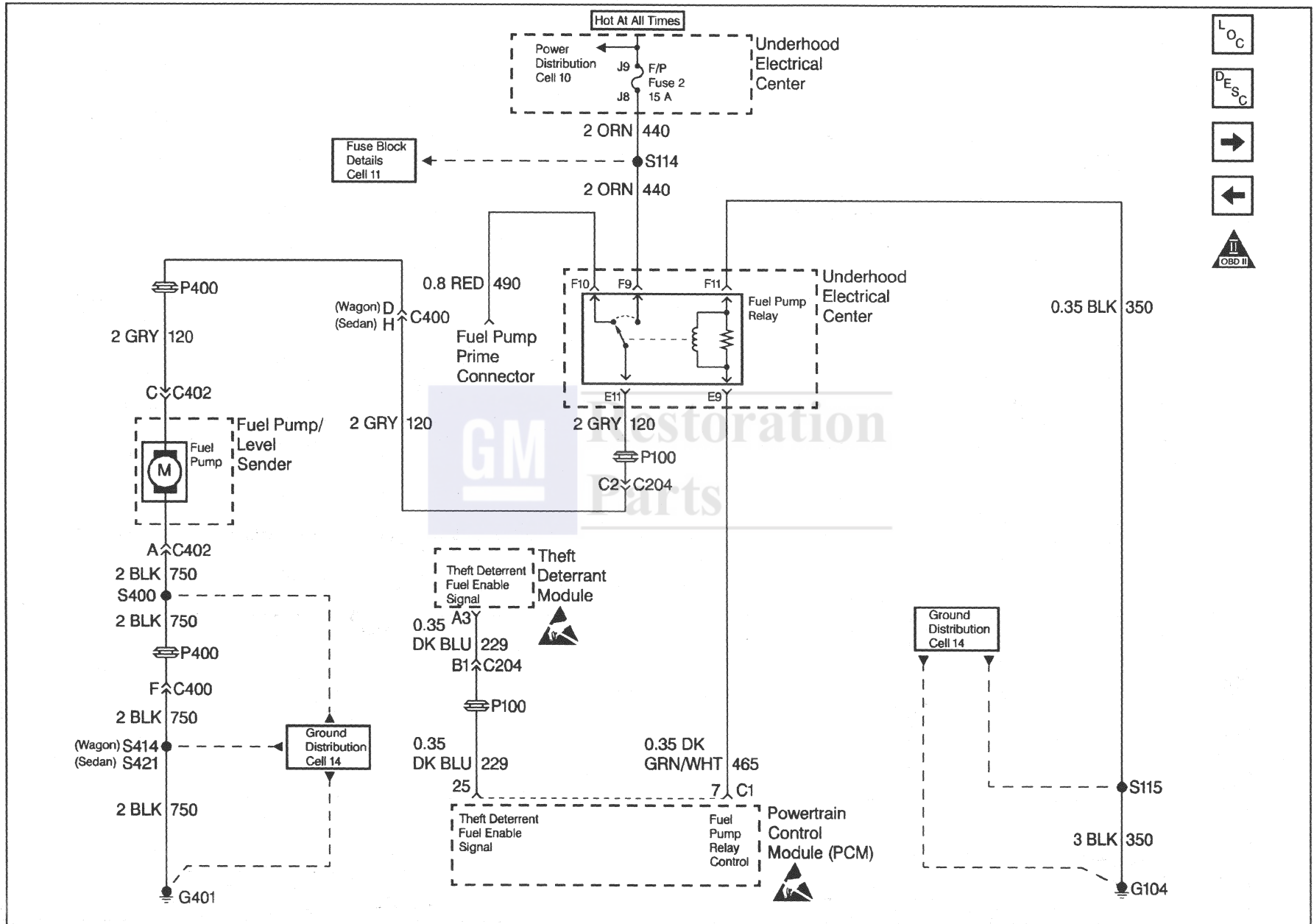
Engine Controls (Power, Ground, MIL and DLC)



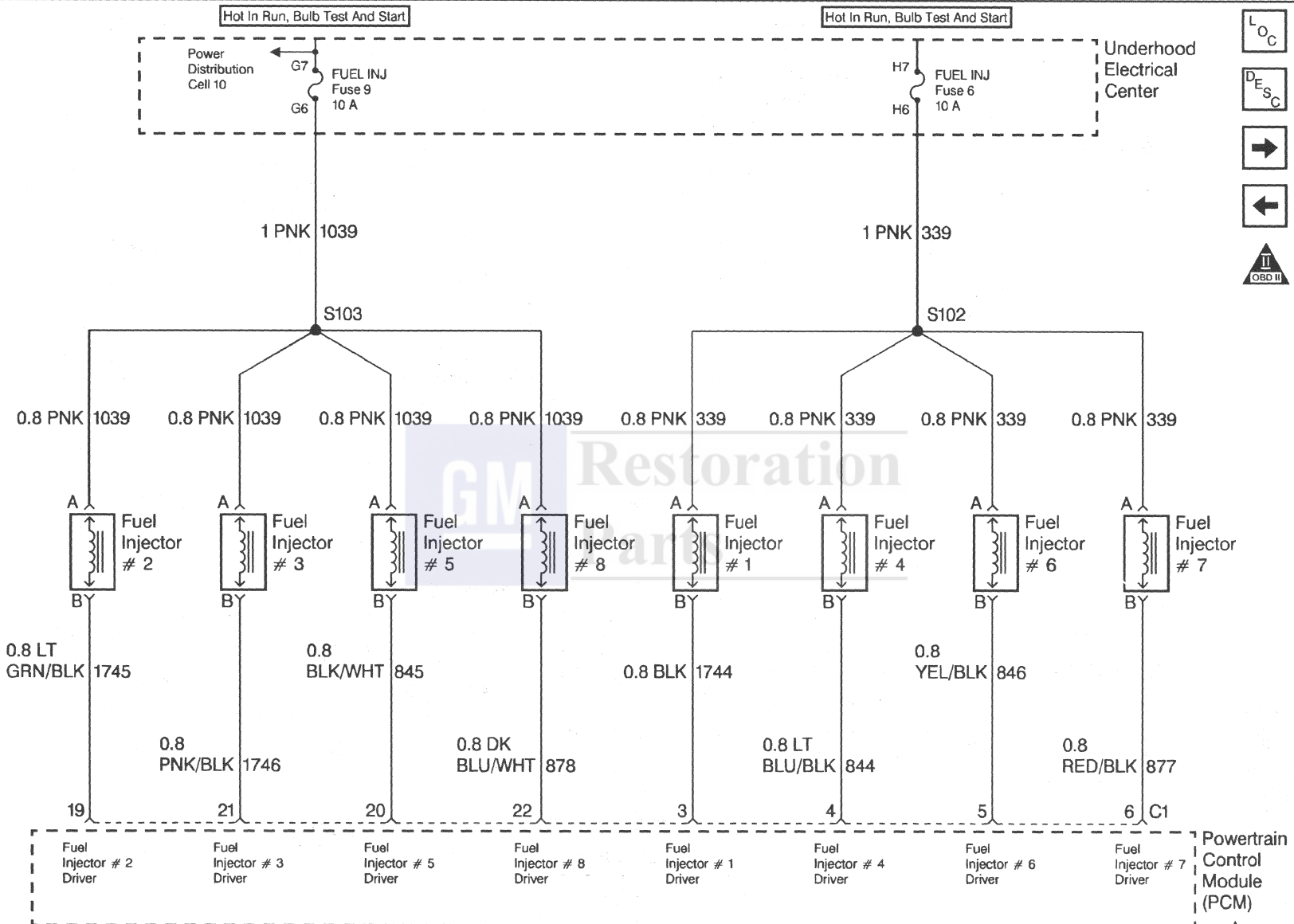
Engine Controls (Ignition System)



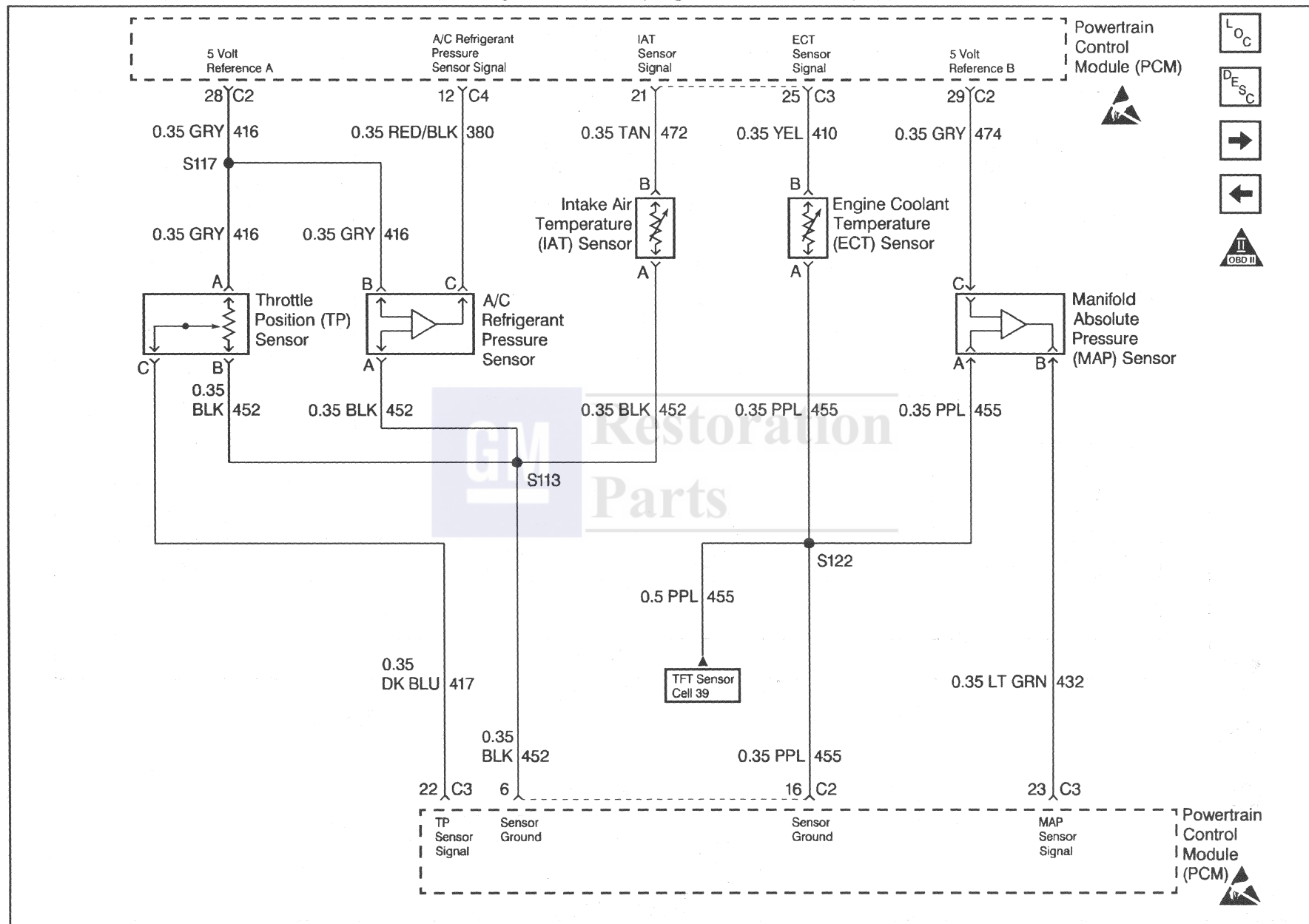
Engine Controls (Fuel Pump)



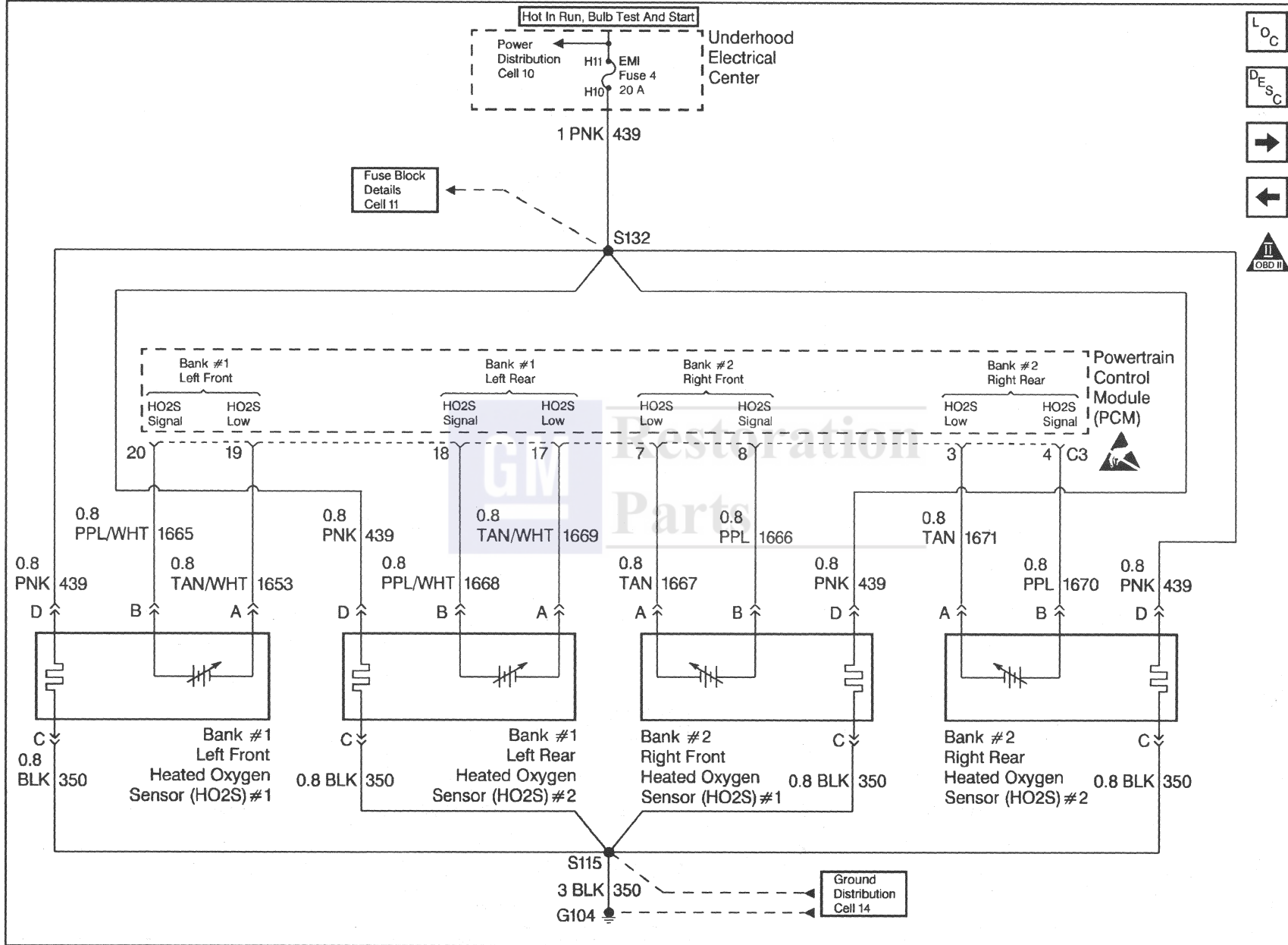
Engine Controls (Injectors)



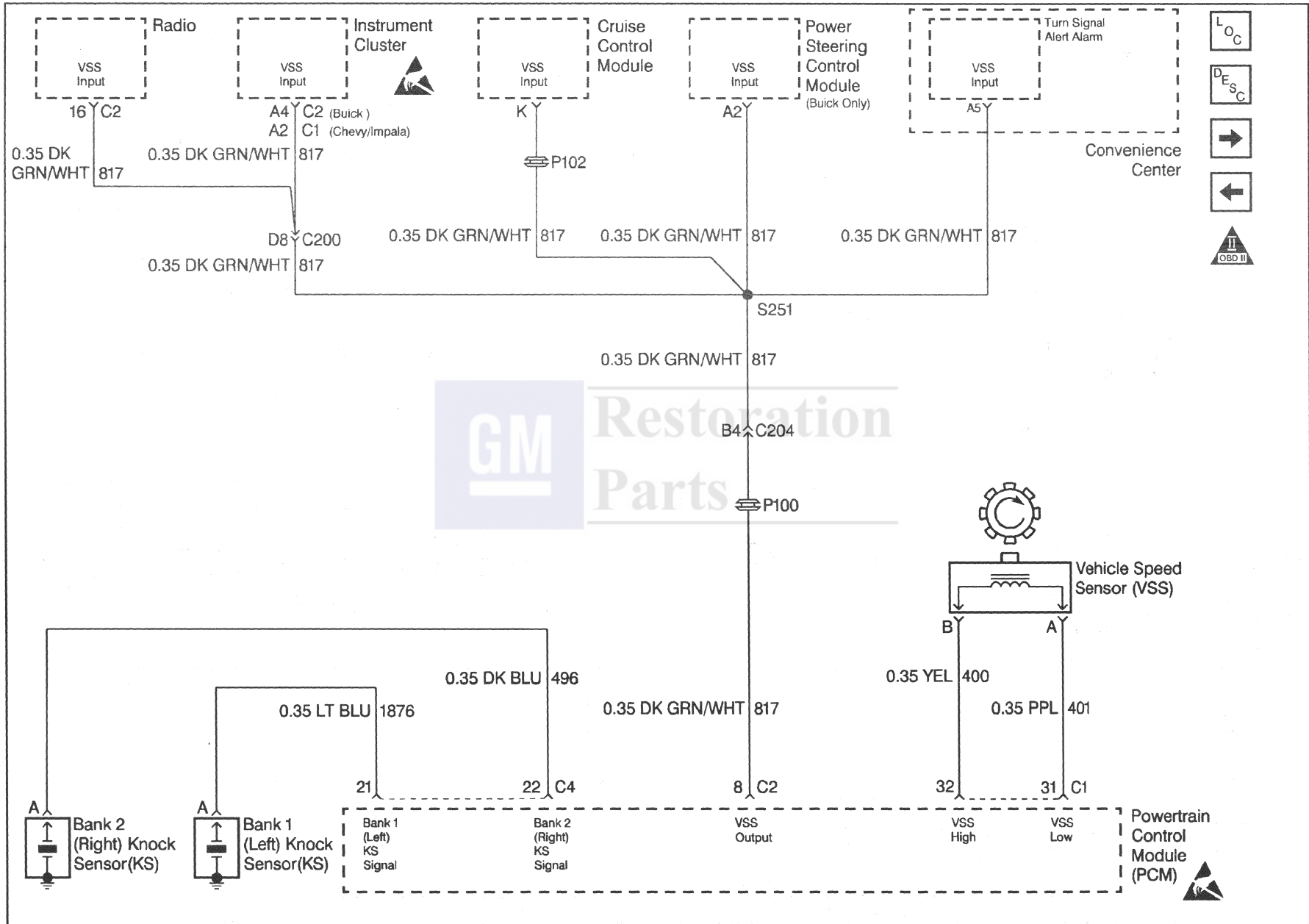
Engine Controls (Engine Data Sensors)



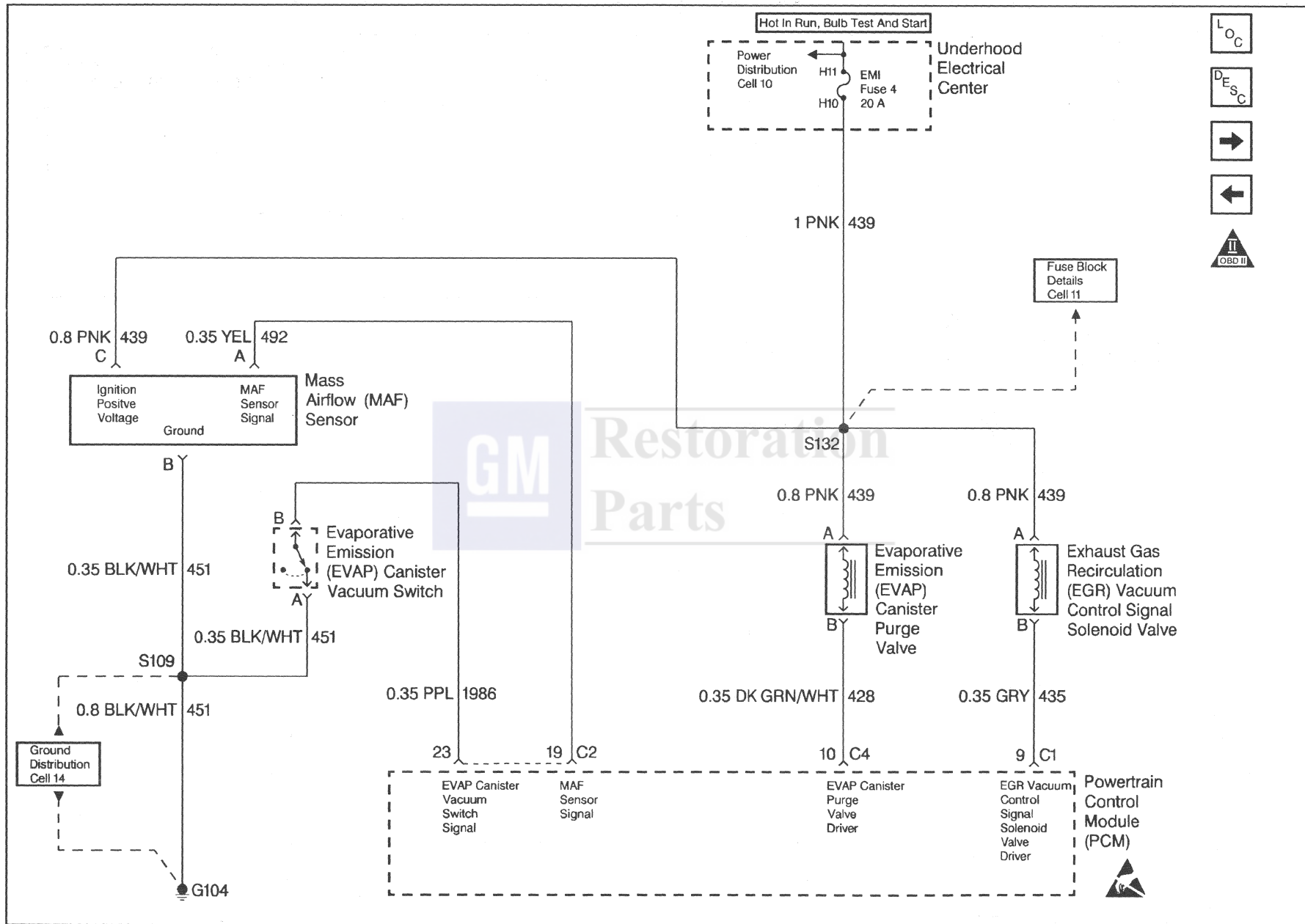
Engine Controls (Heated Oxygen Sensors)



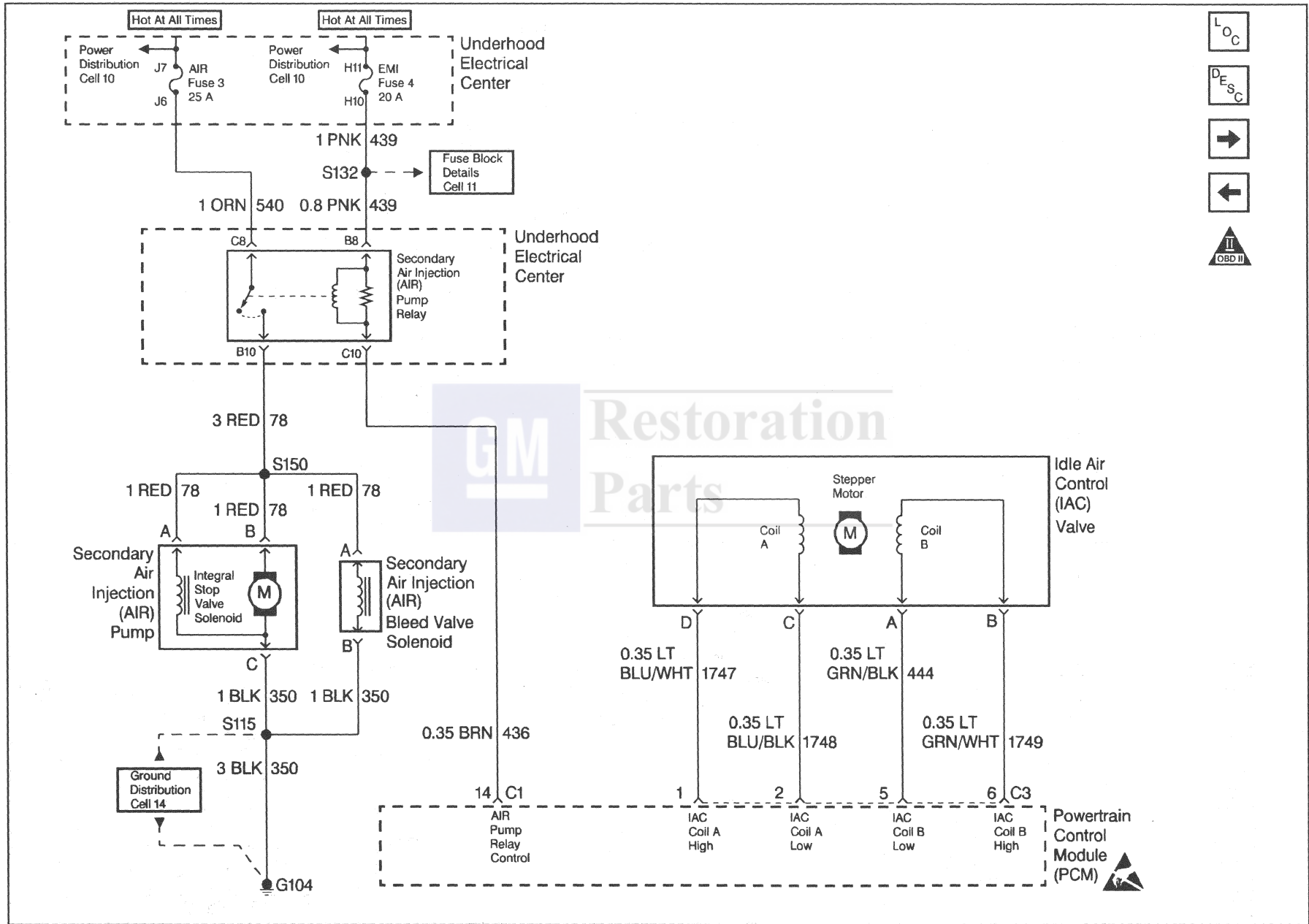
Engine Controls (Engine Data Sensors and VSS Output)



Engine Controls (MAF, EVAP and EGR)



Engine Controls (AIR and IAC)



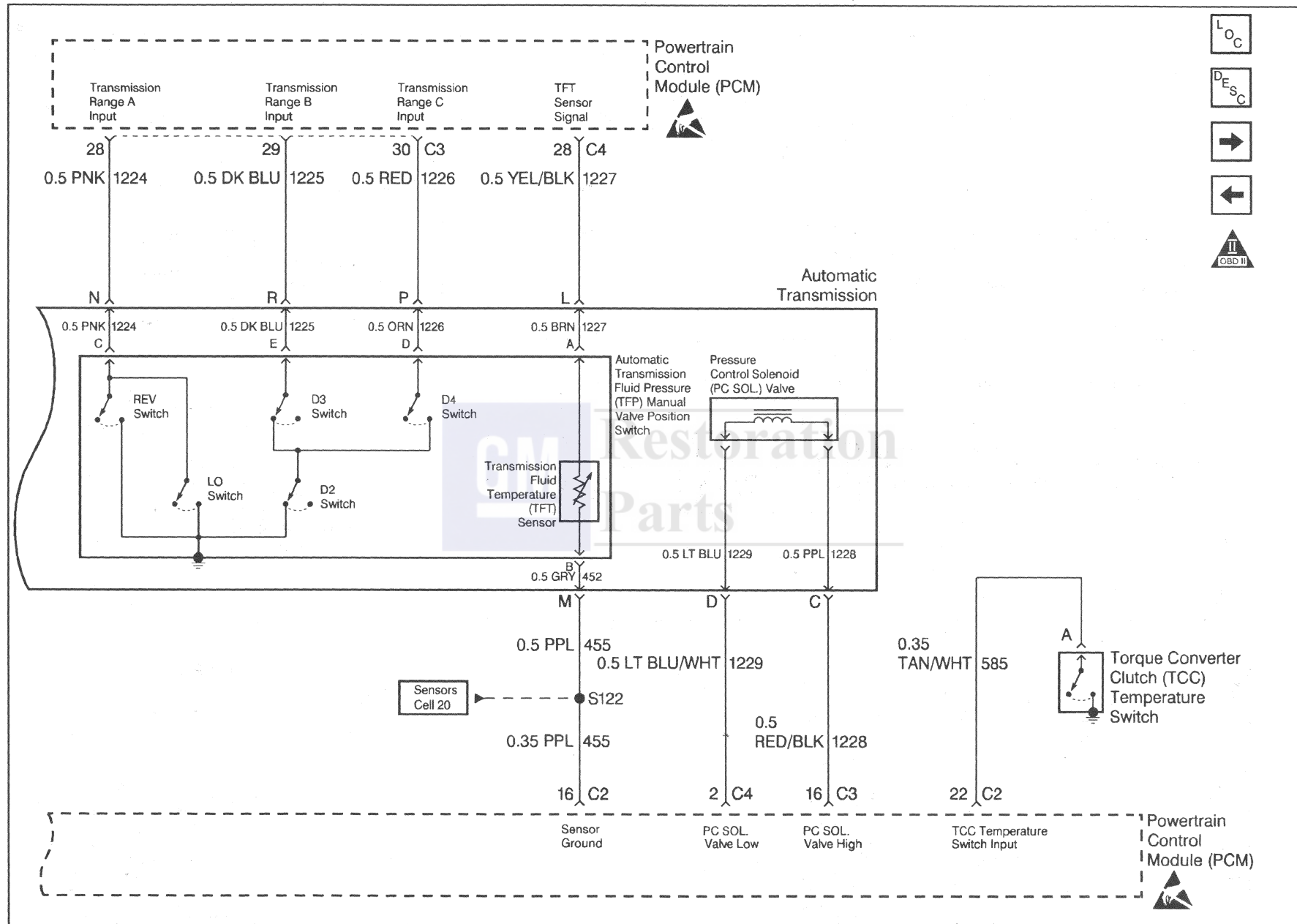
6E-24 Engine Controls - 5.7L



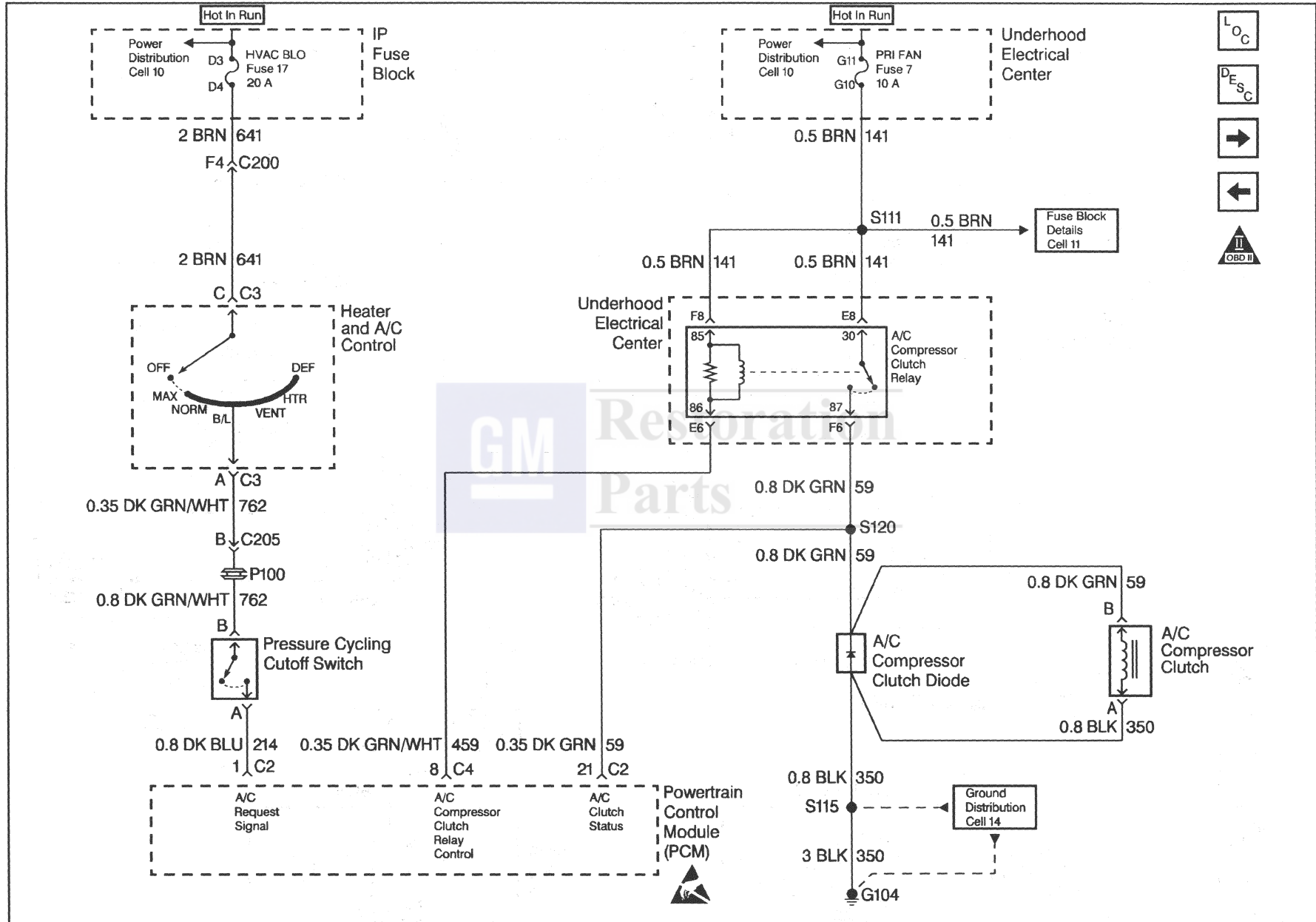
Engine



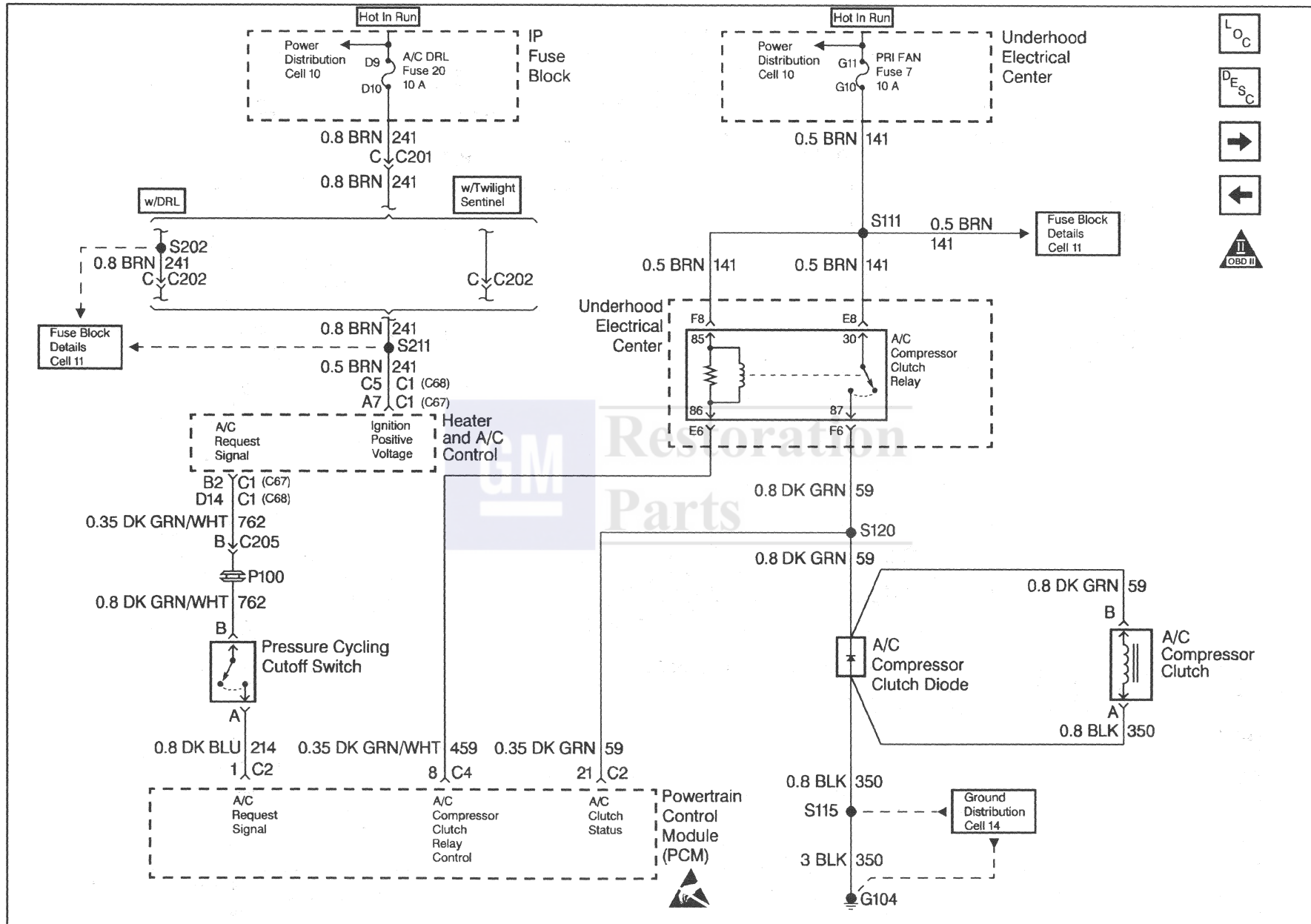
Engine Controls (Transmission Controls)



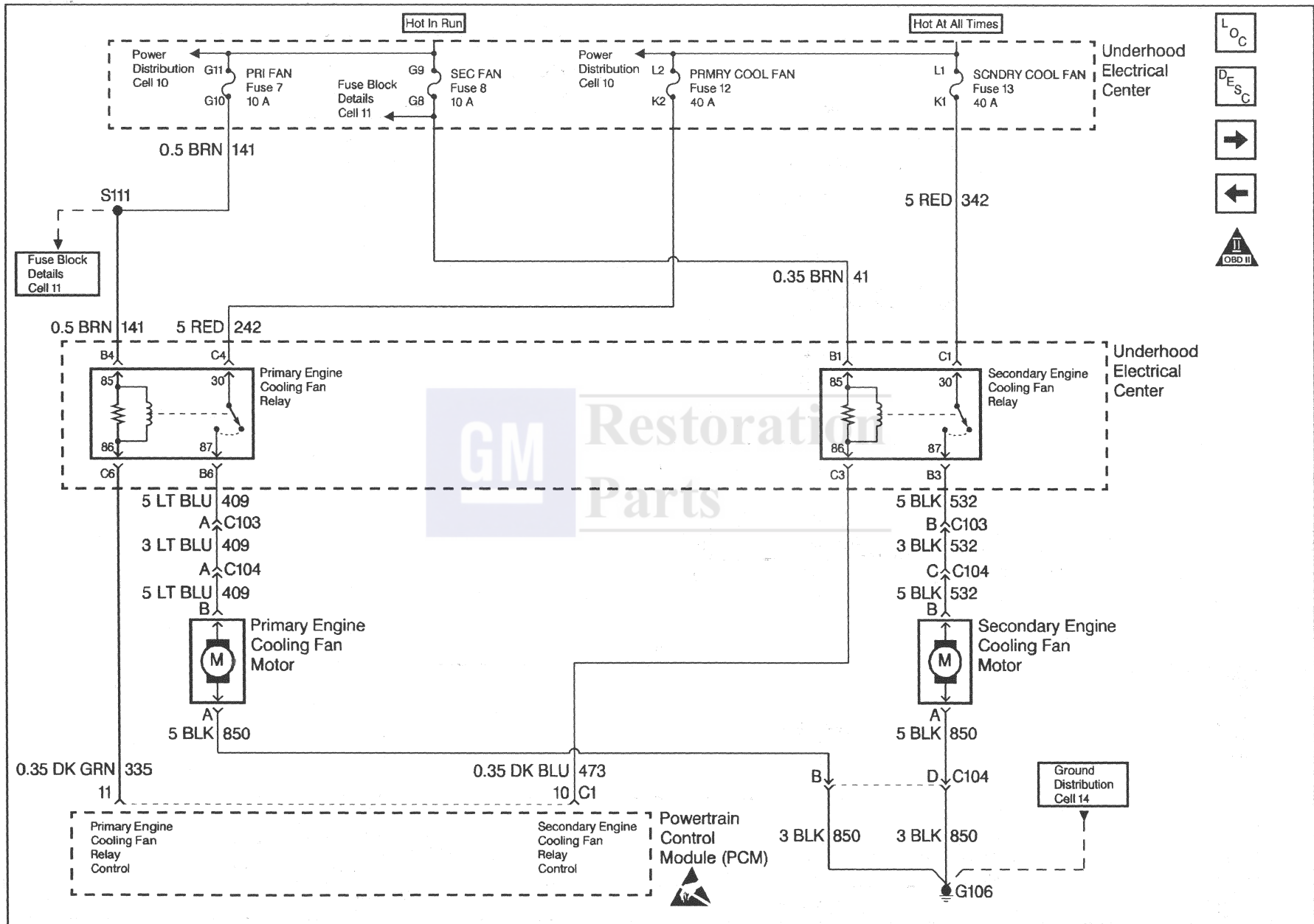
Engine Controls (A/C Controls - C60)



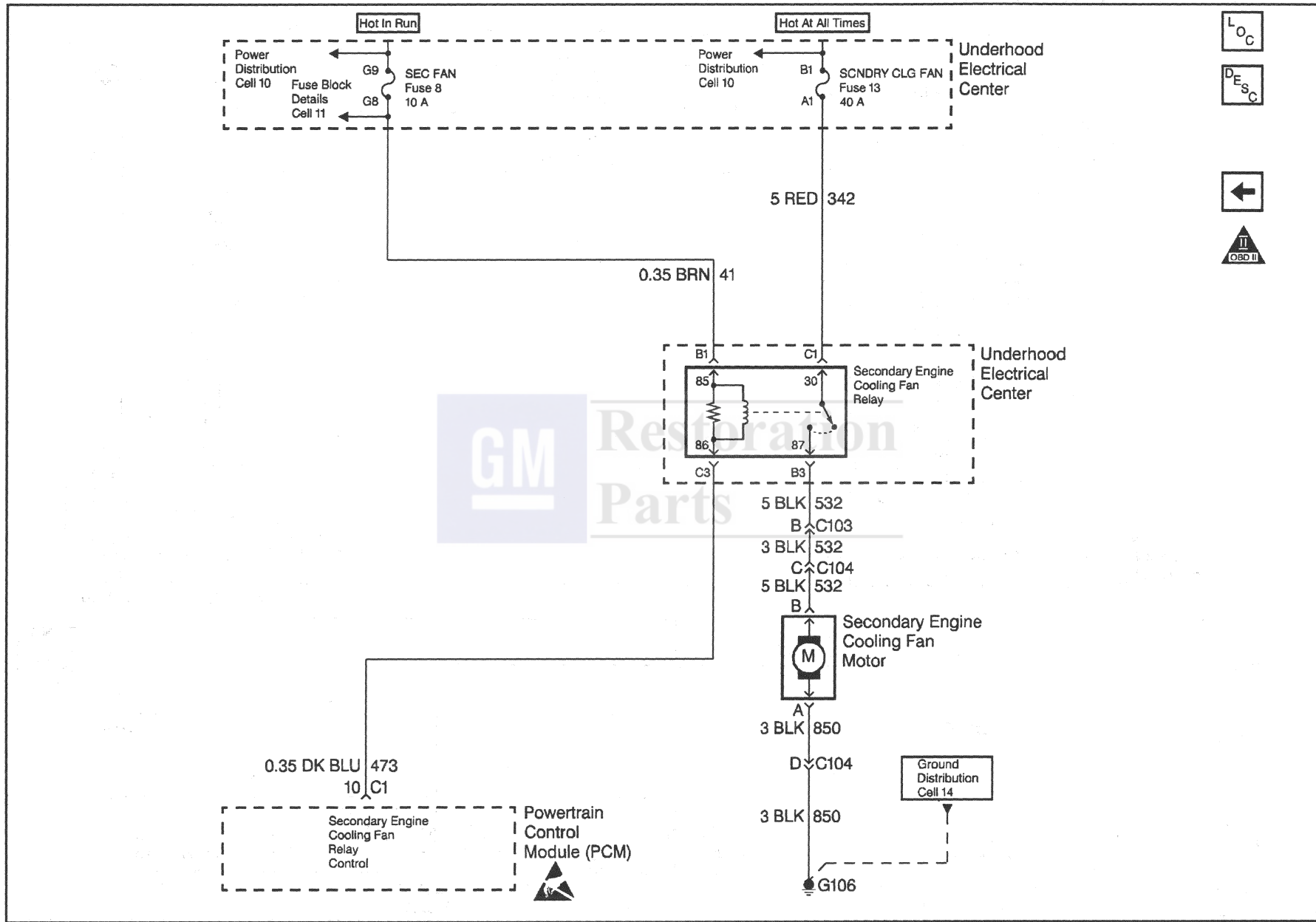
Engine Controls (A/C Controls - C67 and C68)



Engine Controls (Engine Cooling Fan Control - w/o VO8)



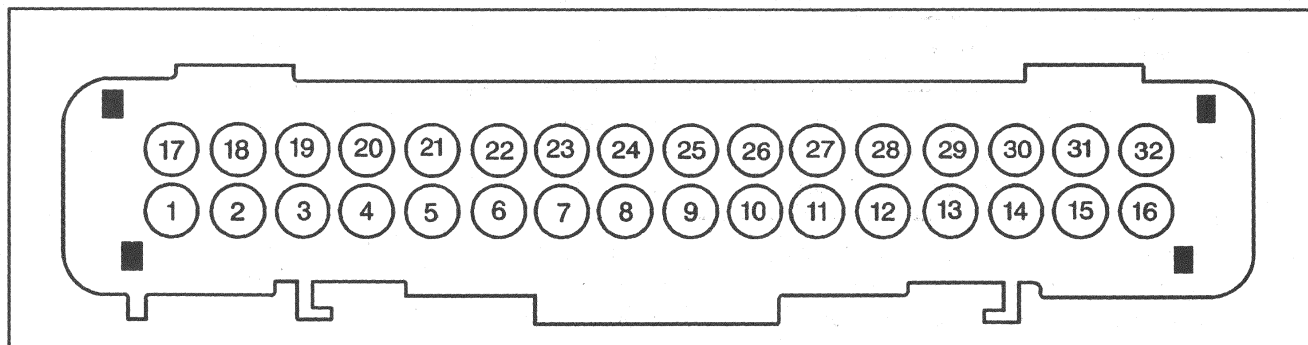
Engine Controls (Engine Cooling Fan Control - VO8)



Component Locator

Engine Controls Connector End Views

Connector C1 - 32 Pin Connector (Red)

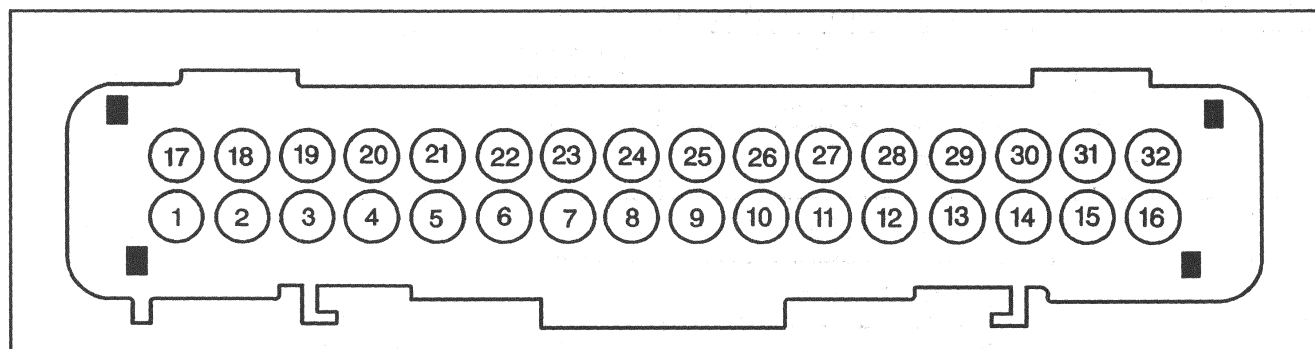


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Connector C1 32 Pin Connector (Red)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
1	Yel	573	Crankshaft Position Sensor Signal	CKP C	P0335, P0336	Misfire diagnostic inoperative
2	Blk/Wht	451	PCM Ground	Engine Ground *	—	Engine cranks but will not start.
3	Blk	1744	Injector #1 Control	Injector #1 A	P0200 (3) P1222	Rough idle, Engine miss
4	Lt Blu/Blk	844	Injector #4 Control	Injector #4 A	P0200 (3) P1222	Rough idle, Engine miss
5	Yel/Blk	846	Injector #6 Control	Injector #6 A	P0200 (3) P1222	Rough idle, Engine miss
6	Red/Blk	877	Injector #7 Control	Injector #7 A	P0200 (3) P1222	Rough idle, Engine miss
7	Dk Grn/Wht	465	FP Relay Control	FP Relay 85	—	Long Crank Time Before Engine Starts
8	—	—	—	—	—	—
9	Gry	435	EGR Vacuum Control signal solenoid valve	EGR Solenoid B	P0400 P0403 (3)	Detonation, Stall, Rough Idle, And Poor Performance
10	Dk Blu	473	Secondary Cooling fan relay control	Fan Relay 86	P1642 (3)	Inoperative Cooling Fan or Fan ON At All Times
11	Dk Grn	335	Primary cooling Fan relay Control. (not used with VO8 option)	Fan Relay 86	P1641 (3)	Inoperative Cooling Fan or Fan ON At All Times
12	—	—	—	—	—	—
13	Wht	121	Engine Speed Output Signal	*	P1643 (3)	Tach inoperative
14	Brn	436	AIR Pump Relay Control	AIR Pump Relay C1	P0412 (3)	AIR Pump Inoperative or ON At All Times.
15	—	—	—	—	—	—
16	—	—	—	—	—	—
17	—	—	—	—	—	—

Connector C1 32 Pin Connector (Red)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
18	Blk/Wht	451	PCM Ground	Engine Ground *	—	Engine cranks but will not start.
19	Lt Grn/Blk	1745	Injector #2 Control	Injector #2 A	P0200 (3) P1222	Rough idle, Engine miss
20	Blk/Wht	845	Injector #5 Control	Injector #5 A	P0200 (3) P1222	Rough idle, Engine miss
21	Pnk/Blk	1746	Injector #3 Control	Injector #3 A	P0200 (3) P1222	Rough idle, Engine miss
22	Dk Blu/Wht	878	Injector #8 Control	Injector #8 A	P0200 (3) P1222	Rough idle, Engine miss
23	Orn/Blk	463	Traction Control System Spark Retard Request	C3-B	—	Poor Performance EBTM DTC 74
24	—	—	—	—	—	—
25	Blu	229	Fuel Enable Signal	*	P1626	Engine Cranks But Will Not Start
26	—	—	—	—	—	—
27	—	—	—	—	—	—
28	—	—	—	—	—	—
29	—	—	—	—	—	—
30	—	—	—	—	—	—
31	Ppl	401	VSS Signal Low	VSS A	P0500 P0502 P0503 P1652 (1)	Inoperative Speedometer, Inoperative Cruise Control, Radio Volume will not increase with vehicle Speed. Transmission Restricted to second Gear.
32	Yel	400	VSS Signal High	VSS B	P0500 P0502 P0503 P1652 (1)	Inoperative Speedometer, Inoperative Cruise Control, Radio Volume will not increase with vehicle Speed. Transmission Restricted to second Gear.

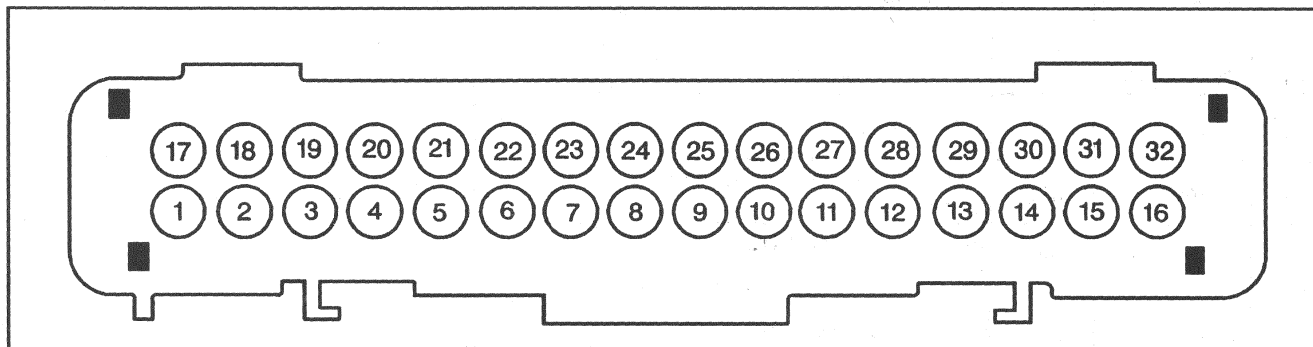
Connector C2 - 32 Pin Connector (Black)



20329

PCM Connector C2 (Black)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted To Voltage * Refer To Electrical Diagnosis			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
1	Dk Blue	214	A/C Request Signal	A/C Pressure cycling switch B	—	A/C Inoperative (1) A/C ON at all times
2	Red/Blk	453	Low Resolution Signal	Test Connector A Distributor A	P1371 (3)	Engine Cranks But Will Not Start
3	Pnk/Blk	632	Distributor Reference Low Signal	Test Connector D Distributor D	—	Engine Cranks But Will Not Start (1)
4	—	—	—	—	—	—
5	Wht	423	Ignition Control	Ignition Coil Module "B"	P1351 (1,4) P1361 (2)	Engine Cranks But Will Not Start
6	Blk	452	Sensor Ground	IAT A, TP sensor B Trans M,	P0118 (1) P0122 (1) P1118 (1) P0713 (1)	Lack of Power, Rough Idle, High Idle and TCC May Not Apply Properly
7	Lt Grn	1222	Transmission 1-2 Shift Solenoid control	Trans A	P0753 (3,4)	Second and Third Gear, or Forth Gear Only
8	Dk Grn/Wht	817	VSS Output	Cruise module and I/P	P1652 (3,4)	Speedometer Inoperative Cruise Inoperative
9	—	—	—	—	—	—
10	—	—	—	—	—	—
11	Brn/Wht	1173	Low Oil Lamp Control	*	P1653	Low Oil Lamp ON at all times or OFF at all times
12	Yel/Blk	1223	Transmission 2-3 Shift Solenoid control	Trans B	P0758 (3,4)	Second or Third Gear Only, No TCC Apply
13	Brn	687	Transmission 3-2 Shift Solenoid control	Transmission S	P0785 (3,4)	Harsh 3-2 Downshift, Third Gear Only
14	Red	631	Distributor Ignition Feed	Test Connector C Distributor C	—	Engine Cranks But Will Not Start
15	Orn	440	PCM Battery Positive Voltage	*	*	Engine Cranks But Will Not Start (3)
16	Ppl	455	Sensor Ground	MAP A ECT A	P0113 (1) P0108 (1) P0530 (1)	Poor Performance, A/C Inoperative

PCM Connector C2 (Black)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted To Voltage * Refer To Electrical Diagnosis			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
17	—	—	—	—	—	—
18	—	—	—	—	—	—
19	Yel	492	MAF Sensor Signal	MAF A	P0100 P0101 P0102 (2) P0103	Engine Stall, Hesitation When Malfunction Occurs
20	Ppl/Wht	430	High Resolution Signal	Test Connector B Distributor B	P1372 (3,4)	Engine Surge, Lack of Power
21	Dk Grn	59	A/C Clutch Status	A/C clutch relay C7 A/C clutch B	P1539 (4) P1546 (1)	A/C Inoperative
22	Tan/Wht	585	TCC Fluid Temperature Switch Signal (5.7 Only)	TCC fluid temperature sensor	—	Modified transmission shift patterns
23	Ppl	1986	EVAP Vacuum Switch	EVAP Vacuum Switch B	P0441 P1441	—
24	—	—	—	—	—	—
25	—	—	—	—	—	—
26	Orn/Blk	495	PSP Switch signal	PSP A	—	Stalling, unstable idle
27	Brn	1174	Engine oil level sensor signal	Oil level sensor B	—	Incorrect low oil lamp operation.
28	Gry	416	5 Volt reference	TP sensor A A/C refrigerant pressure sensor B	P0123 (3)	High Idle, Lack of Performance
29	Gry	474	5 Volt reference	MAP sensor C	P0107 (3) P0530 (3)	A/C Inoperative
30	Pnk	539	PCM Ignition Positive Voltage	—	—	Engine Cranks But Will Not Start
31	Orn	440	PCM Battery Positive Voltage	—	—	—
32	—	—	—	—	—	—

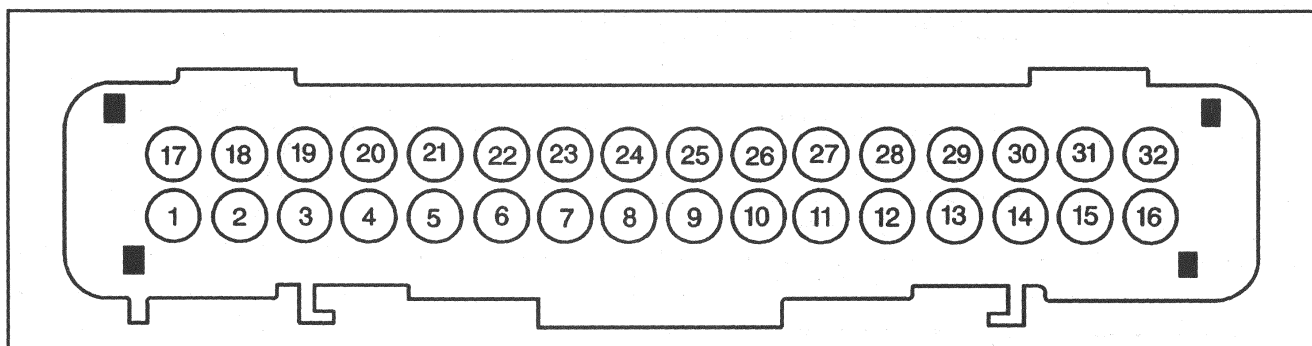
Connector C3 - 32 Pin Connector
 (Clear or Gray)


20329

PCM Connector C3 (Clear or Gray)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
1	Lt Blu/Wht	1747	IAC Coil A High	IAC D	P0506 P0507 P1508 P1509	Incorrect Idle, Surge, Stall
2	Lt Blu/Blk	1748	IAC Coil A Low	IAC C	P0506 P0507 P1508 P1509	Incorrect Idle, Surge, Stall
3	Tan	1671	Bank 2 (Right Rear) HO2S #2 Low	HO2S A	—	—
4	Ppl	1670	Bank 2 (Right Rear) HO2S #2 High	HO2S B	—	—
5	Lt Grn/Blk	444	IAC Coil B Low	IAC A	P0506 P0507 P1508 P1509	Incorrect Idle, Surge, Stall
6	Lt Grn/Wht	1749	IAC Coil B High	IAC B	P0506 P0507 P1508 P1509	Incorrect Idle, Surge, Stall
7	Tan	1667	Bank 2 (Right Front) HO2S #2 Low	HO2S A	P0154 (1)	Rough Idle, Lean Exhaust, Poor Performance and Poor Fuel Economy
8	Ppl	1666	Bank 2 (Right Front) HO2S #2 High	HO2S B	P0151 (2) P0152 (4)	Rough Idle, Lean Exhaust, Poor Performance and Poor Fuel Economy
9	—	—	—	—	—	—
10	—	—	—	—	—	—
11	—	—	—	—	—	—
12	—	—	—	—	—	—
13	—	—	—	—	—	—
14	Ppl	420	Brake Switch Signal	Brake Switch A	P0703 (3,4)	No TCC

PCM Connector C3 (Clear or Gray)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
15	Orn/Blk	434	PNP Switch	PNP Switch B	—	Poor Fuel Economy, Stall, Incorrect Idle
16	Red/Blk	1228	Transmission Pressure Control Solenoid	Transmission C	P0748 (3)	Harsh Transmission Shift
17	Tan/Wht	1669	Bank 1 (Left Rear) HO2S #2 Low	HO2S A	P0140 (1)	—
18	Ppl/Wht	1668	Bank 1 (Left Rear) HO2S #2 High	HO2S B	P0137 P0138 P0140	—
19	Tan/Wht	1653	Bank 1 (Left Front) HO2S #1 Low	HO2S A	P0134 (1)	Rough Idle, Lean Exhaust, Poor Performance and Poor Fuel Economy
20	Ppl/Wht	1665	Bank 1 (Left Front) HO2S #1 High	HO2S B	P0131 (2) P0132 (4) P0134 (1)	Rough Idle, Lean Exhaust, Poor Performance and Poor Fuel Economy
21	Tan	472	IAT Sensor Signal	IAT B	P0112 (2) P0113 (1) P1111 (2) P1112 (1)	Poor Fuel Economy
22	Dk Blu	417	TP Sensor Signal	TP Sensor C	P0121 P0122 (4) P0123 (3) P1121 (3) P1122 (4)	High Idle, Lack of Power, Harsh Transmission Shifts
23	Lt Grn	432	MAP Sensor Signal	MAP B	P0106 P0107 (3) P0108 (4) P1107 (3)	Modified Shift Patterns
24	—	—	—	—	—	—
25	Yel	410	ECT Sensor Signal	ECT B	P0117 (2) P0118 (1) P0125 P1114 (2) P1115 (1)	Exhaust Odor, Rough Idle, Poor Fuel Economy, TCC Apply Cold
26	—	—	—	—	—	—
27	—	—	—	—	—	—
28	Pnk	1224	Transmission Range Signal A	Transmission N	P1810 (3)	No TCC, Harsh Shift
29	Dk Blu	1225	Transmission Range Signal B	Transmission R	P1810 (3)	No TCC, Harsh Shift
30	Red	1226	Transmission Range C	Transmission P	P1810 (3)	No TCC, Harsh Shift
31	—	—	—	—	—	—
32	Blk/Whit	451	PCM Ground	Engine Block	—	Engine Cranks But Will Not Start

Connector C4 - 32 Pin Connector (Blue)



20329

PCM Connector C4 (Blue)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
1	Blk/Wht	451	PCM Ground	Engine Block	—	Engine Cranks But Will Not Start
2	Lt Blu/Wht	1229	Transmission Pressure Control Solenoid Low	Transmission D	P0748 (3)	Harsh Transmission Shifts
3	Pnk	539	PCM Ignition Positive Voltage	*	—	Engine Cranks But Will Not Start
4	—	—	—	—	—	—
5	—	—	—	—	—	—
6	Brn	418	Transmission TCC PWM Solenoid	Transmission U	—	TCC Inoperative
7	Ppl	1807	Serial Data (Class 2)	DLC 2	—	No Scan Tool Communications
8	Dk Grn/Wht	459	A/C Clutch Control	A/C Clutch Relay D7	P1545 P1539	A/C Clutch Inoperative, A/C on At All Times
9	Brn/Wht	419	MIL Control	*	P1661	MIL On All Times or MIL Inoperative
10	Dk Grn/Wht	428	EVAP Canister Purge Solenoid Valve Control	EVAP Canister Purge Solenoid Valve B	P0443 P0441	Purge Inoperative or Purge On At All Times (3)
11	Tan/Blk	422	Transmission TCC Solenoid	Transmission T	—	TCC Inoperative or On At All Times
12	Red/Blk	380	A/C Refrigerant Pressure Sensor Signal	A/C Refrigerant Pressure Sensor C	P0530	A/C Inoperative
13	—	—	—	—	—	—
14	—	—	—	—	—	—
15	—	—	—	—	—	—
16	Pnk	1439	Change Oil Lamp Control	Change oil lamp	P1663	Light ON at all times or light OFF at all times.
17	—	—	—	—	—	—
18	—	—	—	—	—	—
19	—	—	—	—	—	—
20	—	—	—	—	—	—

PCM Connector C4 (Blue)			(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit (4) Shorted to Voltage (*) Refer to <i>Electrical Diagnosis</i>			
Pin	Wire Color	Circuit No.	Function	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From a Faulty Circuit
21	Lt Blu	1876	Bank 1 (Left) KS Signal	Left Knock Sensor	P0327 (3)	Lack of performance and/or detonation
22	Dk Blu	496	Bank 2 (Right) KS Signal	Right Knock Sensor	P0332 (3)	Lack of performance and/or detonation
23	—	—	—	—	—	—
24	—	—	—	—	—	—
25	—	—	—	—	—	—
26	—	—	—	—	—	—
27	—	—	—	—	—	—
28	Yel/Blk	1227	Transmission Fluid Temperature Sensor Signal	Transmission L	P0712 P0713	Early or Delayed Transmission Shifts
29	—	—	—	—	—	—
30	Tan	800	Serial Data (UART)	*	—	—
31	—	—	—	—	—	—
32	—	—	—	—	—	—

Engine Controls Component Location

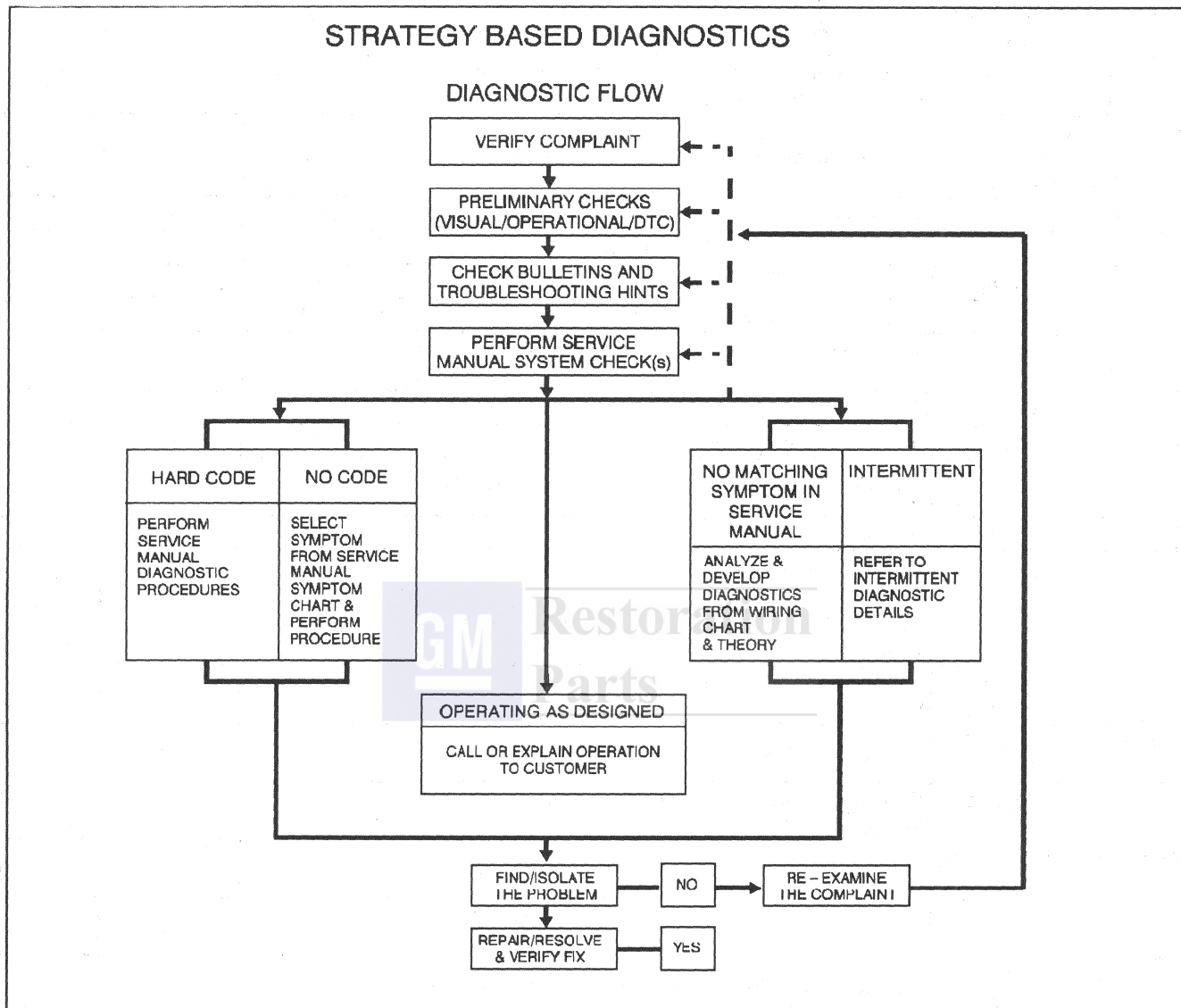
Name	Location	8A Cell 201 Figure:	Connector End View	Group No.
A/C Compressor Clutch Relay	Underhood electrical Center	—	—	—
A/C Cycling Switch	RH rear of the engine compartment, attached to the A/C accumulator	—	—	—
A/C Refrigerant Pressure Sensor	In high pressure line, below coolant reservoir	12	—	—
Bank #1, Left Front Heated Oxygen Sensor (HO2S)	Lower LH side of the Engine, Forward of the Three-way Catalytic Converter (TWC)	—	—	—
Bank #1, Left Rear Heated Oxygen Sensor (HO2S)	Lower RH side of the Engine, Rear of the Three-way Catalytic Converter (TWC)	—	—	—
Bank #2, Right Front Heated Oxygen Sensor (HO2S)	Lower RH side of the Engine, Forward of the Three-way Catalytic Converter (TWC)	—	—	—
Bank #2, Right Rear Heated Oxygen Sensor (HO2S)	Lower RH side of the Engine, Rear of the Three-way Catalytic Converter (TWC)	—	—	—
Crankshaft (CKP) Position Sensor	Lower right side of the Engine, in the Front Engine Cover	—	—	—
Data Link Connector (DLC)	Below LH side of the I/P, right of the Steering Column	22	—	—
Distributor	Front of the Engine behind the Engine Coolant Pump	12	—	—
Engine Coolant Temperature (ECT) Sensor	Lower front of the Engine, mounted to the Coolant Pump	16	—	—
Engine Oil level Sensor	LH side of the Engine Oil pan	—	—	—

Engine Controls Component Location (cont'd)

Name	Location	8A Cell 201 Figure:	Connector End View	Group No.
Evaporative Emissions (EVAP) Canister Purge Solenoid Valve	Top RH front of the Engine, near the Manifold Absolute Pressure (MAP) Sensor	12	—	—
Evaporative Emission Vacuum Switch	Forward of the EVAP Canister Purge Solenoid Valve, Right side of the Engine	—	—	—
Exhaust Gas Recirculation (EGR) Solenoid Valve	Top LH Rear of the Engine, near the EGR Valve	11	—	—
Fuel Injectors	Top of the Engine in the Fuel Rail above each Cylinder	11, 12	—	—
Fuel Pump	Rear of the Vehicle in the Fuel Tank	—	—	—
Fuel Pump Relay	Underhood electrical Center	—	—	—
I/P Fuse Block	LH I/P, accessible with LH front door open	19	—	—
Idle Air Control (IAC) Motor	Top RH Front of the Engine on the side of the Throttle Body	12	—	—
Ignition Coil	LH Front of the Engine	11	—	—
Ignition Coil Module	LH Front of the Engine	11	—	—
Intake Air Temperature (IAT) Sensor	Front of the Engine, in the side of the Air Intake Duct	12	—	—
Instrument Cluster	LH side of the I/P	16	—	—
Knock Sensor, LH	Bottom LH side of the Engine below the Exhaust Manifold	—	—	—
Knock Sensor, RH	Bottom RH side of the Engine below the Exhaust Manifold	—	—	—
Manifold Absolute Pressure (MAP) Sensor	Top RH Front of the Engine, Mounted to the Intake Manifold	12	—	—
Mass Air Flow (MAF) Sensor	Front of the Engine, in the Air Intake Duct	—	—	—
Park Neutral Position switch	Near base of steering column, on column or near floor mounted shifter	—	—	—
Power steering pressure switch	In power steering line near the power steering pump	—	—	—
Powertrain Control Module (PCM)	Engine Compartment, forward of LH wheelhouse under air cleaner	8	—	—
Secondary Air Injection (AIR) Bleed Valve Solenoid	Left Side of the Engine Compartment, attached to the AIR Pump	—	—	—
Secondary Air Injection (AIR) Pump	LH Front of the Engine	1	—	—
Secondary Air Injection (AIR) Pump Relay	Underhood electrical center	—	—	—
Throttle Position (TP) Sensor	Top RH Front of the Engine on the side of the Throttle Body	12	—	—
Theft deterrent module	Behind left hand I/P, left of the brake pedal bracket	19	—	—
Underhood electrical center	Engine Compartment, attached to the RH Wheelhouse	1	—	—
Vehicle speed sensor	RH rear of the transmission, near the prop shaft	28	—	—
Refer to 8A Engine Controls Section for connector, ground, pass through grommet, and splice location references.				

Diagnostic Information and Procedures

Strategy Based Diagnostic Flow



6508

The strategy based diagnostic is a uniform approach to repair all Electrical and Electronic (E/E) systems. Resolve an E/E system problem using the diagnostic flow. The diagnostic flow is also a starting point when repairs are necessary. The steps below are defined in order to instruct the technician how to proceed with a diagnosis.

Verify the Customer Complaint

In order to verify the customer complaint the technician should know the normal operation of the system.

Preliminary Checks

Perform the following steps:

1. Conduct a thorough visual inspection
2. Review the service history
3. Detect unusual sounds or odors
4. Gather diagnostic trouble code information in order to achieve an effective repair

Check Bulletins and Other Service Information

This should include videos, newsletters, and Pulsat programs.

Service Information System Checks

A system may not be supported by one or more DTCs. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.

Service Diagnostics (Paper and Electronic)

1. DTC Stored - Follow the designated DTC Table exactly to make an effective repair.
2. No DTC - Select the symptom from the symptom tables and follow the diagnostic paths or suggestions to complete the repair, or refer to the applicable component/system check.
3. No Matching Symptom - Analyze the complaint. Develop a plan for diagnostics. Utilize the wiring diagrams and theory of operation.
4. Intermittents - Conditions that are not always present are intermittent. In order to resolve Intermittents, perform the following steps:
 - 4.1. Observe the history DTCs, the DTC modes and, the freeze frame data.
Call technical assistance for similar cases where repair history may be available. Combine the technician knowledge with efficient use of the available service information.
 - 4.2. Evaluate the symptoms and conditions described by the customer.
 - 4.3. Use a check sheet or other method in order to identify the circuit or electrical system component.
 - 4.4. Follow the suggestions for intermittent diagnosis found in the service documentation.

4.5. The Tech 1, Tech 2 and Fluke 87 scan tools have data capturing capabilities that can assist in detection of Intermittents.

5. Vehicle operates as designed/No trouble found
6. Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.
 - 6.1. This condition exists when the vehicle is found to operate normally.
 - 6.2. The condition described by the customer may be normal. Verify against another vehicle that is operating normally.
 - 6.3. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

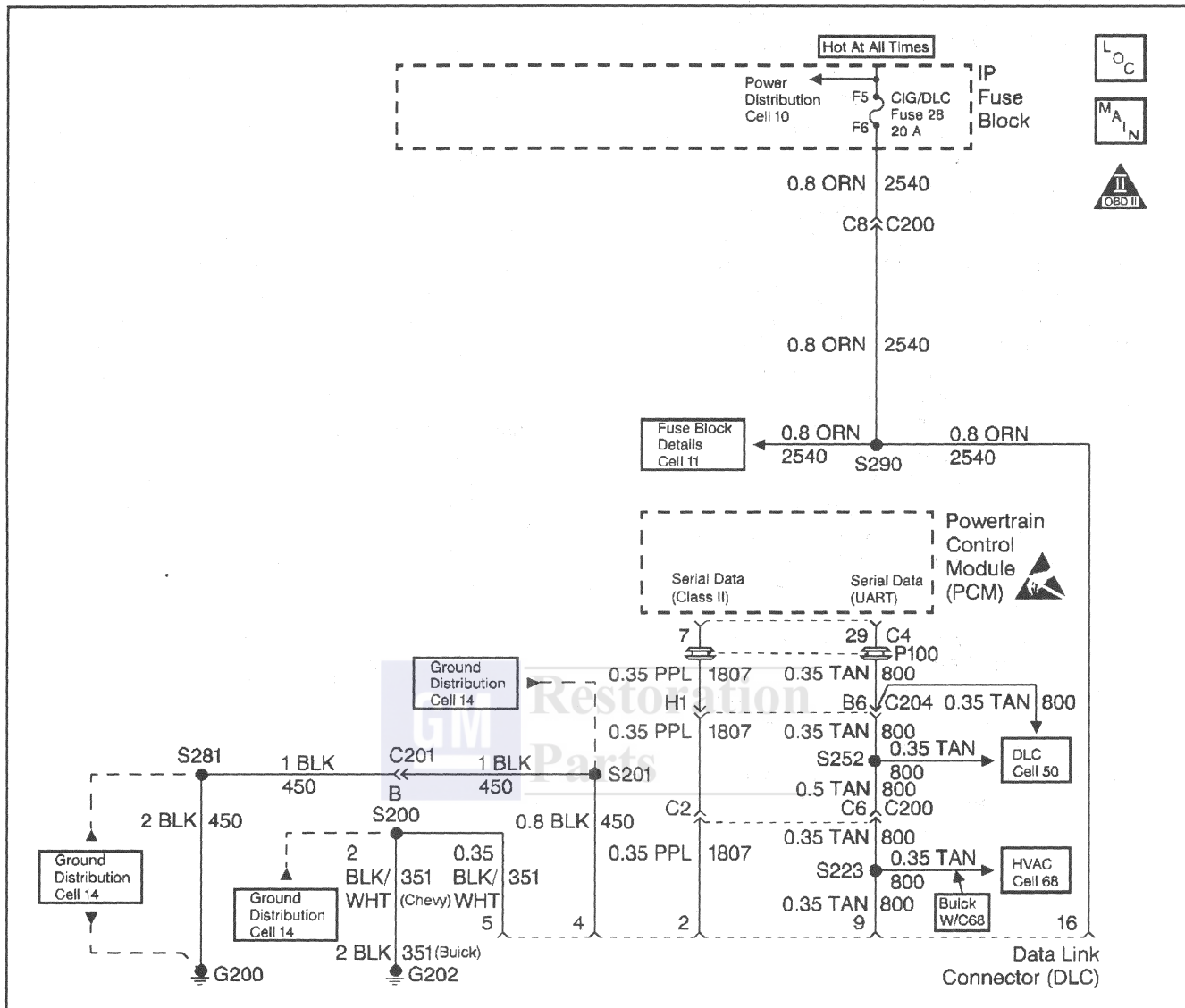
Re-Examine the Complaint

When the complaint cannot be successfully found or isolated, a reevaluation is necessary. The complaint should be re-verified and could be intermittent or normal.

Repair and Verification Tests

After isolating the cause, the repairs should be made. Then validate for proper operation and verify that the symptom has been corrected. This may involve road testing the vehicle in order to verify that the complaint has been resolved.

Powertrain OBD System Check



30388

Description

The Powertrain OBD system check is an organized approach to identifying a problem created by an electronic engine control system malfunction. The Powertrain OBD system check must be the starting point for any driveability complaint diagnosis. The Powertrain OBD system check directs the service technician to the next logical step in diagnosing a complaint. *Do not perform this check if no driveability complaint exists.* Understanding the table and using it correctly will reduce diagnostic time and prevent the replacement of good parts.

Important: This vehicle is equipped with a Powertrain Control Module (PCM) utilizing an Electrically Erasable Programmable Read Only Memory (EEPROM). When diagnostics call for replacement of the PCM, the new PCM must be programmed.

Refer to *PCM Replacement/Programming* Refer to *Data Link Connector* for schematic.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

1. The diagnostic tables in this section are designed for use with a scan tool. If the scan tool is inoperative, this must be corrected before beginning any other diagnostic procedures. DO NOT Clear Info unless instructed by a diagnostic procedure.
3. If multiple DTCs are stored, diagnose in the following order of priority:
 1. PCM failure DTCs (P0601, P0602).
 2. System Voltage DTCs.

3. Component level DTCs (Sensors, Solenoids, Relays etc.). Multiple DTCs within this category should be diagnosed in numerical order starting with the lowest numbered DTC.
4. System level DTCs (Misfire, Fuel Trim, etc.).

Always Diagnose Last Tst Fail before History.

For Transmission DTCs, Refer to the Transmission Section 7A-14A.

Important: Checking for applicable service bulletins before proceeding with diagnosis is recommended

4. If a DTC is only in history, it may be beneficial to review Frez Frme Data and/or Fail Records. Use the odometer information and the fail counter to determine how frequently and how recently the DTC set. This information and the other operating conditions when the DTC set may help diagnose an intermittent problem. This is explained further in *Symptoms*.

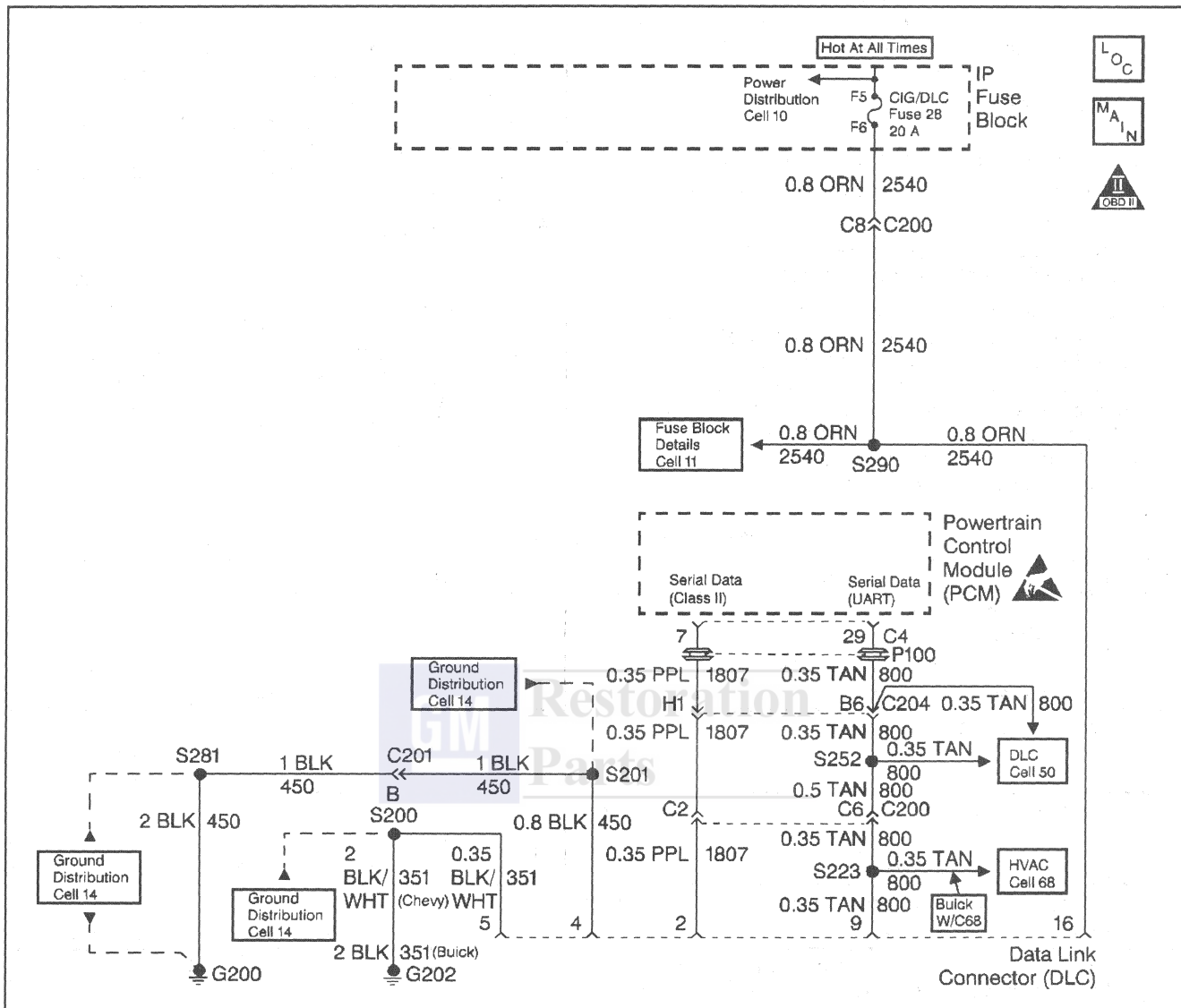
5. Capturing stored info will preserve data that will be lost when instructed to Clear Info at the end of a diagnostic table, or if a PCM disconnect or replacement occurs during a diagnostic procedure. The data is stored in the scan tools memory. The captured info should be reviewed at the end of the diagnostic table to catch the next DTC in the event multiple DTCs were stored. Follow the order of priority as listed for Step 3 above.

6. Compare actual control system data with the values in the *Engine Scan Tool Data List* to determine if any parameter is not within limits. Keep in mind that a base engine problem (i.e. advanced cam timing) may substantially alter sensor values. If the actual data does not correspond with the values in the *Engine Scan Tool Data List* refer to the appropriate system/component diagnostic aids or test descriptions.

Powertrain OBD System Check

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool to the Data Link Connector (DLC). 2. Turn the ignition ON, engine OFF. Does the scan tool display data?	—	Go to Step 2	Go to No Scan Tool Data
2	Does the engine start and run?	—	Go to Step 3	Go to Engine Cranks but Does Not Run
3	Using the scan tool, select Eng DTC, DTC Info, Last Tst Fail. Are any DTCs displayed?	—	Go to Step 5	Go to Step 4
4	Using the scan tool, select Eng DTC, DTC Info, History. Are any DTCs displayed?	—	Go to Step 5	Go to Step 6
5	Using the scan tool, select Capture Info, then Store Info (this option will only be displayed if there is no previously captured data) or Refresh Info (to overwrite older data with current info). Is the action complete?	—	Go to the applicable DTC table	—
6	Compare the scan tool data with the values shown in the <i>Engine Scan Tool Data List</i> . Are the values normal or within typical ranges?	—	Go to Symptoms	Go to Diagnostic Aids and Test Descriptions

No Scan Tool Data



30388

Circuit Description

The diagnostic tables in this section are designed for use with a scan tool. If the scan tool is inoperative, this must be corrected before beginning any other diagnostic procedures. DO NOT Clear Info unless instructed by a diagnostic procedure.

Important: This vehicle is equipped with a Powertrain Control Module (PCM) utilizing an Electrically Erasable Programmable Read Only Memory (EEPROM). When diagnostics call for replacement of the PCM, the new PCM must be programmed. Refer to *PCM Replacement/Programming*

For schematic, refer to *Data Link Connector*

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

10. Some older scan tools are powered through a separate power cord from the cigar lighter. If this type of scan tool is being used, and the tool will not power up, check for a poor connection, or a malfunctioning lighter socket. Refer to *Repair Procedures in Electrical Diagnosis (8A, Cell 114, Cigar Lighter)* for circuit details.
14. Before trying a different scan tool, check for poor connections between the DLC and the scan tool cable. A faulty Vehicle Interface Module (VIM) can also cause loss of communication.

15. If there is no communication between the PCM and the scan tool, no data will be displayed. Class 2 Serial Data is shut down when system voltage is below 9.0 Volts or above 16.0 Volts. A scan tool will not display data if system voltage is outside this range. If no data is displayed with the engine running, but data is displayed with the ignition ON, engine OFF, high system voltage (overcharging) may be at fault. If this is the case, the scan tool should display DTC P0563 System Voltage High with the ignition ON, engine OFF.

18. Before trying a different scan tool, check for poor connections between the DLC and the scan tool cable. A faulty Vehicle Interface Module (VIM) can also cause loss of communication.

Some older scan tools are powered through a separate power cord from the cigar lighter, but the VIM gets its power and ground through the DLC connector. If this type of scan tool is being used, and the tool powers up but no data is displayed, proceed to Step 10.

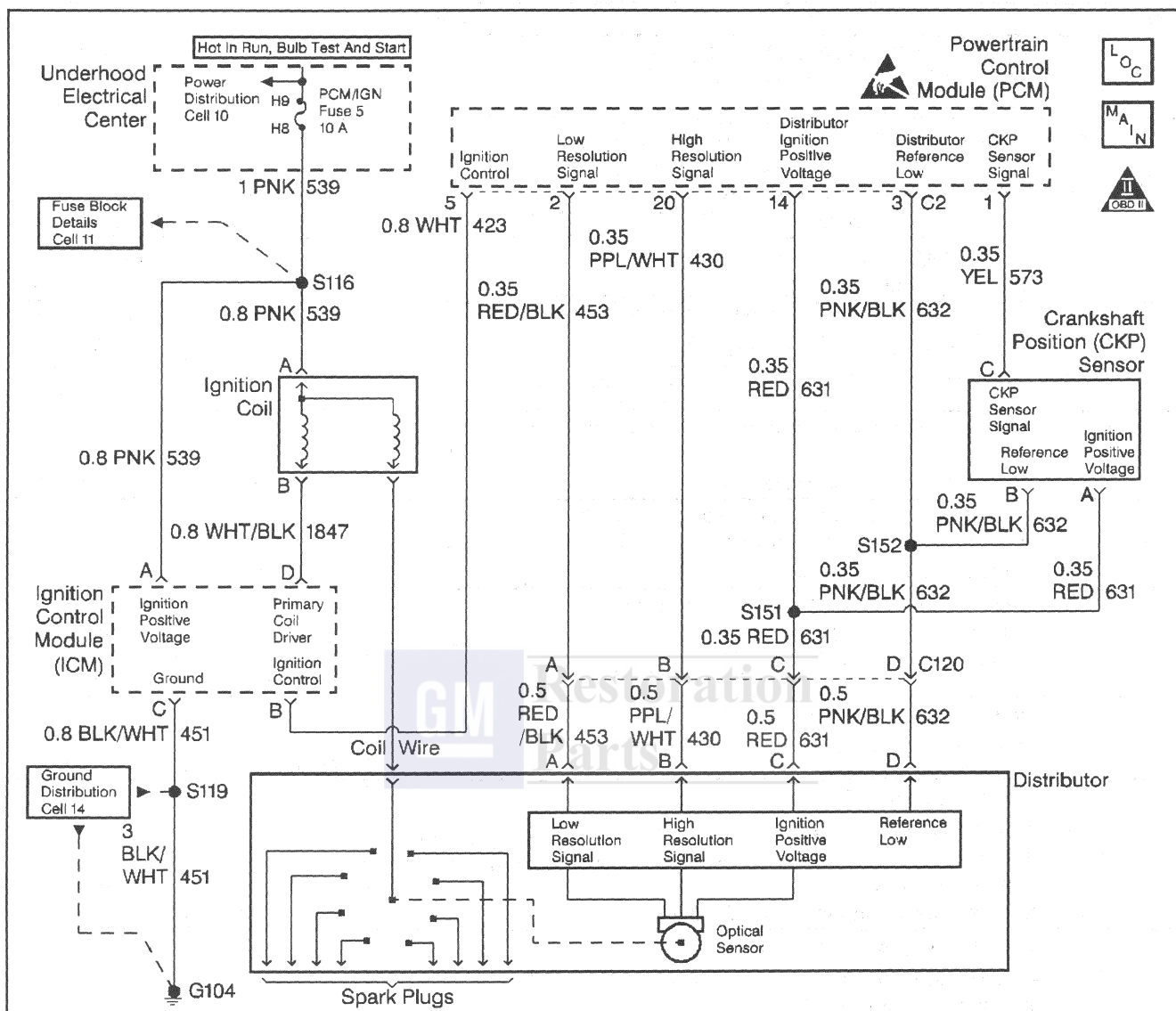
No Scan Tool Data

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	With the scan tool connected to the DLC connector and the ignition ON, engine OFF, is the scan tool powered up?	—	Go to Step 3	Go to Step 10
3	Does the engine start and run?	—	Go to Step 15	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Turn the ignition ON. 4. Using the test light J 34142-B connected to ground, probe the PCM battery and the ignition feed circuits in the PCM harness connectors. 5. Does the test light illuminate on each circuit?	—	Go to Step 5	Go to Step 7
5	Using the DVM J 39200, measure the resistance between the chassis ground and the PCM ground circuits in the PCM harness connectors. Does the DVM display the specified value (or lower) on each circuit?	5 Ω	Go to Step 6	Go to Step 8
6	Check for faulty connections at the PCM. Was a problem found and corrected?	—	Go to Powertrain OBD System Check	Go to Step 9
7	Repair the circuit that did not illuminate the test light. Is the action complete?	—	Go to Powertrain OBD System Check	—
8	Repair the faulty PCM ground circuit(s). Is the action complete?	—	Go to Powertrain OBD System Check	—
9	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Powertrain OBD System Check	—
10	1. Disconnect the scan tool from the DLC. 2. Using the test light J 34142-B connected to chassis ground, probe DLC terminal 16. 3. Does the test light illuminate?	—	Go to Step 11	Go to Step 12
11	Using DVM J 39200, measure the resistance between DLC terminals 4 and 5 and chassis ground. Does the DVM display the value shown (or lower)?	5 Ω	Go to Step 14	Go to Step 13

No Scan Tool Data (cont'd)

Step	Action	Value(s)	Yes	No
12	Repair the B+ circuit to DLC terminal 16. Refer to <i>Electrical Diagnosis, Data Link Connector (DLC)</i> . Is the action complete?	—	Go to Powertrain OBD System Check	—
13	Repair the ground circuit to DLC terminals 4 and 5. Refer to <i>Electrical Diagnosis, Data Link Connector (DLC)</i> . Is the action complete?	—	Go to Powertrain OBD System Check	—
14	Replace the faulty scan tool. Is the action complete?	—	Go to Powertrain OBD System Check	—
15	Using the DVM J 39200, measure the resistance between DLC terminals 4 and 5 and chassis ground. Does the DVM display the specified value (or lower)?	5 Ω	Go to Step 16	Go to Step 17
16	Check the Class 2 Serial Data circuit for being open, shorted to power or ground. Refer to <i>Electrical Diagnosis, Data Link Connector (DLC)</i> . Was a problem found and corrected?	—	Go to Powertrain OBD System Check	Go to Step 18
17	Repair the ground circuit to DLC terminals 4 and 5. Refer to <i>Electrical Diagnosis, Data Link Connector (DLC)</i> . Is the action complete?	—	Go to Powertrain OBD System Check	—
18	Verify the scan tool operation on another vehicle. Does the scan tool display data?	—	Go to Step 19	Go to Step 20
19	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Powertrain OBD System Check	—
20	Replace the faulty scan tool. Is the action complete?	—	Go to Powertrain OBD System Check	—

Engine Cranks but Does Not Run



30389

Description

This table assumes that battery condition and engine cranking speed are OK. If not, refer to *Engine Electrical* for diagnosis. Also, make sure that there is adequate fuel in the tank.

Diagnostic Aids

- An EGR valve sticking open can cause a low air/fuel ratio during cranking.
- Unless the engine enters Clear Flood at the first indication of a flooding condition, a no start may result.
- Check the duct work between the Mass Air Flow (MAF) sensor and the throttle body for air leaks.

- A malfunctioning MAF sensor may cause a no start or a stall after start. If this is suspected, disconnect the MAF sensor. The PCM will default to speed density (MAP, IAT, RPM) to calculate load and air flow. If this corrects the condition and the connections are OK, replace the MAF sensor.

If the steps above check OK, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- If no RPM was indicated on the scan tool during cranking, the power and ground to the distributor from the PCM are both OK, and DTC P1371-DI Low Resolution Circuit is not set, Replace the PCM.

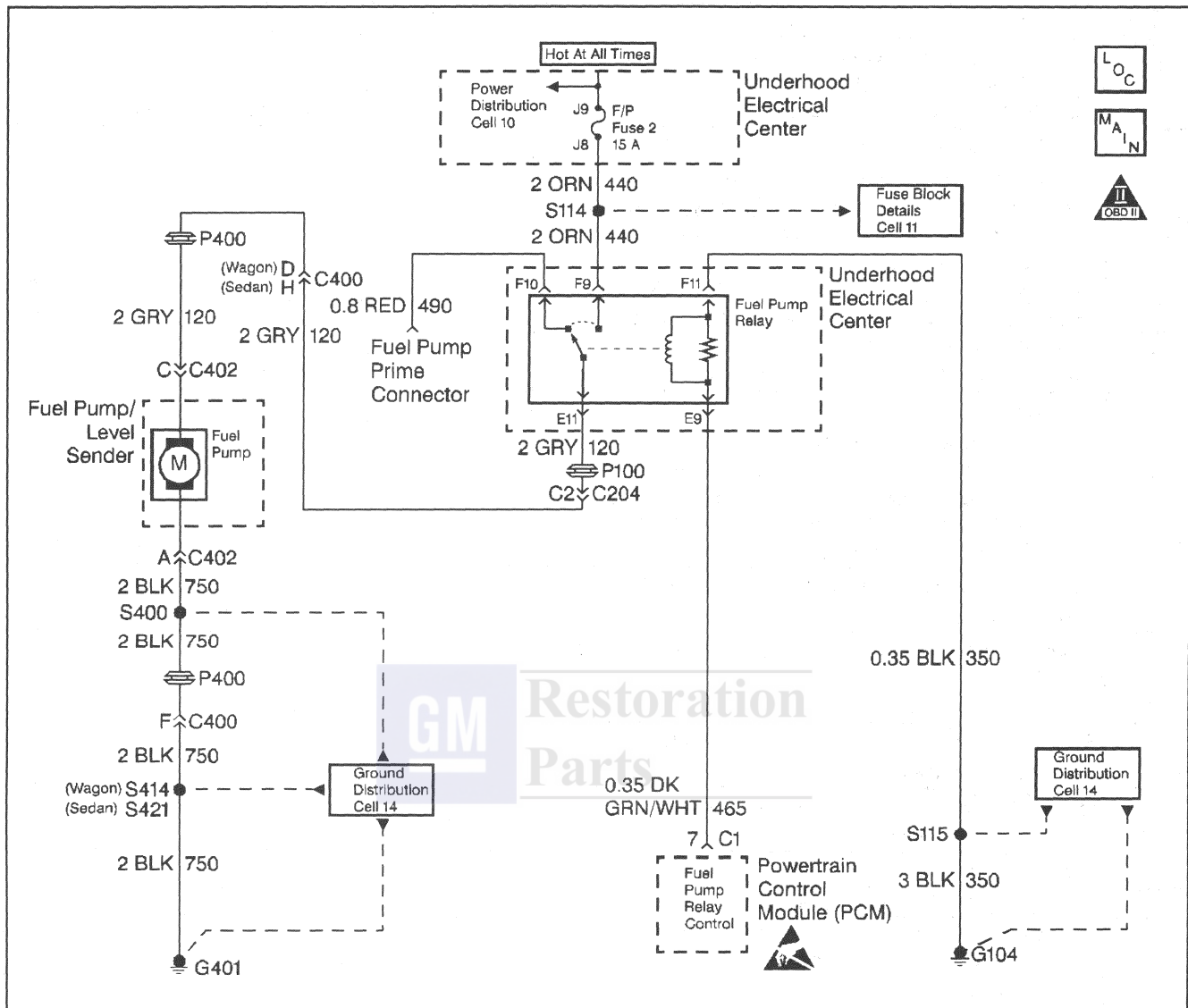
Engine Cranks but Does Not Run

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Using the scan tool, select ENG DTC, DTC Info, LAST TST FAIL. Are any of the following DTCs displayed: P0100, P0200, P0601, P0602, P1351, P1361, P1371?	—	Go to the applicable DTC table	Go to Step 3
3	Using the scan tool, check Pass Key status. Does the scan tool indicate OK?	—	Go to Step 4	Go to Theft Deterrent System
4	Using the scan tool, check Eng Cool Temp. Is the Eng Cool Temp on the scan tool close to the actual engine temperature?	—	Go to Step 5	Go to DTC P0118 ECT Sensor Circuit High Voltage
5	Using the scan tool, check Throttle Angle at a closed throttle. Is the Throttle Angle at the specified value?	0%	Go to Step 6	Go to DTC P0122 TP Sensor Circuit Low Voltage
6	Using the scan tool, check the Engine Speed while cranking the engine. Is RPM indicated on the scan tool?	—	Go to Step 7	Go to Step 11
7	Using Spark Tester J 26792 (ST-125), check for spark while cranking the engine (check 2 wires). Is spark present?	—	Go to Step 8	Basic ignition problem. Go to Distributor Ignition System Check
8	Using the scan tool, enable the fuel pump. Does the fuel pump operate?	—	Go to Step 9	Go to Fuel Pump Relay Circuit Diagnosis
9	1. Turn the ignition OFF. 2. Install a fuel pressure gauge and note the fuel pressure. 3. Turn the ignition ON. Is the fuel pressure within the specified range?	283–325 kPa (41–47 psi)	Go to Step 10	Go to Fuel System Diagnosis
10	Perform the following additional checks: - An EGR valve sticking open can cause a low air/fuel ratio during cranking. - Unless the engine enters Clear Flood at the first indication of a flooding condition, a no start may result. - Check the duct work between the Mass Air Flow (MAF) sensor and the throttle body for air leaks. - A malfunctioning MAF sensor may cause a no start or a stall after start. If this is suspected, disconnect the MAF sensor. The PCM will default to speed density (MAP, IAT, RPM) to calculate load and air flow. If this corrects the condition and the connections are OK, replace the MAF sensor. Was a problem found and corrected?	—	Go to Step 21	Go to Hard Start for diagnosis.
11	1. Turn the ignition OFF. 2. Disconnect the distributor electrical connector. 3. Turn the ignition ON. 4. Probe terminal C of the harness connector with a test light to ground. Does the test light illuminate?	—	Go to Step 12	Go to Step 13

Engine Cranks but Does Not Run (cont'd)

Step	Action	Value(s)	Yes	No
12	Using DVM J 39200 measure resistance from harness connector terminal D to ground. Does the DVM display the specified value (or lower)?	5 Ω	Go to Step 21	Go to Step 15
13	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Using DVM J 39200, check continuity of the ignition feed circuit from the distributor connector to the PCM connector. Does the DVM display the specified value (or lower)?	5 Ω	Go to Step 14	Go to Step 16
14	Using DVM J 39200, measure the resistance from the distributor connector terminal C to ground. Does the DVM display infinite resistance?	—	Go to Step 20	Go to Step 17
15	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Using DVM J 39200, check the continuity of the distributor reference low signal circuit from the distributor connector to the PCM connector. Does the DVM display the specified value (or lower)?	5 Ω	Go to Step 20	Go to Step 18
16	Repair the open ignition feed circuit to the distributor. Is the action complete?	—	Go to Step 22	—
17	Repair the short to ground in the ignition feed circuit to the distributor. Is the action complete?	—	Go to Step 22	—
18	Repair the distributor reference low circuit (ground). Is the action complete?	—	Go to Step 22	—
19	Replace the distributor. Refer to <i>Ignition System</i> . Is the action complete?	—	Go to Step 22	—
20	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 22	Go to Step 21
21	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 22	—
22	1. Using the scan tool, select DTC, Clear Info. 2. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 23	Go to Step 2
23	1. Allow engine to idle until normal operating temperature is reached. 2. Select DTC, Fail This Ign. Are any DTCs displayed?	—	Go to the applicable DTC table	Go to Step 24
24	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

Fuel Pump Relay Circuit Diagnosis



Circuit Description

When the ignition switch is turned ON, the PCM will activate the in-tank fuel pump. The fuel pump will remain ON as long as the PCM is receiving reference pulses from the distributor ignition system. If there are no reference pulses, the PCM will turn the fuel pump OFF after about 2–3 seconds. The pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled at 284–325 kPa (41–47 psi). Excess fuel is returned to the fuel tank. When the engine is stopped, the fuel pump can be turned ON with a scan tool.

- Improper fuel system pressure will result in one or many of the following symptoms:
- Cranks but will not run.

- Cuts out, may feel like an ignition problem.
- Poor fuel economy.
- Loss of power.
- Hesitation.
- DTCs.

Diagnostic Aids

The following conditions may have caused the fuel pump fuse to open:

- The fuse was faulty
- There is an intermittent short in the fuel pump power feed circuit.
- The fuel pump has an intermittent internal problem. Refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

12. If the fuse is open, this circuit should be checked for a possible short to ground. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)* for circuit details.

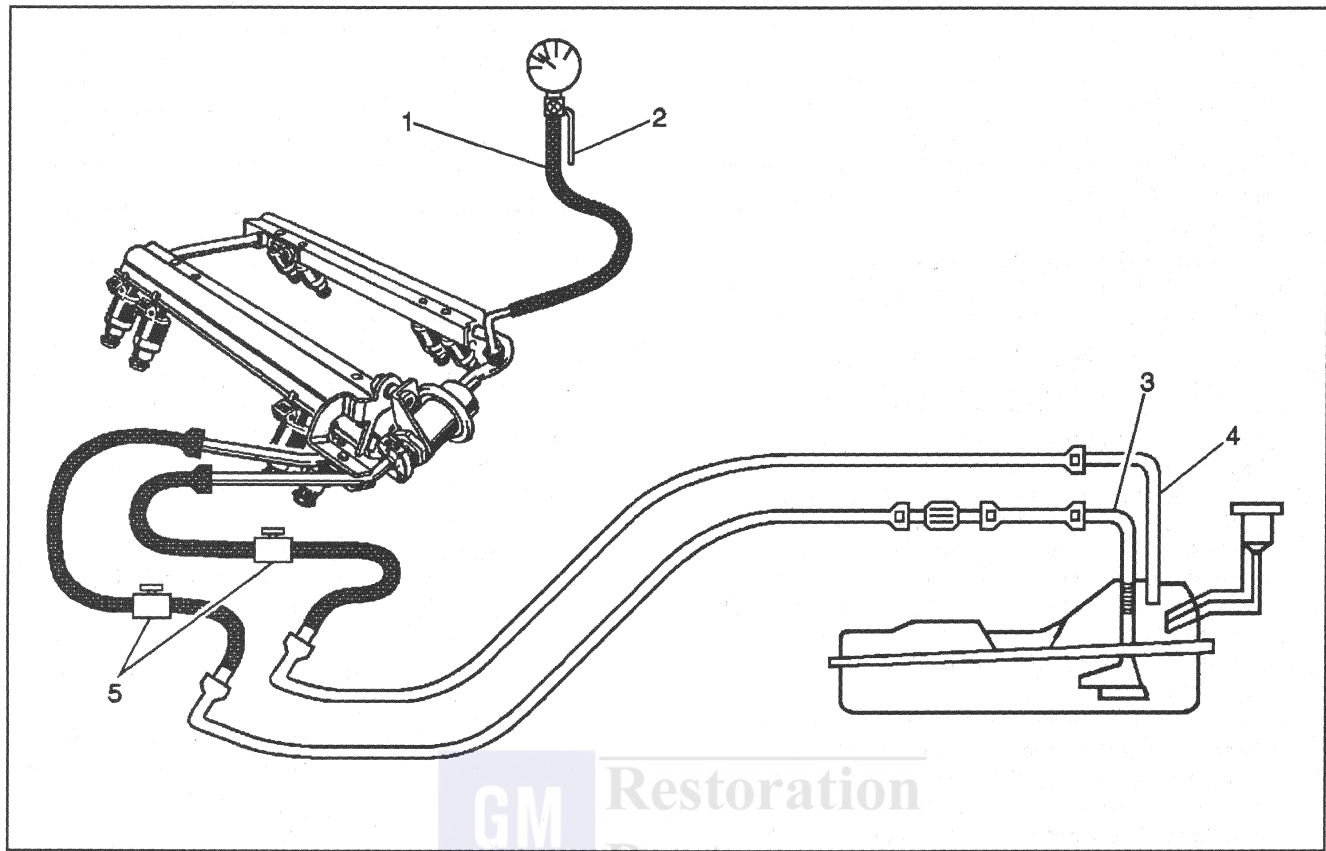
Fuel Pump Relay Circuit Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Check the fuel pump fuse. Is the fuse open?	—	Go to Step 9	Go to Step 3
3	1. Disconnect the fuel pump relay. 2. Probe the battery feed circuit in the fuel pump relay harness connector with test light J 34142-B connected to ground. Does the test light illuminate?	—	Go to Step 4	Go to Step 12
4	Probe the ground circuit in the fuel pump relay harness connector with test light J 34142-B connected to B+. Does the test light illuminate?	—	Go to Step 5	Go to Step 13
5	1. Probe the control circuit in the fuel pump relay harness connector with test light J 34142-B connected to ground. 2. Using a scan tool, enable the fuel pump. Does the test light illuminate?	—	Go to Step 6	Go to Step 11
6	Using a fused jumper wire, jumper the battery feed circuit to the fuel pump circuit in the fuel pump relay harness connector. Does the fuel pump run?	—	Go to Step 18	Go to Step 7
7	1. Leave the fused jumper wire connected. 2. Disconnect the fuel pump harness connector at the fuel pump. 3. Probe the power feed circuit in the fuel pump harness connector with test light J 34142-B connected to ground. Does the test light illuminate?	—	Go to Step 8	Go to Step 14
8	1. Leave the fused jumper wire connected. 2. Connect the test light J 34142-B between the power feed circuit and the ground circuit in the fuel pump harness connector. Does the test light illuminate?	—	Go to Step 20	Go to Step 15
9	1. Turn the ignition OFF. 2. Remove the fuel pump fuse. 3. Disconnect the fuel pump harness connector at the fuel pump. 4. Probe the power feed circuit in the fuel pump harness connector with test light J 34142-B connected to B+. Does the test light illuminate?	—	Go to Step 16	Go to Step 10

Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Reconnect the fuel pump. 2. Install a new fuel pump fuse. 3. Turn the ignition ON. 4. Recheck the fuel pump fuse. Is the fuse open?	—	Go to Step 20	Go to Diagnostic Aids - Table A-5 Fuel Pump Circuit
11	1. Turn the ignition OFF. 2. Disconnect the PCM connector C1. 3. Using DVM J 39200, check continuity of the fuel pump relay control circuit from the relay harness connector to the PCM connector. Does the DVM display the specified value (or lower)?	5 Ω	Go to Step 22	Go to Step 17
12	Repair the open relay battery feed circuit. Is the action complete?	—	Go to Step 24	—
13	Repair the open relay ground circuit. Is the action complete?	—	Go to Step 24	—
14	Repair the open fuel pump feed circuit. Is the action complete?	—	Go to Step 24	—
15	Repair the open fuel pump ground circuit. Is the action complete?	—	Go to Step 24	—
16	Repair the short to ground in the fuel pump feed circuit. Is the action complete?	—	Go to Step 24	—
17	Repair the fuel pump relay control circuit. Is the action complete?	—	Go to Step 24	—
18	Check for poor connections at the relay. Was a problem found and corrected?	—	Go to Step 24	Go to Step 19
19	Replace the relay. Is the action complete?	—	Go to Step 24	—
20	Check the fuel pump harness for damage. Was a problem found and corrected?	—	Go to Step 24	Go to Step 21
21	Replace the fuel pump. Refer to <i>Engine Fuel</i> . Is the action complete?	—	Go to Step 24	—
22	Check for poor connections at the PCM. Was a problem found and corrected?	—	Go to Step 24	Go to Step 23
23	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 24	—
24	1. Using the scan tool, select DTC, Clear Info. 2. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 25	Go to Step 2
25	1. Allow engine to idle until normal operating temperature is reached. 2. Select DTC, Fail This Ign. Are any DTCs displayed?	—	Go to the applicable DTC table	Go to Step 26
26	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

Fuel System Diagnosis



21317

Legend

- (1) J 34730-1A Fuel Pressure Gauge
- (2) Fuel Pressure Gauge Bleed Hose
- (3) Feed Pipe
- (4) Return Pipe
- (5) J 37287 Fuel Line Shut-off Adapters

Circuit Description

When the ignition switch is turned ON, the Powertrain Control Module (PCM) will turn ON the in-tank fuel pump. The in-tank fuel pump will remain ON as long as the engine is cranking or running and the PCM is receiving reference pulses. If there are no reference pulses, the PCM will turn the in-tank fuel pump OFF 2 seconds after the ignition switch is turned ON or 2 seconds after the engine stops running.

The in-tank fuel pump is an electric pump within an integral reservoir. The in-tank fuel pump supplies fuel through an in-pipe fuel filter to the fuel rail assembly. The fuel pump is designed to provide fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate fuel return pipe. The fuel pump test connector is located near the A/C accumulator.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. When the ignition switch is ON and the fuel pump is running, the fuel pressure indicated by the fuel pressure gauge should be 284–325 kPa (41–47 psi). This pressure is controlled by spring pressure inside the fuel pressure regulator.
3. A fuel system that can not maintain a constant fuel pressure has a leak in one or more of the following areas:
 - The fuel pump check valve.
 - The fuel pump feed hose.
 - The valve or valve seat within the fuel pressure regulator.
 - The fuel injector(s).

4. Fuel pressure that drops-off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging, or misfire. A lean condition can be diagnosed using a scan tool. If an extremely lean condition occurs, the heated oxygen sensors(s) will stop toggling. The heated oxygen sensor output voltage(s) will drop below 300 mV. Also, the fuel injector pulse width will increase.

Important: Make sure the fuel system is not operating in the Fuel Cut-Off Mode. This can cause false indications by the scan tool.

7. When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in Step 2 with the engine OFF.
12. A rich condition may result from the fuel pressure being above 325 kPa (47 psi). A rich condition may cause DTC P0132, DTC P0152, DTC P0172 or DTC P0175 to set. Driveability conditions associated with rich conditions can include hard starting (followed by black smoke) and a strong sulfur smell in the exhaust.
13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
16. A lean condition may result from the fuel pressure being below 284 kPa (41 psi). A lean condition may cause DTC P0131, DTC P0151, DTC P0171 or DTC P0174 to set. Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging, and misfiring.

17. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated fuel pressure. Using a scan tool to pressurize the system, the fuel pressure should rise above 325 kPa (47 psi) as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.

Notice: Do not allow the fuel pressure to exceed 414 kPa (60 psi). Fuel Pressure in excess of 414 kPa (60 psi) may damage the fuel pressure regulator.

23. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure:

1. Remove the fuel rail, but leave the fuel pipes connected to the fuel rail. Refer to Fuel Rail Assembly.
2. Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

Caution: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports, and verify that the fuel injector retaining clips are intact.

Pressurize the fuel system by using the scan tool fuel pump enable.

3. Visually and physically inspect the fuel injector nozzles for leaks.
25. The fuel pressure regulator filter screen is designed to trap any contaminants introduced during engine assembly. If the fuel pressure regulator screen is dirty, it can be removed with a small pick and discarded without potential harm to the fuel pressure regulator.

Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition OFF. 2. Turn the air conditioning system OFF. Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete. 3. Install the J34730 fuel pressure gauge (refer to 1 in the illustration). 4. Place the bleed hose (refer to 2 in the illustration) of the fuel pressure gauge into an approved gasoline container. 5. Turn the ignition ON. 6. Bleed the air out of the fuel pressure gauge. 7. Turn the ignition OFF for 10 seconds. 8. Turn the ignition ON. Important: The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 9. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	284–325 kPa (41–47 psi)	Go to Step 3	Go to Step 12
3	Important: The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running the fuel pressure should stabilize and remain constant. After the fuel pump stops running, does the fuel pressure remain constant?	—	Go to Step 4	Go to Step 9
4	Is the fuel pressure suspected of dropping-off during acceleration, cruise, or hard cornering.	—	Go to Step 5	Go to Step 7
5	Visually and physically inspect the following items for a restriction: • The fuel filter. • The fuel feed pipe (refer to (3) in the illustration). Was a restriction found?	—	Go to Step 26	Go to Step 6
6	1. Remove the fuel sender assembly. Refer to Fuel Sender Assembly Replacement. 2. Visually and physically inspect the following items: • The fuel pump strainer for a restriction. • The fuel pump feed hose for leaks. • Verify the fuel pump is the correct fuel pump for this vehicle. Was a problem found in any of these areas?	—	Go to Step 26	Go to Step 20

Fuel System Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. Does the fuel pressure drop by the amount specified?	21–69 kPa (3–10 psi)	Go to <i>Symptoms</i>	Go to <i>Step 8</i>
8	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12–14 inches of vacuum to the fuel pressure regulator manifold vacuum hose connection. Does the fuel pressure drop by the amount specified?	21–69 kPa (3–10 psi)	Go to <i>Step 21</i>	Go to <i>Step 22</i>
9	1. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 2. Disconnect the fuel feed pipe (refer to (3) in the illustration) and the fuel return pipe (refer to (4) in the illustration) from the fuel rail. Refer to Servicing Quick-Connect Fittings. 3. Install the J 37287 fuel pipe shut-off adapters (refer to (5) in the illustration) between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition OFF. 6. Using a 10 amp fused jumper, connect the fuel pump test connector to B+. 7. Place the bleed hose (refer to (2) in the illustration) of the fuel pressure gauge (refer to (1) in the illustration) into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. 9. Wait for the fuel pressure to build. 10. Disconnect the 10 amp fused jumper. 11. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe. Does the fuel pressure remain constant?	—	Go to <i>Step 10</i>	Go to <i>Step 11</i>
10	1. Remove the fuel sender assembly. Refer to Fuel Sender Assembly Replacement. 2. Visually and physically inspect the fuel pump feed hose. Is the fuel pump feed hose leaking?	—	Go to <i>Step 20</i>	Go to <i>Step 20</i>
11	1. Open the valve in the fuel pipe shut-off adapter (refer to (5) in the illustration) that is connected to the fuel feed pipe (refer to (3) in the illustration). 2. Using a 10 amp fused jumper, connect the fuel pump test connector to B+. 3. Wait for the fuel pressure to build. 4. Disconnect the 10 amp fused jumper. 5. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe (refer to (4) in the illustration). Does the fuel pressure remain constant?	—	Go to <i>Step 22</i>	Go to <i>Step 23</i>
12	Is the fuel pressure above the specified limit?	325 kPa (47 psi)	Go to <i>Step 13</i>	Go to <i>Step 16</i>

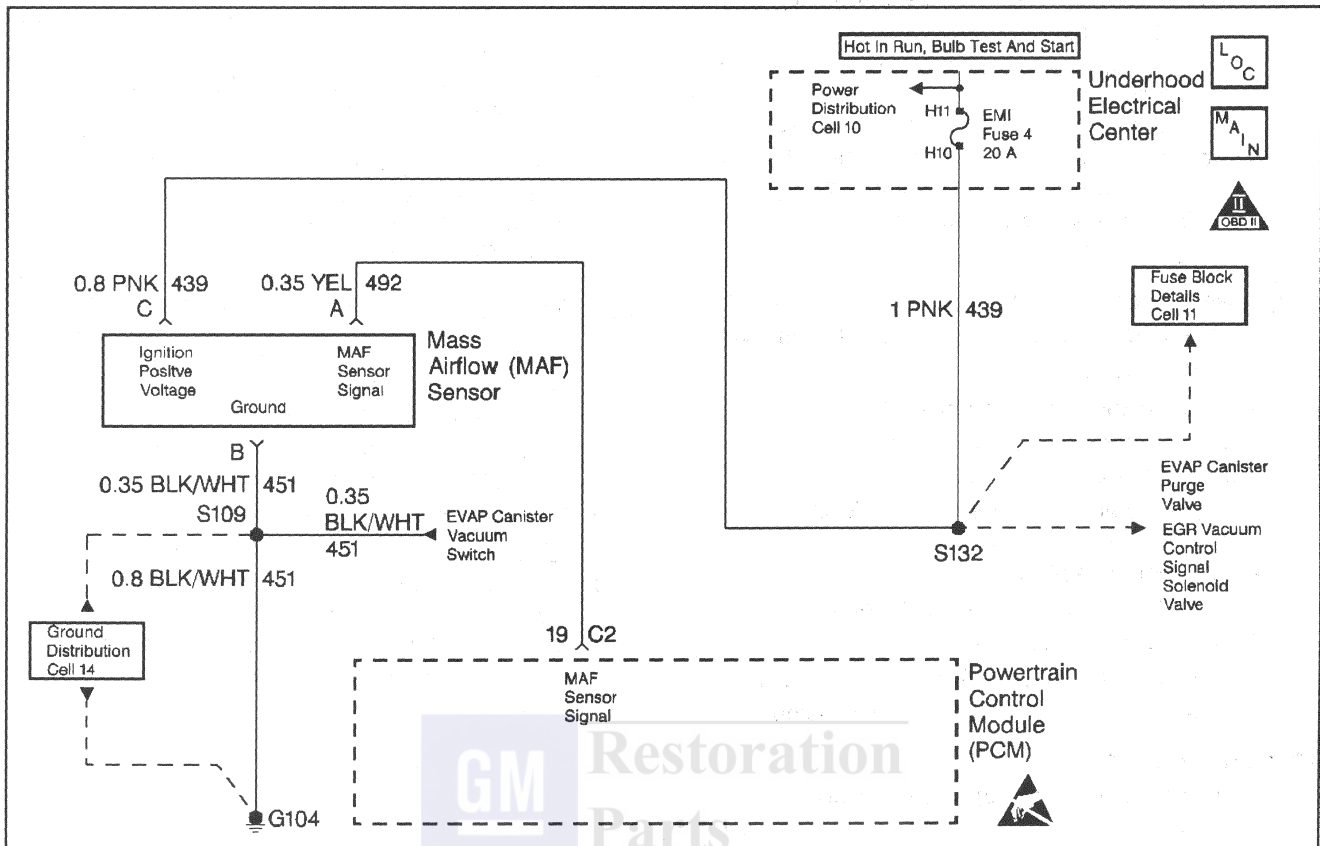
Fuel System Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
13	1. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 2. Disconnect the fuel return pipe (refer to (4) in the illustration) from the fuel rail. Refer to Servicing Quick-Connect Fittings. 3. Attach a length of flexible fuel hose to the fuel rail outlet passage. 4. Place the open end of the flexible fuel hose into an approved gasoline container. 5. Turn the ignition OFF for 10 seconds. 6. Turn the ignition ON. 7. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	284–325 kPa (41–47 psi)	Go to Step 24	Go to step 14
14	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Go to Step 26	Go to Step 15
15	1. Remove the fuel pressure regulator. Refer to Fuel Pressure Regulator Assembly. 2. Visually and physical inspect the fuel pressure regulator filter screen for a restriction. Was a restriction found?	—	Go to Step 25	Go to Step 22
16	Is the fuel pressure above the specified value?	0 kPa (0 psi)	Go to Step 17	Go to Step 18
17	1. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 2. Disconnect the fuel return pipe (refer to (4) in the illustration) from the fuel rail. Refer to Servicing Quick-Connect Fittings. 3. Install the J 37287 fuel pipe shut-off adapter (refer to (5) in the illustration) between the fuel return pipe and the fuel rail. 4. Open the valve on the fuel pipe shut-off adapter. 5. Turn the ignition OFF. 6. Using a 10 amp fused jumper, connect the fuel pump test connector to B+. 7. Place the bleed hose (refer to (2) in the illustration) of the fuel pressure gauge (refer to (1) in the illustration) into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. Notice: Do not allow the fuel pressure to exceed 414 kPa (60 psi). Fuel Pressure in excess of 414 kPa (60 psi) may damage the fuel pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the specified value?	325 kPa (47 psi)	Go to Step 22	Go to Step 6
18	Refer to Fuel Pump Relay Circuit to diagnose the fuel pump electrical circuit. Was a problem found with the fuel pump electrical circuit?	—	Go to Step 26	Go to Step 19

Fuel System Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
19	Visually and physically inspect the following items: • The fuel filter for obstructions. • The fuel feed pipe (refer to (3) in the illustration) for a restriction. • The fuel pump strainer for obstructions. • The fuel pump feed hose for leaks. Was a problem found in any of these areas?	—	Go to Step 26	Go to Step 20
20	Replace the fuel pump. Is the action complete?	—	System OK	—
21	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
23	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
24	Locate and correct the restriction in the fuel return pipe (refer to (4) in the illustration). Is the action complete?	—	System OK	—
25	1. Remove the fuel pressure regulator filter screen. 2. Discard the fuel pressure regulator filter screen. Is the action complete?	—	System OK	—
26	Repair the problem as necessary. Is the action complete?	—	System OK	—

DTC P0100 MAF Sensor Circuit Insufficient Activity



30411

Circuit Description

The Mass Air Flow (MAF) sensor measures the amount of air that is ingested by the engine. Direct measurement of air entering the engine is more accurate than calculating airflow from MAP, IAT and RPM (speed/density). The MAF sensor has a battery feed, ground and signal circuit.

The MAF sensor used on this vehicle is a hot wire type and is used to measure air flow rate. The MAF output frequency is a function of the power required to keep the air flow sensing elements (hot wires) at a fixed temperature above ambient temperature. Air flowing through the sensor cools the sensing elements. The amount of cooling is proportional to the amount of air flow. As air flow increases, a greater amount of current is required to maintain the hot wires at a constant temperature. The MAF sensor converts the changes in current draw to a frequency signal read by the PCM. The PCM calculates air flow (grams per second) based on this signal.

The PCM monitors the MAF sensor frequency and can determine if the sensor is stuck low, stuck high, not providing the airflow value expected for a given operating condition, or that the signal appears to be

stuck based on a lack of signal variation expected during normal operation. This diagnostic checks for a stuck MAF sensor signal. If the MAF sensor frequency varies less than a predetermined minimum amount, this DTC will set.

Conditions for Setting the DTC

- Engine running.
- Engine speed greater than 50 RPM.
- Ignition voltage greater than 10 volts.
- Mass Air Flow frequency varies less than a predetermined minimum amount.
- All conditions met for 1 second.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will use speed density (RPM, MAP, IAT) for fuel management.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids:

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.

For intermittents, refer to *Symptoms*.

- Any un-metered air may cause this DTC to set. Check for the following:
 - An engine vacuum leak.
 - The PCV system for vacuum leaks.
 - An incorrect PCV valve.
 - The engine oil dip stick not fully seated.
 - The engine oil fill cap loose or missing.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

1. Monitoring MAF sensor grams per second (gm/s) will determine if the fault is present or the malfunction is intermittent. For any test

that requires back probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.

2. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
3. This checks whether the signal circuit is open, grounded or shorted to a voltage.
4. Verifies whether a ground circuit is available.
5. Verifies B+ supply to the MAF sensor.
6. Checks whether a good connection is present.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

GM Restoration
Parts

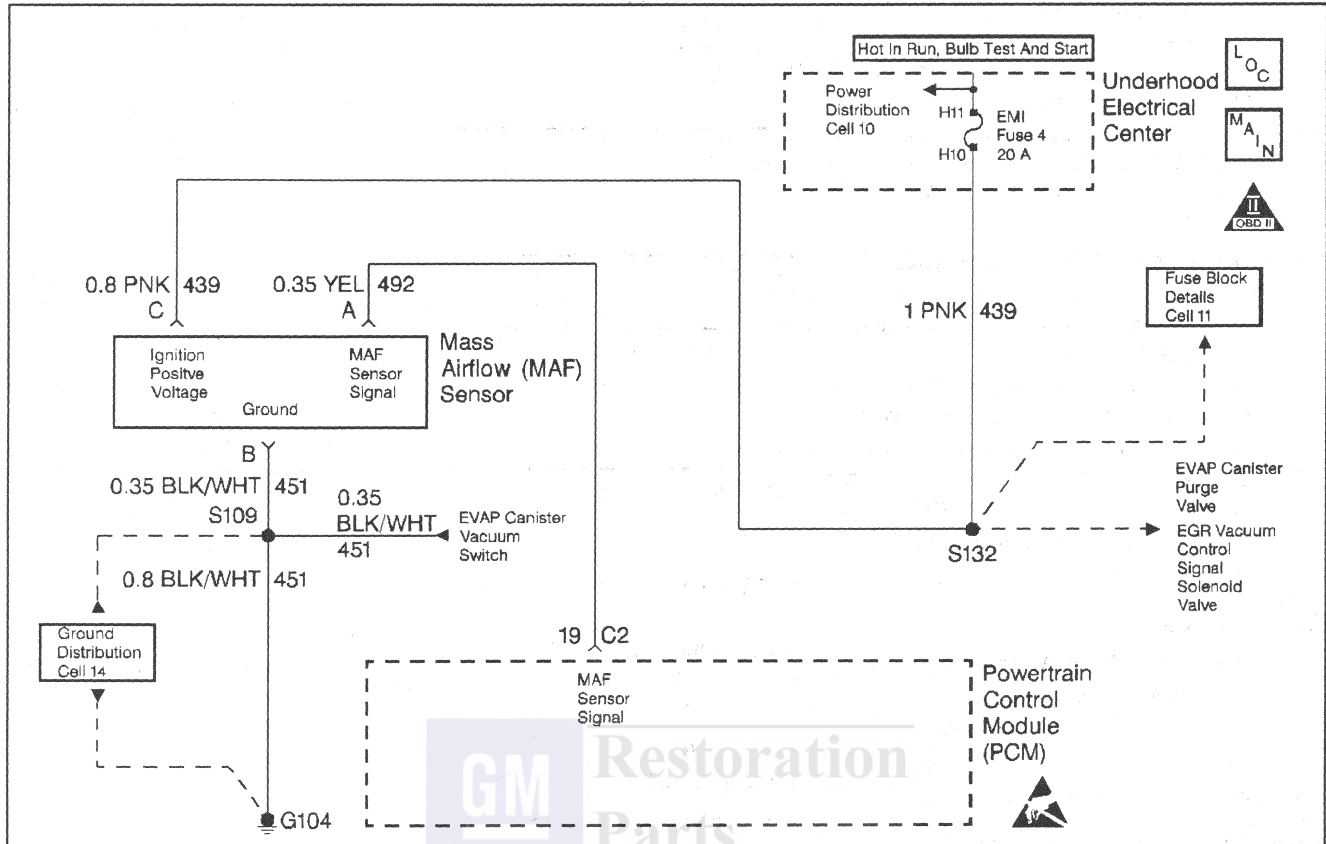
DTC P0100 MAF Sensor Circuit Insufficient Activity

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start and idle the engine. 2. With the engine idling, monitor MAF gm/s display on the Engine 1 Data List of the scan tool. Is MAF gm/s below the specified value?	3.9 gm/s	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0100 (MAF) Insufficient Activity
4	1. Turn the ignition OFF. 2. Disconnect the MAF sensor connector. 3. Turn the ignition ON, engine OFF. 4. Using a DVM (J 39200), measure the voltage between the MAF signal circuit and the battery ground. Is the voltage near the specified value?	5 V	Go to Step 5	Go to Step 8
5	Connect a test light (J 34142-B) between the MAF sensor ignition feed circuit and the ground circuit at the MAF sensor harness connector. Is the test light on?	—	Go to Step 7	Go to Step 6
6	Connect a test light (J 34142-B) between MAF sensor ignition feed circuit and the battery ground. Is the test light on?	—	Go to Step 9	Go to Step 10
7	1. Check for a poor connection at the MAF sensor harness terminals. 2. If a poor connection is found, replace faulty terminal(s). Was a poor connection found?	—	Go to Step 13	Go to Step 11
8	1. Disconnect the PCM. 2. Check the MAF signal circuit between the PCM and the MAF sensor for the following: • An open circuit • A short to ground • A short to the MAF sensor ground circuit • A short to voltage 3. If the MAF signal circuit is open or shorted, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the MAF sensor signal circuit open or shorted?	—	Go to Step 13	Go to Step 12

DTC P0100 MAF Sensor Circuit Insufficient Activity (cont'd)

Step	Action	Value(s)	Yes	No
9	Locate and repair the open in the ground circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
10	Locate and repair the open in the ignition feed circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
11	Replace the MAF sensor. Refer to <i>MAF Sensor</i> . Is the action complete?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0101 Mass Air Flow System Performance



30411

Circuit Description

The Mass Air Flow (MAF) sensor measures the amount of air that is ingested by the engine. Direct measurement of air entering the engine is more accurate than calculating airflow from MAP, IAT and RPM (speed/density). The MAF sensor has a battery feed, ground and signal circuit.

The MAF sensor used on this vehicle is a hot wire type and is used to measure air flow rate. The MAF output frequency is a function of the power required to keep the air flow sensing elements (hot wires) at a fixed temperature above ambient temperature. Air flowing through the sensor cools the sensing elements. The amount of cooling is proportional to the amount of air flow. As air flow increases, a greater amount of current is required to maintain the hot wires at a constant temperature. The MAF sensor converts the changes in current draw to a frequency signal read by the PCM. The PCM calculates air flow (grams per second) based on this signal.

The PCM monitors the MAF sensor frequency and can determine if the sensor is stuck low, stuck high, not providing the airflow value expected for a given operating condition, or that the signal appears to be

stuck based on a lack of signal variation expected during normal operation. This diagnostic checks the range/performance of the MAF sensor. The MAF system performance or rationality diagnostic uses MAP, IAT and RPM to calculate an expected airflow rate that is then compared to the actual measured airflow from the MAF sensor. The actual MAF value and the calculated value are only compared during conditions where they are likely to match. If the actual MAF reading is not within a predetermined range of the calculated reading, this DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0122, P0123, P0107, P0108 not set.
- Engine running.
- Engine speed greater than 50 RPM but less than 2800 RPM.
- TP sensor angle less than 50% when engine vacuum (MAP) is greater than 40 kPa.
- Ignition voltage greater than 10 volts.
- Actual MAF reading does not match calculated MAF reading (speed density).
- All above conditions stable for entire MAF test.
- All conditions met for 5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will utilize speed density (RPM, MAP, IAT) for fuel management.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.

For intermittents, refer to *Symptoms*.

- Any un-metered air may cause this DTC to set. Check for the following:
 - An engine vacuum leak.
 - The PCV system for vacuum leaks.
 - An incorrect PCV valve.
 - The engine oil dip stick not fully seated.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. The MAF system performance or rationality diagnostic uses the MAP sensor signal along with other inputs to calculate an expected

airflow rate that is then compared to the actual measured airflow from the MAF sensor. The first few steps of this table verify that the MAP sensor is working properly. Any MAP sensor DTC should be corrected first. The value shown for the MAP sensor will vary with altitude. The value will decrease by approximately 3 kPa for every 1000 feet of altitude. 100 kPa is the approximate value displayed at or near sea level.

6. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For any test that requires back probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.
7. Any un-metered air may cause this DTC to set. Check PCV system for vacuum leaks. Also inspect dip stick for being pulled out. Check oil fill cap for being loose.
8. Verifies the signal circuit from the MAF sensor electrical connector to the PCM.
9. Verifies whether a ground and B+ circuit is available.
10. Checks for a signal circuit for an open.
11. Checks for a signal circuit shorted to B+.

DTC P0101 Mass Air Flow System Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any MAP DTCs are set, refer to the applicable DTC before proceeding. This value will vary with altitude. Refer to <i>Test Description</i>. 1. Turn the ignition ON, engine OFF. 2. Using a scan tool, select MAP from the Engine 1 Data List. Is the value displayed greater than the value shown?	100 kPa	Go to Step 3	Go to Step 19
3	1. Remove the MAP sensor from the intake manifold but leave the electrical harness connected. 2. Connect a hand operated vacuum pump to the MAP sensor. 3. Observe the MAP display while slowly applying vacuum up to 20 inch Hg as indicated on the pump gauge. Each 1 inch of vacuum applied should result in a 3 to 4 kPa drop in the MAP sensor value on the scan tool and the value should change smoothly with each increase in vacuum. Did the MAP value change smoothly through the entire range of the test without any erratic readings?	—	Go to Step 19	Go to Step 4
4	With 20 inch Hg vacuum applied to the MAP sensor. Is the MAP sensor reading the same or less than the specified value?	34 kPa	Go to Step 5	Go to Step 19
5	Disconnect the vacuum source from the MAP sensor. Does the MAP sensor reading return to the original value?	—	Go to Step 6	Go to Step 19
6	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 7	Go to Diagnostic Aids - DTC P0101 (MAF) System Performance
7	1. Check for the following conditions: • Objects blocking the MAF sensor inlet screen • Intake manifold vacuum leaks • Vacuum leaks at throttle body • Vacuum leaks at EGR valve flange and pipes • Crankcase ventilation valve faulty, missing, or incorrectly installed 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 21	Go to Step 8

DTC P0101 Mass Air Flow System Performance (cont'd)

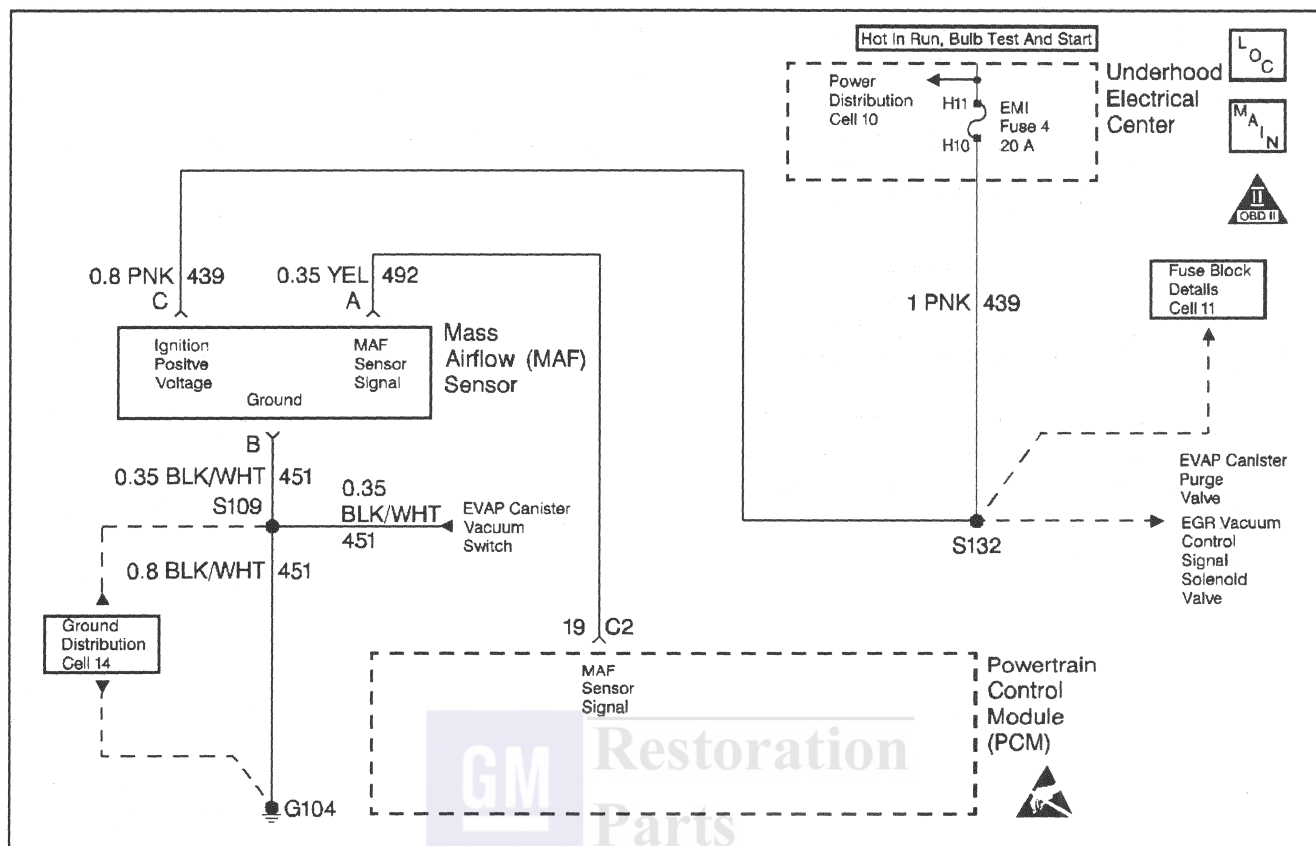
Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Disconnect the MAF sensor connector. 3. Turn the ignition ON, engine OFF. 4. Using DVM J 39200, measure voltage between the MAF sensor signal circuit and chassis ground. Is the voltage near the specified value?	5.0V	Go to Step 9	Go to Step 10
9	Connect a test light (J 34142-B) between the MAF sensor ignition feed and the ground circuit at the MAF sensor harness connector. Is the test light ON?	—	Go to Step 13	Go to Step 12
10	Is the voltage less than the specified value?	4.5V	Go to Step 14	Go to Step 11
11	1. Turn the ignition OFF, disconnect the PCM. 2. Turn the ignition ON, engine OFF. 3. Measure the voltage between the MAF signal circuit and ground. Does the voltage measure near the specified value?	0.0V	Go to Step 20	Go to Step 17
12	Connect a test light (J 34142-B) between MAF sensor ignition feed circuit and chassis ground. Is the test light ON?	—	Go to Step 15	Go to Step 16
13	1. Check for a poor connection at the MAF sensor. 2. If a poor connection is found, replace faulty terminal(s). Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found?	—	Go to Step 21	Go to Step 18
14	1. Check the MAF signal circuit between the PCM and the MAF sensor for the following: • An open circuit • A short to ground • A short to the MAF ground circuit. 2. If the MAF signal circuit is open or shorted, repair it as necessary. Was the MAF signal circuit open or shorted?	—	Go to Step 21	Go to Step 20
15	Locate and repair the open in the ground circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 21	—
16	Locate and repair the open in the ignition feed circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 21	—
17	Locate and repair the short to voltage in the MAF signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 21	—
18	Replace the MAF sensor. Refer to <i>MAF Sensor</i> . Is the action complete?	—	Go to Step 21	—
19	Replace the MAP sensor. Refer to <i>MAP Sensor</i> . Is the action complete?	—	Go to Step 21	—

DTC P0101 Mass Air Flow System Performance (cont'd)

Step	Action	Value(s)	Yes	No
20	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 21	—
21	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 22	Go to Step 2
22	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0102 MAF Sensor Circuit Low Frequency



30411

Circuit Description

The Mass Air Flow (MAF) sensor measures the amount of air that is ingested by the engine. Direct measurement of air entering the engine is more accurate than calculating airflow from MAP, IAT and RPM (speed/density). The MAF sensor has a battery feed, ground and signal circuit.

The MAF sensor used on this vehicle is a hot wire type and is used to measure air flow rate. The MAF output frequency is a function of the power required to keep the air flow sensing elements (hot wires) at a fixed temperature above ambient temperature. Air flowing through the sensor cools the sensing elements. The amount of cooling is proportional to the amount of air flow. As air flow increases, a greater amount of current is required to maintain the hot wires at a constant temperature. The MAF sensor converts the changes in current draw to a frequency signal read by the PCM. The PCM calculates air flow (grams per second) based on this signal.

The PCM monitors the MAF sensor frequency and can determine if the sensor is stuck low, stuck high, not providing the airflow value expected for a given

operating condition, or that the signal appears to be stuck based on a lack of signal variation expected during normal operation. This diagnostic checks for too low an airflow rate. When the PCM detects that the MAF sensor grams per second is below a predetermined value, this DTC will set.

Conditions for Setting the DTC

- Engine running.
- Engine speed greater than 50 RPM.
- Ignition voltage greater than 10 volts.
- Mass Air Flow less than 3.9 grams per second.
- All conditions met for 1 second.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will utilize speed density (RPM, MAP, IAT) for fuel management.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.

For intermittents, refer to *Symptoms*.

- Any un-metered air may cause this DTC to set. Check for the following:
 - An engine vacuum leak.
 - The PCV system for vacuum leaks.
 - An incorrect PCV valve.
 - The engine oil dip stick not fully seated.
 - The engine oil fill cap loose or missing.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Monitoring MAF sensor grams per second (gm/s) will determine if the fault is present or the malfunction is intermittent. For any test that requires back probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- This checks whether the MAF signal circuit is open or shorted to ground. If 5.0 volts is present indicates the circuit is OK.
- This checks whether the B+ supply and ground circuit are OK.
- This checks whether B+ is available at the MAF sensor.

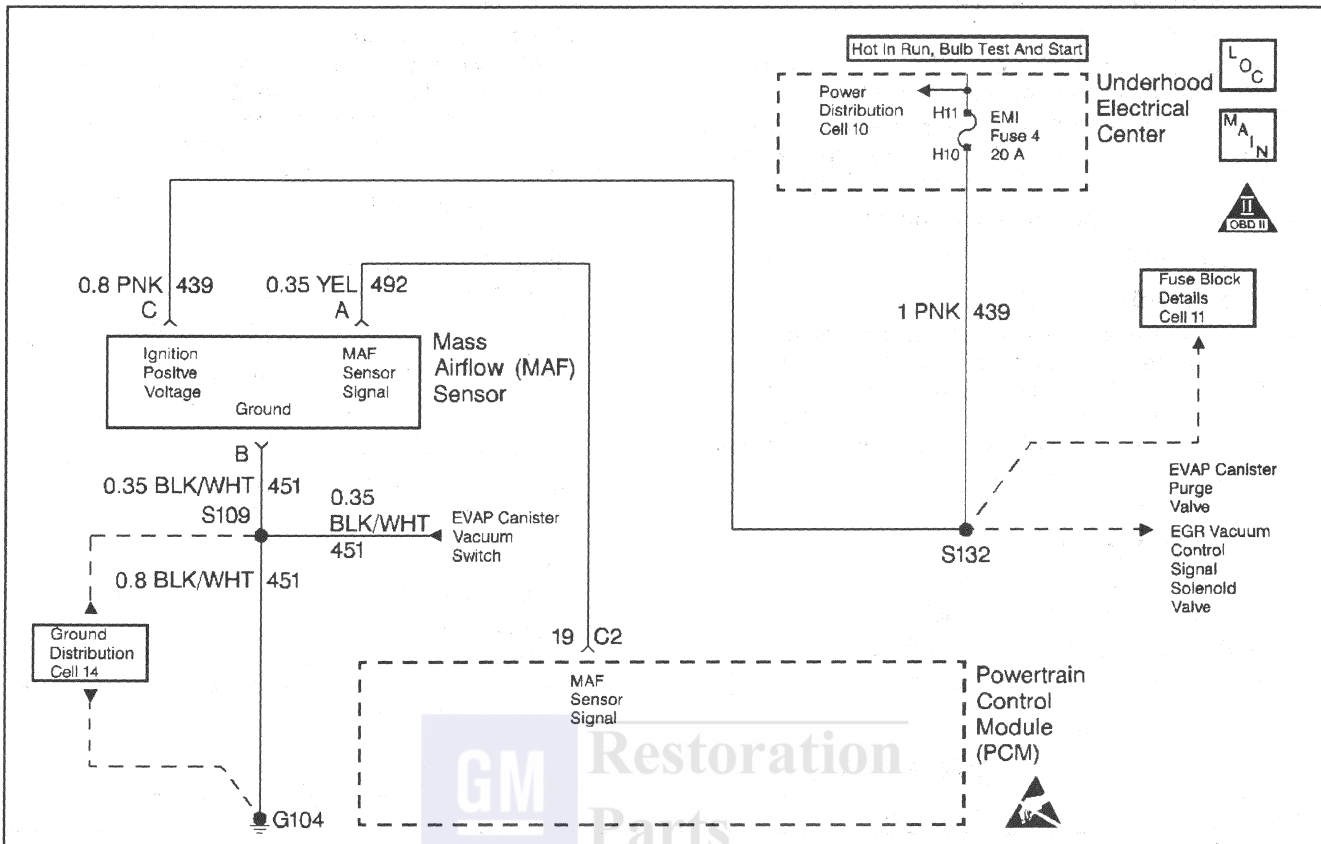
DTC P0102 MAF Sensor Circuit Low Frequency

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine and idle. 2. With the engine idling, monitor MAF gm/s display on the Engine 1 Data List of the scan tool. Is MAF gm/s below the specified value?	3.9 gm/s	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0102 (MAF) Sensor Circuit Low Frequency

DTC P0102 MAF Sensor Circuit Low Frequency (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Turn the ignition OFF. 2. Disconnect the MAF sensor connector. 3. Turn the ignition ON, engine OFF. 4. Using a DVM (J 39200), measure voltage between the MAF signal circuit and battery ground. Is the voltage near the specified value?	5V	Go to Step 5	Go to Step 8
5	Connect a test light (J 34142-B) between the MAF sensor ignition feed circuit and the ground circuit at the MAF sensor harness connector. Is the test light ON?	—	Go to Step 7	Go to Step 6
6	Connect a test light (J 34142-B) between MAF sensor ignition feed circuit and the battery ground. Is the test light ON?	—	Go to Step 9	Go to Step 10
7	1. Check for a poor connection at the MAF sensor harness terminals. 2. If a poor connection is found, replace the faulty terminal(s). Was a poor connection found?	—	Go to Step 13	Go to Step 11
8	1. Check the MAF signal circuit between the PCM and the MAF sensor for an open, short to ground, short to the MAF ground circuit, or short to voltage. 2. If the MAF signal circuit is open or shorted, repair it as necessary. Was the MAF sensor signal circuit open or shorted?	—	Go to Step 13	Go to Step 12
9	Locate and repair the open in the ground circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
10	Locate and repair the open in the ignition feed circuit to the MAF sensor. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
11	Replace the MAF sensor. Refer to <i>MAF Sensor</i> . Is the action complete?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0103 MAF Sensor Circuit High Frequency



30411

Circuit Description

The Mass Air Flow (MAF) sensor measures the amount of air that is ingested by the engine. Direct measurement of air entering the engine is more accurate than calculating airflow from MAP, IAT and RPM (speed/density). The MAF sensor has a battery feed, ground and signal circuit.

The MAF sensor used on this vehicle is a hot wire type and is used to measure air flow rate. The MAF output frequency is a function of the power required to keep the air flow sensing elements (hot wires) at a fixed temperature above ambient temperature. Air flowing through the sensor cools the sensing elements. The amount of cooling is proportional to the amount of air flow. As air flow increases, a greater amount of current is required to maintain the hot wires at a constant temperature. The MAF sensor converts the changes in current draw to a frequency signal read by the PCM. The PCM calculates air flow (grams per second) based on this signal.

The PCM monitors the MAF sensor frequency and can determine if the sensor is stuck low, stuck high, not providing the airflow value expected for a given operating condition, or that the signal appears to be

stuck based on a lack of signal variation expected during normal operation. This diagnostic checks for too high an airflow rate. When the PCM detects that the MAF sensor grams per second is above a predetermined value, this DTC will set.

Conditions for Setting the DTC

- Engine running.
- Engine speed greater than 50 RPM.
- Ignition voltage greater than 10 volts.
- Mass Air Flow greater than 300 grams per second.
- All conditions met for 1 second.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will utilize speed density (RPM, MAP, IAT) for fuel management.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Water entering the air intake system that reaches the MAF sensor could cause this DTC to set. The water rapidly cools the hot wires in the sensor, causing a false indication of excessive airflow. Check the following areas for evidence (witness marks) of water intrusion:
- AIR system.
 - Poor connections.
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Monitoring MAF sensor grams per second (gm/s) will determine if the fault is present or the malfunction is intermittent. For any test that requires back probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- This checks for electro-magnetic interference on the MAF sensor signal circuit. There should be no signal indicated on the scan tool with the sensor disconnected.

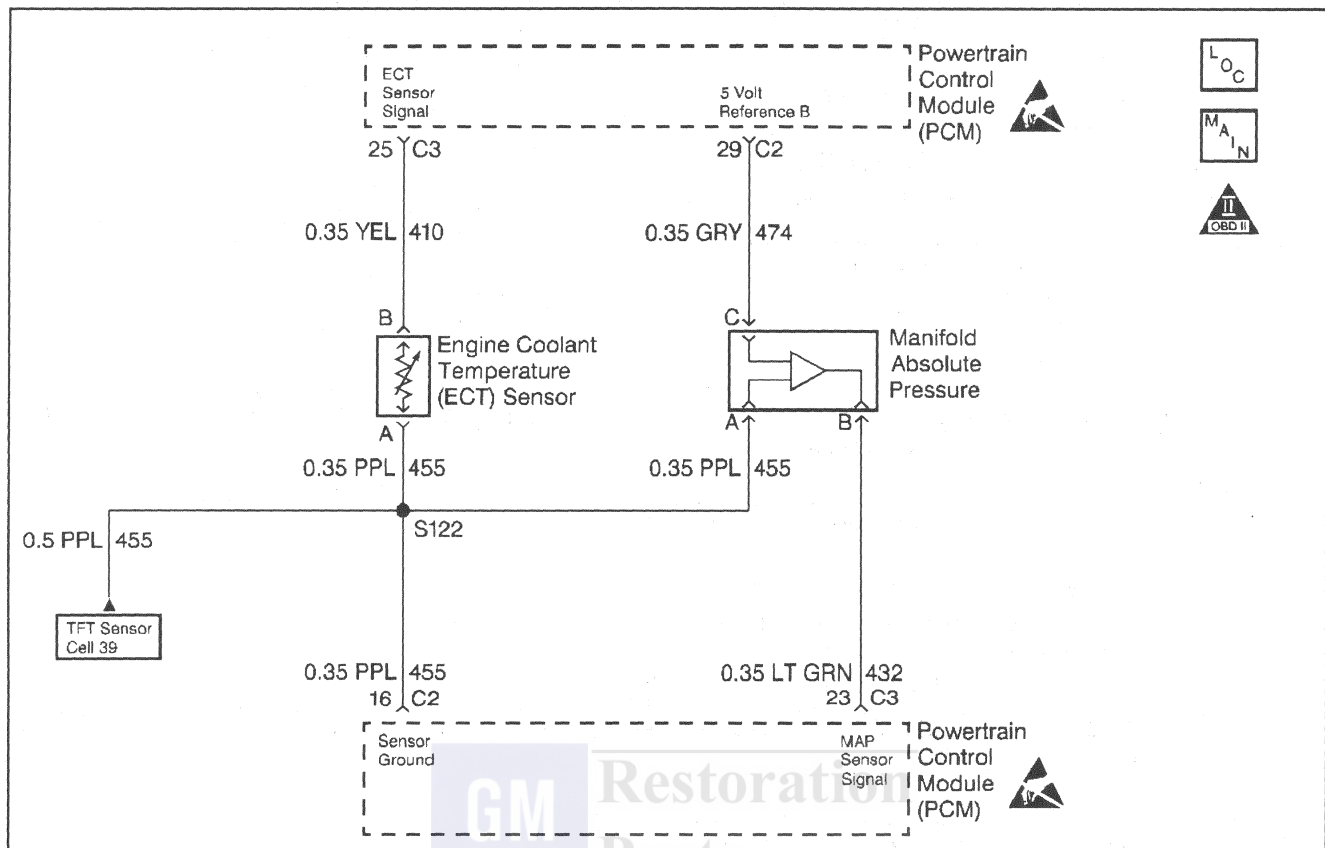
DTC P0103 MAF Sensor Circuit High Frequency

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start and idle the engine. 2. With the engine idling, monitor MAF gm/s display on the Engine 1 Data List of the scan tool. Is MAF gm/s above the specified value?	300 gm/s	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0103 (MAF) Sensor Circuit High Frequency

DTC P0103 MAF Sensor Circuit High Frequency (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Turn the ignition OFF. 2. Disconnect the MAF sensor connector. 3. Start and idle the engine. 4. Using a scan tool, monitor MAF gm/s. Does the scan tool indicate MAF gm/s at the specified value?	1.9 gm/s	Go to Step 5	Go to Step 7
5	1. Check for a poor connection at the MAF sensor harness terminals. 2. If a poor connection is found, replace the faulty terminal(s). Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found and corrected?	—	Go to Step 10	Go to Step 6
6	Replace the MAF sensor. Refer to <i>MAF Sensor</i> . Is the action complete?	—	Go to Step 10	—
7	1. Check the MAF harness for incorrect routing at the following locations: • Near secondary ignition wires or components. • Other high current components. Such as solenoids, relays, and motors. 2. If incorrect routing is found, correct harness routing. Was a problem found and corrected?	—	Go to Step 10	Go to Step 8
8	1. Check the MAF signal circuit terminal connections at the PCM. 2. If a poor connection is found, replace the faulty terminal(s). Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found and corrected?	—	Go to Step 10	Go to Step 9
9	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 10	—
10	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 11	Go to Step 2
11	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table.	System OK

DTC P0106 MAP System Performance



30394

Circuit Description

The Manifold Absolute Pressure (MAP) sensor is mounted to the top of the intake manifold. The MAP sensor measures pressure changes within the intake manifold which are an indication of engine load. The MAP sensor has a 5.0 volt reference circuit, a ground and a signal circuit.

The PCM compares the MAP sensor signal activity with throttle angle and RPM. If the PCM detects a large MAP change without sensing a change in throttle angle and RPM, this DTC will set.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0121, P0122 and P0123 not set.
- Engine operating.
- ASR/TCS not in a traction event (If so equipped).
- Engine speed does not change more than 100 RPM.
- TP sensor angle does not change more than 5%.
- EGR position does not change more than 25%.
- IAC position, at a steady state.

- No change (steady state) in A/C clutch, power steering signal, brake signal, and transmission position.
- PCM detects a substantial change in MAP, without being preceded by a large change in throttle angle and RPM.
- All conditions stable for 0.5 second.
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.
- The PCM will use TP sensor values to calculate MAP.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

An intermittent may be caused by the following:

- Mis-routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Erratic engine vacuum caused by a base engine problem or a misfire condition should be diagnosed first.

- When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).
 - Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.

DTC P0106 MAP System Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Is DTC P0300 also set?	—	Go to DTC P0300 Engine Misfire Detected	Go to Step 3
3	1. Start and idle the engine. 2. Using a scan tool, select MAP from the Engine 1 Data List. Is MAP varying more than the specified amount?	6.3 kPa	Go to Step 4	Go to Step 9
4	1. Turn the ignition ON, engine OFF. 2. Move the MAP sensor electrical connector, the harness and the PCM connectors (by hand only) while observing the scan tool display. Is the MAP value affected by moving the harness or connectors?	—	Go to Step 12	Go to Step 5
5	Important: This value will vary with altitude. Refer to <i>Test Description</i> . Does the scan tool display the MAP value shown?	100 kPa	Go to Step 6	Go to Step 13

DTC P0106 MAP System Performance (cont'd)

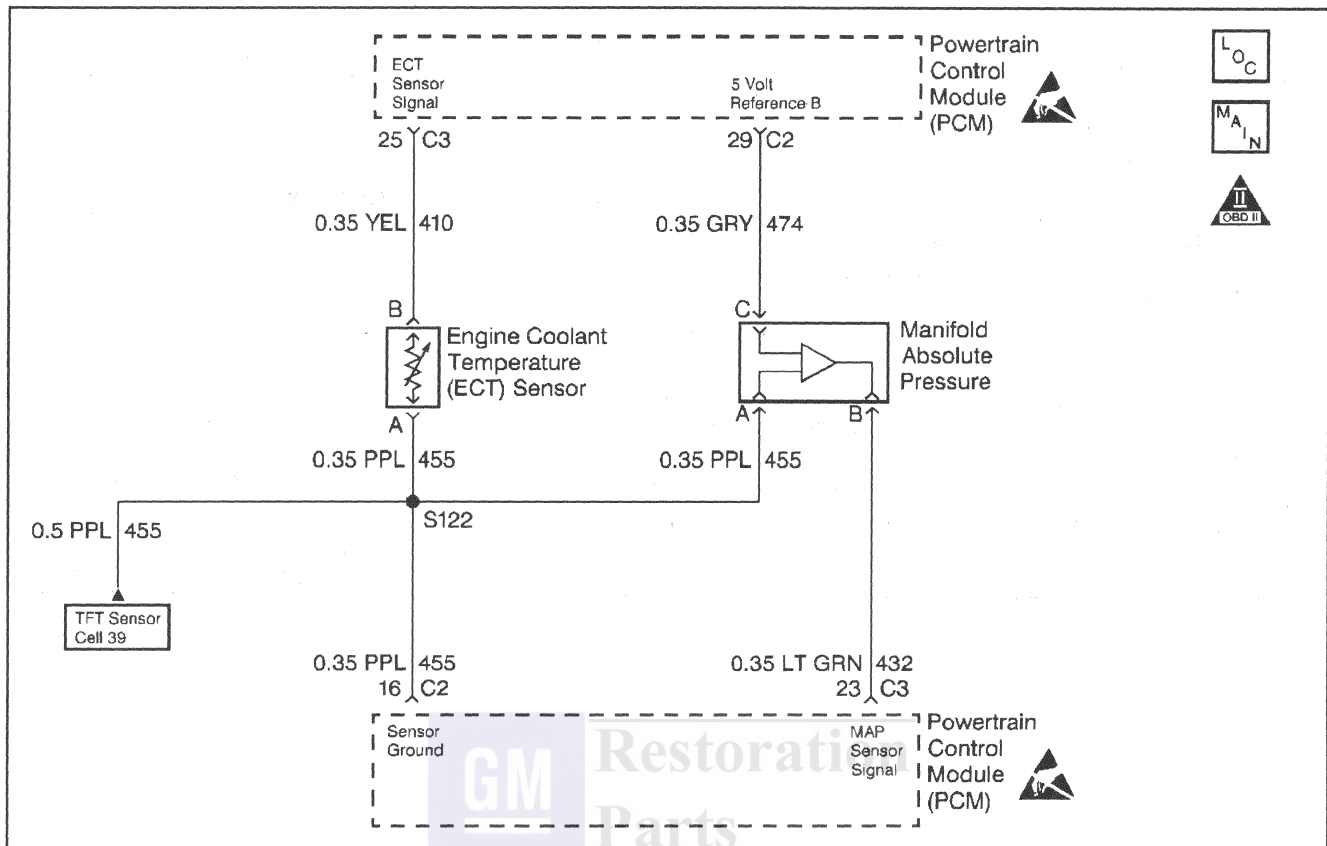
Step	Action	Value(s)	Yes	No
6	1. Remove the MAP sensor from the intake manifold but leave the electrical harness connected. 2. Connect a hand operated vacuum pump to the MAP sensor. 3. Observe the MAP display while slowly applying vacuum up to 20 inch Hg as indicated on the pump gauge. Each 1 inch of vacuum applied should result in a 3 to 4 kPa drop in the MAP sensor value on the scan tool and the value should change smoothly with each increase in vacuum. Did the MAP value change smoothly through the entire range of the test without any erratic readings?	—	Go to Step 13	Go to Step 7
7	Apply 20 inch Hg vacuum to the MAP sensor. Is the MAP sensor reading the same or less than the specified value?	34 kPa	Go to Step 8	Go to Step 13
8	Disconnect the vacuum source from the MAP sensor. Does the MAP sensor reading return to its original value?	—	Go to Step 9	Go to Step 13
9	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 10	Go to Diagnostic Aids - DTC P0106 MAP System Performance
10	1. Check the MAF sensor harness for incorrect routing. 2. Near secondary ignition or components. 3. Other high voltage components. 4. Solenoids, relays, motors. 5. If incorrect routing is found, correct harness routing. Was a problem found and corrected?	—	Go to Step 16	Go to Step 11
11	Check for a plugged or leaking vacuum supply to the MAP sensor. Was a problem found and corrected?	—	Go to Step 13	Go to Step 14
12	Check for the following conditions and repair as necessary: • Electrical connector terminals for poor connections, improper contact tension or poor terminal to wire connection. • Rubbed through wire insulation. • Broken wire inside the insulation. • Mis-routed harness. Is action complete?	—	Go to Step 16	Go to Step 10
13	Replace the MAP sensor. Is action complete?	—	Go to Step 16	—

DTC P0106 MAP System Performance (cont'd)

Step	Action	Value(s)	Yes	No
14	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 16	Go to Step 15
15	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 16	—
16	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 17	Go to Step 2
17	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0107 MAP Sensor Circuit Low Voltage



30394

Circuit Description

The Manifold Absolute Pressure (MAP) sensor is mounted to the top of the intake manifold. The MAP sensor measures pressure changes within the intake manifold which are an indication of engine load. The MAP sensor has a 5.0 volt reference, a ground and a signal circuit.

The MAP sensor contains a diaphragm which changes resistance based on pressure. When manifold pressure is low (high vacuum) sensor output voltage is low. When manifold pressure is high (low vacuum) sensor output voltage is high.

MAP sensor voltage (depending on altitude) can range from 1.0–1.5 volts at idle (high vacuum) to 4.0 – 4.9 volts at wide open throttle (low vacuum).

When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- No TP sensor DTCs set.
- TP Angle greater than 15%.
- MAP is less than 0.24 volts.
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.
- The PCM will use TP sensor values to calculate MAP.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids:

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- The PCM 5 volt reference circuits are internally connected within the PCM. If all the MAP sensor circuits check to be OK, inspect related 5.0 volt reference circuits.
- If it is determined that the DTC occurs intermittently, performing the DTC P1107 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the malfunction is present. For any test that requires back probing the PCM or

component harness connectors, must use the Connector Test Adapter Kit J 35616–A. Using this kit will prevent any damage to the harness connector terminals.

3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If the scan tool displays 5.0 volts, indicates that the MAP sensor signal, 5.0 volt reference circuit and PCM are OK.
5. If the scan tool displays 5.0 volts, indicates that the MAP sensor signal circuit and PCM are OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

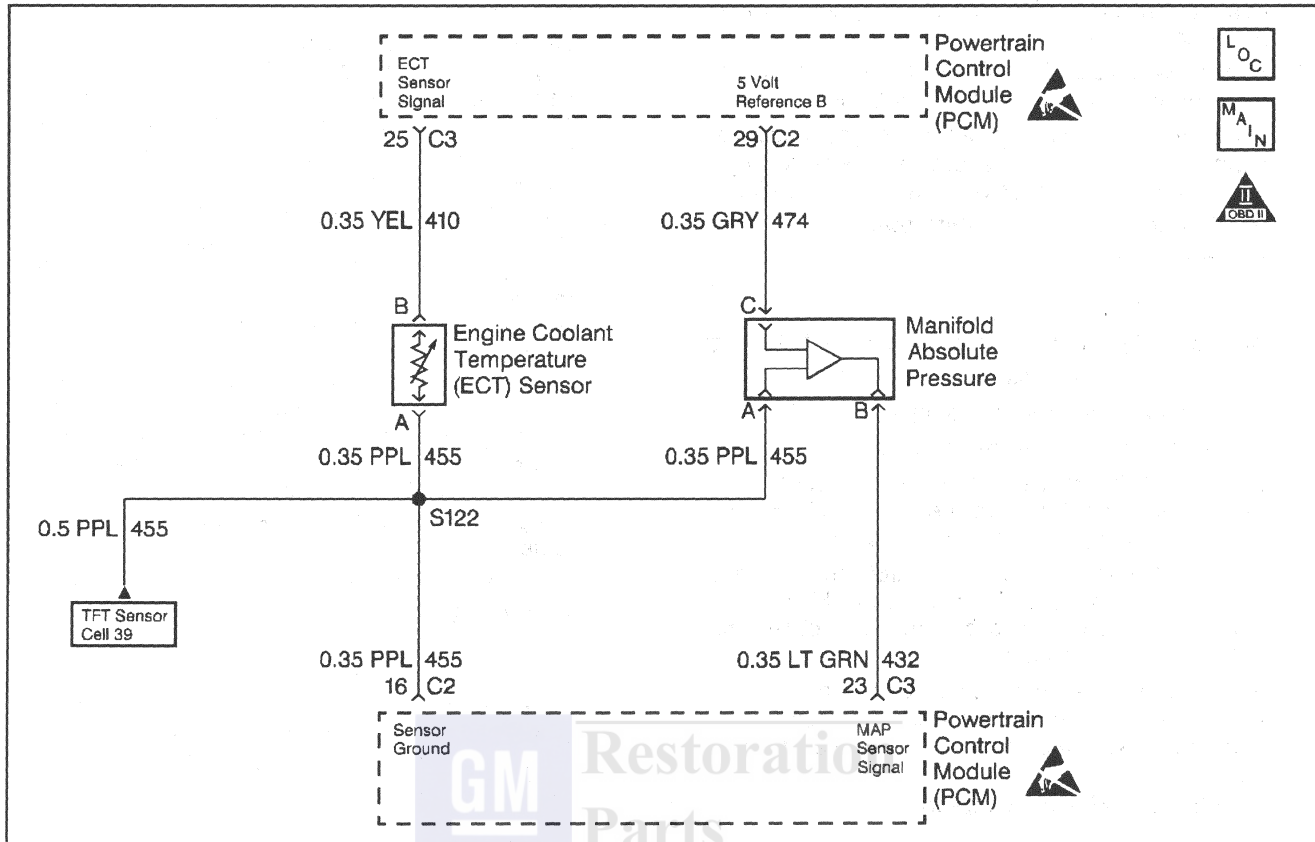
DTC P0107 MAP Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine, monitor MAP voltage on Engine 1 Data List on the scan tool. Is MAP voltage below the specified value?	0.24 V	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0107 (MAP) Sensor Circuit Low Voltage
4	1. Disconnect the MAP sensor electrical connector. 2. Jumper the 5 volt reference circuit and the MAP signal circuit together at the MAP sensor harness connector. 3. Observe the MAP voltage display on the scan tool. Is MAP voltage at the specified value?	5.0V	Go to Step 10	Go to Step 5

DTC P0107 MAP Sensor Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Connect a test light (J 34142-B) between B+ and the MAP sensor signal circuit at the MAP sensor harness connector. 2. Observe the MAP voltage display on the scan tool. Is MAP voltage at the specified value?	5.0 V	Go to Step 6	Go to Step 8
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 12	Go to Step 7
7	Check the 5 volt reference circuit for a poor connection at the PCM and replace the terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
8	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the MAP signal circuit the following: • Open circuit. • Short to ground. • Short to sensor ground circuit. 3. If the MAP sensor signal circuit is open or shorted to ground, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the MAP signal circuit open or shorted to ground?	—	Go to Step 12	Go to Step 9
9	Check the MAP sensor signal circuit for a poor connection at the PCM and replace the terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
10	Replace the MAP sensor. Refer to <i>MAP Sensor</i> . Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0108 MAP Sensor Circuit High Voltage



30394

Circuit Description

The Manifold Absolute Pressure (MAP) sensor is mounted to the top of the intake manifold. The MAP sensor measures pressure changes within the intake manifold which are an indication of engine load. The MAP sensor has a 5.0 volt reference, a ground and a signal circuit.

The MAP sensor contains a diaphragm which changes resistance based on pressure. When manifold pressure is low (high vacuum) sensor output voltage is low. When manifold pressure is high (low vacuum) sensor output voltage is high.

MAP sensor voltage (depending on altitude) can range from 1.0–1.5 volts at idle (high vacuum) to 4.0–4.9 volts at wide open throttle (low vacuum).

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- DTCs P0122 and P0123 not set.
- Engine Operating.

- TP sensor angle less than 3% when RPM is greater than 1000 RPM.
- TP sensor angle 0% when engine speed is below 1000 RPM.
- MAP voltage is greater than 4.2 volts.
- All conditions met for 3 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.
- The PCM will use TP sensor values to calculate MAP.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- The PCM 5 volt reference circuits are internally connected within the PCM. If all the MAP sensor circuits check to be OK, inspect related 5.0 volt reference circuits.
- If it is determined that the DTC occurs intermittently, performing the DTC P1106 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the malfunction is present. For any test that requires back probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. This checks whether the signal circuit is shorted to a voltage.
5. This checks whether a ground circuit is available at the MAP sensor.
8. Remove the MAP sensor and check if vacuum is available to the sensor. Also inspect MAP sensor seal for nicks and cuts. A vacuum leak at the seal will cause P0108 to set.

DTC P0108 MAP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. If the engine idle is rough, unstable or incorrect, repair the idle problem before using this table; refer to <i>Symptoms</i> . 2. Install the scan tool. 3. With the engine idling, monitor MAP voltage on Engine 1 Data List on the scan tool. Is the MAP voltage above the specified value?	4.2V	Go to Step 4	Go to Step 3

DTC P0108 MAP Sensor Circuit High Voltage (cont'd)

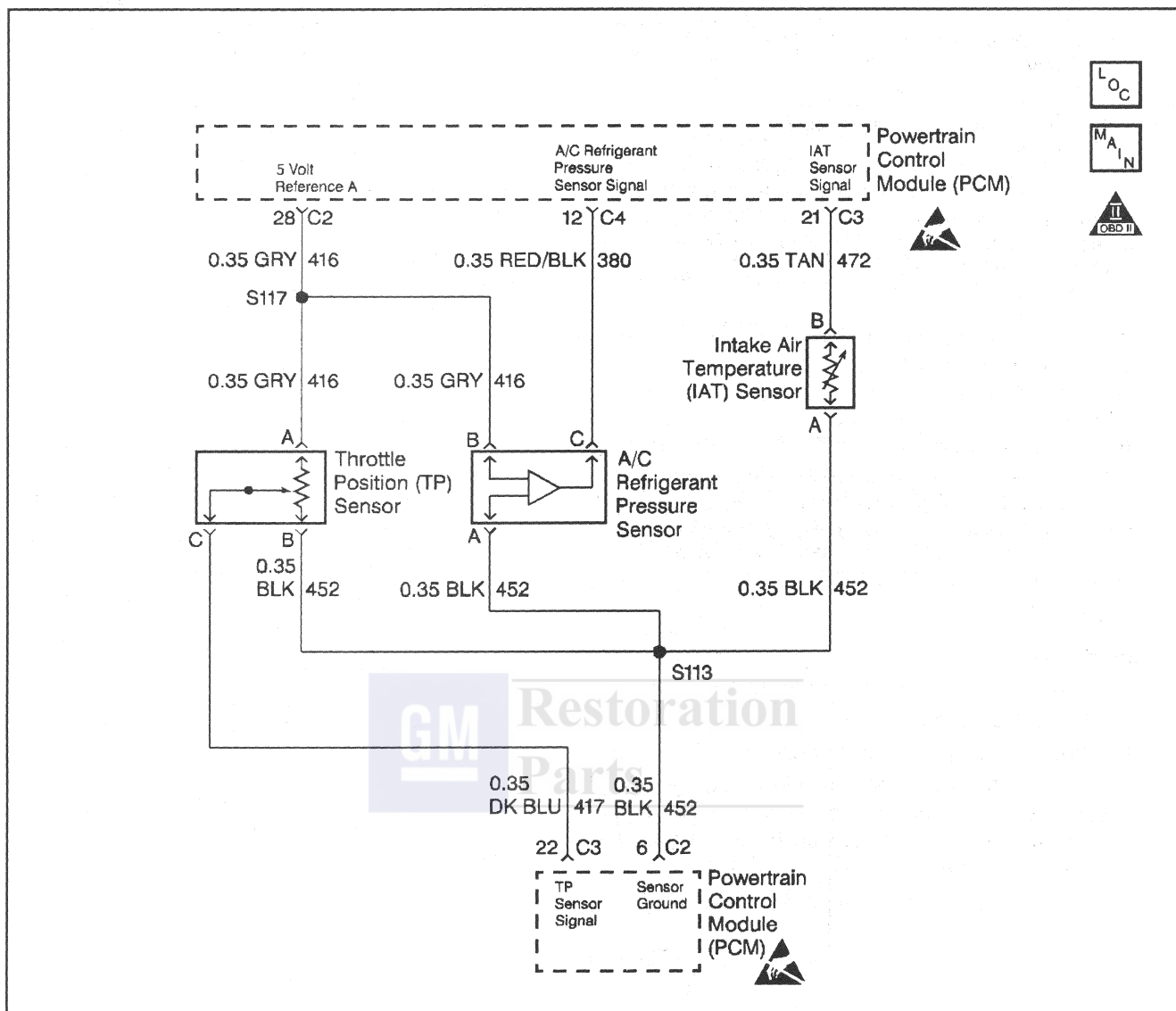
Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0108 MAP Sensor Circuit High Voltage
4	1. Disconnect the MAP sensor electrical connector. 2. Note the MAP sensor voltage displayed on the scan tool. Is the MAP sensor voltage below the specified value?	1.0V	Go to Step 5	Go to Step 6
5	Probe the sensor ground circuit with a test light (J 34142-B) to B+. Is the test light ON?	—	Go to Step 7	Go to Step 9
6	1. Check the MAP signal circuit for a short to voltage or a short to the 5 volt reference circuit. 2. If the MAP sensor signal circuit is shorted, repair circuit as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Was the MAP sensor signal circuit shorted?	—	Go to Step 15	Go to Step 11
7	Using a DVM (J 39200), measure the voltage at the 5.0 volt reference circuit to ground. Is the voltage greater than the specified value?	5.0V	Go to Step 14	Go to Step 8
8	Check for a plugged or leaking vacuum supply to the MAP sensor. Is the vacuum supply OK?	—	Go to Step 12	Go to Step 13
9	1. Check for a poor sensor ground terminal connection at the PCM. 2. If a problem is found, replace the faulty terminal. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Did the terminal require replacement?	—	Go to Step 15	Go to Step 10
10	1. Check continuity of the MAP sensor ground circuit. 2. If the MAP sensor ground circuit measures over the specified value, repair open or poor connection. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Was a condition found and corrected?	5 Ω	Go to Step 15	Go to Step 11
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i>. Replace the PCM. Is the action complete?	—	Go to Step 15	—

DTC P0108 MAP Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the MAP sensor. Refer to <i>MAP Sensor</i> . Is the action complete?	—	Go to Step 15	—
13	Repair the faulty vacuum supply. Is the action complete?	—	Go to Step 15	—
14	Repair the 5.0 volt reference circuit for a short to voltage. Is the action complete?	—	Go to Step 15	—
15	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 16	Go to Step 2
16	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0112 IAT Sensor Circuit Low Voltage



30393

Circuit Description

The Intake Air Temperature (IAT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The IAT sensor is located in the air intake passage of the engine air induction system. The IAT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine intake air temperature.

When the intake air is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the intake air

is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature).

When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0117, P0118, P0502, P0503 not set.
- Engine operating longer than 30 seconds.
- Vehicle speed greater than 40 km/h (25 mph).
- Intake Air Temperature greater than 150°C (302°F).
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness
 - Rubbed through wire insulation
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.

- If the engine has been allowed to sit overnight, the engine coolant temperature and engine intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*
- If it is determined that the DTC occurs intermittently, performing the P1112 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

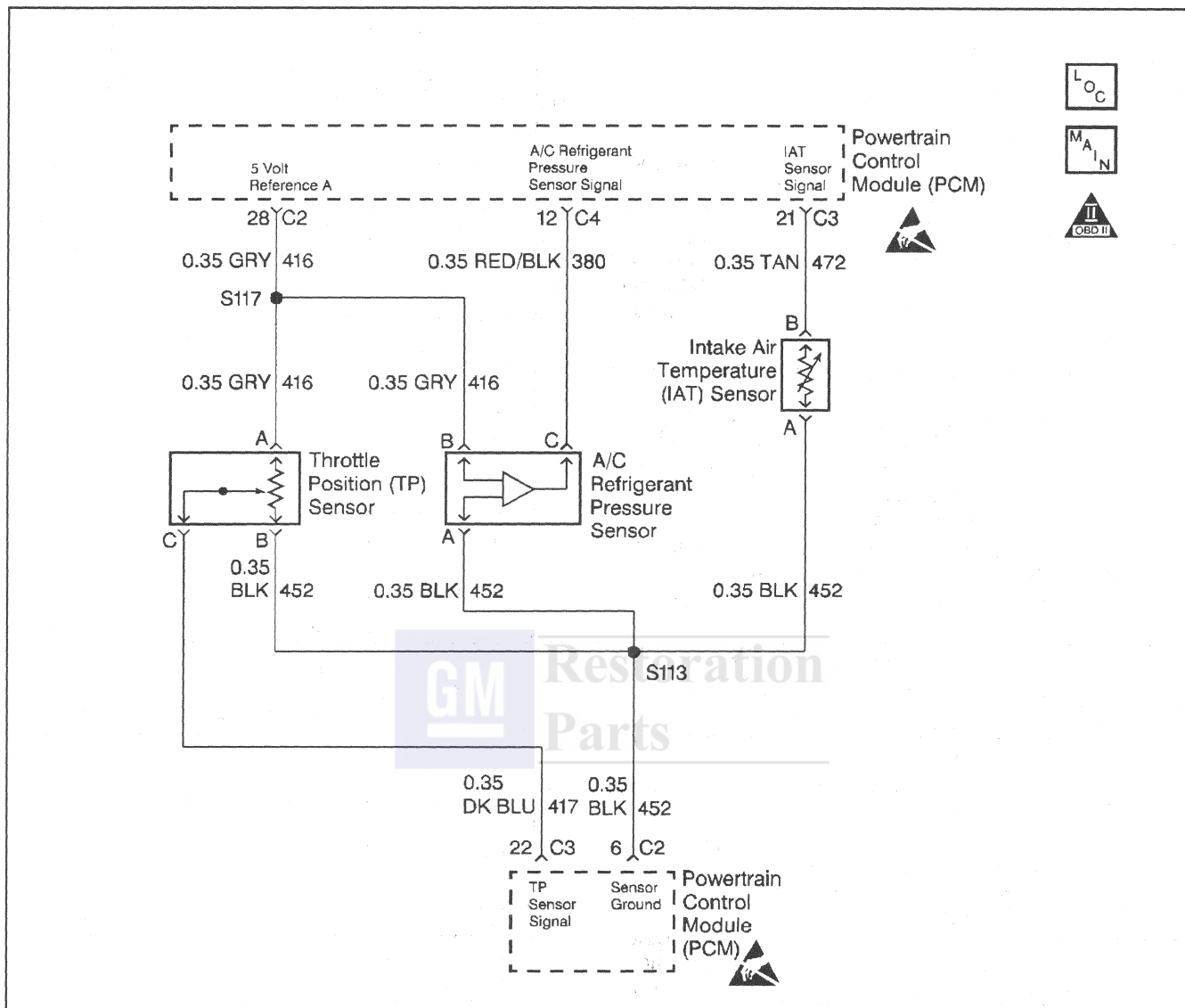
Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the malfunction is present.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If the intake air temperature goes below -30°C (-22°F), indicates the PCM and IAT wiring are OK.
5. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0112 IAT Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Monitor the IAT display on the Engine 1 Data List of the scan tool. Is the IAT above the specified value?	150 °C (302 °F)	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0112 IAT Sensor Circuit Low Voltage
4	1. Disconnect the IAT sensor electrical connector. 2. Observe the IAT display on the scan tool. Is the IAT at the specified value?	-40 °C (-22 °F)	Go to Step 6	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the IAT signal circuit for a short to ground. 3. If the IAT sensor signal circuit is grounded, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the IAT signal circuit grounded?	—	Go to Step 8	Go to Step 7
6	Replace the IAT sensor. Refer to <i>IAT Sensor</i> . Is the action complete?	—	Go to Step 8	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0113 IAT Sensor Circuit High Voltage



30393

Circuit Description

The Intake Air Temperature (IAT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The IAT sensor is located in the air intake passage of the engine air induction system. The IAT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine intake air temperature.

When the intake air is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the intake air is warm, the sensor resistance is low, and the signal

voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature).

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- DTC(s) P0100, P0102, P0103, P0117, P0118, P0500, P0502, P0503 not set.
- Engine operating longer than 100 seconds.
- Engine Coolant Temperature greater than 0°C (32°F).
- Intake Air Temperature is less than -35°C (-31°F).
- Vehicle speed less than 11 km/h (7 mph).

- Mass Air Flow less than 15 grams per second.
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.

- If it is determined that the DTC occurs intermittently, performing the P1111 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the malfunction is present. For any test that requires probing the PCM or component harness connectors, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If the intake air temperature goes above 150°C (302°F), indicates the PCM and IAT wiring are OK.
5. If the intake air temperature goes above 150°C (302°F), indicates the PCM and IAT signal circuit is OK.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
8. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0113 IAT Sensor Circuit High Voltage

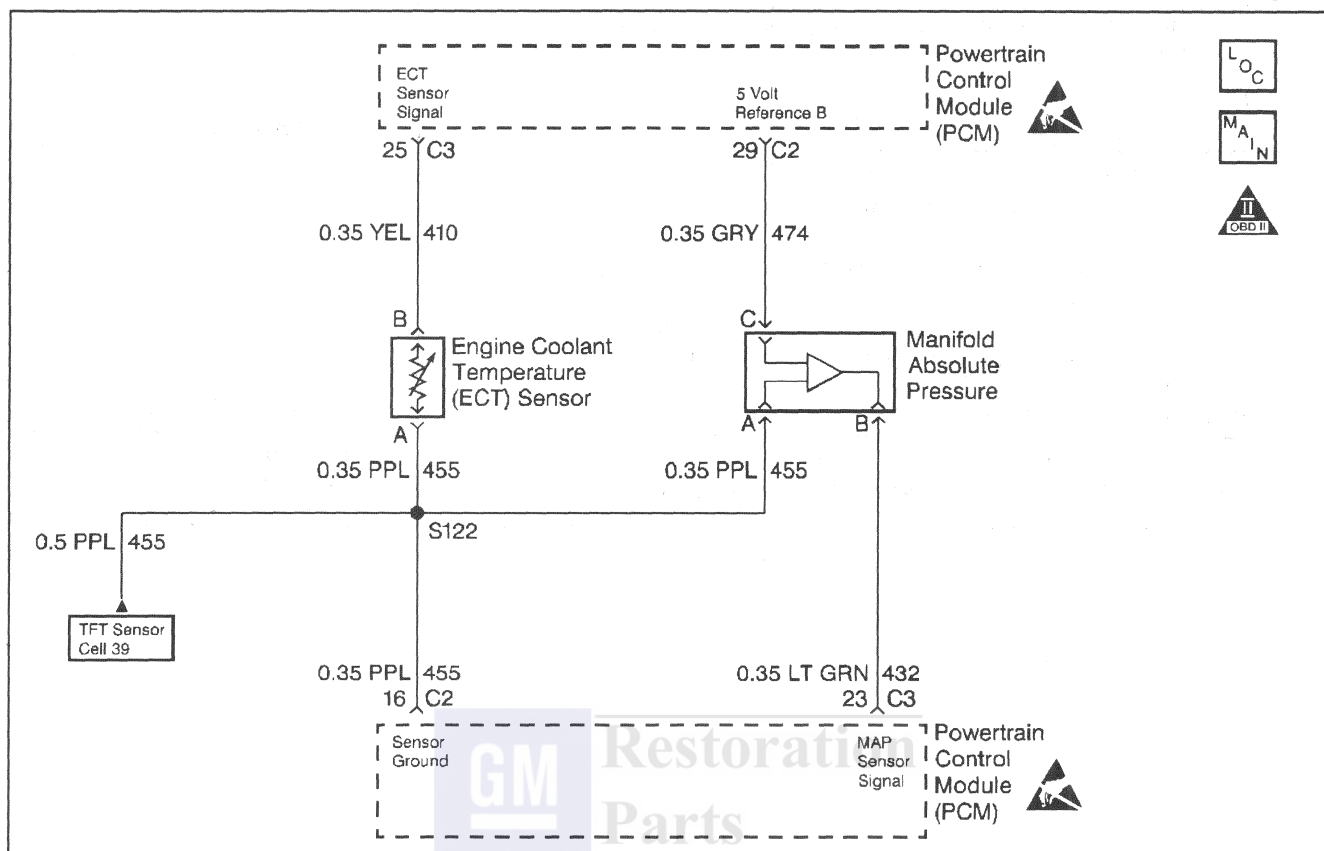
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Monitor the IAT display on the Engine 1 Data List of the scan tool. Is the IAT at the specified value?	-40°C (-40°F)	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0113 IAT Sensor Circuit High Voltage
4	1. Disconnect the IAT Sensor electrical connector. 2. Jumper the IAT harness terminals together. 3. Observe IAT parameter on the scan tool. Is the IAT at the specified value?	151°C (304°F)	Go to Step 9	Go to Step 5
5	Jumper the IAT signal circuit to a known good ground. Is the IAT at the specified value?	151°C (304°F)	Go to Step 8	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connectors. 3. Check the IAT sensor signal circuit for an open. Is the IAT sensor signal circuit open?	—	Go to Step 7	Go to Step 11
7	Repair the IAT sensor signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connectors. 3. Check the IAT sensor ground circuit for an open. Is the IAT sensor ground circuit open?	—	Go to Step 10	Go to Step 11
9	Replace the IAT sensor. Refer to <i>IAT Sensor</i> . Is the action complete?	—	Go to Step 12	—
10	Repair the IAT sensor ground circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—

DTC P0113 IAT Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0117 ECT Sensor Circuit Low Voltage



30394

Circuit Description

The Engine Coolant Temperature (ECT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The ECT sensor is mounted in the engine coolant pump housing. The ECT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine coolant temperature.

When the coolant is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the coolant is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature). At normal operating temperature, the voltage should measure about 1.5–2.0 volts at the PCM.

When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- Engine operating longer than 20 seconds.
- The PCM indicates Engine Coolant Temperature greater than 151 °C (304 °F).
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.
- The PCM will use a default engine coolant temperature.
- Transmission torque converter clutch (TCC) will apply early.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness
 - Rubbed through wire insulation
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*
- If it is determined that the DTC occurs intermittently, performing the P1114 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Determines if the malfunction is present.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- If the engine coolant temperature goes below -30°C (-22°F), indicates the PCM and ECT wiring are OK.
- Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

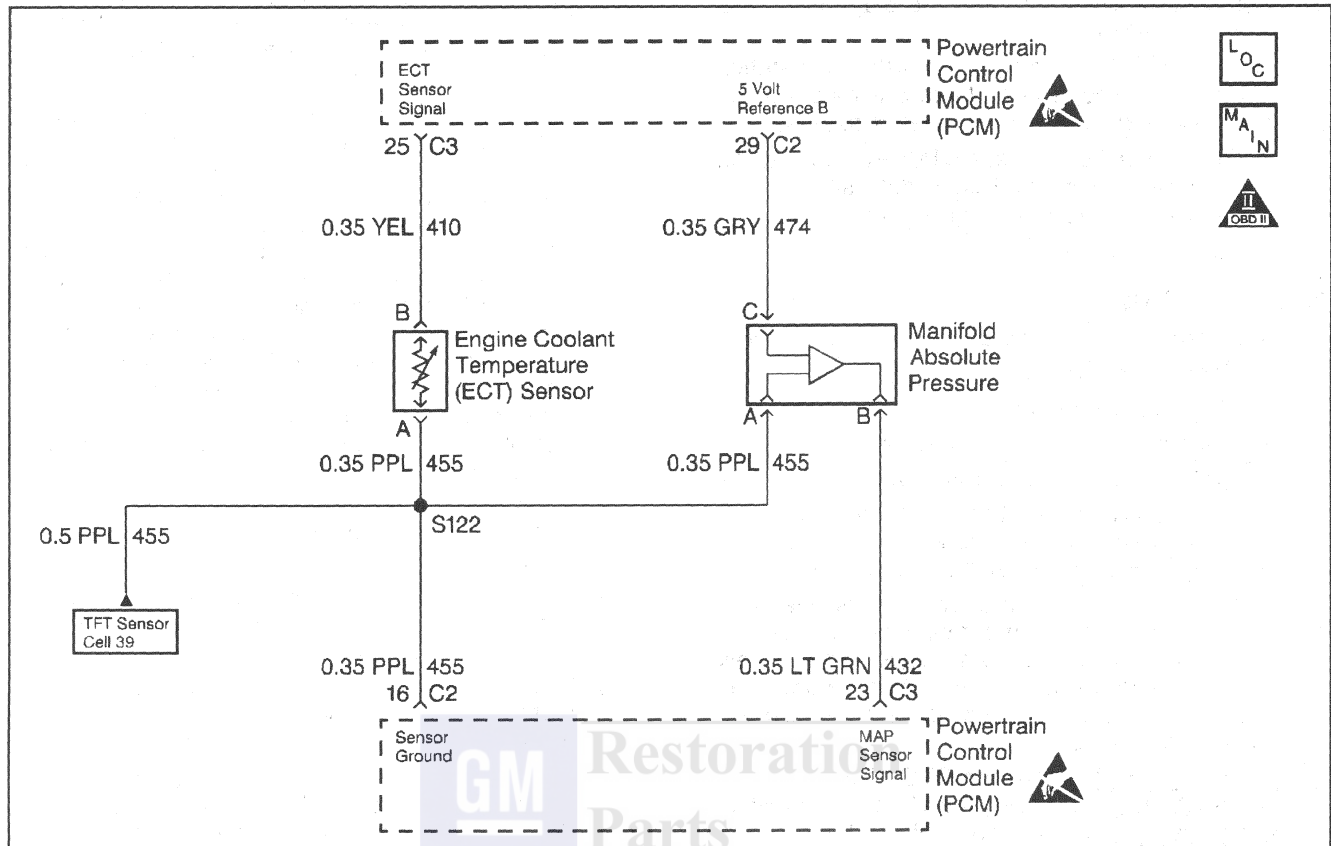
DTC P0117 ECT Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If the vehicle is overheating, the overheating condition must be corrected before proceeding with this table. 1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Monitor the ECT display on the Engine 1 Data List of the scan tool. Is the ECT above the specified value?	150°C (302°F)	Go to Step 4	Go to Step 3

DTC P0117 ECT Sensor Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0117 ECT Sensor Circuit Low Voltage
4	1. Disconnect the ECT sensor electrical connector. 2. Observe the ECT display on the scan tool. Is ECT below the specified value?	-30°C (-22°F)	Go to Step 6	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the ECT sensor signal circuit for a short to ground. 3. If the ECT sensor signal circuit is grounded, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the ECT signal circuit grounded?	—	Go to Step 8	Go to Step 7
6	Replace the ECT sensor. Refer to <i>ECT Sensor</i> . Is the action complete?	—	Go to Step 8	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0118 ECT Sensor Circuit High Voltage



30394

Circuit Description

The Engine Coolant Temperature (ECT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The ECT sensor is mounted in the engine coolant pump housing. The ECT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine coolant temperature.

When the coolant is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the coolant is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature). At normal operating temperature, the voltage should measure about 1.5–2.0 volts at the PCM.

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- Engine operating longer than 20 seconds.
- The PCM indicates Engine Coolant Temperature less than -40°C (-40°F)
- All conditions met for 4.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.
- The PCM will use a default engine coolant temperature.
- Transmission torque converter clutch (TCC) will apply early.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Poor Connections.
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*
- If it is determined that the DTC occurs intermittently, performing the P1115 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the malfunction is present. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms*.
4. If the engine coolant temperature goes above 150°C (302°F), indicates the PCM and ECT wiring is OK.
5. If the engine coolant temperature goes above 150°C (302°F), indicates the PCM and ECT signal circuit is OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
8. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0118 ECT Sensor Circuit High Voltage

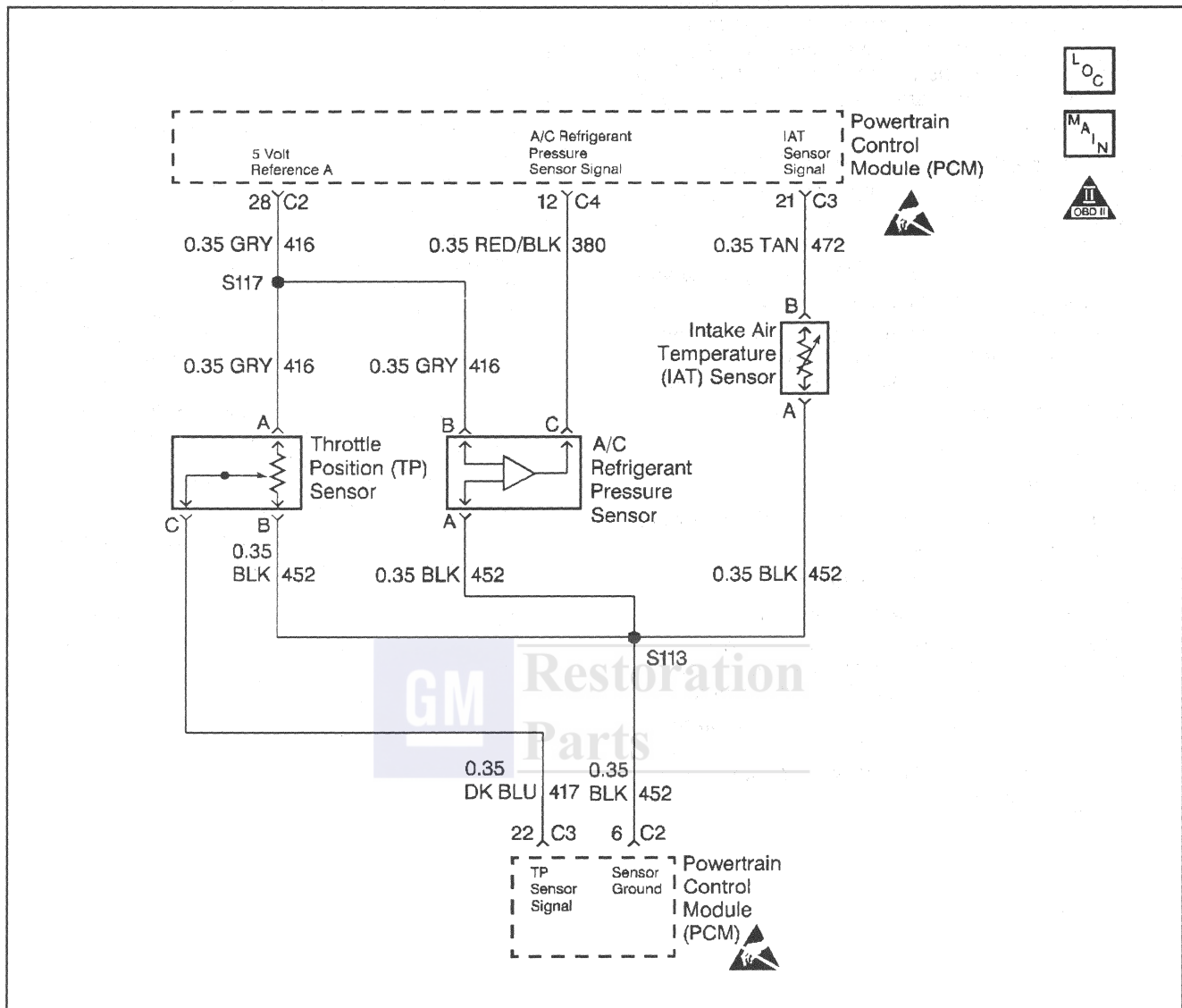
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Monitor the ECT display on the Engine 1 Data List of the scan tool. Is the ECT at the specified value?	-40°C (-40°F)	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0118 ECT Sensor Circuit High Voltage
4	1. Disconnect the ECT Sensor electrical connector. 2. Jumper the ECT harness terminals together. 3. Observe the engine coolant temperature parameter on the scan tool. Is the ECT at the specified value?	151°C (304°F)	Go to Step 9	Go to Step 5
5	Jumper the ECT signal circuit to a known good ground. Is the ECT at the specified value?	151°C (304°F)	Go to Step 8	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connectors. 3. Check the ECT sensor signal circuit for an open. Is the ECT sensor signal circuit open?	—	Go to Step 7	Go to Step 11
7	Repair the ECT sensor signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connectors. 3. Check the ECT sensor ground circuit for an open. Is the ECT sensor ground circuit open?	—	Go to Step 10	Go to Step 11
9	Replace the ECT sensor. Refer to <i>ECT Sensor</i> . Is the action complete?	—	Go to Step 12	—
10	Repair the ECT sensor ground circuit. Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—

DTC P0118 ECT Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0121 TP Sensor Circuit Insufficient Activity



30393

Circuit Description

The Throttle Position (TP) sensor is a potentiometer. The TP sensor is mounted to the right side of the throttle body. The TP sensor provides a voltage signal that changes relative to throttle blade angle. This signal voltage is one of the most important inputs used by the PCM. The TP sensor has a 5.0 volt reference, a ground and a signal circuit.

TP sensor Signal voltage should be about 0.6 volt at idle. The TP sensor voltage should increase to above 4.0 volts at wide open throttle (WOT).

This diagnostic compares actual throttle position from the TP sensor to a predicted throttle position value. The predicted throttle position is calculated from engine speed and other inputs. If the PCM detects the predicted throttle position is below the actual TP sensor value, this DTC will set.

Conditions for Setting the DTC

- No MAP sensor DTCs set and no other TP sensor DTCs set.
- MAP less than 60 kPa.
- TP steady.
- Predicted throttle angle is less than actual throttle angle.
- All conditions present for 38 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.

- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- The PCM 5 volt reference circuits are internally connected within the PCM. If all the TP sensor circuits check to be OK, inspect related 5.0 volt reference circuits.

- If it is determined that the DTC occurs intermittently, performing the DTC P1121 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This checks if the fault is present.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If the TP sensor voltage drops indicates that there is no malfunction with the TP sensor wiring or the PCM.
5. This checks the 5.0 volt reference circuit, signal circuit and the PCM. If the scan tool displayed 5.0 volts indicates the TP sensor circuits are OK.

DTC P0121 TP Sensor Circuit Insufficient Activity

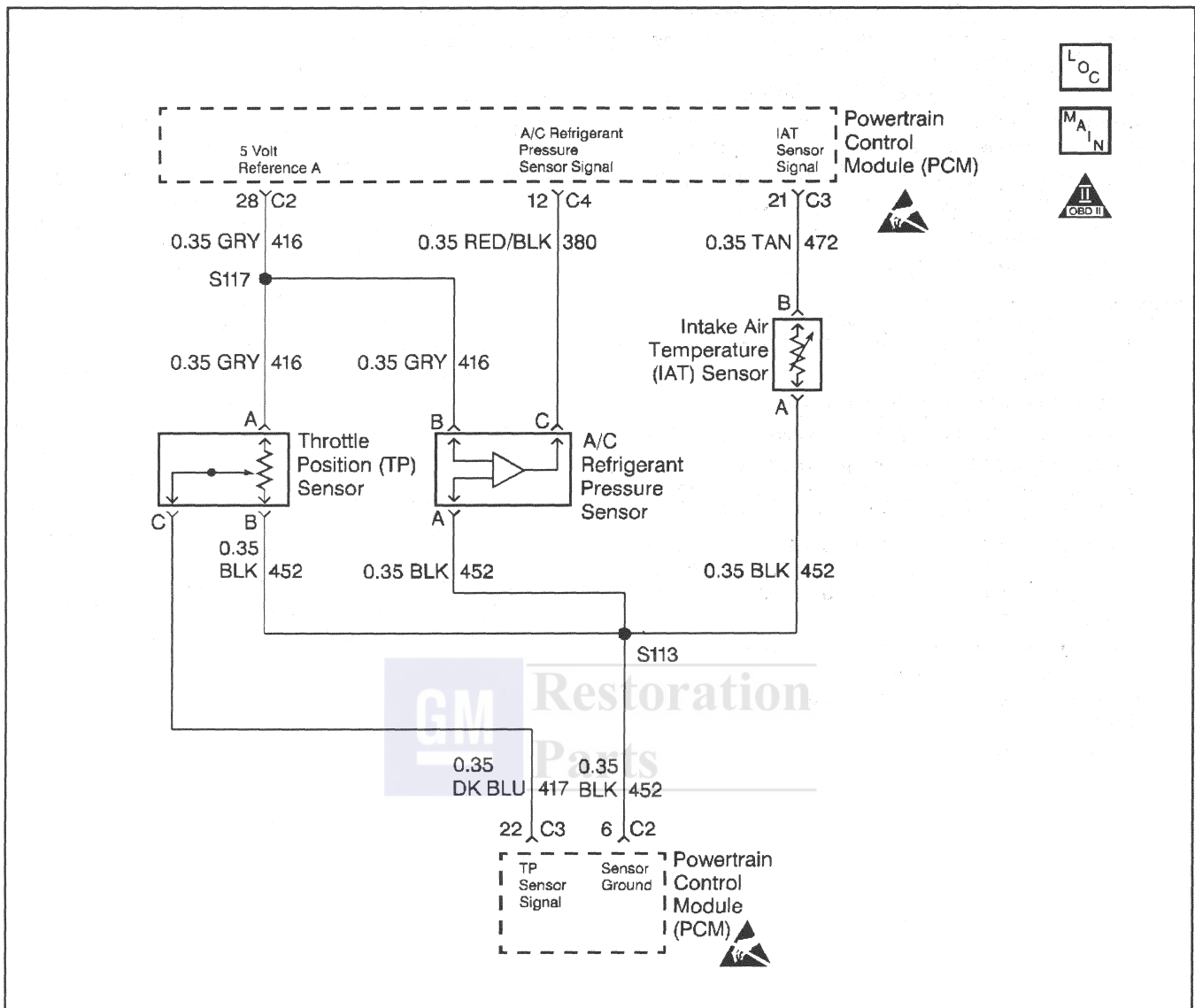
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a scan tool on the Engine 1 data list, monitor the TP sensor voltage while moving accelerator pedal from a closed throttle to a wide open throttle. Does the TP sensor voltage go from below the specified value to above the specified value?	Below 1.0 V to above 4.0 V	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0121 TP Sensor Insufficient Activity
4	1. Disconnect the TP sensor. 2. Observe the TP sensor reading on the scan tool. Is the TP sensor voltage near the specified value?	0.0 V	Go to Step 5	Go to Step 7
5	Using a fused jumper wire, jump the TP sensor 5.0 volt reference circuit to the TP sensor signal circuit. Is the TP sensor voltage near the specified value?	5.0 V	Go to Step 6	Go to Step 8
6	Replace the TP sensor. Refer to <i>TP Sensor</i> . Is the action complete?	—	Go to Step 10	—
7	Check for the following conditions: - TP signal circuit for a short to voltage. - TP sensor ground circuit for high resistance between the PCM and the TP sensor. - TP sensor ground circuit for a poor connection. If a problem is found, repair wiring harness as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found?	—	Go to Step 10	Go to Step 9
8	Check for the following conditions: - TP signal circuit or 5 volt reference circuit for a poor connection. - TP signal circuit or 5 volt reference circuit for high resistance between the PCM and the TP sensor. If a problem is found, repair wiring harness as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found?	—	Go to Step 10	Go to Step 9

DTC P0121 TP Sensor Circuit Insufficient Activity (cont'd)

Step	Action	Value(s)	Yes	No
9	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 10	—
10	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 11	Go to Step 2
11	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0122 TP Sensor Circuit Low Voltage



30393

Circuit Description

The Throttle Position (TP) sensor is a potentiometer. The TP sensor is mounted to the right side of the throttle body. The TP sensor provides a voltage signal that changes relative to throttle blade angle. This signal voltage is one of the most important inputs used by the PCM. The TP sensor has a 5.0 volt reference, a ground and a signal circuit. TP sensor Signal voltage should be about 0.6 volt at idle. The TP sensor voltage should increase to above 4.0 volts at wide open throttle (WOT). When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- TP sensor signal voltage is less than 0.2 volts.
- Condition present for 1 second.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The PCM will use a default TP sensor value.
- Transmission TCC will not apply.
- High transmission line pressure.
- Fixed transmission shift points, hard shifts and no fourth gear in hot mode.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- The PCM 5 volt reference circuits are internally connected within the PCM. If all the TP sensor circuits check to be OK, inspect related 5.0 volt reference circuits.
- If it is determined that the DTC occurs intermittently, performing the DTC P1122 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This checks if the fault is present.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. Vehicles equipped with traction control will have to disconnect the EBTM. This will determine if the short is caused from the EBTM. After repairs are made, reconnect the EBTM, clear any DTCs that may have been set when the EBTM was disconnected.
6. This checks whether the ground circuit is available to the TP sensor. Check for poor electrical connections at the TP sensor. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

GM Restoration Parts

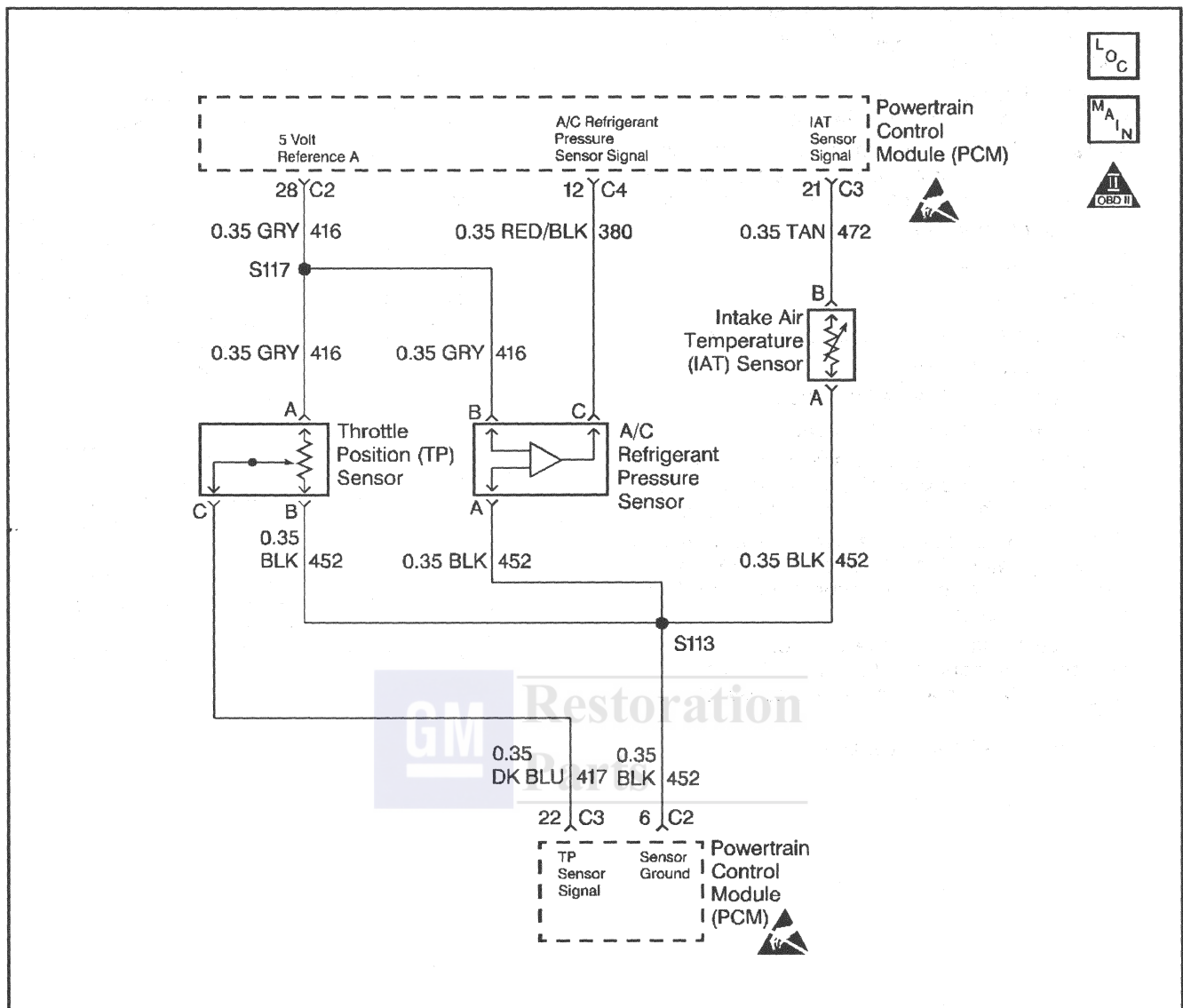
DTC P0122 TP Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. With the throttle closed, observe the TP sensor voltage and percentage display on the Engine 1 Data List of the scan tool. Is the TP sensor voltage or the Throttle Angle above the specified values?	4.7V, 0%	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0123 TP Sensor Circuit High Voltage
4	Important: This step is only for D and Y cars. Proceed to step 5 if the vehicle is not a D or Y car. 1. Turn the ignition OFF. 2. Disconnect the EBCM. 3. Turn the ignition ON. Is the TP sensor voltage above the specified value?	4.7V	Go to Step 5	Go to Section 5E2 for further diagnosis of the EBCM
5	1. Disconnect the sensor electrical connector. 2. Observe the TP sensor voltage display on the scan tool. Is the TP sensor voltage below the specified value?	0.20V (200mV)	Go to Step 6	Go to Step 9
6	Probe the sensor ground circuit at the TP sensor harness connector with a test light (J 34142-B) connected to B+. Is the test light ON?	—	Go to Step 7	Go to Step 10
7	Using a DVM (J 3920) measure the voltage at the 5 volt reference circuit to ground. Is the voltage greater than the specified value?	5.0V	Go to Step 13	Go to Step 8
8	Replace the TP sensor with a new TP Sensor. Is the action complete?	—	Go to Step 14	—
9	1. Turn the ignition OFF and disconnect the PCM. 2. Turn the ignition OFF. 3. Check for a short to ground on the TP sensor signal circuit; also check for short circuit between the TP sensor signal circuit and the EBCM. 4. If the TP sensor signal circuit is shorted, repair it as necessary. Refer to Air Procedures in Electrical Diagnosis (8A Cell). Was the TP sensor signal circuit shorted?	—	Go to Step 14	Go to Step 12

DTC P0122 TP Sensor Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Turn the ignition OFF, disconnect the PCM. 2. Check the TP sensor ground circuit for a good connection at the PCM. 3. If a poor connection is found at the PCM, replace the terminal as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found at the PCM?	—	Go to Step 14	Go to Step 11
11	1. Check for an open TP sensor ground circuit. 2. If the TP sensor ground circuit is open, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the TP sensor ground circuit open?	—	Go to Step 14	Go to Step 12
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
13	Repair the 5 volt reference circuit for a short to voltage. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0123 TP Sensor Circuit High Voltage



Circuit Description

The Throttle Position (TP) sensor is a potentiometer. The TP sensor is mounted to the right side of the throttle body. The TP sensor provides a voltage signal that changes relative to throttle blade angle. This signal voltage is one of the most important inputs used by the PCM. The TP sensor has a 5.0 volt reference, a ground and a signal circuit. TP sensor Signal voltage should be about 0.6 volt at idle. The TP sensor voltage should increase to above 4.0 volts at wide open throttle (WOT).

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting The DTC

- TP sensor signal voltage is greater than 4.8 volts.
- Condition present for 1 second.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will use a default TP sensor value.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- Transmission TCC will not apply.
- High transmission line pressure.
- Fixed transmission shift points, hard shifts and no fourth gear in hot mode.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An intermittent may be caused by the following:
 - Mis-routed harness.
 - Rubbed through wire insulation.
 - Broken wire inside the insulation.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- The PCM 5 volt reference circuits are internally connected within the PCM. If all the TP sensor circuits check to be OK, inspect related 5.0 volt reference circuits.
- If it is determined that the DTC occurs intermittently, performing the DTC P1121 diagnostic table may isolate the cause of the fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This checks if the fault is present.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. Vehicles equipped with traction control will have to disconnect the EBTCTM. This will determine if the short is caused from the EBTCTM. After repairs are made, reconnect the EBTCTM, clear any DTCs that may have been set when the EBTCTM was disconnected.
6. This checks whether the ground circuit is available to the TP sensor. Check for poor electrical connections at the TP sensor. Refer to *Repair Procedures in Electrical Diagnosis* (8A Cell 5).

Restoration
Parts

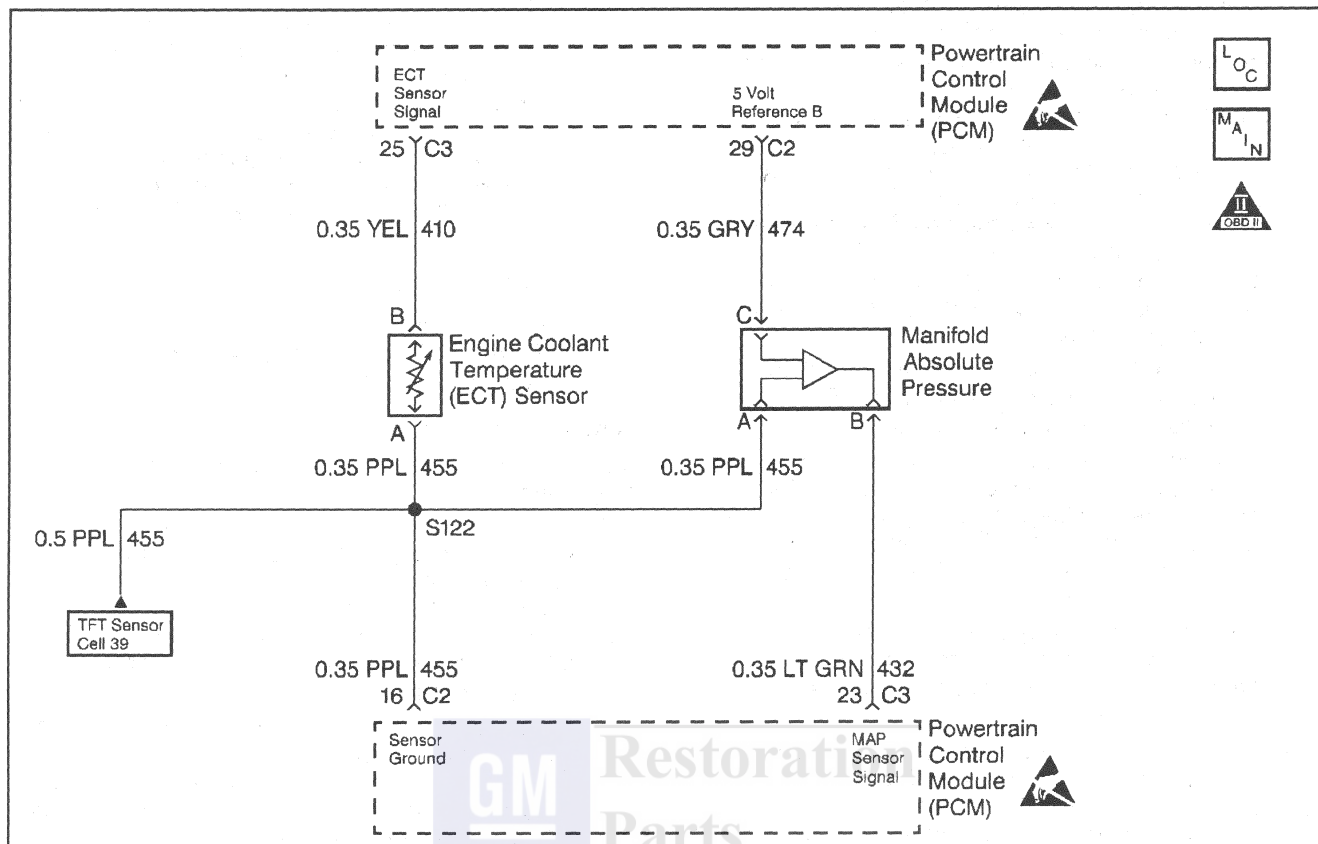
DTC P0123 TP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. With the throttle closed, observe the TP sensor voltage and percentage display on the Engine 1 Data List of the scan tool. Is the TP sensor voltage or the Throttle Angle above the specified values?	4.7V, 0%	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - DTC P0123 TP Sensor Circuit High Voltage
4	Important: This step is only for D and Y cars. Proceed to step 5 if the vehicle is not a D or Y car. 1. Turn the ignition OFF. 2. Disconnect the EBTCM. 3. Turn the ignition ON. Is the TP sensor voltage above the specified value?	4.7V	Go to Step 5	Go to Section 5E2 for further diagnosis of the EBTCM
5	1. Disconnect the TP sensor electrical connector. 2. Observe the TP sensor voltage display on the scan tool. Is the TP sensor voltage below the specified value?	0.20V (200mV)	Go to Step 6	Go to Step 9
6	Probe the sensor ground circuit at the TP sensor harness connector with a test light (J 34142-B) connected to B+. Is the test light ON?	—	Go to Step 7	Go to Step 10
7	Using a DVM (J 39200), measure the voltage at the 5 volt reference circuit to ground. Is the voltage greater than the specified value?	5.0V	Go to Step 13	Go to Step 8
8	Replace the TP sensor. Refer to <i>TP Sensor</i> . Is the action complete?	—	Go to Step 14	—
9	1. Turn the ignition OFF, disconnect the PCM. 2. Turn the ignition ON, engine OFF. 3. Check for a short to voltage on the TP sensor signal circuit; also check for a short circuit between the TP sensor signal circuit and the EBTCM. 4. If the TP sensor signal circuit is shorted, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the TP sensor signal circuit shorted?	—	Go to Step 14	Go to Step 12

DTC P0123 TP Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Turn the ignition OFF, disconnect the PCM. 2. Check the TP sensor ground circuit for a good connection at the PCM. 3. If a poor connection is found at the PCM, replace the terminal as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found at the PCM?	—	Go to Step 14	Go to Step 11
11	1. Check for an open TP sensor ground circuit. 2. If the TP sensor ground circuit is open, repair it as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was the TP sensor ground circuit open?	—	Go to Step 14	Go to Step 12
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
13	Repair the 5 volt reference circuit for a short to voltage. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0125 ECT Excessive Time to Closed Loop



30394

Circuit Description

While the engine is warming, the PCM monitors the ECT sensor to determine how long it takes the engine to reach the coolant temperature required for Closed Loop operation. DTC P0125 will set if the PCM determines that the engine does not reach Closed Loop temperature in a specified amount of time. This test will not run if either the intake air or engine coolant temperature is too low at start up. The PCM will only run this DTC on a cold start and only once per cold start.

Conditions for Setting the DTC

- DTCs P0112, P0113, P0117, P0118, not set.
- Engine coolant and intake air temperature are greater than 10°C (50°F) at start-up.
- Vehicle speed greater than 8 km/h (5 mph).
- Closed loop coolant temperature, 60°C (140°F), is not reached within about 7 minutes.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.

- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.
- If it is determined that the DTC occurs intermittently, performing the P1114 or P1115 diagnostics table may isolate the cause of the fault.
- If the engine coolant temperature exceeds 60°C (140°F), this indicates that the engine is capable of reaching the proper temperature, but not necessarily in the correct amount of time.

This diagnostic table must be repeated on a cold engine, engine coolant and intake air temperature less than 50°C (122°F) and within 3°C (5°F) of each other, and the time required to reach the temperature threshold must be measured. When starting a cold engine, measure the amount of time it takes the engine to reach the specified temperature. The engine should reach the specified temperature within 7 minutes. If the specified temperature is not reached within 7 minutes, check the following:

- Coolant level.
- Thermostat operation.
- Are fans on at all times?
- Refer to *Engine Cooling System (6B)* for additional information.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- An ECT failure could cause a DTC P0125 to set, so correct any ECT DTCs that are set. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
- If it is obvious that the engine is not reaching full operating temperature, for example the radiator hoses never get very warm, or there is a complaint of little or no heat from the heater, this step could be skipped.

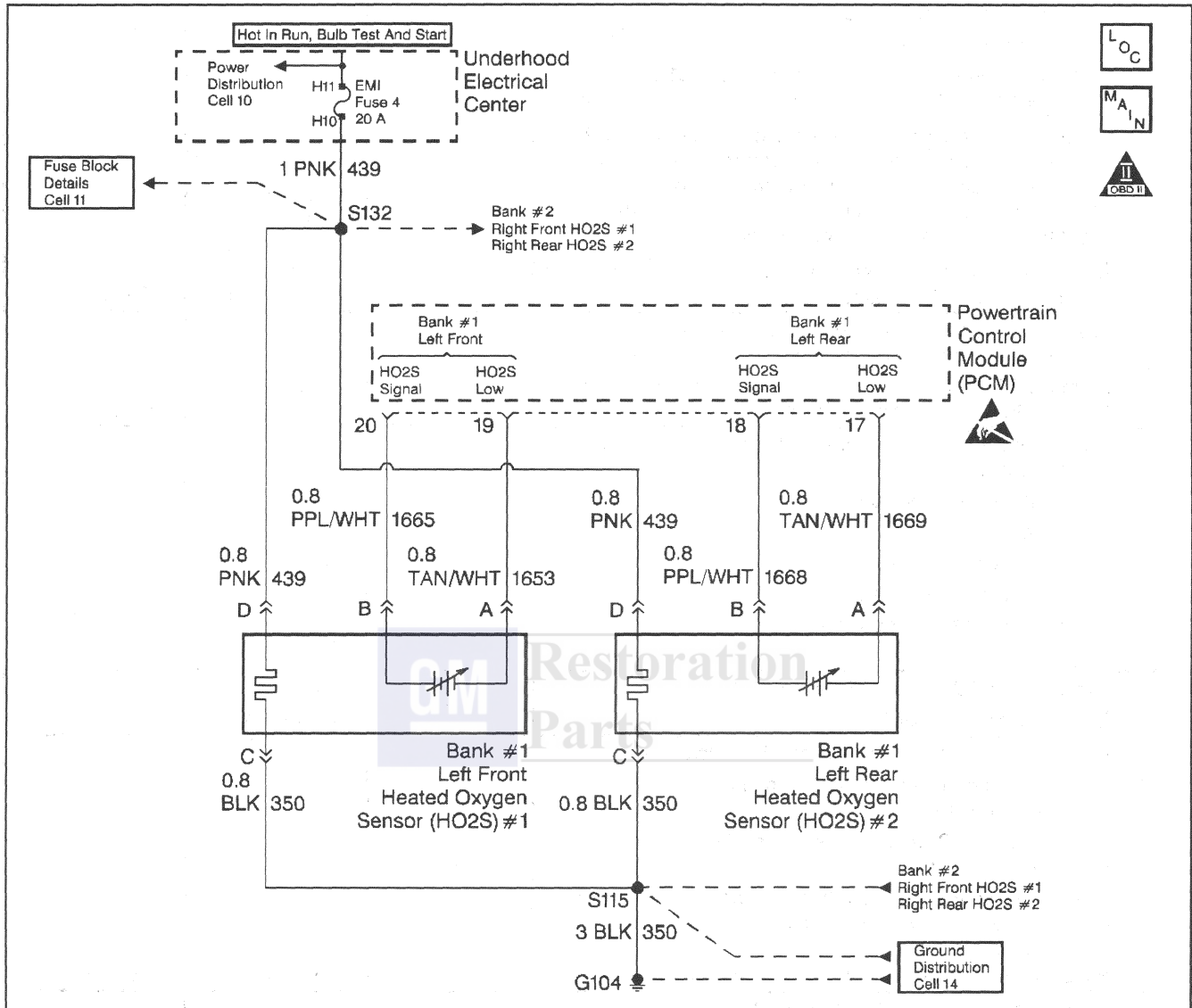
DTC P0125 ECT Excessive Time to Closed Loop

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Are any engine coolant temperature DTCs set?	—	Go to applicable DTC table	Go to Step 3
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Disconnect the ECT sensor. Does the scan tool indicate the ECT sensor is less than the specified value?	-35°C (-31°F)	Go to Step 4	Go to DTC P0117 ECT Sensor Circuit Low Voltage
4	Using a jumper wire, jumper terminals at the ECT sensor harness connector together. Does the scan tool indicate the ECT is greater than the specified value?	150°C (302°F)	Go to Step 5	Go to DTC P0118 ECT Sensor Circuit High Voltage

DTC P0125 ECT Excessive Time to Closed Loop (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Reconnect the ECT sensor. 2. Start and idle the engine. 3. With the engine idling, observe the ECT sensor display on the Engine 1 Data List of the scan tool. Important: Allow time for the engine to warm up if it has not already reached the specified temperature. 7 minutes is the maximum amount of time it should take to reach this temperature from a cold start. Less time should be necessary if the engine is already warm. Does the scan tool indicate the engine coolant temperature reached the specified value?	60°C (140°F)	System must be rechecked on a cold start. Refer to Diagnostic Aids.	Go to Step 6
6	Using a DVM (J 39200), measure the resistance of the ECT sensor. Refer to <i>Temperature Vs Resistance Table</i> . Is the ECT resistance close to the value indicated in the Temperature Vs Resistance Table?	—	Go to Step 7	Go to Step 8
7	For an engine cooling system problem, check for the following conditions: • Thermostat operation • Coolant level • Coolant to water ratio • Cooling fan operation etc. Refer to <i>Engine Cooling System</i> . Is the action complete?	—	Go to Step 9	—
8	Replace the ECT sensor. Refer to <i>ECT Sensor</i> . Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed below a predetermined voltage. If the PCM detects the voltage is below a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0200, P0372, P1371 not set.
- Engine coolant temperature greater than 48°C (118°F).
- Fuel system operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains below 200 mV for 30 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Heated Oxygen Sensor (HO2S) wire. Sensor pigtail may be contacting the exhaust manifold.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*
- Check for intermittent ground in signal wire between connector and sensor.
- Lean injector(s). Perform Injector Balance Test.
- Fuel contamination. Water near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a DTC.

- Fuel pressure. System will be lean if fuel pressure is low. Refer to *Fuel System* diagnosis.
- Exhaust leaks. An exhaust leak near the HO2S can cause a lean condition. Vacuum or crankcase leaks can also cause a lean condition.
- If the above are OK, the HO2S may be at fault. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage. If the voltage stayed near 0.0 volts indicates the low circuit is open, or the high circuit is open or grounded.
5. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1

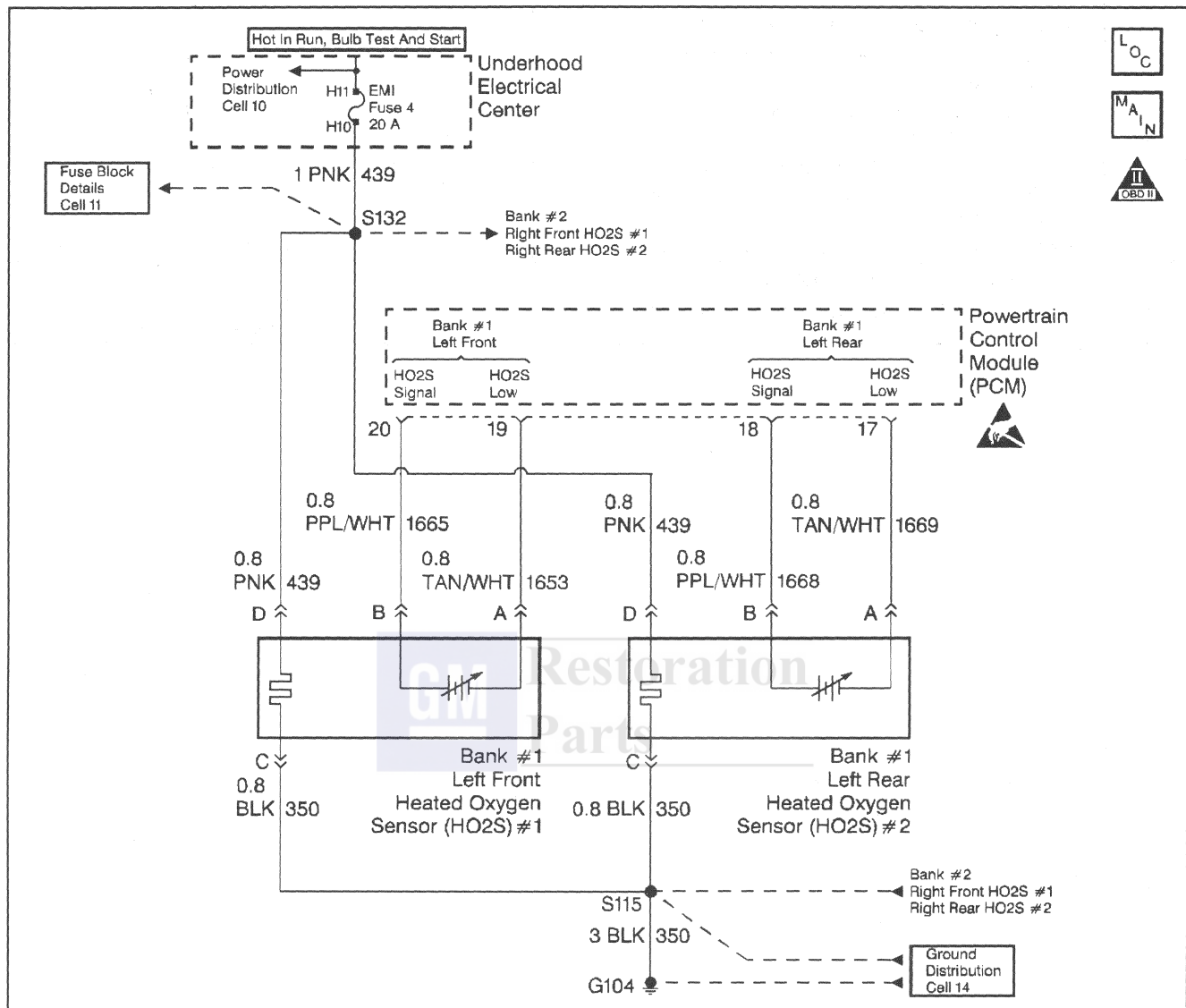
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start the engine and idle until normal operating temperature is reached. 3. Operate the vehicle within parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor the HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage less than the specified value?	200 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Circuit Low
4	Disconnect the HO2S and jumper the HO2S low circuit (PCM side) to ground. Does the scan tool indicate HO2S voltage is within the specified values?	375–525 mV	Go to Diagnostic Aids-HO2S Circuit Low	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Check the HO2S signal circuit for a short to ground or a short to the sensor ground circuit. Is the HO2S signal circuit shorted?	—	Go to Step 6	Go to Step 7
6	Repair the HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 8	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i>. Replace the PCM. Is the action complete?	—	Go to Step 8	—

DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed above a predetermined voltage. If the PCM detects the voltage is above a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0118, P0121, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- System operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains above 774 mV for 30 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Fuel pressure. System will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC may set. Refer to *Fuel System Diagnosis*
- Rich injector(s). Perform Injector Balance Test.
- Leaking injector. Refer to *Fuel System Diagnosis*
- Evaporative emissions (EVAP) canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. Refer to *EVAP Control System*
- MAF sensor. Disconnect the MAF sensor and see if rich condition is corrected. If so, check for proper installation. If installed OK, replace MAF sensor. If MAF sensor is installed backwards, the system will go rich. The plastic portion of the sensor has arrows cast into it indicating proper air flow direction. The arrow must point toward the engine.

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TP sensor. An intermittent TP sensor output will cause the system to go rich, due to a false indication of the engine accelerating. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

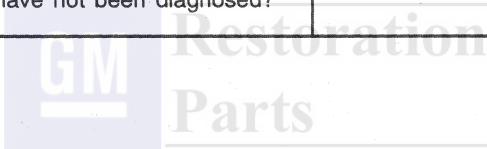
2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms*.
5. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage.
9. Review the system mechanization. Check for a short between the HO2S signal circuit and any other wires powered by this fuse that run together inside the harness.

DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1

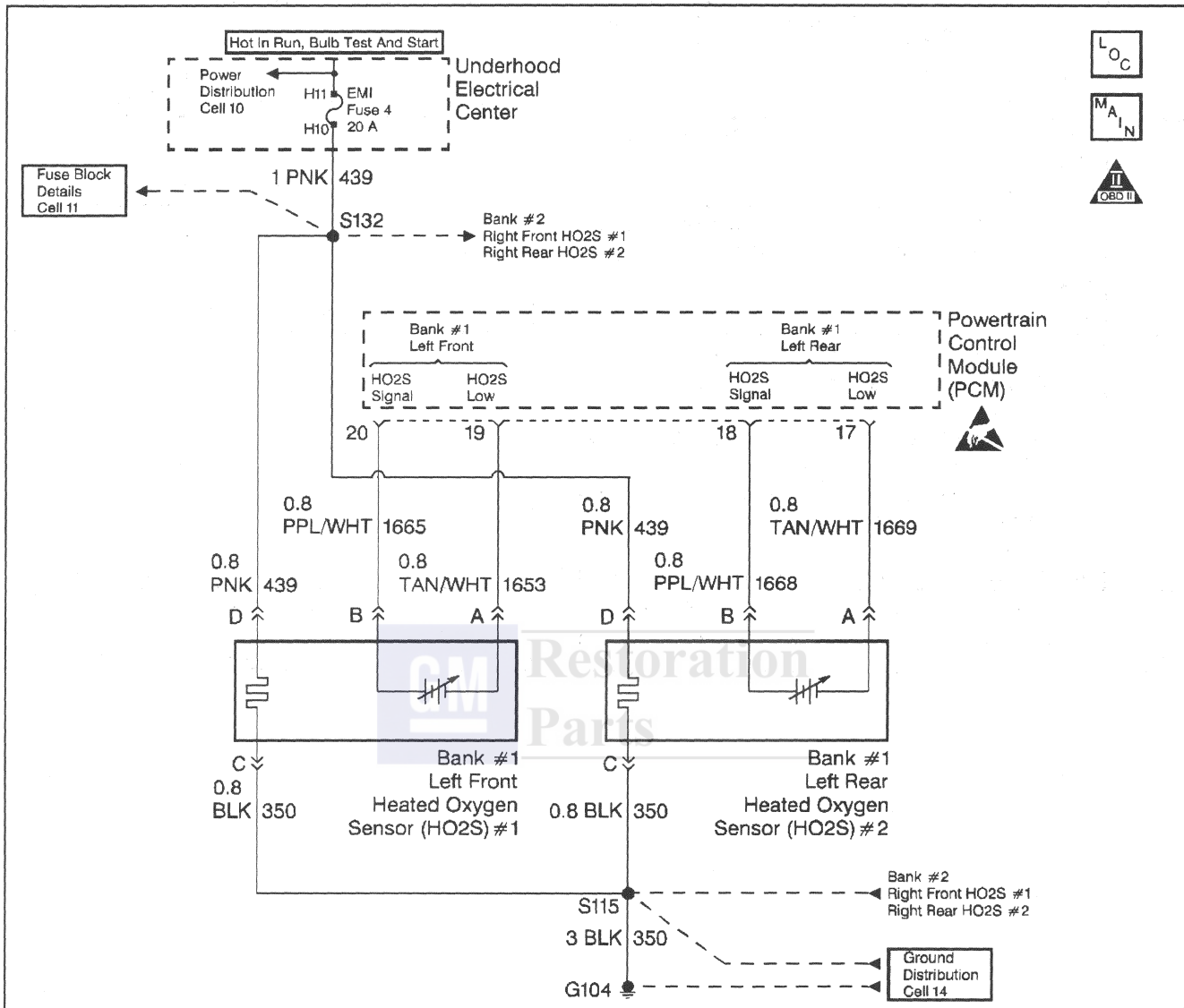
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start the engine and idle until normal operating temperature is reached. 3. Raise the engine speed to 1200 RPM. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage greater than the specified value?	774 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - HO2S Circuit High Voltage
4	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 5	Go to Step 7
5	1. Reinstall the fuse. 2. Disconnect HO2S and jumper the HO2S low signal (PCM side) circuit to ground. Does the scan tool indicate HO2S voltage within the specified values?	375–525 mV	Go to Step 10	Go to Step 6
6	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 9	Go to Step 8
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the HO2S signal circuit. 3. Disconnect the HO2S. 4. Turn the ignition ON. 5. Using a DVM (J 39200), check for voltage on the HO2S sensor signal circuit at PCM harness connector. Is there any voltage present?	—	Go to Step 8	Go to Diagnostic Aids - HO2S Circuit High Voltage
8	Repair short to voltage in HO2S signal circuit. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Is the action complete?	—	Go to Step 12	—

DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair HO2S signal circuit and HO2S heater B+ circuit shorted together. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 10	Go to Step 11
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0133 HO2S Slow Response Bank1 Sensor1



30395

Circuit Description

The PCM continuously monitors the Heated Oxygen Sensor (HO2S) activity for 100 seconds. During the monitor period the PCM counts the number of times that the HO2S responds from rich to lean and from lean to rich and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. If the average response time is too slow, a DTC will set.

A lean to rich transition is determined when the HO2S voltage changes from less than 300 mV to greater than 600 mV. A rich to lean transition is determined when the HO2S voltage changes from more than 600 mV to less than 300 mV. An HO2S that responds too slowly is most likely defective and should be replaced.

Conditions for Setting the DTC

- DTCs P0100, P0107, P0108, P0116, P0117, P0118, P0131, P0132, P0134, P0135, P0171, P0172, P0174, P0175, P0410, P1114, P1115, P1133, not set.
- Fuel system operating in Closed Loop.
- Engine speed between 1000 RPM and 1700 RPM.
- Engine Air Flow between 12 grams per second and 28 grams per second.
- EVAP Canister purge duty cycle less than 100%.
- Lean to rich (Below 300 mV to above 600 mV) response average time is greater than 110 Milliseconds or 150 milliseconds if the vehicle is equipped with an L99 engine.

- Rich to lean (Above 600 mV to below 300 mV) response average time is greater than 110 Milliseconds or 150 milliseconds if the vehicle is equipped with an L99 engine.
- Above conditions are met for 100 seconds

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- A malfunction in the HO2S heater circuits will cause a DTC to set. Check HO2S heater circuits for intermittent opens/connections.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. When DTCs P0133 and P0153 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6–12 inches away from the HO2S can cause a DTC to set.
5. Checks whether a good ground circuit is available.
6. Checks the integrity of the signal circuit to the PCM.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicone and all silicone sealant is a none silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

DTC P0133 HO2S Slow Response Bank1 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0153), refer to those DTCs before proceeding with this diagnostic table. 1. Install the scan tool. 2. Start the and idle engine until normal operating temperature is reached. 3. Operate vehicle within parameters specified under Conditions for setting the DTC in the supporting text. 4. Using the scan tool, monitor FAIL THIS IGN. under DTC Info. Does the scan tool indicate DTC P0133 test failed?	—	Go to Step 3	Go to Diagnostic Aids - HO2S Slow Response
3	Did the scan tool also indicate P0153 test failed?	—	Go to Step 8	Go to Step 4
4	1. Perform Exhaust System Leak Test. Refer to <i>Exhaust System (6F)</i>. After Exhaust System Leak Test has been performed, return to this diagnostic. 2. If an exhaust leak is found, repair as necessary. Was an exhaust leak isolated?	—	Go to Step 2	Go to Step 5
5	Visually/physically inspect the following items: • Ensure that the Bank 1 HO2S 1 is securely installed. • Check for corrosion on terminals. • Check terminal tension (at Bank 1 HO2S 1 and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect Bank 1 HO2S 1 and jumper HO2S low (PCM side) signal circuit to ground. 2. Using the scan tool, monitor Bank 1 HO2S 1 voltage on the Engine 1 Data List. Does the scan tool indicate voltage within the specified values?	375–525 mV	Go to Step 7	Go to Step 10
7	1. Jumper Bank 1 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using the scan tool, monitor Bank 1 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200 mV	Go to Step 12	Go to Step 11
8	Important: Before replacing a sensor, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Replace the affected Heated Oxygen sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
9	Repair condition as necessary. Is the action complete?	—	Go to Step 13	—

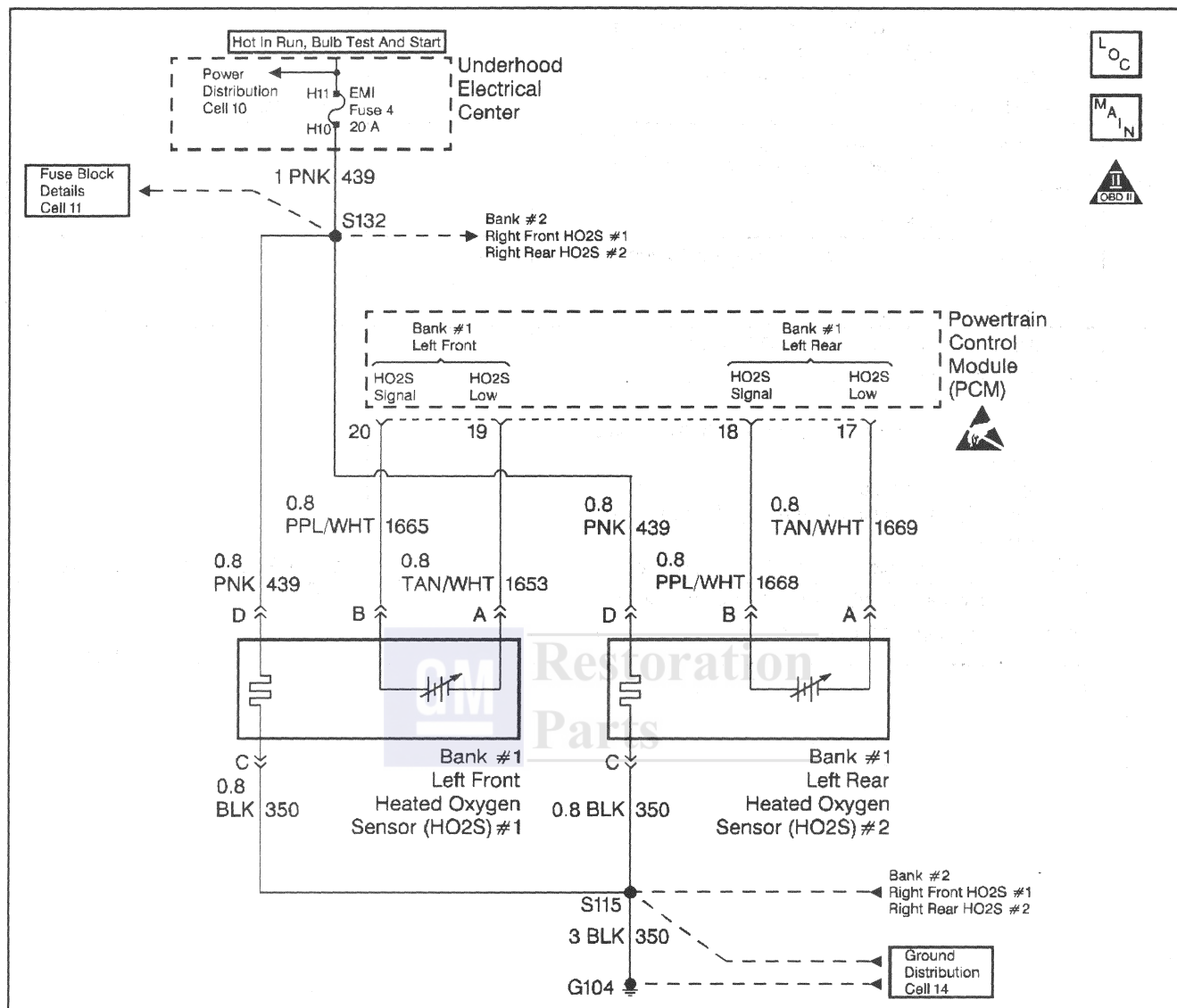
DTC P0133 HO2S Slow Response Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
10	Repair open Bank 1 HO2S 1 low signal circuit or grounded Bank 1 HO2S 1 high signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
11	Repair open Bank 1 HO2S 1 high signal circuit or faulty PCM connections. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
12	Replace Bank 1 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

GM

Restoration
Parts

DTC P0134 HO2S Insufficient Activity Bank1 Sensor1



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage and detects if the voltage goes out of the bias range. If the PCM does not detect the voltage went out of the bias range, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- Engine operating longer than 68 seconds.
- Engine coolant temperature greater than 48°C (118°F).
- HO2S signal voltage steady between 352 mV and 552 mV for 45 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms*.
4. If the scan tool indicates the HO2S voltage goes below 200 mV, indicates the HO2S circuits and PCM are OK.
5. Checks whether the signal circuit from the PCM is OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

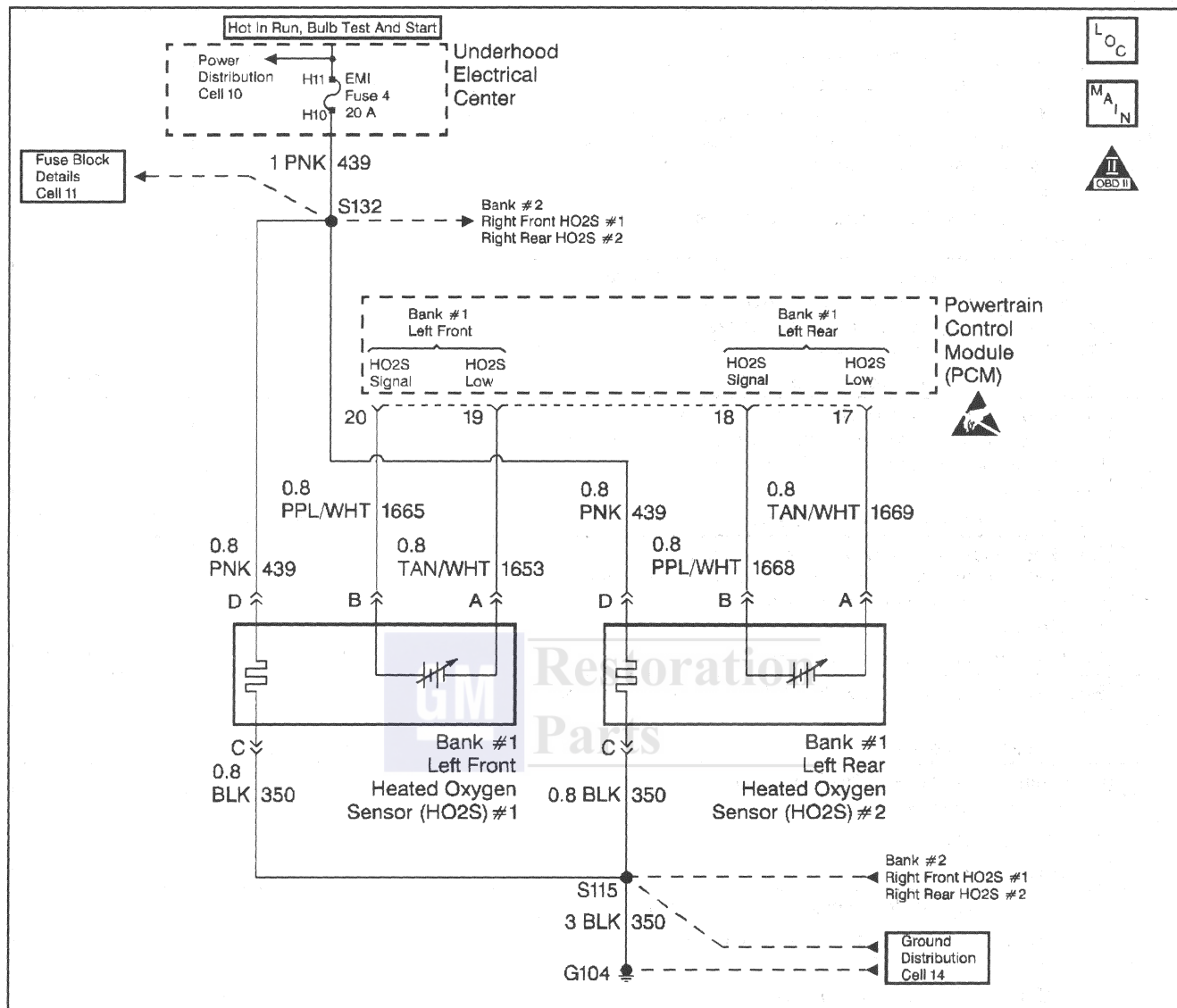
DTC P0134 HO2S Insufficient Activity Bank1 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Raise the engine above 1200 RPM for two minutes. 4. Using a scan tool, monitor the HO2S voltage display on the Engine 1 Data List. Does the scan tool indicate Bank 1 HO2S 1 voltage varying outside the specified values?	352–552 mV	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Insufficient Activity DTCs
4	1. Turn the ignition ON, Engine OFF. 2. Disconnect Bank 1 HO2S 1 and jumper HO2S high and low (PCM side) signal circuits to ground. 3. Using the scan tool, monitor Bank 1 HO2S 1 voltage. Is the Bank 1 HO2S 1 voltage below the specified value?	200 mV	Go to Step 8	Go to Step 5
5	1. Remove the jumper wire. 2. Using a DVM (J 39200), measure the voltage between the Bank 1 HO2S 1 high signal circuit (PCM side) and the Bank 1 HO2S 1 heater ground circuit. Does the Bank 1 HO2S 1 voltage measure above the specified value?	375 mV	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 1 HO2S 1 low circuit. 3. If the Bank 1 HO2S 1 low circuit measures over the specified value, repair open or poor connection as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Was a Bank 1 HO2S 1 low circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 9

DTC P0134 HO2S Insufficient Activity Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 1 HO2S 1 signal circuit. 3. If the Bank 1 HO2S 1 signal circuit measures over the specified value, repair open or poor connection as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a Bank 1 HO2S 1 signal circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 10
8	Check for a poor Bank 1 HO2S 1 signal or low circuit terminal connection at the Bank 1 HO2S 1 harness connector and replace terminal(s) if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did any terminals require replacement?	—	Go to Step 13	Go to Step 11
9	Check for poor Bank 1 HO2S 1 low circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
10	Check for poor Bank 1 HO2S 1 signal circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
11	Replace Bank 1 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action completed?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0135 HO2S Heater Circuit Bank1 Sensor1



30395

Circuit Description

The PCM supplies a bias voltage (approximately 450 mV) on the Heated Oxygen Sensor (HO2S) signal high and low circuits. When the ignition is turned to the ON position, battery voltage is supplied to the HO2S heater. As the heater reaches operating temperature, the HO2S voltage responds by changing from a bias voltage range to normal operation. Typically, as the HO2S reaches operating temperature, the HO2S voltage goes from a bias voltage to a voltage below 300 mV. Depending on the exhaust gas content, it is possible for the HO2S voltage to go above 450 mV.

The PCM will run the heater test only on a cold start (depends on cumulative air flow) and only once an ignition cycle. When the engine is started the PCM will monitor the HO2S voltage. When the HO2S

voltage goes above or below the bias range threshold, the PCM will determine how much time it took. If the PCM detects that it took too much time for the HO2S to enter into normal operating range, a DTC will set. The time it takes the HO2S to reach operating temperature is based on the amount of air that flows into the engine.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0134, P0200 not set.
- Engine is started and Intake Air and Engine Coolant temperatures are less than 50°C (122°F) and are within 3°C (5°F) of each other at start-up.
- Ignition voltage between 10 volts and 16 volts.

- Engine air flow less than 40 grams per second.
- TP sensor angle less than 20%.
- HO2S voltage remains between 300 mV and 700 mV for a predetermined amount of time (depends on engine coolant temperature and air flow).

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles

the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

- The heater diagnostic will only run on a cold start and it will only run once per ignition cycle.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- The engine must be allowed to cool, as the HO2S maybe at operating temperature and no drop or rise in HO2S voltage would occur. If the HO2S voltage stays between 300–700 mV indicates the HO2S heater is inoperative. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616–A. Using this kit will prevent damage to the harness connector terminals.
- If more then one HO2S DTC is set, is good indication that the HO2S fuse is open. Check all related circuits going to all heated oxygen sensors for a short to ground. If all wiring checks to be OK, it may be necessary to disconnect each HO2S one at a time to locate a shorted sensor.
- Checks whether B+ supply is available at the sensor.
- Checks whether a ground is available at the sensor.
- Checks whether the HO2S heater element is internally open.

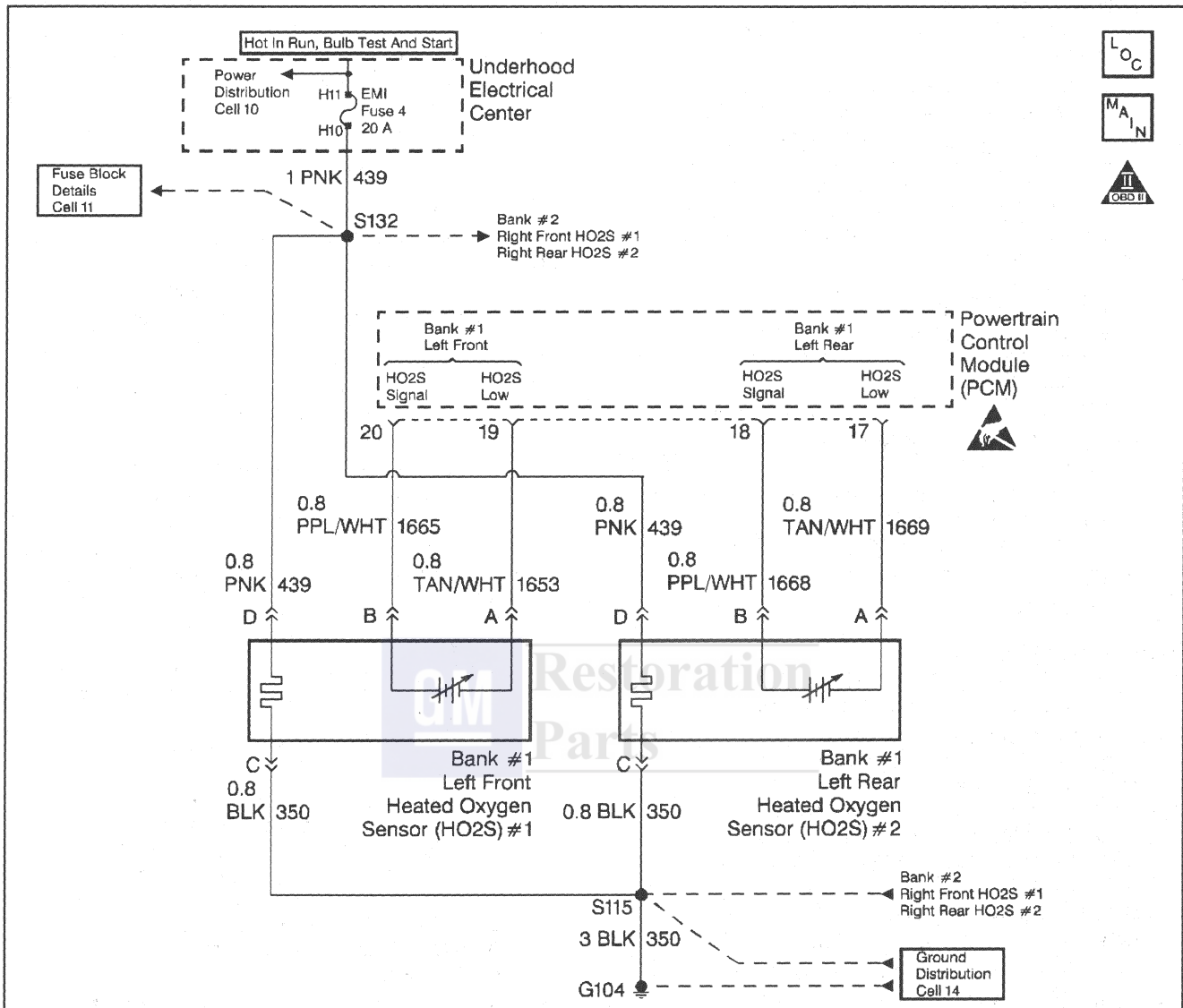
DTC P0135 HO2S Heater Circuit Bank1 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On–Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If engine has just been operating, allow engine to cool for about one half hour before proceeding. 1. Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON, engine OFF. 4. Monitor the HO2S voltage display on the Engine 1 Data List of the scan tool. Does HO2S voltage go from a bias voltage to above or below the specified values?	300–700 mV	Go to Diagnostic Aids–HO2S Heater Circuit DTCs	Go to Step 3

DTC P0135 HO2S Heater Circuit Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
3	Inspect fuse for the HO2S ignition feed. Is HO2S fuse open?	—	Go to Step 11	Go to Step 4
4	1. Raise the vehicle. 2. Disconnect HO2S electrical connector. 3. Using a test light (J 34142-B) connected to ground (A known good ground. Do not use HO2S heater ground or HO2S low), probe ignition feed circuit at the HO2S electrical connector (PCM side). Does the test light illuminate?	—	Go to Step 5	Go to Step 7
5	Connect the test light between HO2S ignition feed and HO2S heater ground. Does the test light illuminate?	—	Go to Step 6	Go to Step 8
6	Using a DVM (J 39200), measure resistance between HO2S ignition feed and HO2S heater ground at HO2S pigtail. Is the HO2S resistance within the specified values?	3.5–14.0 Ω	Go to Step 9	Go to Step 10
7	Repair the open in the HO2S ignition feed circuit to HO2S. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	Repair the open in the HO2S heater ground circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
9	1. Check for a poor connection at the HO2S harness terminals. 2. If a poor connection is found, replace terminals. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found?	—	Go to Step 12	Go to Step 10
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Locate and repair the short to ground in HO2S ignition feed circuit and replace the faulty fuse. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0137 HO2S Circuit Low Voltage Bank1 Sensor2



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed below a predetermined voltage. If the PCM detects the voltage is below a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0151, P0200, P0372, P1371 not set.
- Engine coolant temperature greater than 48°C (118°F).
- Fuel system operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains below 39 mV for 38 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Heated Oxygen Sensor (HO2S) wire. Sensor pigtail may be contacting the exhaust manifold.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for intermittent ground in signal wire between connector and sensor.
- Lean injector(s). Perform Injector Balance Test.
- Fuel contamination. Water near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a DTC.

- Fuel pressure. System will be lean if fuel pressure is low. Refer to *Fuel System* diagnosis.
- Exhaust leaks. An exhaust leak near the HO2S can cause a lean condition. Vacuum or crankcase leaks can also cause a lean condition.
- If the above are OK, the HO2S may be at fault. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or its connector. Refer to *Exhaust System*. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage. If the voltage stayed near 0.0 volts indicates the low circuit is open, or the high circuit is open or grounded.
5. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0137 HO2S Circuit Low Voltage Bank1 Sensor2

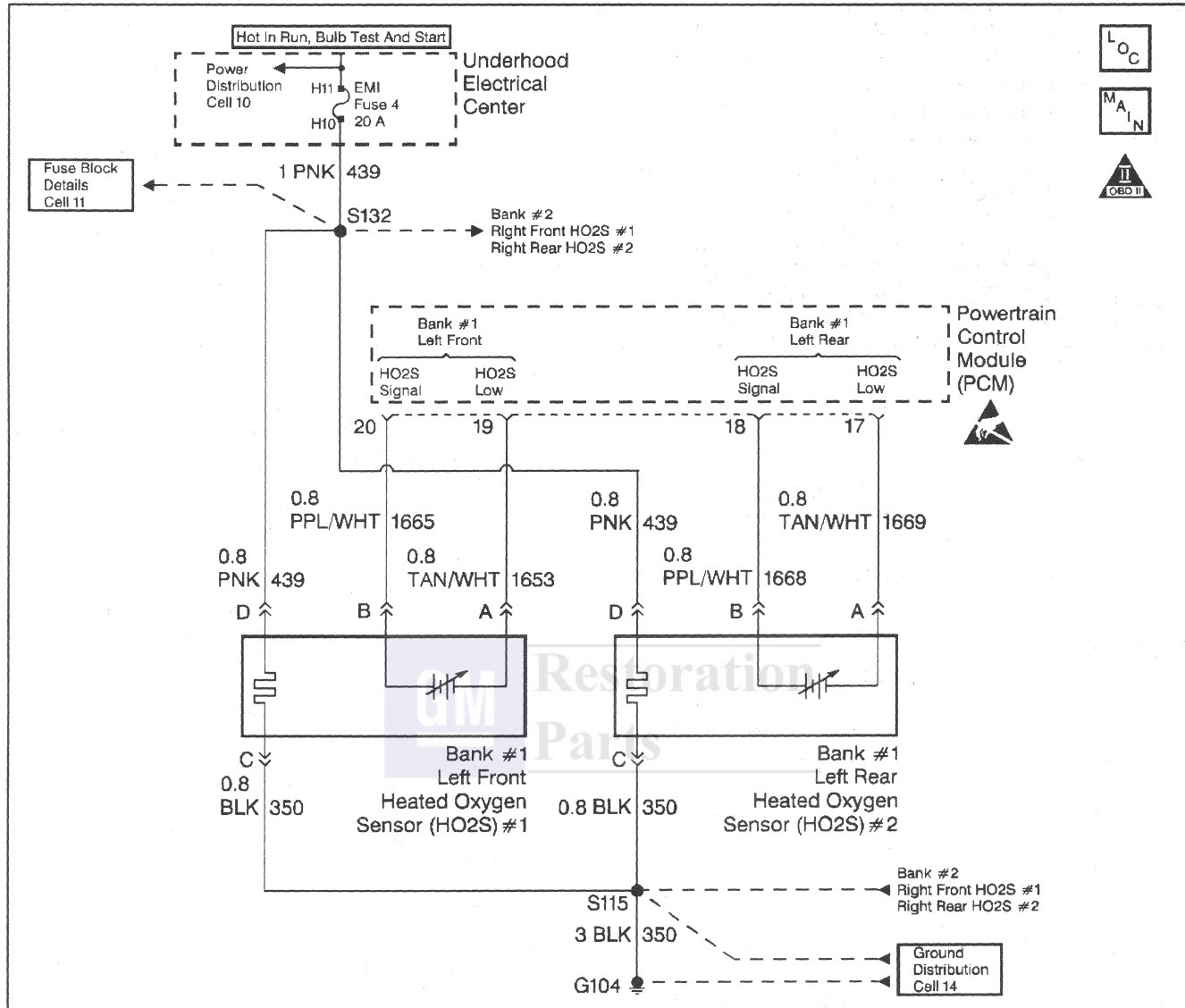
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within the parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using the scan tool, monitor the HO2S voltage display on the Engine 1 Data List . Is the HO2S voltage less than the specified value?	39 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Circuit Low (Rear HO2S) DTCs
4	Disconnect the HO2S and jumper the HO2S low circuit (PCM side) to ground. Does the scan tool indicate the HO2S voltage is within the specified values?	375–525 mV	Go to Diagnostic Aids-HO2S Circuit Low (Rear HO2S) DTCs	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Check the HO2S signal circuit for a short to ground or a short to the sensor ground circuit. Is the HO2S signal circuit shorted?	—	Go to Step 6	Go to Step 7
6	Repair the HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 8	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 8	—

DTC P0137 HO2S Circuit Low Voltage Bank1 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0138 HO2S Circuit High Voltage Bank1 Sensor2



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed above a predetermined voltage. If the PCM detects the voltage is above a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- Closed Loop.
- Fuel Trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains above 930 mV for 38 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Fuel pressure. System will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC may set. Refer to *Fuel System Diagnosis*.
- Rich injector(s). Perform Injector Balance Test.
- Leaking injector. Refer to *Fuel System Diagnosis*.
- Evaporative emissions (EVAP) canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. Refer to *EVAP Control System*.
- MAF sensor. Disconnect the MAF sensor and see if rich condition is corrected. If so, check for proper installation. If installed OK, replace MAF sensor. If MAF sensor is installed backwards, the system will go rich. The plastic portion of the sensor has arrows cast into it indicating proper air flow direction. The arrow must point toward the engine.

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TP sensor. An intermittent TP sensor output will cause the system to go rich, due to a false indication of the engine accelerating. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

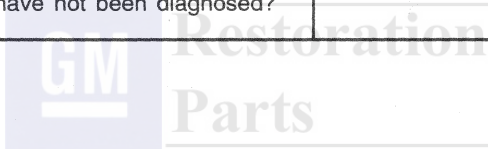
2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms*.
5. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage.
9. Review the system mechanization. Check for a short between the HO2S signal circuit and any other wires powered by this fuse that run together inside the harness.

DTC P0138 HO2S Circuit High Voltage Bank1 Sensor2

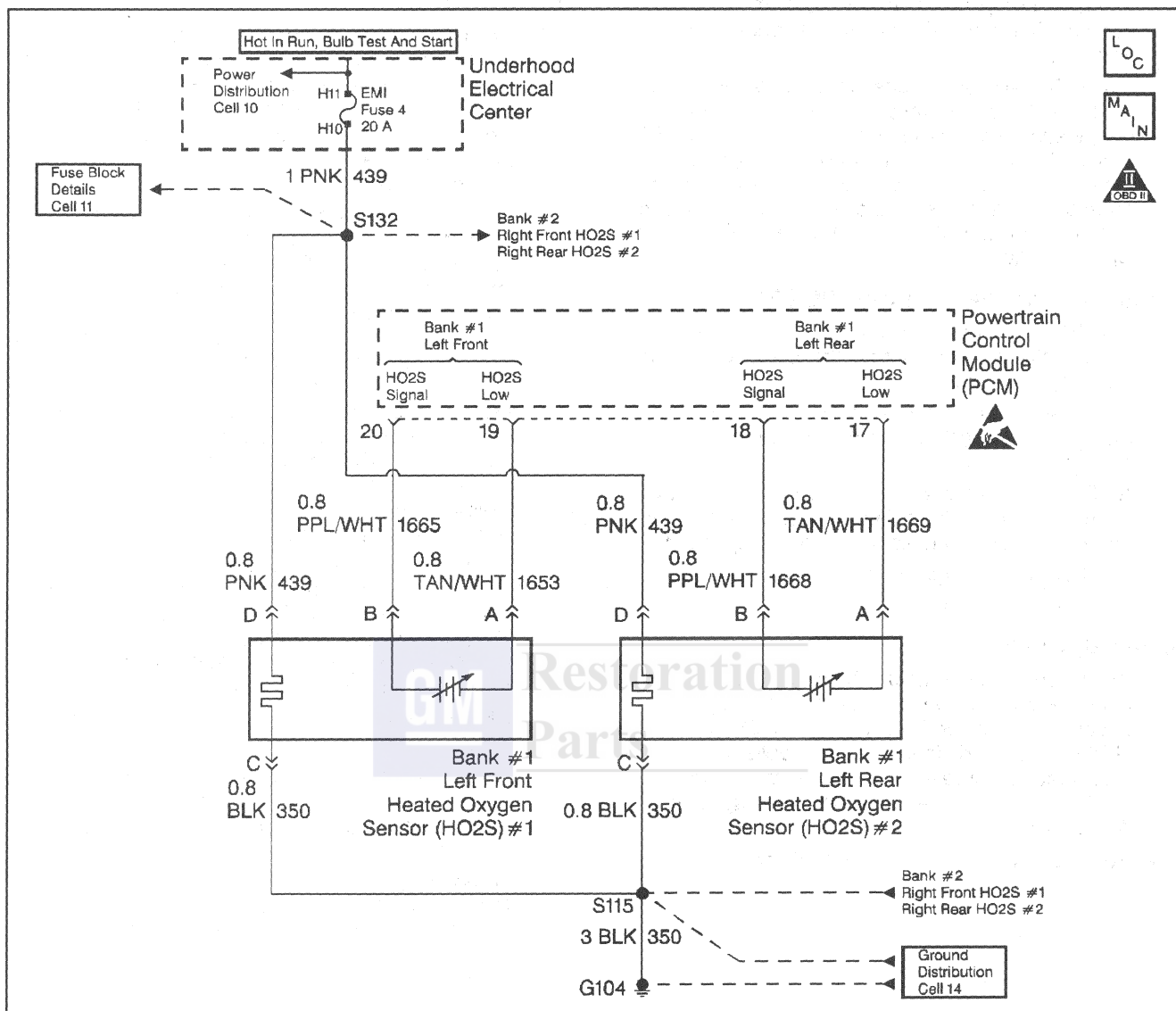
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Raise the engine speed to 1200 RPM. 4. Using the scan tool, monitor HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage greater than the specified value?	930 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - HO2S Circuit High Voltage
4	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 5	Go to Step 7
5	1. Reinstall the fuse. 2. Disconnect the HO2S and jumper the HO2S low signal (PCM side) circuit to ground. Does the scan tool indicate the HO2S voltage is within the specified values?	375–525 mV	Go to Step 10	Go to Step 6
6	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 9	Go to Step 8
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the HO2S signal circuit. 3. Disconnect the HO2S. 4. Turn the ignition ON. 5. Using a DVM (J 39200), check for voltage on the HO2S sensor signal circuit at PCM harness connector. Is there any voltage present?	—	Go to Step 8	Go to Diagnostic Aids - HO2S Circuit High Voltage
8	Repair the short to voltage in the HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis</i> (8A Cell 5). Is the action complete?	—	Go to Step 12	—

DTC P0138 HO2S Circuit High Voltage Bank1 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the HO2S signal circuit and the HO2S heater B+ circuit for being shorted together. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 10	Go to Step 11
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0140 HO2S Insufficient Activity Bank1 Sensor2



30395

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage and detects if the voltage goes out of the bias range. If the PCM does not detect the voltage went out of the bias range, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0141, P0200, P0372, P1371 not set.
- Engine operating longer than 68 seconds.
- Fuel system operating in Closed Loop.
- Engine coolant temperature greater than 48°C (118°F).
- HO2S signal voltage steady between 391 mV and 491 mV for 2.5 minutes.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms, Intermittents*.
4. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or its connector. Refer to *Section 6F, Exhaust System*. If the scan tool indicates the HO2S voltage goes below 200 mV, indicates the HO2S circuits and PCM are OK.
5. Checks whether the signal circuit from the PCM is OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

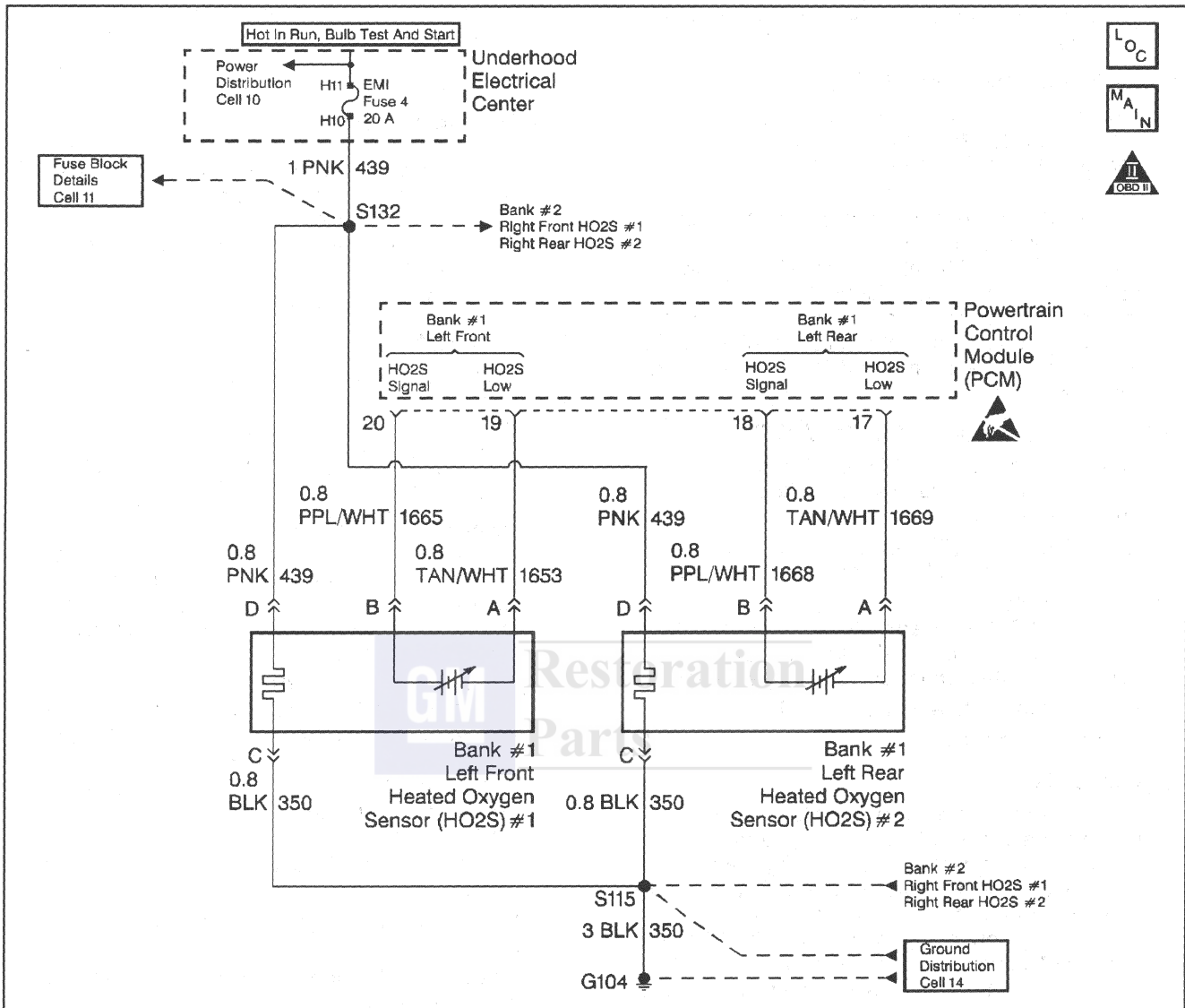
DTC P0140 HO2S Insufficient Activity Bank1 Sensor2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate engine above 1200 RPM for two minutes. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Does the scan tool indicate Bank 1 HO2S 1 voltage varying outside the specified values?	391–491 mV	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Insufficient Activity DTCs
4	1. Turn the ignition ON, Engine OFF. 2. Disconnect Bank 1 HO2S 1 and jumper HO2S high and low (PCM side) signal circuits to ground. 3. Using a scan tool, monitor Bank 1 HO2S 1 voltage. Is Bank 1 HO2S 1 voltage below the specified value?	200 mV	Go to Step 8	Go to Step 5
5	1. Remove the jumper wire. 2. Using a DVM (J 39200), measure voltage between the Bank 1 HO2S 1 high signal circuit (PCM side) and the Bank 1 HO2S 1 heater ground circuit. Does Bank 1 HO2S 1 voltage measure above the specified value?	375 mV	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 1 HO2S 1 low circuit. 3. If the Bank 1 HO2S 1 low circuit measures over the specified value, repair open or poor connection as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Was a Bank 1 HO2S 1 low circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 9

DTC P0140 HO2S Insufficient Activity Bank1 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 1 HO2S 1 signal circuit. 3. If the Bank 1 HO2S 1 signal circuit measures over the specified value, repair open or poor connection as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a Bank 1 HO2S 1 signal circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 10
8	Check for a poor Bank 1 HO2S 1 signal or low circuit terminal connection at the Bank 1 HO2S 1 harness connector and replace terminal(s) if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did any terminals require replacement?	—	Go to Step 13	Go to Step 11
9	Check for poor Bank 1 HO2S 1 low circuit terminal connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
10	Check for poor Bank 1 HO2S 1 signal circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
11	Replace Bank 1 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0141 HO2S Heater Circuit Bank1 Sensor2



Circuit Description

The PCM supplies a bias voltage (approximately 450 mV) on the Heated Oxygen Sensor (HO2S) signal high and low circuits. When the ignition is turned to the ON position, battery voltage is supplied to the HO2S heater. As the heater reaches operating temperature, the HO2S voltage responds by changing from a bias voltage range to normal operation. Typically, as the HO2S reaches operating temperature, the HO2S voltage goes from a bias voltage to a voltage below 300 mV. Depending on the exhaust gas content, it is possible for the HO2S voltage to go above 450 mV.

The PCM will run the heater test only on a cold start (depends on cumulative air flow) and only once an ignition cycle. When the engine is started the PCM will monitor the HO2S voltage. When the HO2S

voltage goes above or below the bias range threshold, the PCM will determine how much time it took. If the PCM detects that it took too much time for the HO2S to enter into normal operating range, a DTC will set. The time it takes the HO2S to reach operating temperature is based on the amount of air that flows into the engine.

Conditions for Setting the DTC

- DTCs P0100,P0102, P0103, P0112, P0113, P0117, P0118, P0122, P0123, P0200 not set.
- Engine is started and Intake Air and Engine Coolant temperatures are less than 50°C (122°F) and are within 3°C (5°F) of each other at start-up.
- Ignition voltage between 10 volts and 16 volts.
- Engine air flow less than 30 grams per second.

- TP sensor angle less than 20%.
- HO2S voltage remains between 300 mV and 700 mV for a predetermined amount of time (depends on engine coolant temperature and air flow).

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles

the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

- The heater diagnostic will only run on a cold start and it will only run once per ignition cycle.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- The engine must be allowed to cool, as the HO2S maybe at operating temperature and no drop or rise in HO2S voltage would occur. If the HO2S voltage stays between 300–700 mV indicates the HO2S heater is inoperative. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616–A. Using this kit will prevent damage to the harness connector terminals.
- If more than one HO2S DTC is set, is good indication that the HO2S fuse is open. Check all related circuits going to all heated oxygen sensors for a short to ground. If all wiring checks to be OK, it may be necessary to disconnect each HO2S one at a time to locate a shorted sensor.
- Checks whether B+ supply is available at the sensor.
- Checks whether a ground is available at the sensor.
- Checks whether the HO2S heater element is internally open.

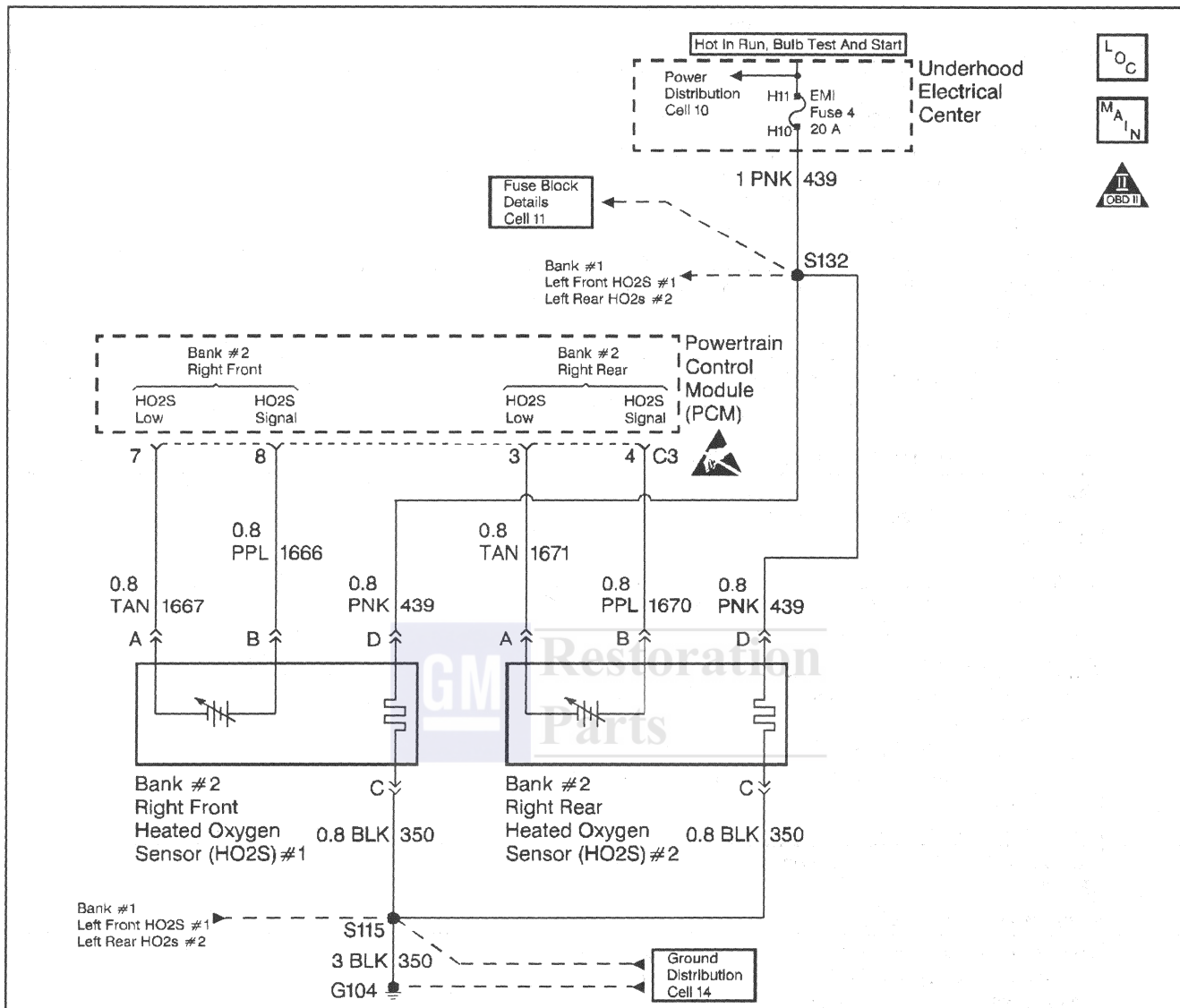
DTC P0141 HO2S Heater Circuit Bank1 Sensor2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If the engine has just been operating, allow the engine to cool for about one half hour before proceeding. - Turn the ignition OFF. - Install the scan tool. - Turn the ignition ON, engine OFF. - Monitor the HO2S voltage display on the Engine 1 Data List of the scan tool. Does the HO2S voltage go from a bias voltage to above or below the specified values?	300–700 mV	Go to Diagnostic Aids- HO2S Heater Circuit DTCs	Go to Step 3

DTC P0141 HO2S Heater Circuit Bank1 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
3	Inspect the fuse for HO2S ignition feed. Is the HO2S fuse open?	—	Go to Step 11	Go to Step 4
4	1. Raise the vehicle. 2. Disconnect the HO2S electrical connector. 3. Using a test light (J 34142-B) connected to ground (A known good ground. Do not use HO2S heater ground or HO2S low), probe the ignition feed circuit at HO2S electrical connector (PCM side). Does the test light illuminate?	—	Go to Step 5	Go to Step 7
5	Connect the test light between HO2S ignition feed and HO2S heater ground. Does the test light illuminate?	—	Go to Step 6	Go to Step 8
6	Using a DVM (J 39200), measure resistance between HO2S ignition feed and HO2S heater ground at HO2S pigtail. Is the HO2S resistance within the specified values?	3.5–14.0 Ω	Go to Step 9	Go to Step 10
7	Repair open in the HO2S ignition feed circuit to HO2S. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	Repair open in the HO2S heater ground circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
9	1. Check for a poor connection at the HO2S harness terminals. 2. If a poor connection is found, replace terminals. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found?	—	Go to Step 12	Go to Step 10
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Locate and repair the short to ground in the HO2S ignition feed circuit and replace faulty fuse. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1



30396

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed below a predetermined voltage. If the PCM detects the voltage is below a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0200, P0372, P1371 not set.
- Engine coolant temperature greater than 48°C (118°F).
- Fuel system operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains below 200 mV for 30 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Heated Oxygen Sensor (HO2S) wire. Sensor pigtail may be contacting the exhaust manifold.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*
- Check for intermittent ground in signal wire between connector and sensor.
- Lean injector(s). Perform Injector Balance Test.
- Fuel contamination. Water near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a DTC.

- Fuel pressure. System will be lean if fuel pressure is low. Refer to *Fuel System* diagnosis.
- Exhaust leaks. An exhaust leak near the HO2S can cause a lean condition. Vacuum or crankcase leaks can also cause a lean condition.
- If the above are OK, the HO2S may be at fault. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage. If the voltage stayed near 0.0 volts indicates the low circuit is open, or the high circuit is open or grounded.
5. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1

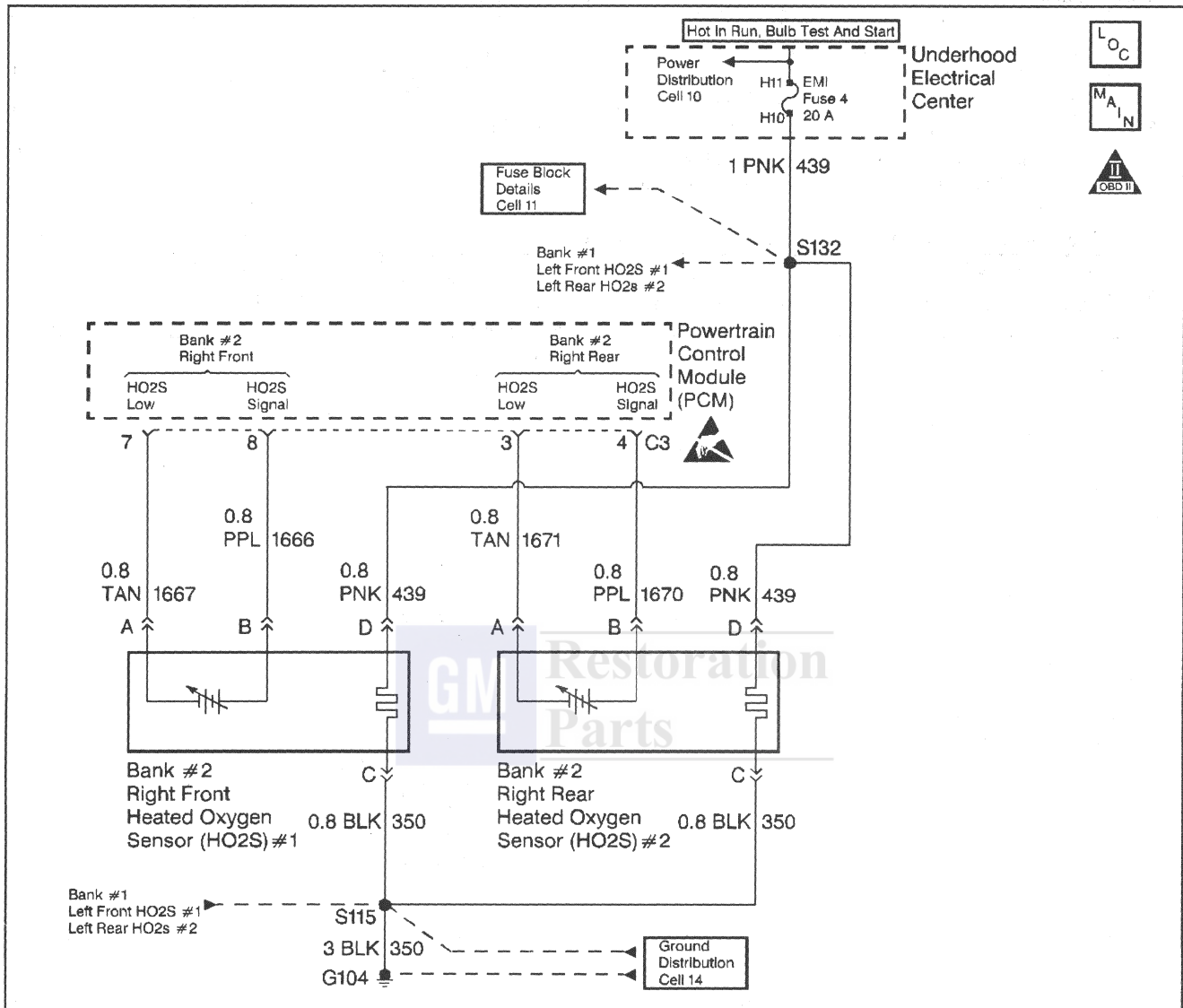
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature reached. 3. Operate the vehicle within parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage less than the specified value?	200 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Circuit Low
4	Disconnect the HO2S and jumper the HO2S low circuit (PCM side) to ground. Does the scan tool indicate HO2S voltage within the specified values?	375–525 mV	Go to Diagnostic Aids-HO2S Circuit Low	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Check the HO2S signal circuit for a short to ground or a short to the sensor ground circuit. Is the HO2S signal circuit shorted?	—	Go to Step 6	Go to Step 7
6	Repair the HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 10	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i>. Replace the PCM. Is the action complete?	—	Go to Step 10	—

DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 9</i>	<i>Go to Step 2</i>
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1



Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed above a predetermined voltage. If the PCM detects the voltage is above a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0118, P0121, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- System operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains above 774 mV for 30 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Fuel pressure. System will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC may set. Refer to *Fuel System Diagnosis*
- Rich injector(s). Perform Injector Balance Test.
- Leaking injector. Refer to *Fuel System Diagnosis*
- Evaporative emissions (EVAP) canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. Refer to *EVAP Control System*
- MAF sensor. Disconnect the MAF sensor and see if rich condition is corrected. If so, check for proper installation. If installed OK, replace MAF sensor. If MAF sensor is installed backwards, the system will go rich. The plastic portion of the sensor has arrows cast into it indicating proper air flow direction. The arrow must point toward the engine.

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TP sensor. An intermittent TP sensor output will cause the system to go rich, due to a false indication of the engine accelerating. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms, Intermittents*.
5. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage.
9. Review the system mechanization. Check for a short between the HO2S signal circuit and any other wires powered by this fuse that run together inside the harness.

DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1

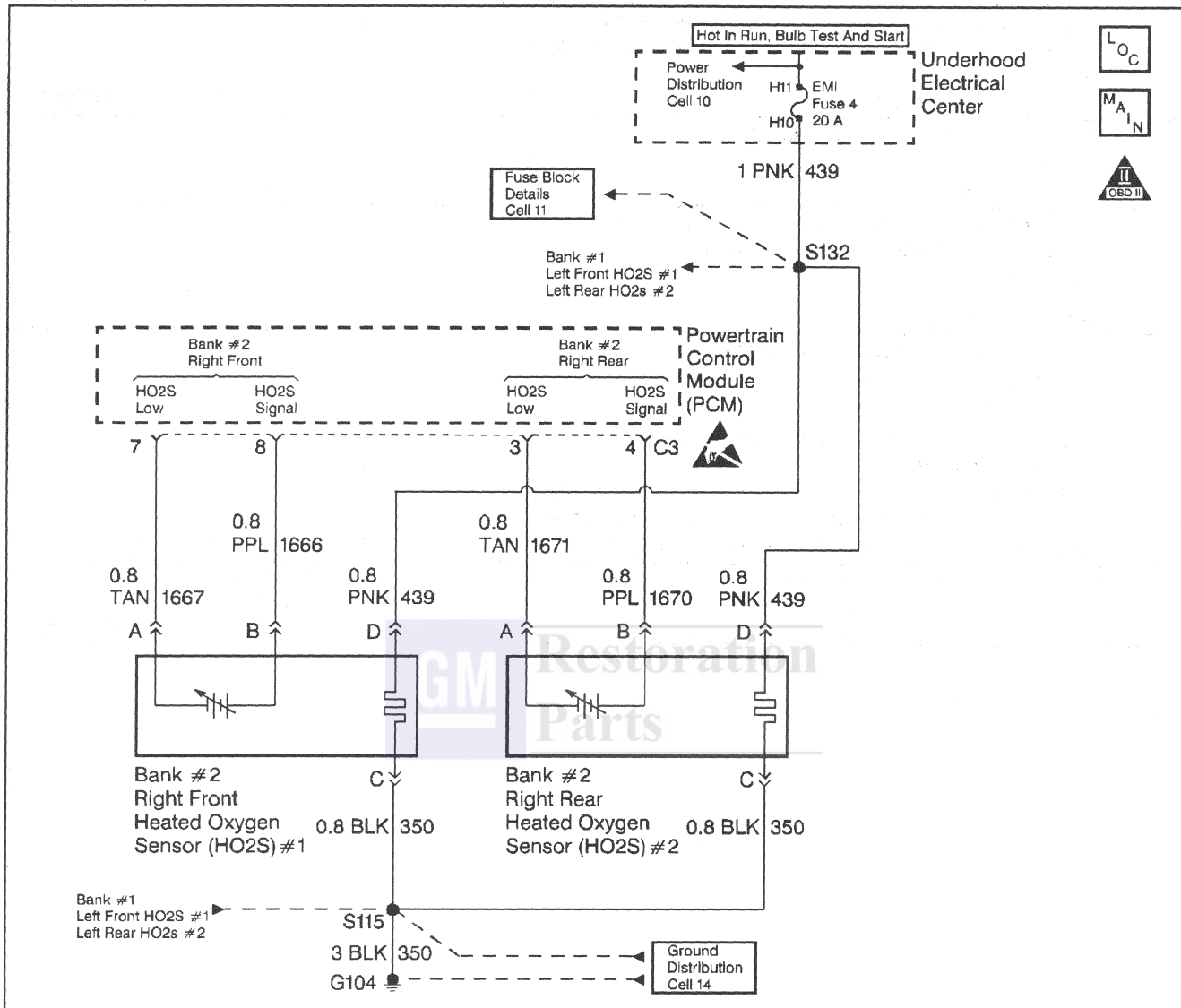
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Engine at operating temperature. 3. Engine speed at 1200 RPM. 4. Using a scan tool, monitor the HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage greater than the specified value?	774 mV	Go to Step 4	Go to Step 3
3	1. Ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - HO2S Circuit High Voltage
4	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 5	Go to Step 7
5	1. Reinstall the fuse. 2. Disconnect HO2S and jumper the HO2S low signal (PCM side) circuit to ground. Does the scan tool indicate the HO2S voltage within the specified values?	375–525 mV	Go to Step 10	Go to Step 6
6	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 9	Go to Step 8
7	1. Turn the Ignition OFF. 2. Disconnect the PCM connector containing the HO2S signal circuit. 3. Disconnect the HO2S. 4. Turn the Ignition ON. 5. Using a DVM (J 39200), check for voltage on the HO2S sensor signal circuit at PCM harness connector. Is there any voltage?	—	Go to Step 8	Go to Diagnostic Aids - HO2S Circuit High Voltage
8	Repair short to voltage in HO2S signal circuit. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Is the action complete?	—	Go to Step 12	—

DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair HO2S signal circuit and HO2S heater B+ circuit shorted together. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 10	Go to Step 11
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0153 HO2S Slow Response Bank2 Sensor1



30396

Circuit Description

The PCM continuously monitors the Heated Oxygen Sensor (HO2S) activity for 100 seconds. During the monitor period the PCM counts the number of times that the HO2S responds from rich to lean and from lean to rich and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. If the average response time is too slow, a DTC will set.

A lean to rich transition is determined when the HO2S voltage changes from less than 300 mV to greater than 600 mV. A rich to lean transition is determined when the HO2S voltage changes from more than 600 mV to less than 300 mV. An HO2S that responds too slowly is most likely defective and should be replaced.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0125, P0151, P0152, P0154, P0155, P0200, P0372, not set.
- Fuel system operating in Closed Loop.
- Engine speed between 1000 RPM and 1700 RPM.
- Engine Air Flow between 12 grams per second and 28 grams per second.
- EVAP Canister purge duty cycle less than 100%.
- Lean to rich (Below 300 mV to above 600 mV) response average time is greater than 110 Milliseconds or 150 milliseconds if the vehicle is equipped with an L99 engine.

- Rich to lean (Above 600 mV to below 300 mV) response average time is greater than 110 Milliseconds or 150 milliseconds if the vehicle is equipped with an L99 engine.
- Above conditions are met for 100 seconds

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- A malfunction in the HO2S heater circuits will cause a DTC to set. Check HO2S heater circuits for intermittent opens/connections.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. When DTCs P0133 and P0153 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6–12 inches away from the HO2S can cause a DTC to set.
5. Checks whether a good ground circuit is available.
6. Checks the integrity of the signal circuit to the PCM.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicone and all silicone sealant is a none silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

DTC P0153 HO2S Slow Response Bank2 Sensor1

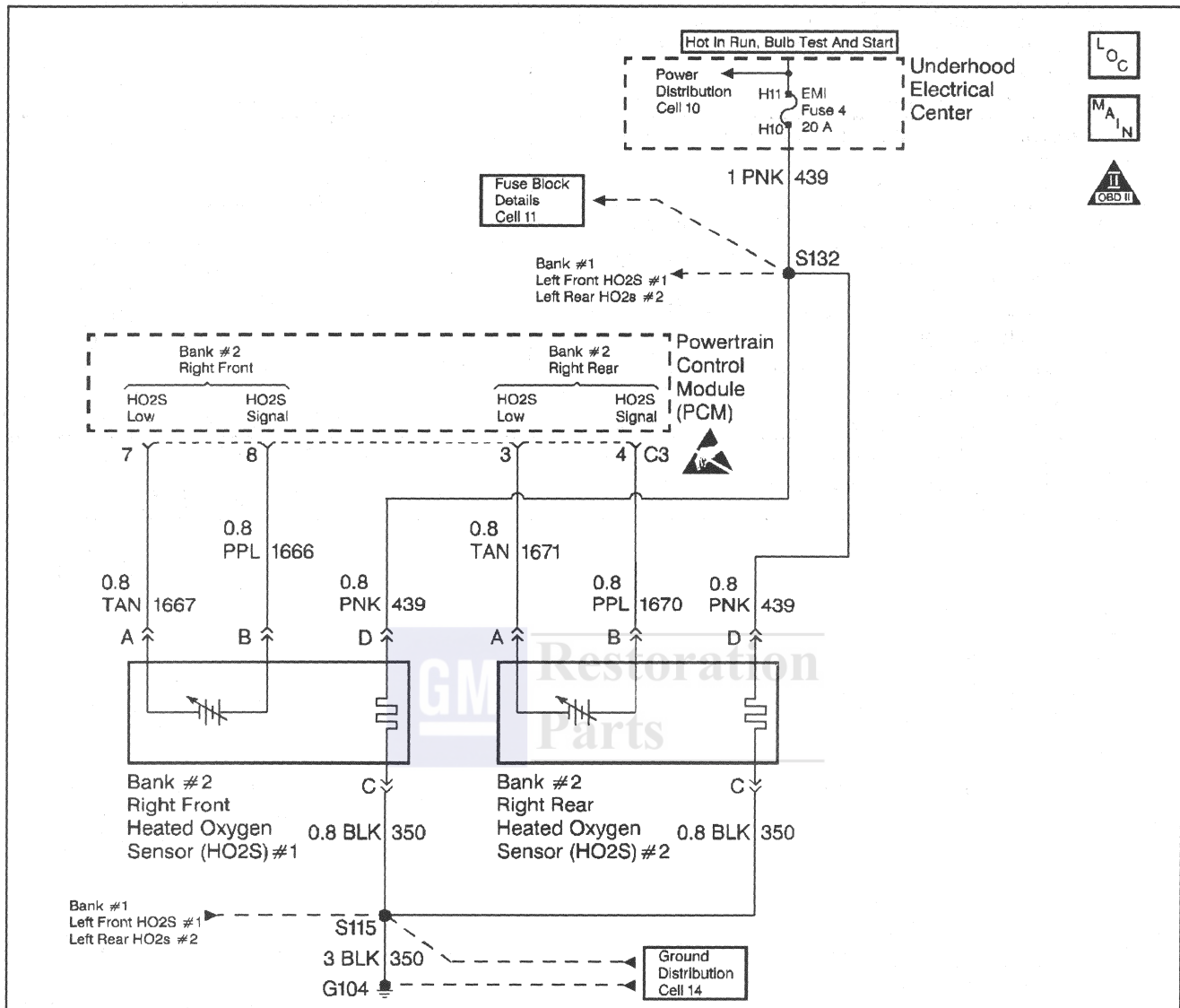
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0133), refer to those DTCs before proceeding with this diagnostic table. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within parameters specified under Conditions for setting the DTC in the supporting text. 4. Using a scan tool, monitor FAIL THIS IGN. under DTC Info. Does the scan tool indicate DTC P0153 test failed?	—	Go to Step 3	Go to Diagnostic Aids - HO2S Slow Response
3	Did the scan tool also indicate P0133 test failed?	—	Go to Step 8	Go to Step 4
4	Inspect the exhaust system for leaks. If an exhaust leak is found, repair as necessary. Was a problem found and corrected?	—	Go to Step 2	Go to Step 5
5	Visually/physically inspect the following items: • Ensure that the Bank 2 HO2S 1 is securely installed. • Check for corrosion on terminals. • Check terminal tension (at Bank 2 HO2S 1 and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect Bank 2 HO2S 1 and jumper HO2S low (PCM side) signal circuit to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage on the Engine 1 Data List. Does the scan tool indicate voltage within the specified values?	375–525mV	Go to Step 7	Go to Step 10
7	1. Jumper Bank 2 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200mV	Go to Step 12	Go to Step 11
8	Replace affected Heated Oxygen Sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Important: Before replacing sensors, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Is the action complete?	—	Go to Step 13	—
9	Repair condition as necessary. Is the action complete?	—	Go to Step 13	—
10	Repair open Bank 2 HO2S 1 low signal circuit or grounded Bank 2 HO2S 1 high signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—

DTC P0153 HO2S Slow Response Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair open Bank 2 HO2S 1 high signal circuit or faulty PCM connections. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 13	—
12	Replace Bank 2 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0154 HO2S Insufficient Activity Bank2 Sensor1



30396

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage and detects if the voltage goes out of the bias range. If the PCM does not detect the voltage went out of the bias range, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- Engine operating longer than 68 seconds.
- Engine coolant temperature greater than 48°C (118°F).
- HO2S signal voltage steady between 352 mV and 552 mV for 45 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- Open loop fueling.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms, Intermittents*.
4. If the scan tool indicates the HO2S voltage goes below 200 mV, indicates the HO2S circuits and PCM are OK.
5. Checks whether the signal circuit from the PCM is OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0154 HO2S Insufficient Activity Bank2 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate engine above 1200 RPM for two minutes. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Does the scan tool indicate Bank 2 HO2S 1 voltage varying outside the specified values?	352–552 mV	Go to Step 3	Go to Step 4

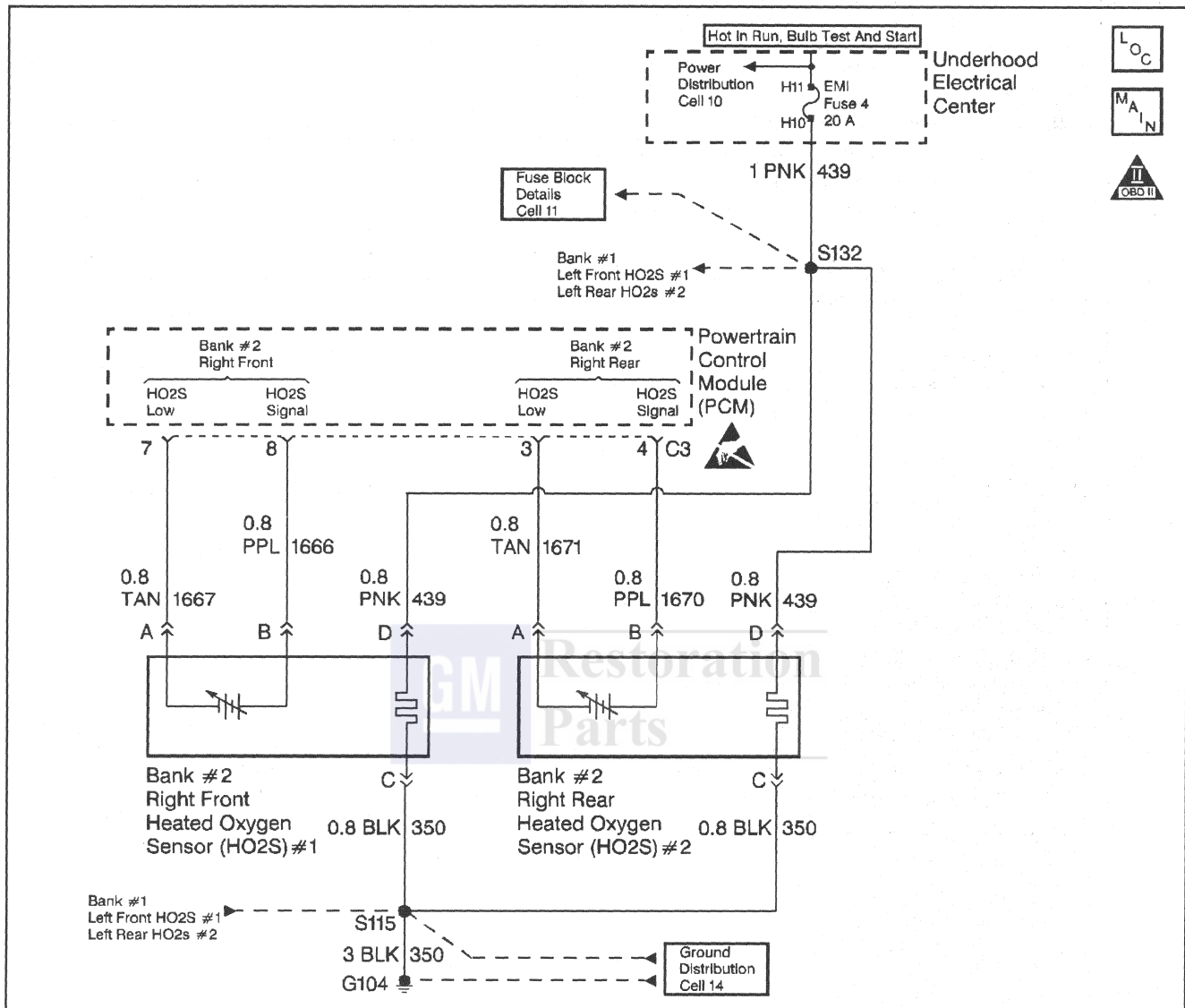
DTC P0154 HO2S Insufficient Activity Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON, engine OFF, review the Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Insufficient Activity DTCs
4	1. Turn the ignition ON, Engine OFF. 2. Disconnect the Bank 2 HO2S 1 and jumper the HO2S high and low (PCM side) signal circuits to ground. 3. Using a scan tool, monitor Bank 2 HO2S 1 voltage. Is Bank 2 HO2S 1 voltage below the specified value?	200 mV	Go to Step 8	Go to Step 5
5	1. Remove jumper wire. 2. Using a DVM (J 39200), measure the voltage between the Bank 2 HO2S 1 high signal circuit (PCM side) and the Bank 2 HO2S 1 heater ground circuit. Does Bank 2 HO2S 1 voltage measure above the specified value?	375 mV	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 2 HO2S 1 low circuit. 3. If the Bank 2 HO2S 1 low circuit measures over the specified value, repair open or poor connection as necessary. Was a Bank 2 HO2S 1 low circuit problem found and corrected?	2 Ω	Go to Step 10	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 2 HO2S 1 signal circuit. 3. If the Bank 2 HO2S 1 signal circuit measures over the specified value, repair open or poor connection as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Was a Bank 2 HO2S 1 signal circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 10
8	Check for a poor Bank 2 HO2S 1 signal or low circuit terminal connection at the Bank 2 HO2S 1 harness connector and replace terminal(s) if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Did any terminals require replacement?	—	Go to Step 13	Go to Step 11

DTC P0154 HO2S Insufficient Activity Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
9	Check for poor Bank 2 HO2S 1 low circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
10	Check for poor Bank 2 HO2S 1 signal circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
11	Replace Bank 2 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0155 HO2S Heater Circuit Bank2 Sensor1



30396

Circuit Description

The PCM supplies a bias voltage (approximately 450 mV) on the Heated Oxygen Sensor (HO2S) signal high and low circuits. When the ignition is turned to the ON position, battery voltage is supplied to the HO2S heater. As the heater reaches operating temperature, the HO2S voltage responds by changing from a bias voltage range to normal operation. Typically, as the HO2S reaches operating temperature, the HO2S voltage goes from a bias voltage to a voltage below 300 mV. Depending on the exhaust gas content, it is possible for the HO2S voltage to go above 450 mV.

The PCM will run the heater test only on a cold start (depends on cumulative air flow) and only once an ignition cycle. When the engine is started the PCM will monitor the HO2S voltage. When the HO2S

voltage goes above or below the bias range threshold, the PCM will determine how much time it took. If the PCM detects that it took too much time for the HO2S to enter into normal operating range, a DTC will set. The time it takes the HO2S to reach operating temperature is based on the amount of air that flows into the engine.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0112, P0113, P0117, P0118, P0122, P0123, P0151, P0152, P0154, P0200 not set.
- Engine is started and Intake Air and Engine Coolant temperatures are less than 50°C (122°F) and are within 3°C (5°F) of each other at start-up.
- Ignition voltage between 10 volts and 16 volts.

- Engine air flow less than 40 grams per second.
- TP sensor angle less than 20%.
- HO2S voltage remains between 300 mV and 700 mV for a predetermined amount of time (depends on engine coolant temperature and air flow).

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles

the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

- The heater diagnostic will only run on a cold start and it will only run once per ignition cycle.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. The engine must be allowed to cool, as the HO2S maybe at operating temperature and no drop or rise in HO2S voltage would occur. If the HO2S voltage stays between 300–700 mV indicates the HO2S heater is inoperative. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616–A. Using this kit will prevent damage to the harness connector terminals.
3. If more then one HO2S DTC is set, is good indication that the HO2S fuse is open. Check all related circuits going to all heated oxygen sensors for a short to ground. If all wiring checks to be OK, it may be necessary to disconnect each HO2S one at a time to locate a shorted sensor.
4. Checks whether B+ supply is available at the sensor.
5. Checks whether a ground is available at the sensor.
6. Checks whether the HO2S heater element is internally open.

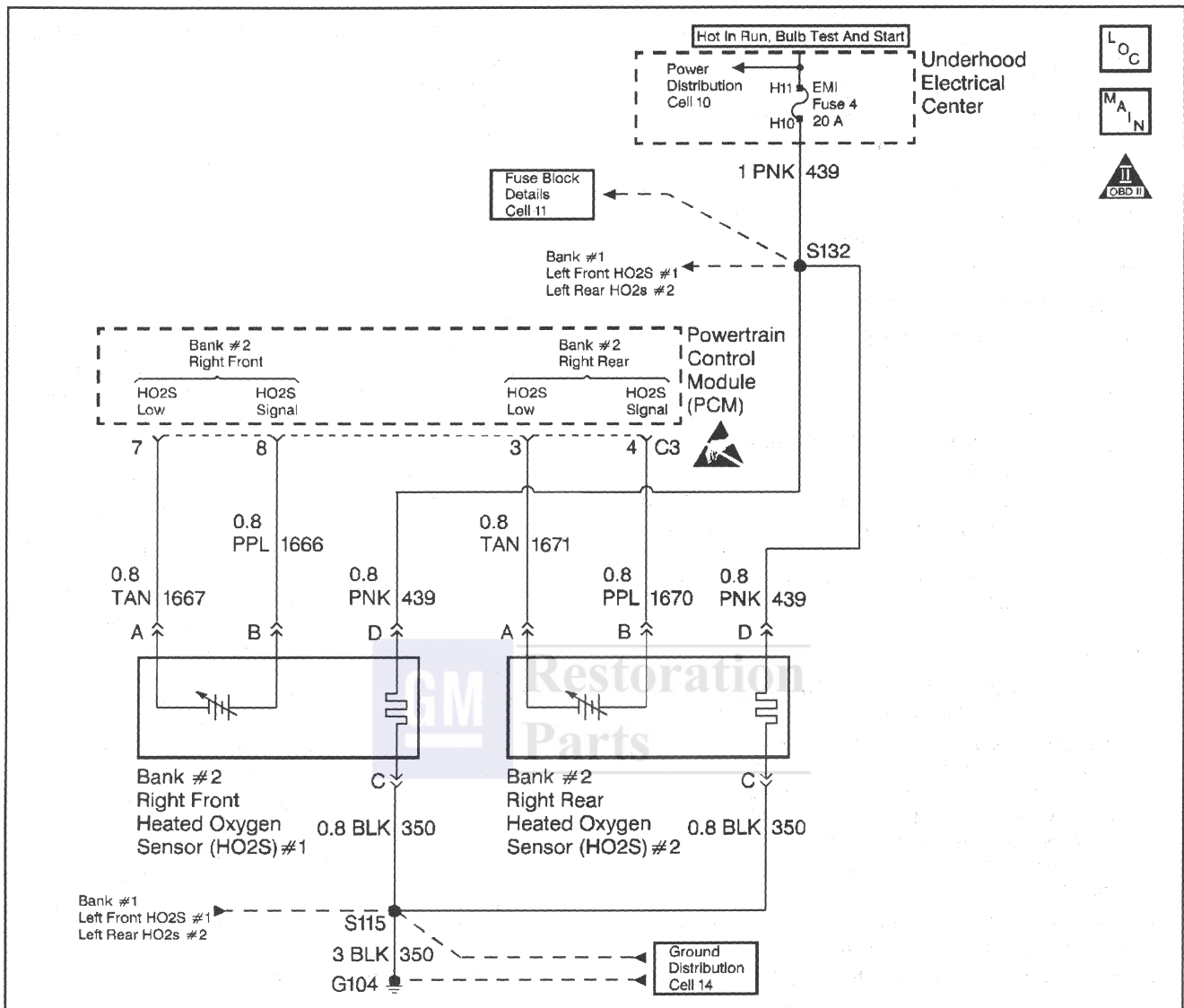
DTC P0155 HO2S Heater Circuit Bank2 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If engine has just been operating, allow engine to cool for about one half hour before proceeding. 1. Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON, engine OFF. 4. Monitor HO2S voltage display on the Engine 1 Data List of the scan tool. Does the HO2S voltage go from a bias voltage to above or below the specified values?	300–700 mV	Go to Diagnostic Aids-HO2S Heater Circuit DTCs	Go to Step 3

DTC P0155 HO2S Heater Circuit Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
3	Inspect the fuse for HO2S ignition feed. Is the HO2S fuse open?	—	Go to Step 11	Go to Step 4
4	1. Raise the vehicle. 2. Disconnect the HO2S electrical connector. 3. Using a test light (J 34142-B) connected to ground (A known good ground. Do not use the HO2S heater ground or the HO2S low), probe ignition feed circuit at HO2S electrical connector (PCM side). Does the test light illuminate?	—	Go to Step 5	Go to Step 7
5	Connect the test light between HO2S ignition feed and HO2S heater ground. Does the test light illuminate?	—	Go to Step 6	Go to Step 8
6	Using a DVM (J 39200), measure resistance between HO2S ignition feed and HO2S heater ground at HO2S pigtail. Is the HO2S resistance within the specified values?	3.5–14.0 Ω	Go to Step 9	Go to Step 10
7	Repair the open HO2S ignition feed circuit to HO2S. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	Repair open HO2S heater ground circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
9	1. Check for a poor connection at the HO2S harness terminals. 2. If a poor connection is found, replace terminals. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found?	—	Go to Step 12	Go to Step 10
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Locate and repair short to ground in HO2S ignition feed circuit and replace faulty fuse. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle until normal operating temperature is reached. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0157 HO2S Circuit Low Voltage Bank2 Sensor2



30396

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed below a predetermined voltage. If the PCM detects the voltage is below a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0151, P0200, P0372, P1371 not set.
- Engine coolant temperature greater than 48°C (118°F).
- Fuel system operating in Closed Loop.
- Fuel trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains below 39 mV for 38 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Heated Oxygen Sensor (HO2S) wire. Sensor pigtail may be contacting the exhaust manifold.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for intermittent ground in signal wire between connector and sensor.
- Lean injector(s). Perform Injector Balance Test.
- Fuel contamination. Water near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a DTC.

- Fuel pressure. System will be lean if fuel pressure is low. Refer to *Fuel System* diagnosis.
- Exhaust leaks. An exhaust leak near the HO2S can cause a lean condition. Vacuum or crankcase leaks can also cause a lean condition.
- If the above are OK, the HO2S may be at fault.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or its connector. Refer to *Section 6F, Exhaust System*. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage. If the voltage stayed near 0.0 volts indicates the low circuit is open, or the high circuit is open or grounded.
5. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

DTC P0157 HO2S Circuit Low Voltage Bank2 Sensor2

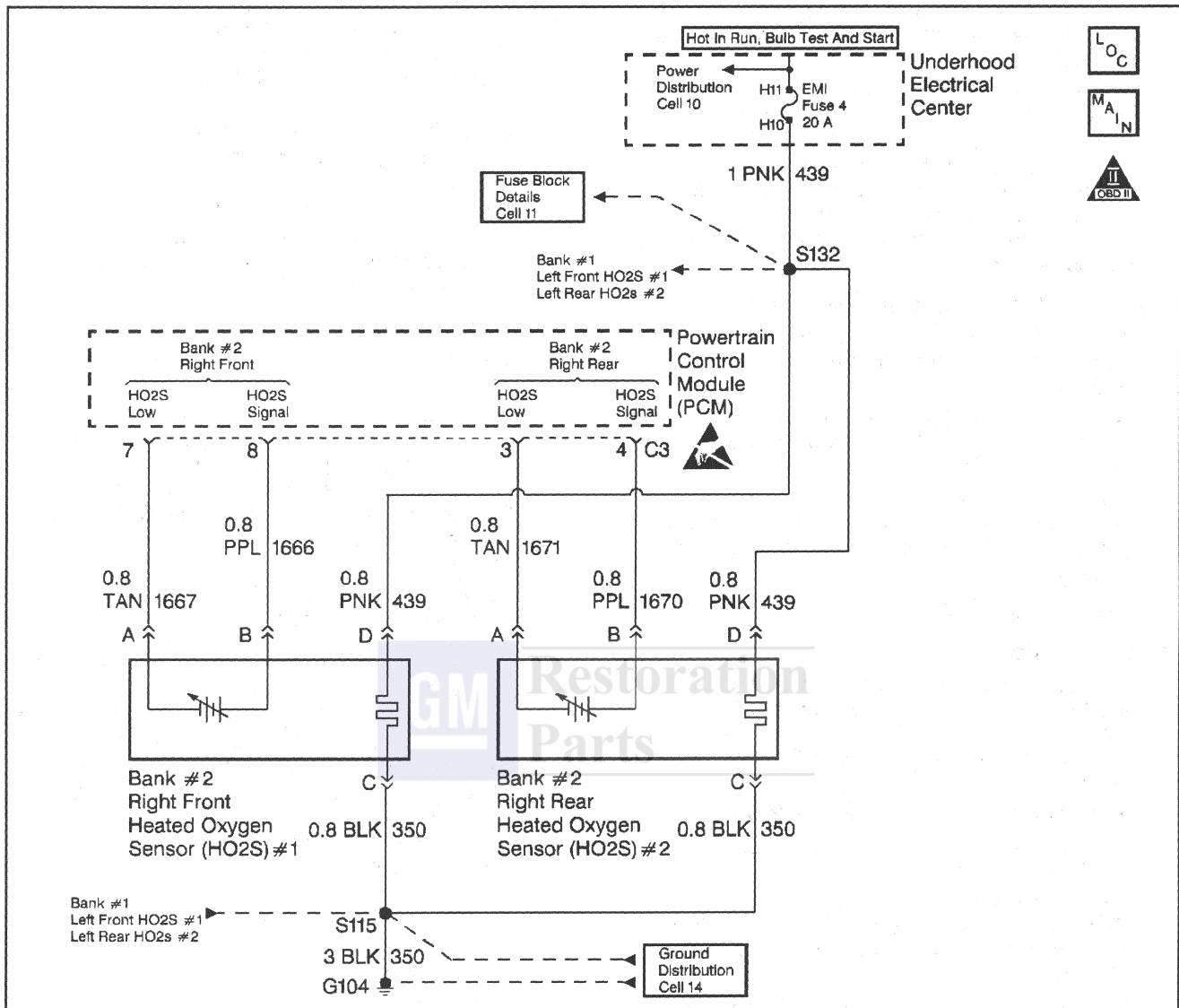
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Before proceeding with this DTC, check the HO2S for being secure. A sensor that is loose could cause this DTC to set. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor the HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage less than the specified value?	39 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Circuit Low (Rear HO2S) DTCs
4	Disconnect the HO2S and jumper the HO2S low circuit (PCM side) to ground. Does the scan tool indicate HO2S voltage within the specified values?	375–525 mV	Go to Diagnostic Aids-HO2S Circuit Low (Rear HO2S) DTCs	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM 3. Check the HO2S signal circuit for a short to ground or a short to the sensor ground circuit. Is the HO2S signal circuit shorted?	—	Go to Step 6	Go to Step 7
6	Repair the HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 8	—
7	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i>. Replace the PCM. Is the action complete?	—	Go to Step 8	—

DTC P0157 HO2S Circuit Low Voltage Bank2 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0158 HO2S Circuit High Voltage Bank2 Sensor2



30396

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed above a predetermined voltage. If the PCM detects the voltage is above a predetermined voltage, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0200, P0372, P1371 not set.
- Closed Loop.
- Fuel Trim learn enabled.
- Air/fuel ratio between 14.6:1 and 14.8:1.
- TP angle between 3% and 20%.
- HO2S signal voltage remains above 930 mV for 38 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Fuel pressure. System will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC may set. Refer to *Fuel System Diagnosis*
- Rich injector(s). Perform Injector Balance Test.
- Leaking injector. Refer to *Fuel System Diagnosis*
- Evaporative emissions (EVAP) canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. Refer to *EVAP Control System*
- MAF sensor. Disconnect the MAF sensor and see if rich condition is corrected. If so, check for proper installation. If installed OK, replace MAF sensor. If MAF sensor is installed backwards, the system will go rich. The plastic portion of the sensor has arrows cast into it indicating proper air flow direction. The arrow must point toward the engine.

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TP sensor. An intermittent TP sensor output will cause the system to go rich, due to a false indication of the engine accelerating. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

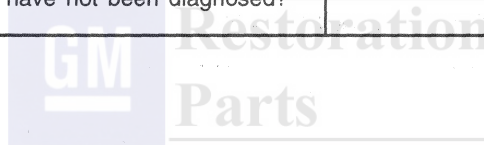
2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms , Intermittents*.
5. Grounding the low side circuit of the HO2S should cause the HO2S voltage to display a bias voltage.
9. Review the system mechanization. Check for a short between the HO2S signal circuit and any other wires powered by this fuse that run together inside the harness.

DTC P0158 HO2S Circuit High Voltage Bank2 Sensor2

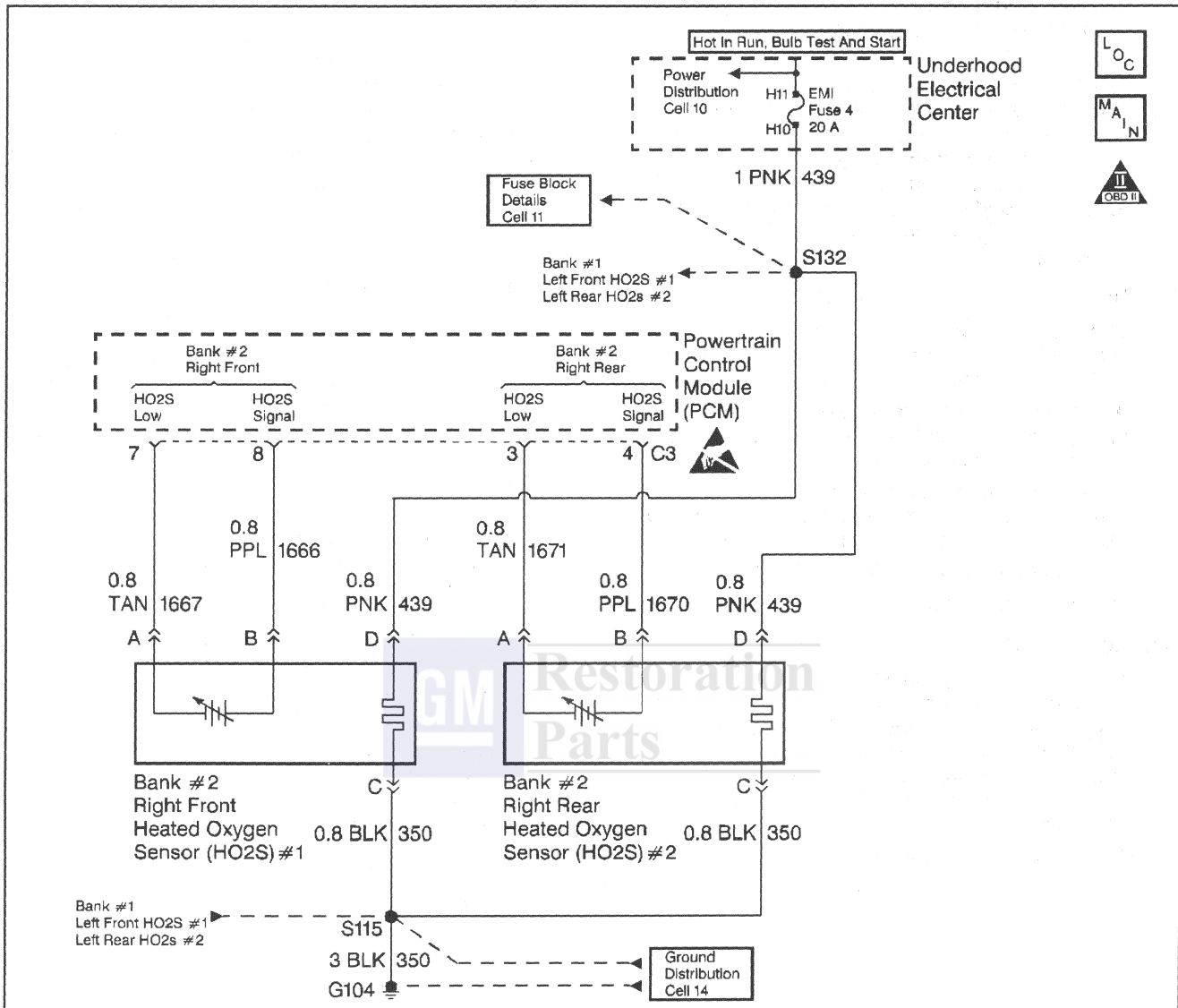
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Engine speed at 1200 RPM. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Is the HO2S voltage greater than the specified value?	930 mV	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids - HO2S Circuit High Voltage
4	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 5	Go to Step 7
5	1. Reinstall the fuse. 2. Disconnect HO2S and jumper the HO2S low signal (PCM side) circuit to ground. Does the scan tool indicate HO2S voltage within the specified values?	375–525 mV	Go to Step 10	Go to Step 6
6	While monitoring the HO2S voltage, remove the HO2S heater fuse. Does the voltage drop to within the specified range when the power to the heater is disconnected?	375–525 mV	Go to Step 9	Go to Step 8
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the HO2S signal circuit. 3. Disconnect the HO2S. 4. Turn the ignition ON. 5. Using a DVM (J 39200), check for voltage on the HO2S sensor signal circuit at PCM harness connector. No voltage should be present. Is there?	—	Go to Step 8	Go to Diagnostic Aids - HO2S Circuit High Voltage
8	Repair the short to voltage in HO2S signal circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—

DTC P0158 HO2S Circuit High Voltage Bank2 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair HO2S signal circuit and HO2S heater B+ circuit shorted together. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 10	Go to Step 11
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0160 HO2S Insufficient Activity Bank2 Sensor2



30396

Circuit Description

The PCM supplies a voltage of about 450 mV between the HO2S high and low signal circuits. The oxygen sensor varies the voltage over a range from about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean.

The PCM monitors and stores the heated oxygen sensor (HO2S) voltage information. The PCM evaluates the HO2S voltage samples to determine the amount of time the HO2S voltage was out of range. The PCM will compare the stored HO2S voltage samples taken within each sample period and determine if majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage and detects if the voltage goes out of the bias range. If the PCM does not detect the voltage went out of the bias range, a DTC will set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0141, P0200, P0372, P1371 not set.
- Engine operating longer than 68 seconds.
- Fuel system operating in Closed Loop.
- Engine coolant temperature greater than 48°C (118°F).
- HO2S signal voltage steady between 391 mV and 491 mV for 2.5 minutes.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Engine must be at normal operating temperature before performing this test. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. Refer to *Symptoms*.
4. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or it's connector. Refer to *Section 6F, Exhaust System*. If the scan tool indicates the HO2S voltage goes below 200 mV, indicates the HO2S circuits and PCM are OK.
5. Checks whether the signal circuit from the PCM is OK.
6. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.
7. Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

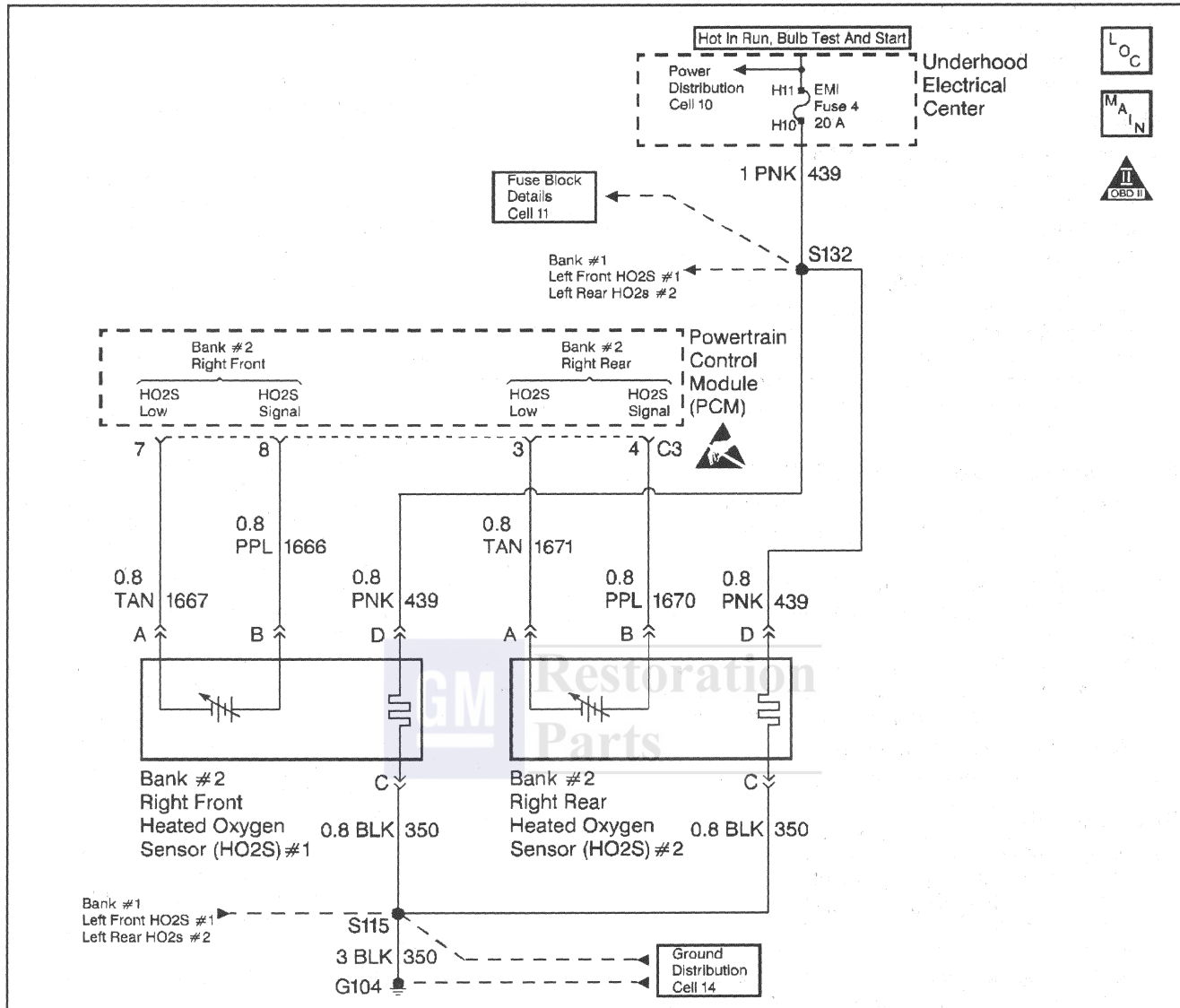
DTC P0160 HO2S Insufficient Activity Bank2 Sensor2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the Engine until normal operating temperature is reached. 3. Operate the engine above 1200 RPM for two minutes. 4. Using a scan tool, monitor HO2S voltage display on the Engine 1 Data List. Does the scan tool indicate the Bank 2 HO2S 2 voltage varying outside the specified values?	391–491 mV	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-HO2S Insufficient Activity DTCs
4	1. Turn the ignition ON, Engine OFF. 2. Disconnect the Bank 2 HO2S 2 and jumper the HO2S high and low (PCM side) signal circuits to ground. 3. Using a scan tool, monitor the Bank 2 HO2S 2 voltage. Is the Bank 2 HO2S 2 voltage below the specified value?	200 mV	Go to Step 8	Go to Step 5
5	1. Remove the jumper wire. 2. Using a DVM (J 39200), measure voltage between the Bank 2 HO2S 2 high signal circuit (PCM side) and the Bank 2 HO2S 2 heater ground circuit. Does the Bank 2 HO2S 2 voltage measure above the specified value?	375 mV	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 2 HO2S 2 low circuit. 3. If the Bank 2 HO2S 2 low circuit measures over the specified value, repair open or poor connection as necessary. Was a Bank 2 HO2S 2 low circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 9

DTC P0160 HO2S Insufficient Activity Bank2 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Disconnect the PCM and check continuity of the Bank 2 HO2S 2 signal circuit. 3. If the Bank 2 HO2S 2 signal circuit measures over the specified value, repair open or poor connection as necessary. Was a Bank 2 HO2S 2 signal circuit problem found and corrected?	2 Ω	Go to Step 13	Go to Step 10
8	Check for a poor Bank 2 HO2S 2 signal or low circuit terminal connection at the Bank 2 HO2S 2 harness connector and replace terminal(s) if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did any terminals require replacement?	—	Go to Step 13	Go to Step 11
9	Check for poor Bank 2 HO2S 2 low circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
10	Check for poor Bank 2 HO2S 2 signal circuit terminal connection at the PCM and replace terminal if necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal require replacement?	—	Go to Step 13	Go to Step 12
11	Replace the Bank 2 HO2S 2. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
12	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0161 HO2S Heater Circuit Bank2 Sensor2



30396

Circuit Description

The PCM supplies a bias voltage (approximately 450 mV) on the Heated Oxygen Sensor (HO2S) signal high and low circuits. When the ignition is turned to the ON position, battery voltage is supplied to the HO2S heater. As the heater reaches operating temperature, the HO2S voltage responds by changing from a bias voltage range to normal operation. Typically, as the HO2S reaches operating temperature, the HO2S voltage goes from a bias voltage to a voltage below 300 mV. Depending on the exhaust gas content, it is possible for the HO2S voltage to go above 450 mV.

The PCM will run the heater test only on a cold start (depends on cumulative air flow) and only once an ignition cycle. When the engine is started the PCM will monitor the HO2S voltage. When the HO2S

voltage goes above or below the bias range threshold, the PCM will determine how much time it took. If the PCM detects that it took too much time for the HO2S to enter into normal operating range, a DTC will set. The time it takes the HO2S to reach operating temperature is based on the amount of air that flows into the engine.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0112, P0113, P0117, P0118, P0125, P0122, P0123, P0157, P0158, P0160, P0200 not set.
- Engine is started and Intake Air and Engine Coolant temperatures are less than 50 °C (122 °F) and are within 3 °C (5 °F) of each other at start-up.
- Ignition voltage between 10 volts and 16 volts.

- Engine air flow less than 40 grams per second.
- TP sensor angle less than 20%.
- HO2S voltage remains between 300 mV and 700 mV for a predetermined amount of time (depends on engine coolant temperature and air flow).

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail.

Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

- The heater diagnostic will only run on a cold start and it will only run once per ignition cycle.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. The engine must be allowed to cool, as the HO2S maybe at operating temperature and no drop or rise in HO2S voltage would occur. If the HO2S voltage stays between 300–700 mV indicates the HO2S heater is inoperative. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616–A. Using this kit will prevent damage to the harness connector terminals.
3. If more than one HO2S DTC is set, is good indication that the HO2S fuse is open. Check all related circuits going to all heated oxygen sensors for a short to ground. If all wiring checks to be OK, it may be necessary to disconnect each HO2S one at a time to locate a shorted sensor.
4. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or it's connector. Refer to *Section 6F, Exhaust System Checks* whether B+ supply is available at the sensor.
5. Checks whether a ground is available at the sensor.
6. Checks whether the HO2S heater element is internally open.

DTC P0161 HO2S Heater Circuit Bank2 Sensor2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If engine has just been operating, allow engine to cool for about one half hour before proceeding. 1. Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON, engine OFF. 4. Monitor the HO2S voltage display on the Engine 1 Data List of the scan tool. Does the HO2S voltage go from a bias voltage to above or below the specified values?	300–700 mV	Go to Diagnostic Aids-HO2S Heater Circuit DTCs	Go to Step 3
3	Inspect the fuse for HO2S ignition feed. Is the HO2S fuse open?	—	Go to Step 11	Go to Step 4
4	1. Raise the vehicle. 2. Disconnect the HO2S electrical connector. 3. Using a test light (J 34142-B) connected to ground (A known good ground. Do not use HO2S heater ground or HO2S low), probe ignition feed circuit at HO2S electrical connector (PCM side). Does the test light illuminate?	—	Go to Step 5	Go to Step 7
5	Connect test light between HO2S ignition feed and HO2S heater ground. Does the test light illuminate?	—	Go to Step 6	Go to Step 8
6	Using a DVM (J 39200), measure resistance between HO2S ignition feed and HO2S heater ground at HO2S pigtail. Is the HO2S resistance within the specified values?	3.5–14.0 Ω	Go to Step 9	Go to Step 10
7	Repair open HO2S ignition feed circuit to HO2S. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
8	Repair open HO2S heater ground circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—
9	1. Check for a poor connection at the HO2S harness terminals. 2. If a poor connection is found, replace terminals. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a poor connection found?	—	Go to Step 12	Go to Step 10
10	Replace the HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 12	—
11	Locate and repair the short to ground in the HO2S ignition feed circuit and replace faulty fuse. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 12	—

DTC P0161 HO2S Heater Circuit Bank2 Sensor2 (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 13</i>	<i>Go to Step 2</i>
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0171 Fuel Trim System Lean Bank1

Circuit Description

To provide the best possible combination of driveability, fuel economy and emission control, a 'Closed Loop' air/fuel metering system is used. While in 'Closed Loop', the PCM monitors the heated oxygen sensor signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the Long and Short Term Fuel Trim values. Short Term Fuel Trim values change rapidly in response to the HO2S signal voltages. These changes 'fine tune' engine fueling. Long Term Fuel Trim values change in response to trends in Short Term Fuel Trim. Long Term Fuel Trim makes coarse adjustments to fueling in order to re-center and restore control to Short Term Fuel Trim. Short and Long Term Fuel Trim can be monitored with a scan tool. Ideal fuel trim values are around 0%. A positive Fuel Trim value indicates that the PCM is adding fuel to compensate for a lean condition. A negative Fuel Trim value indicates that the PCM is reducing the amount of fuel to compensate for a rich condition. If an excessively Rich or Lean condition is detected, the PCM will set a DTC. The long term fuel trim diagnostic parameter is an average of several of the long term speed load learn cells which are selected based on speed and load.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0300, P0372, P0441, P0443, P0500, P0601, P1133, P1153, P1351, P1361, P1371, P1415, P1416, P1441 not set.
- Engine Coolant Temperature between 60°C (120°F) and 115°C (239°F).
- Fuel system operating in Closed Loop.
- Fuel trim enabled.
- Barometric Pressure greater than 70 kPa.
- Mass Air Flow between 5 grams per second and 100 grams per second.
- Manifold Absolute Pressure between 20 kPa and 90 kPa.
- Intake Air Temperature between -30°C (-22°F) and 150°C (302°F).
- EVAP Canister purge not enabled or EVAP Canister purge duty cycle greater than 75%.
- Engine speed between 500 RPM and 4000 RPM.
- TP Sensor angle less than 75%.
- Vehicle speed less than 121 km/h (75 mph).
- The PCM detects the average Long Term Fuel Trim cell values are above a predetermined threshold.
- All above conditions met for approximately 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails, if the diagnostic fails under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed.
- The first time the diagnostic fails, the PCM will record operating conditions in Failure Records.
- The second consecutive drive trip that this diagnostic fails [under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed], this information will be stored in Freeze Frame. Any data previously stored in Freeze Frame will be copied into Failure Records and Freeze Frame will be overwritten by this DTC. The only exception to this is if a Misfire DTC was already recorded in Freeze Frame. In this case, the Misfire data stays in Freeze Frame and the Fuel Trim data will be updated in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail within the same conditions that the DTC last failed.

Important: If the last failure was during a non-typical driving condition, the MIL may remain ON longer than three drive trips. Review Freeze Frame/Failure Records for the last failure conditions.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If a DTC P0171 cannot be duplicated, it may have been caused by the customer running the vehicle out of fuel.
- A fuel delivery malfunction will cause this DTC to set. Thoroughly inspect all items that can cause a lean condition.
- For intermittents, refer to *Symptoms*

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether the fault is present. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.

3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If DTC 174 is also set indicates both banks of the engine are operating lean. Inspect items that would cause both banks to operate lean.
5. A vacuum leak will cause DTCs P0171 and P0174 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect PCV valve for being the correct one for this application. Make sure the engine oil fill cap is in place and that its tight. Check that the engine oil dip stick is fully seated.

DTC P0171 Fuel Trim System Lean Bank1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0171 and P0174) refer to those DTCs before proceeding with this diagnostic. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Fuel system in Closed Loop. 4. Using a scan tool, monitor LT FT Bn 1 and ST FT Bn 1 display on the Fuel Trim Data List. Is the LT FT and the ST FT less than the specified values indicated?	22% LT 10% ST	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Refer to Diagnostic Aids
4	Is DTC P0174 also set?	—	Go to Step 5	Go to Step 6

DTC P0171 Fuel Trim System Lean Bank1 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: • Vacuum hoses for splits, kinks and proper connections. Refer to <i>Under Hood Vacuum Hose Routing Diagrams</i>. • Throttle body, intake manifold and EGR valve for vacuum leaks. • Crankcase ventilation valve and/or system for leaks. • Contaminated fuel. Refer to <i>Crankcase Ventilation System</i>. • PCM and sensor grounds are clean tight and in proper locations. • Air induction system after MAF sensor for vacuum leaks. • Engine mechanical failure. Refer to <i>Engine General Information</i>. Was a problem found in any of the above areas?	—	Go to Step 7	Go to Fuel System Diagnosis
6	Visually/physically inspect the following items: • Bank 1 exhaust leaks, missing or loose exhaust hardware. • Bank 1 HO2S 1 is installed securely and electrical connector not contacting exhaust system or ignition wires. • Engine mechanical failure. Refer to <i>Engine General Information</i>. • Vacuum leaks that will only affect bank 1 (Intake manifold, injector "O" rings, etc.) Was a problem found in any of the above areas?	—	Go to Step 7	Go to Fuel System Diagnosis
7	Repair or replace any faulty items found. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0172 Fuel Trim System Rich Bank1**Circuit Description**

To provide the best possible combination of driveability, fuel economy and emission control, a 'Closed Loop' air/fuel metering system is used. While in 'Closed Loop', the PCM monitors the heated oxygen sensor signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the Long and Short Term Fuel Trim values. Short Term Fuel Trim values change rapidly in response to the HO2S signal voltages. These changes 'fine tune' engine fueling. Long Term Fuel Trim values change in response to trends in Short Term Fuel Trim. Long Term Fuel Trim makes coarse adjustments to fueling in order to re-center and restore control to Short Term Fuel Trim. Short and Long Term Fuel Trim can be monitored with a scan tool. Ideal fuel trim values are around 0%. A positive Fuel Trim value indicates that the PCM is adding fuel to compensate for a lean condition. A negative Fuel Trim value indicates that the PCM is reducing the amount of fuel to compensate for a rich condition. If an excessively Rich or Lean condition is detected, the PCM will set a DTC. The long term fuel trim diagnostic parameter is an average of several of the long term speed load learn cells which are selected based on speed and load.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0300, P0372, P0441, P0443, P0500, P0601, P1133, P1153, P1351, P1361, P1371, P1415, P1416, P1441 not set.
- Engine Coolant Temperature between 60°C (120°F) and 115°C (239°F).
- Fuel system operating in Closed Loop.
- Fuel trim enabled.
- Barometric Pressure greater than 70 kPa.
- Mass Air Flow between 5 grams per second and 100 grams per second.
- Manifold Absolute Pressure between 20 kPa and 90 kPa.
- Intake Air Temperature between -30°C (-22°F) and 150°C (302°F).
- EVAP Canister purge not enabled or EVAP Canister purge duty cycle greater than 75%.
- Engine speed between 500 RPM and 4000 RPM.
- TP Sensor angle less than 75%.
- Vehicle speed less than 121 km/h (75 mph).

- The PCM detects the average Long Term Fuel Trim cell values are below a predetermined threshold.
- All above conditions met for approximately 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails, if the diagnostic fails under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed.
- The first time the diagnostic fails, the PCM will record operating conditions in Failure Records.
- The second consecutive drive trip that this diagnostic fails [under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed], this information will be stored in Freeze Frame. Any data previously stored in Freeze Frame will be copied into Failure Records and Freeze Frame will be overwritten by this DTC. The only exception to this is if a Misfire DTC was already recorded in Freeze Frame. In this case, the Misfire data stays in Freeze Frame and the Fuel Trim data will be updated in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail within the same conditions that the DTC last failed.

Important: If the last failure was during a non-typical driving condition, the MIL may remain ON longer than three drive trips. Review Freeze Frame/Failure Records for the last failure conditions.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether the fault is present.

3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If DTC 175 is also set, then both banks are operating rich. Inspect items that would cause both banks to operate rich.
5. Excessive fuel in the oil will cause DTCs P0172 and P0175 to set at the same time. Remove the PCV valve from the intake manifold and plug with a suitable stopper. Also disconnect the fresh air pipe from the rocker cover and plug with a suitable stopper. If the long and short trim values increase, indicates there is fuel in the oil.

DTC P0172 Fuel Trim System Rich Bank1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0172 and P0175) refer to those DTCs before proceeding with this diagnostic. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Fuel system in Closed Loop. 4. Using a scan tool, monitor LT FT Bn 1 and ST FT Bn 1 display on the Fuel Trim Data List. Is LT FT and the ST FT greater than the specified values indicated?	-14% LT -10% ST	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-Fuel Trim System Rich
4	Is DTC P0175 also set?	—	Go to Step 5	Go to Step 6

DTC P0172 Fuel Trim System Rich Bank1 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: - Collapsed air intake duct. - Air filter element for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i>. - MAF sensor for being installed in the proper direction and for foreign objects blocking the inlet screen. Refer to <i>MAF Sensor</i>. - For fuel in the pressure regulator hose. Refer to <i>Fuel System Diagnosis</i>. - For excessive fuel in the crankcase. Check the engine oil level. Change oil as necessary. Was a problem found in any of the above areas?	—	Go to Step 7	Go to <i>Fuel System Diagnosis</i>
6	Important: When the fuel system check is finished, return to this table. Inspect injectors for leaking (Bank 1), refer to <i>Fuel System Diagnosis</i>. Was any injector(s) leaking?	—	Go to Step 9	Go to Step 8
7	Repair or replace any faulty items found. Is the action complete?	—	Go to Step 9	—
8	Replace faulty HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i>. Is the action complete?	—	Go to Step 9	—
9	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0174 Fuel Trim System Lean Bank2

Circuit Description

To provide the best possible combination of driveability, fuel economy and emission control, a 'Closed Loop' air/fuel metering system is used. While in 'Closed Loop', the PCM monitors the heated oxygen sensor signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the Long and Short Term Fuel Trim values. Short Term Fuel Trim values change rapidly in response to the HO₂S signal voltages. These changes 'fine tune' engine fueling. Long Term Fuel Trim values change in response to trends in Short Term Fuel Trim. Long Term Fuel Trim makes coarse adjustments to fueling in order to re-center and restore control to Short Term Fuel Trim. Short and Long Term Fuel Trim can be monitored with a scan tool. Ideal fuel trim values are around 0%. A positive Fuel Trim value indicates that the PCM is adding fuel to compensate for a lean condition. A negative Fuel Trim value indicates that the PCM is reducing the amount of fuel to compensate for a rich condition. If an excessively Rich or Lean condition is detected, the PCM will set a DTC. The long term fuel trim diagnostic parameter is an average of several of the long term speed load learn cells which are selected based on speed and load.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0300, P0372, P0441, P0443, P0500, P0601, P1133, P1153, P1351, P1361, P1371, P1415, P1416, P1441 not set.
- Engine Coolant Temperature between 60°C (120°F) and 115°C (239°F).
- Fuel system operating in Closed Loop.
- Fuel trim enabled.
- Barometric Pressure greater than 70 kPa.
- Mass Air Flow between 5 grams per second and 100 grams per second.
- Manifold Absolute Pressure between 20 kPa and 90 kPa.
- Intake Air Temperature between -30°C (-22°F) and 150°C (302°F).
- EVAP Canister purge not enabled or EVAP Canister purge duty cycle greater than 75%.
- Engine speed between 500 RPM and 4000 RPM.
- TP Sensor angle less than 75%.
- Vehicle speed less than 121 km/h (75 mph).
- The PCM detects the average Long Term Fuel Trim cell values are above a predetermined threshold.
- All above conditions met for approximately 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails, if the diagnostic fails under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed.
- The first time the diagnostic fails, the PCM will record operating conditions in Failure Records.
- The second consecutive drive trip that this diagnostic fails [under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed], this information will be stored in Freeze Frame. Any data previously stored in Freeze Frame will be copied into Failure Records and Freeze Frame will be overwritten by this DTC. The only exception to this is if a Misfire DTC was already recorded in Freeze Frame. In this case, the Misfire data stays in Freeze Frame and the Fuel Trim data will be updated in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail within the same conditions that the DTC last failed.

Important: If the last failure was during a non-typical driving condition, the MIL may remain ON longer than three drive trips. Review Freeze Frame/Failure Records for the last failure conditions.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If a DTC P0174 cannot be duplicated, it may have been caused by the customer running the vehicle out of fuel.
- A fuel delivery malfunction will cause this DTC to set. Thoroughly inspect all items that can cause a lean condition.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether the fault is present. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.

3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If DTC 171 is also set indicates both banks of the engine are operating lean. Inspect items that would cause both banks to operate lean.
5. A vacuum leak will cause DTCs P0171 and P0174 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect PCV valve for being the correct one for this application. Make sure the engine oil fill cap is in place and that its tight. Check that the engine oil dip stick is fully seated.

DTC P0174 Fuel Trim System Lean Bank2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0171 and P0174) refer to those DTCs before proceeding with this diagnostic. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Fuel system in Closed Loop. 4. Using a scan tool, monitor LT FT Bn 2 and ST FT Bn 2 display on the Fuel Trim Data List. Is LT FT and the ST FT less than the specified values indicated?	22% LT 10% ST	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0174 Fuel Trim System Lean Bank 2
4	Is DTC P0171 also set?	—	Go to Step 5	Go to Step 6

DTC P0174 Fuel Trim System Lean Bank2 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: • Vacuum hoses for splits, kinks and proper connections. Refer to <i>Under Hood Vacuum Hose Routing diagrams</i> • Throttle body, intake manifold and EGR valve for vacuum leaks. • Crankcase ventilation valve and/or system for leaks. • Contaminated fuel. Refer to <i>Air Filter Element/Air Cleaner Assembly</i>. • PCM and sensor grounds are clean tight and in proper locations. • Air induction system after MAF sensor for vacuum leaks. • Engine mechanical failure. Refer to <i>Engine General Information</i>. Was a problem found in any of the above areas?	—	Go to Step 7	Go to Fuel System Diagnosis
6	Visually/physically inspect the following items: • Bank 2 exhaust leaks, missing or loose exhaust hardware. • Bank 2 HO2S #1 is installed securely and electrical connector not contacting exhaust system or ignition wires. • Engine mechanical failure. Refer to <i>Engine General Information</i>. • Vacuum leaks that will only affect bank 1 (Intake manifold, injector O rings, etc.) Was a problem found in any of the above areas?	—	Go to Step 7	Go to Fuel System Diagnosis
7	Repair or replace any faulty items found. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0175 Fuel Trim System Rich Bank2**Circuit Description**

To provide the best possible combination of driveability, fuel economy and emission control, a Closed Loop air/fuel metering system is used. While in Closed Loop, the PCM monitors the heated oxygen sensor signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the Long and Short Term Fuel Trim values. Short Term Fuel Trim values change rapidly in response to the HO2S signal voltages. These changes fine tune engine fueling. Long Term Fuel Trim values change in response to trends in Short Term Fuel Trim. Long Term Fuel Trim makes coarse adjustments to fueling in order to re-center and restore control to Short Term Fuel Trim. Short and Long Term Fuel Trim can be monitored with a scan tool. Ideal fuel trim values are around 0%. A positive Fuel Trim value indicates that the PCM is adding fuel to compensate for a lean condition. A negative Fuel Trim value indicates that the PCM is reducing the amount of fuel to compensate for a rich condition. If an excessively Rich or Lean condition is detected, the PCM will set a DTC. The long term fuel trim diagnostic parameter is an average of several of the long term speed load learn cells which are selected based on speed and load.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0300, P0372, P0441, P0443, P0500, P0601, P1133, P1153, P1351, P1361, P1371, P1415, P1416, P1441 not set.
- Engine Coolant Temperature between 60°C (120°F) and 115°C (239°F).
- Fuel system operating in Closed Loop.
- Fuel trim enabled.
- Barometric Pressure greater than 70 kPa.
- Mass Air Flow between 5 grams per second and 100 grams per second.
- Manifold Absolute Pressure between 20 kPa and 90 kPa.
- Intake Air Temperature between -30°C (-22°F) and 150°C (302°F).
- EVAP Canister purge not enabled or EVAP Canister purge duty cycle greater than 75%.
- Engine speed between 500 RPM and 4000 RPM.
- TP Sensor angle less than 75%.
- Vehicle speed less than 121 km/h (75 mph).

- The PCM detects the average Long Term Fuel Trim cell values are below a predetermined threshold.
- All above conditions met for approximately 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails, if the diagnostic fails under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed.
- The first time the diagnostic fails, the PCM will record operating conditions in Failure Records.
- The second consecutive drive trip that this diagnostic fails [under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed], this information will be stored in Freeze Frame. Any data previously stored in Freeze Frame will be copied into Failure Records and Freeze Frame will be overwritten by this DTC. The only exception to this is if a Misfire DTC was already recorded in Freeze Frame. In this case, the Misfire data stays in Freeze Frame and the Fuel Trim data will be updated in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail within the same conditions that the DTC last failed.

Important: If the last failure was during a non-typical driving condition, the MIL may remain ON longer than three drive trips. Review Freeze Frame/Failure Records for the last failure conditions.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether the fault is present.

3. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If DTC 172 is also set, then both banks are operating rich. Inspect items that would cause both banks to operate rich.
5. Excessive fuel in the oil will cause DTCs P0172 and P0175 to set at the same time. Remove the PCV valve from the intake manifold and plug with a suitable stopper. Also disconnect the fresh air pipe from the rocker cover and plug with a suitable stopper. If the long and short trim values increase, indicates there is fuel in the oil.

DTC P0175 Fuel Trim System Rich Bank2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P0172 and P0175) refer to those DTCs before proceeding with this diagnostic. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Fuel system in Closed Loop. 4. Using a scan tool, monitor LT FT Bn 2 and ST FT Bn 2 display on the Fuel Trim Data List. Is LT FT and the ST FT greater than the specified values indicated?	-14% LT -10% ST	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-Fuel Trim System Rich
4	Is DTC P0172 also set?	—	Go to Step 5	Go to Step 6

DTC P0175 Fuel Trim System Rich Bank2 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: - Collapsed air intake duct. - Air filter element for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i>. - MAF sensor for being installed in the proper direction and for foreign objects blocking inlet screen. Refer to <i>MAF Sensor</i>. - For fuel in pressure regulator hose. Refer to <i>Fuel System Diagnosis</i>. - For excessive fuel in the crankcase. Check the engine oil level. Change oil as necessary. Was a problem found in any of the above areas?	—	Go to Step 7	Go to <i>Fuel System Diagnosis</i>
6	Important: When the fuel system check is finished, return to this table. Inspect injectors for leaking (Bank 2), refer to <i>Fuel System Diagnosis</i> . Was any injector(s) leaking?	—	Go to Step 9	Go to Step 8
7	Repair or replace any faulty items found. Is the action complete?	—	Go to Step 9	—
8	Replace faulty HO2S. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0200 Injector Control Circuit

Circuit Description

The PCM will enable an injector on the intake stroke of each cylinder. Individual cylinder fuel control is referred to as Sequential Multiport Fuel Injection (SFI).

Ignition voltage is supplied directly to the fuel injectors. The PCM controls each injector by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be (refer to *Injectors* for schematic) low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The PCM will monitor each injector circuit for the following:

- A grounded circuit.
- An open circuit.
- A circuit shorted to voltage.
- An injector that is open.
- An injector that is shorted or has low resistance.

When the PCM detects any of the above malfunctions, a DTC P0200/P1222 will set and the driver will be disabled.

Conditions for Setting the DTC

- Engine operating.
- Ignition voltage greater than 10.0 volts.
- The PCM detects the wrong voltage potential on any injector driver circuits for 4.0 seconds or more.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If an injector is disconnected while the engine is operating and a DTC P0200 sets, the injector driver will be disabled for the entire ignition cycle.
- When the injector driver is disabled, an engine misfire will be apparent and a misfire DTC will set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if a malfunction is present. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. There are two ways to isolate a malfunctioning injector circuit:
 - DTC P0300 indicates a misfire is present. So if an injector DTC is present at the same time a misfire DTC is set, use misfire event counters to locate the cylinder that is misfiring.
 - If no misfire DTC is present, Start and idle the engine while monitoring misfire event counters. If a misfire is present, the misfire event counters will increase for a cylinder that has a misfire.
6. Check injector connections before replacing the injector. A faulty connection will cause a DTC P0200 to set.
9. Checks for an ignition feed circuit that is shorted to ground.

Disconnecting the PCM will allow using the DVM (J 39200) to check continuity of the circuits. This will aid in locating an open or shorted circuit.

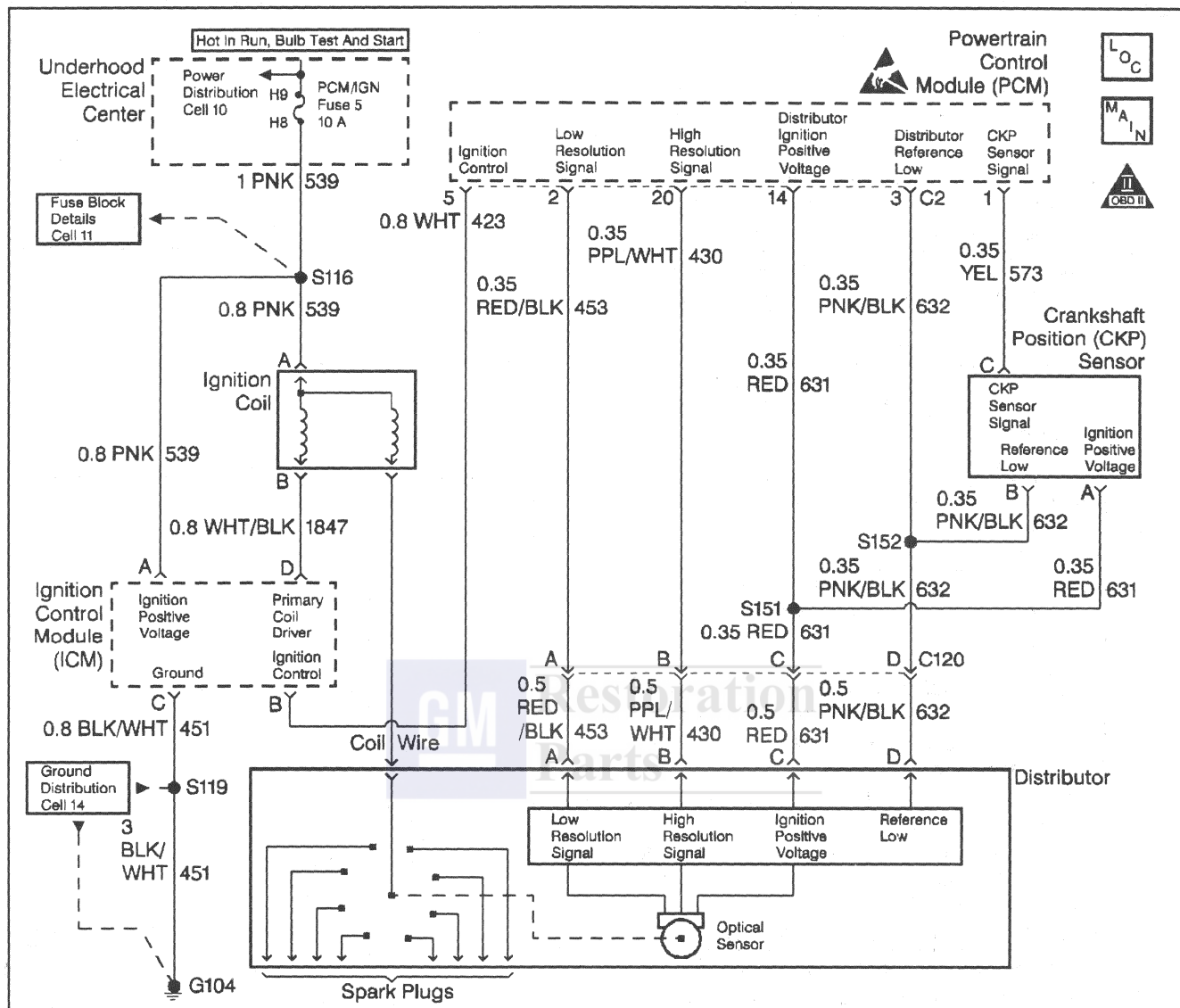
DTC P0200 Injector Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle engine. 3. Using a scan tool, monitor all the Misfire Cur. Counters on the Misfire Data List (There are a total of 8 counters. One counter per cylinder.) Are any of the Misfire Cur. Counters incrementing?	—	Go to Step 4	Go to Step 3
3	Using a scan tool, monitor the Misfire Hist. Counters on the Misfire Data List (There are a total of 8 counters. One counter per cylinder.) Do any of the Misfire Hist. Counters indicate a number other than 0.0 counts?	—	Go to DTC P1222 Injector Control Circuit Intermittent	Go to Diagnostic Aids
4	Important: This step is only for B, D and Y cars. Proceed to step 5 if the vehicle is not a B, D or Y car. Are the injector fuses OK?	—	Go to Step 5	Go to Step 8
5	1. Turn the ignition OFF. 2. Disconnect the injector(s) harness that the Misfire Cur counter was incrementing for. 3. Turn the ignition ON. 4. Using a test light (J 34142-B) connected to ground, probe the injector harness ignition feed circuit. Does the test light illuminate?	—	Go to Step 6	Go to Step 10
6	1. Turn the ignition OFF. 2. Connect injector test light (J 34730-2C) to isolated injector harness. 3. Start engine and idle. Does the test light blink?	—	Go to Step 7	Go to Step 11
7	1. Inspect the injector harness terminals for proper terminal tension. 2. Replace terminal as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Did the terminal need replacing?	—	Go to Step 17	Go to Step 15
8	1. Turn the ignition OFF. 2. Disconnect the four injector harness connectors related to the fuse that was open. 3. Using a test light (J 34142-B) connected to B+, probe the injector ignition feed circuits of one of the injector harnesses that are disconnected. Does the test light illuminate?	—	Go to Step 13	Go to Step 9
9	Using a DVM (J 39200), measure resistance of each injector that is powered by the fuse that was open. Does any injector measure less than the specified value?	11.6 Ω	Go to Step 15	Go to Step 14
10	Repair the injector ignition feed circuit to isolated injector. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 17	—

DTC P0200 Injector Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connector. 3. Check injector driver circuit for an open. Is the injector driver circuit open?	—	Go to Step 12	Go to Step 16
12	Repair injector driver circuit for an open. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 17	—
13	Repair the grounded ignition feed circuit to the injectors. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 17	—
14	Repair intermittent short to ground in the injector ignition feed circuit. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 17	—
15	Replace the faulty injector(s) that was isolated. Refer to <i>Fuel Injector</i> . Is the action complete?	—	Go to Step 17	—
16	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 17	—
17	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 18	Go to Step 2
18	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0300 Engine Misfire Detected



30389

Circuit Description

A 4X reluctor wheel is located on the front of the crankshaft. The crankshaft position sensor will send a pulse every falling edge of the 4X reluctor wheel. A misfire causes a change in crankshaft speed. The PCM times the interval between each pulse and compares each new time interval with the previous one to determine when an excessive change in crankshaft speed has occurred. A certain amount of acceleration/deceleration is expected between each firing stroke, but if the crankshaft speed changes are greater than an expected amount, the PCM will interpret this as a misfire. The PCM continuously calculates crankshaft position from the low and high resolution signals. This information is used to determine which cylinder is misfiring so that the PCM can increment the appropriate misfire counter.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0122, P0123, P0335, P0336, P0500, P0502, P0601, P0742, not set.
- Engine speed between 325 RPM and 3000 RPM.
- Ignition voltage between 9.0 volts and 16.0 volts.
- Engine coolant temperature between -7°C (19°F) and 130°C (266°F).
- Throttle angle steady within 1%.
- ABS and Traction Control not active.
- Transmission not changing gears.

- EGR and AIR diagnostic tests not in progress.
- A/C clutch steady state.
- Not in fuel shut-off or decel fuel cut-off.
- ABS signals not exceeding rough road thresholds.
- The PCM determines that an emission type Misfire is present.
- The PCM determines that a catalyst damaging Misfire is present.

Action Taken When the DTC Sets

The PCM will illuminate the Malfunction Indicator Lamp (MIL) under the following conditions:

- The PCM determines the percent of misfire over a 1000 revolution period is high enough to cause excessive tail pipe emissions. The PCM will illuminate the Malfunction Indicator lamp the next consecutive ignition cycle that the diagnostic runs and fails, if the diagnostic fails under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed.
- The second consecutive drive trip that this diagnostic fails, under the same conditions (load, RPM, temperature, etc.) as the previous ignition cycle that the test ran and failed, this information will be stored in Freeze Frame. Any data previously stored in Freeze Frame will be copied into Failure Records and Freeze Frame will be overwritten by this DTC. The only exception to this is if a Fuel Trim DTC was already recorded in Freeze Frame. In this case, the Fuel Trim data stays in Freeze Frame and the Misfire data will be updated in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail within the same conditions that the DTC last failed.

Important: If the last failure was during a non-typical driving condition, the MIL may remain ON longer than three drive trips. Review Freeze Frame/Failure Records for the last failure conditions.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If cylinder #1 is misfiring, inspect the EGR valve for hanging open. Remove the EGR valve and inspect for contaminants. Clean the EGR as necessary. Refer to *EGR Valve*.
- The vehicle running out of fuel can cause sufficient misfire to set DTC P0300.
- A misfire DTC could be caused by excessive vibration from sources other than the engine. The following are possible sources:
 - Tire/wheel out of round/balance
 - Variable thickness brake rotor/drum
 - Drive shaft not balanced
 - Certain rough road conditions
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. If the Misfire Cur counters are incrementing and there is no apparent misfire, an erratic CKP sensor signal could be the cause. Perform the diagnostic table for DTC P0335 first if this condition is suspected. If misfire is present and a fuel control problem is suspected, force the system into Open Loop using the scan tool and allow the engine to run for a few minutes. If this eliminates the misfire, refer to any fuel control related DTCs which are set. If no other DTCs are set, refer to the Engine Scan Tool Data List.
- This distributor ignition system has lower KV requirements than typical systems. The J 26792 spark tester (ST-125) may not fire *consistently* when testing this system. This chart only asks if the system is *capable* of firing the spark tester.
- This distributor ignition system has lower KV requirements than typical systems. The J 26792 spark tester (ST-125) may not fire *consistently* when testing this system. This chart only asks if the system is *capable* of firing the spark tester.
- If the plug is gas fouled, dry out the plug before reinstalling it in another cylinder.
- If the customers complaint is The MIL is flashing, indicates that a Catalyst Misfire has occurred. The vehicle must be driven in the conditions to run the catalyst diagnostic. Refer to *DTC P0420 TWC System Low Efficiency Bank1* and/or *DTC P0430 TWC System Low Efficiency Bank2* for Conditions for Setting the DTC.

DTC P0300 Engine Misfire Detected

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set, (except DTCs P0131, P0132, P0133, P0151, P0152, P0153, P0171, P0172, P0174, P0175, P1133, P1135, P1136, P1153, P1155, P1156) refer to those DTCs before proceeding with this diagnostic. 1. Install the scan tool. 2. Start and idle engine. 3. Using a scan tool, monitor all the Misfire Cur. counters on the misfire data list (There are a total of 8 counters, One counter per cylinder). Are any of the Misfire Cur. counters incrementing?	—	Go to Step 3	Go to Step 4
3	Important: If only one cylinder is misfiring, go to step 5. Visually/physically inspect the following items: • Proper vent system operation, Refer to Service Category <i>Distributor Vent System Check</i>. • Vacuum hoses for splits, kinks and proper connections. • Throttle body, intake manifold and EGR valve for vacuum leaks. • Crankcase ventilation valve and/or system for vacuum leaks. • PCM grounds for being clean and secure. • Check that all injector harness connectors are connected to the proper injector/cylinder. • Check that the ignition wires are connected to the proper cylinders. Did any of the above checks isolate a condition requiring a repair?	—	Go to Step 19	Go to Step 5
4	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 5	Go to Diagnostic Aids-DTCP0300 Engine Misfire Detected
5	1. Turn the ignition OFF. 2. Disconnect ignition coil wire from distributor and install spark tester J 26792 to ground. 3. Crank the engine and observe the spark tester. With engine cranking, does spark jump the tester gap?	—	Go to Step 6	Go to Step 12

DTC P0300 Engine Misfire Detected (cont'd)

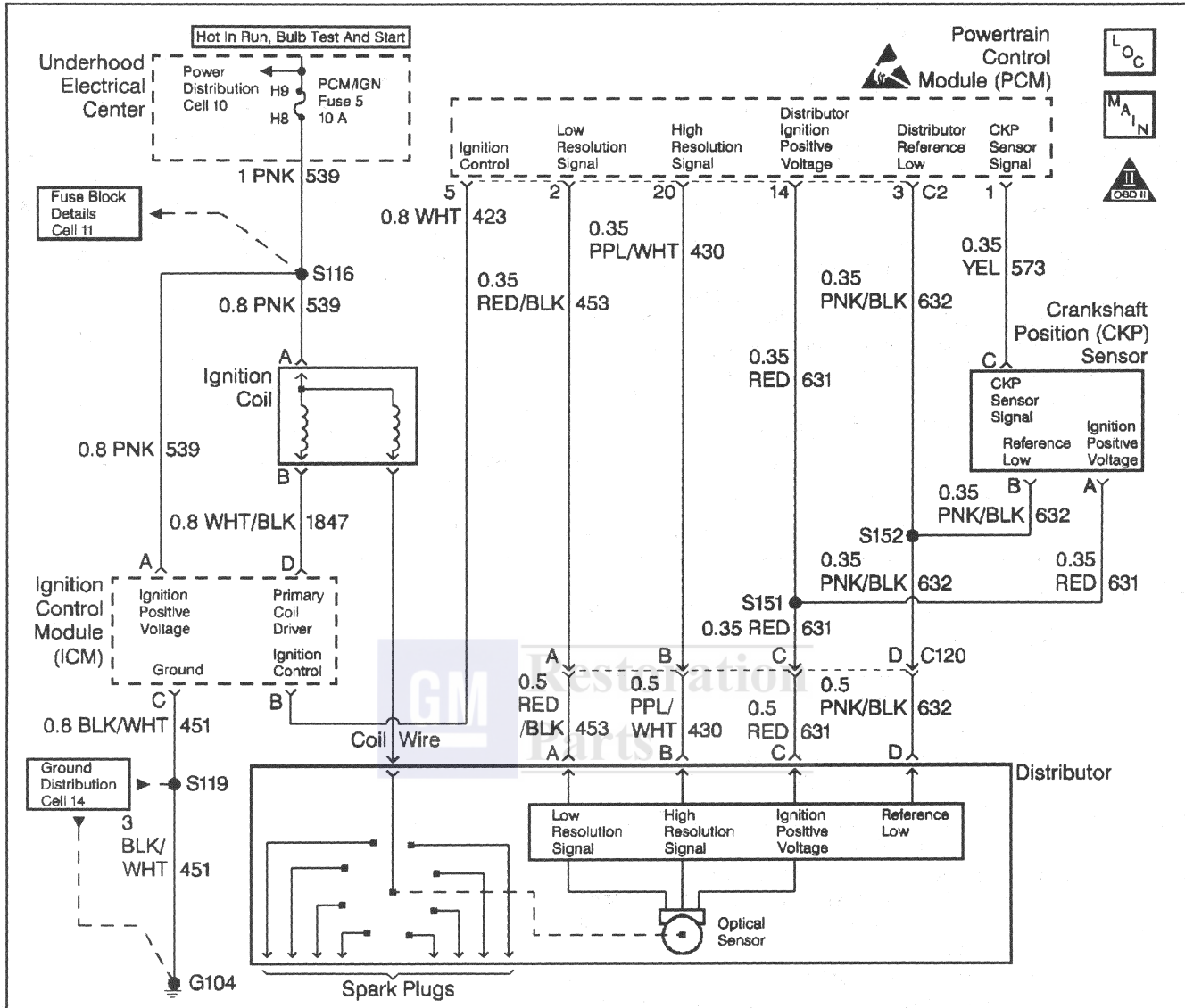
Step	Action	Value(s)	Yes	No
6	1. Reconnect coil wire to the distributor. 2. Disconnect the ignition wire(s) that corresponds to the Misfire Cur counter(s) that was incrementing. 3. Using spark tester J 26792 check for spark at the ignition wire(s) that indicated a misfire. Does spark jump the tester gap?	—	Go to Step 7	Go to Step 15
7	Remove the spark plugs from the cylinder that indicated a misfire. Does the spark plug appear to be OK or only gas fouled (not oil or coolant fouled)?	—	Go to Step 8	Go to Step 9
8	1. Swap the suspected spark plug with another cylinder that is operating properly. 2. Operate the vehicle under the same conditions that the misfire occurred. Important: If the Injector Coil Test Procedure checks to be OK, refer to Engine Mechanical diagnosis. Did the misfire move with the spark plug?	—	Go to Step 17	Go to Fuel Injector Coil Test
9	Are the spark plugs oil or coolant fouled?	—	Refer to Engine Mechanical for diagnosis	Go to Step 10
10	Do the spark plugs show any signs of being cracked, worn, or improperly gapped?	—	Go to Step 11	Go to Step 18
11	Replace or re-gap spark plugs (If improper gap is found, be sure to re-gap spark plugs using a wire type gauge, J 41319.) Is the action complete?	—	Go to Step 19	—
12	Using a DVM (J 39200), measure the resistance of the coil wire. Is the coil wire resistance less than the specified value?	10,000 Ω	Go to Step 13	Go to Step 14
13	Replace ignition coil. Is the action complete?	—	Go to Step 19	—
14	Replace coil wire. Is the action complete?	—	Go to Step 19	—
15	Using a DVM (J 39200), measure resistance of ignition wire(s) that are indicating a misfire. Do any ignition wires measure greater than the specified value?	10,000 Ω	Go to Step 16	Go to Step 17
16	Replace faulty ignition wire(s). Is the action complete?	—	Go to Step 19	—
17	Replace faulty spark plug(s). Is the action complete?	—	Go to Step 19	—
18	Inspect the distributor for the following: • Carbon tracking • Contamination • Moisture • Physical damage Refer to <i>Ignition System (6D)</i> . Did any of the above checks isolate a condition requiring a repair?	—	Go to Step 19	Refer to Engine Mechanical for diagnosis.

DTC P0300 Engine Misfire Detected (cont'd)

Step	Action	Value(s)	Yes	No
19	Was the customer complaining that the MIL was flashing?	—	Go to DTC P0420 TWC System Low Efficiency Bank1 or DTC P0430 TWC System Low Efficiency Bank2	Go to Step 20
20	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 21	Go to Step 2
21	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0323 DI Low/High Resolution CKT Intermittent



30389

Circuit Description

The distributor ignition system supplies two timing inputs to the PCM, a high resolution signal (180 pulses per one crankshaft revolution) and a low resolution signal (4 pulses per one crankshaft revolution). The PCM can determine if one of the timing inputs is not being received by comparing the two inputs.

The high and low resolution circuits toggle between 0 and 5 volts as the camshaft turns. The following intermittent malfunctions to the low resolution circuit may cause a DTC P0323 to set:

- An open.
- A short to voltage.
- A short to ground.
- A defective ignition module within the distributor.

Conditions for Setting the DTC

- The PCM detects an interruption in the either the low or high resolution signal.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- When DTC P0323 occurs, a misfire may be apparent. To locate an intermittent, use the scan tools snapshot feature. Try to duplicate the conditions under which the misfire is present. When reviewing captured data, watch for any abnormal high and low resolution timing pulses.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted.
- A defective ignition module within the distributor could cause this DTC to set. Inspect the distributor for signs of damage including contamination. Refer to *Section 6D4, Ignition System*. If distributor components must be replaced, check distributor vent system operation. Refer to *Distributor Vent System Check*.

DTC P0323 DI Low/High Resolution CKT Intermittent

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Engine idling. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTCs P0372 and P1371 Did DTC P0372 or P1371 fail this ignition cycle?	—	Go to applicable DTC Table	Go to Step 3
3	1. Install the scan tool. 2. Using the scan tool, observe Engine Speed while moving related harness connectors (at component and PCM). Also watch for an engine miss or stall when a connector is moved. Does the Engine Speed display change abruptly, or does an engine miss or stall occur while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe Engine Speed while moving related wiring harnesses. Also watch for an engine miss or stall when the harness is moved. Does the Engine Speed display change abruptly, or does an engine miss or stall occur while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5

DTC P0323 DI Low/High Resolution CKT Intermittent (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids- DTC P0323 DI Low/High Resolution Circuit Intermittent
6	Repair the damage connectors/terminals. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all circuits have been checked thoroughly and no faults can be found, inspect the distributor. Refer to <i>Section 6D4, Ignition System</i>. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0325 Knock Sensor Module Circuit**Circuit Description**

A removable Knock Sensor (KS) module is located in the PCM. The KS module monitors both knock sensors to determine if detonation is present. If the KS module determines that excessive knock (detonation) is present, the PCM will retard the spark timing based on the signals from the KS module. When knock is present, the KS module voltage input signal to the PCM goes low. The PCM will then retard timing until no knock is present. When the KS module is missing or malfunctioning, the KS circuit voltage going to the PCM will go low. The PCM interprets this low signal as spark knock.

Conditions for Setting the DTC

- The PCM detects that the KS module is missing
- A malfunction with the KS module or circuits to the module are faulty.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- If the diagnostic test does not run, review Conditions for Setting the DTC criteria.
- Check the KS module terminals for corrosion. If corrosion is found, inspect KS Module access cover seal for cuts and nicks.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. Check the KS module terminals for corrosion. If corrosion is found, replace the PCM and the KS module.
5. If the PCM is at fault, the original KS module must be installed in the new PCM.

DTC P0325 Knock Sensor Module Circuit

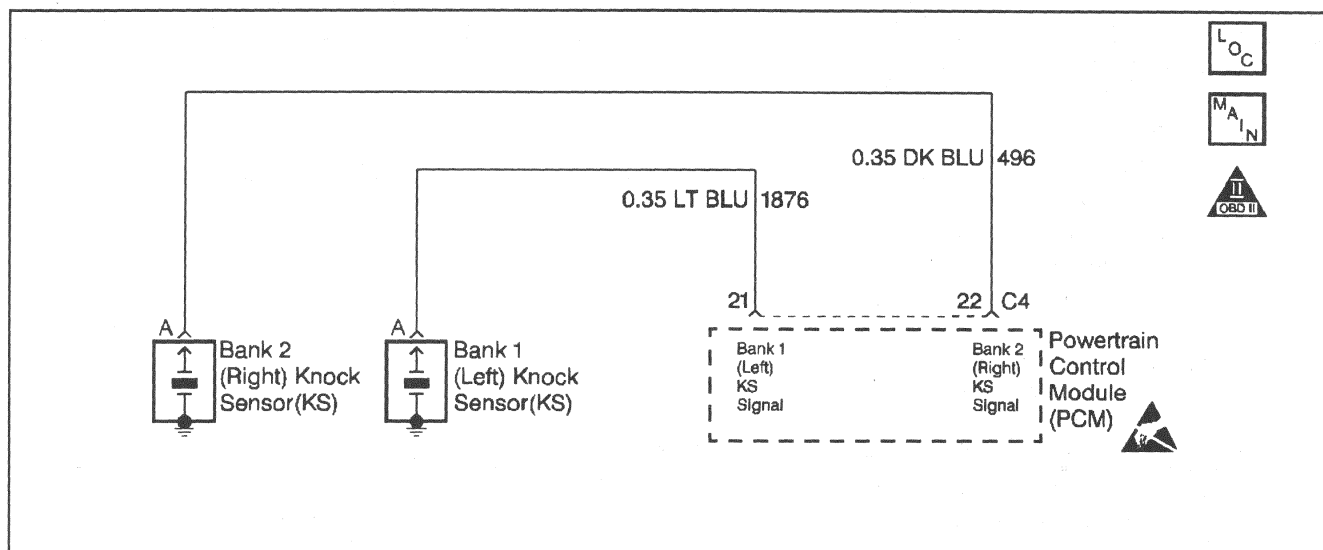
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If an engine knock can be heard, repair the engine mechanical problem before proceeding with this diagnostic. 1. Start and idle the engine for 2 minutes. 2. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn the ignition OFF. 2. Check the PCM for a missing module, for the module not being fully seated or for incorrect installation. Was a problem found and corrected?	—	Go to Step 6	Go to Step 4
4	1. Replace the KS module. Refer to <i>Knock Sensor Module</i> . 2. Start and idle the engine for 2 minutes. 3. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 5	Go to Step 6

DTC P0325 Knock Sensor Module Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	<i>Go to Step 6</i>	—
6	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 7</i>	<i>Go to Step 2</i>
7	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0327 Knock Sensor Circuit Bank1



30399

Circuit Description

The Knock Sensor (KS) system is used to detect engine detonation. The PCM will retard the spark timing based on the signals from the KS module. The Knock Sensors produce an AC voltage that is sent to the KS module. The amount of AC voltage produced is proportional to the amount of knock.

An operating engine produces a normal amount of engine mechanical vibration (Noise). The knock sensors will produce an AC voltage signal from this Noise. When an engine is operating, the PCM will learn the minimum and maximum frequency of the noise the engine produces. When the PCM determines that this frequency is less than or greater than the expected amount, a knock sensor DTC will set.

Conditions for Setting the DTC

- DTCs P0117, P0118, P0122, P0123, P0125, P1114, P1115 not set.
- Engine operating time is greater than 20 seconds.
- Engine Coolant temperature greater than 80°C (176°F).
- Engine speed between 1100 and 2500 RPM.
- Throttle angle greater than 10%.
- The PCM determines that this frequency is less than or greater than the expected amount, a knock sensor DTC will set.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

Check the Knock Sensor for proper installation. A Knock Sensor that is loose or over torqued may cause DTC P0327 to set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This verifies the malfunction is present.
3. Failure Records data does not include the parameter KS Activity, however other parameters may aid in locating the conditions under which an intermittent occurred.
4. This test will isolate the Knock Sensor from the rest of the circuit.

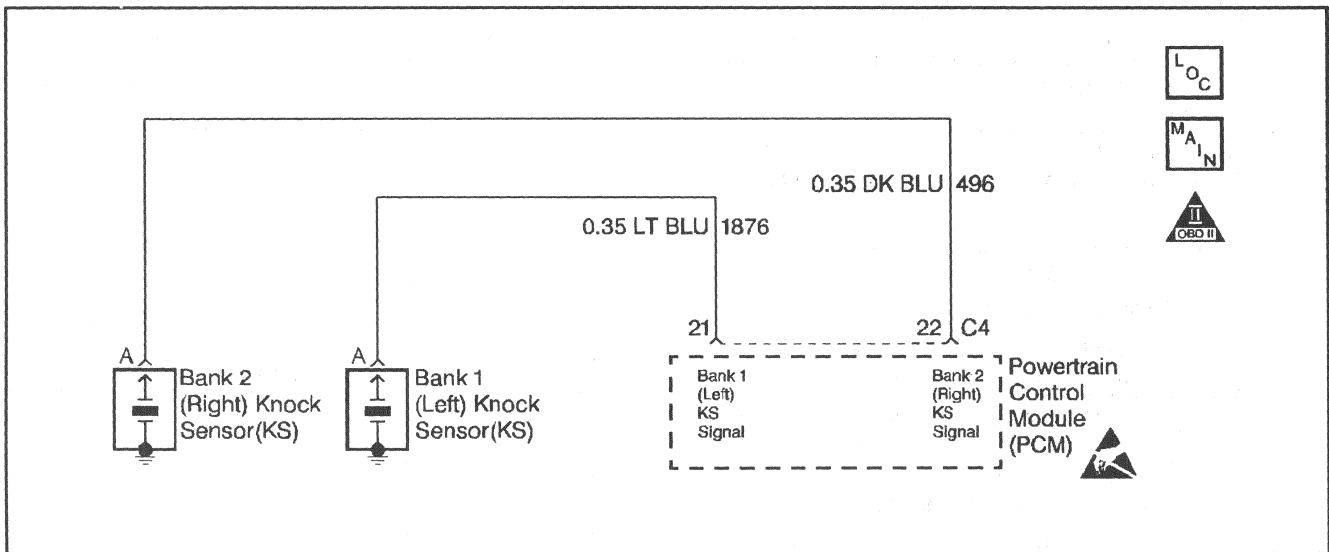
DTC P0327 Knock Sensor Circuit Bank1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If an engine knock can be heard, repair the engine mechanical problem before proceeding with this diagnostic. 1. Start the engine and allow it to reach normal operating temperature. 2. Install the scan tool. 3. Using the scan tool, monitor KS Activity. Does the scan tool indicate YES?	—	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0327 KS Circuit Low
4	1. Disconnect knock sensor electrical connector. 2. Using a DVM (J 39200), measure voltage between the KS signal circuit and ground. Does the DVM indicate voltage at the specified value?	5.0 V	Go to Step 5	Go to Step 8
5	1. Measure the resistance of the knock sensor by connecting the DVM between the sensor terminal and the engine block. 2. Set DVM to 400K Ω scale. Is resistance of the knock sensor within the specified range?	93K–107K Ω	Go to Step 6	Go to Step 9
6	1. Turn the ignition OFF. 2. Connect DVM to Knock Sensor and ground. 3. Set DVM to AC voltage scale. 4. Tap on engine while observing signal indicated on DVM. Is any signal indicated on the DVM while tapping on the engine near the Knock Sensor?	—	Go to Step 7	Go to Step 9
7	Check the KS signal circuit for a poor terminal connection at the knock sensor. Was a problem found and corrected?	—	Go to Step 12	Go to Step 10

DTC P0327 Knock Sensor Circuit Bank1 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF, disconnect the PCM. 2. Turn the ignition ON, check the KS signal circuit between the PCM and the knock sensor connector for the following: • An open. • A short to voltage. • A short to ground. Was a problem found and corrected?	—	Go to Step 12	Go to Step 10
9	Replace the Knock Sensor. Refer to <i>Knock Sensor</i> . Is action complete?	—	Go to Step 12	—
10	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Check the KS signal circuit for a poor terminal connection at the PCM. Was a problem found and corrected?	—	Go to Step 12	Go to Step 11
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0332 Knock Sensor Circuit Bank2



30399

Circuit Description

The Knock Sensor (KS) system is used to detect engine detonation. The PCM will retard the spark timing based on the signals from the KS module. The Knock Sensors produce an AC voltage that is sent to the KS module. The amount of AC voltage produced is proportional to the amount of knock.

An operating engine produces a normal amount of engine mechanical vibration (Noise). The knock sensors will produce an AC voltage signal from this Noise. When an engine is operating, the PCM will learn the minimum and maximum frequency of the noise the engine produces. When the PCM determines that this frequency is less than or greater than the expected amount, a knock sensor DTC will set.

Conditions for Setting the DTC

- DTCs P0117, P0118, P0122, P0123, P0125, P1114, P1115 not set.
- Engine operating time is greater than 20 seconds.
- Engine Coolant temperature greater than 80°C (176°F).
- Engine speed between 1100 and 2500 RPM.
- Throttle angle greater than 10%.
- The PCM determines that this frequency is less than or greater than the expected amount, a knock sensor DTC will set.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

Check the Knock Sensor for proper installation. A Knock Sensor that is loose or over torqued may cause DTC P0332 to set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This verifies the malfunction is present.
3. Failure Records data does not include the parameter KS Activity, however other parameters may aid in locating the conditions under which an intermittent occurred.
4. This test will isolate the Knock Sensor from the rest of the circuit.

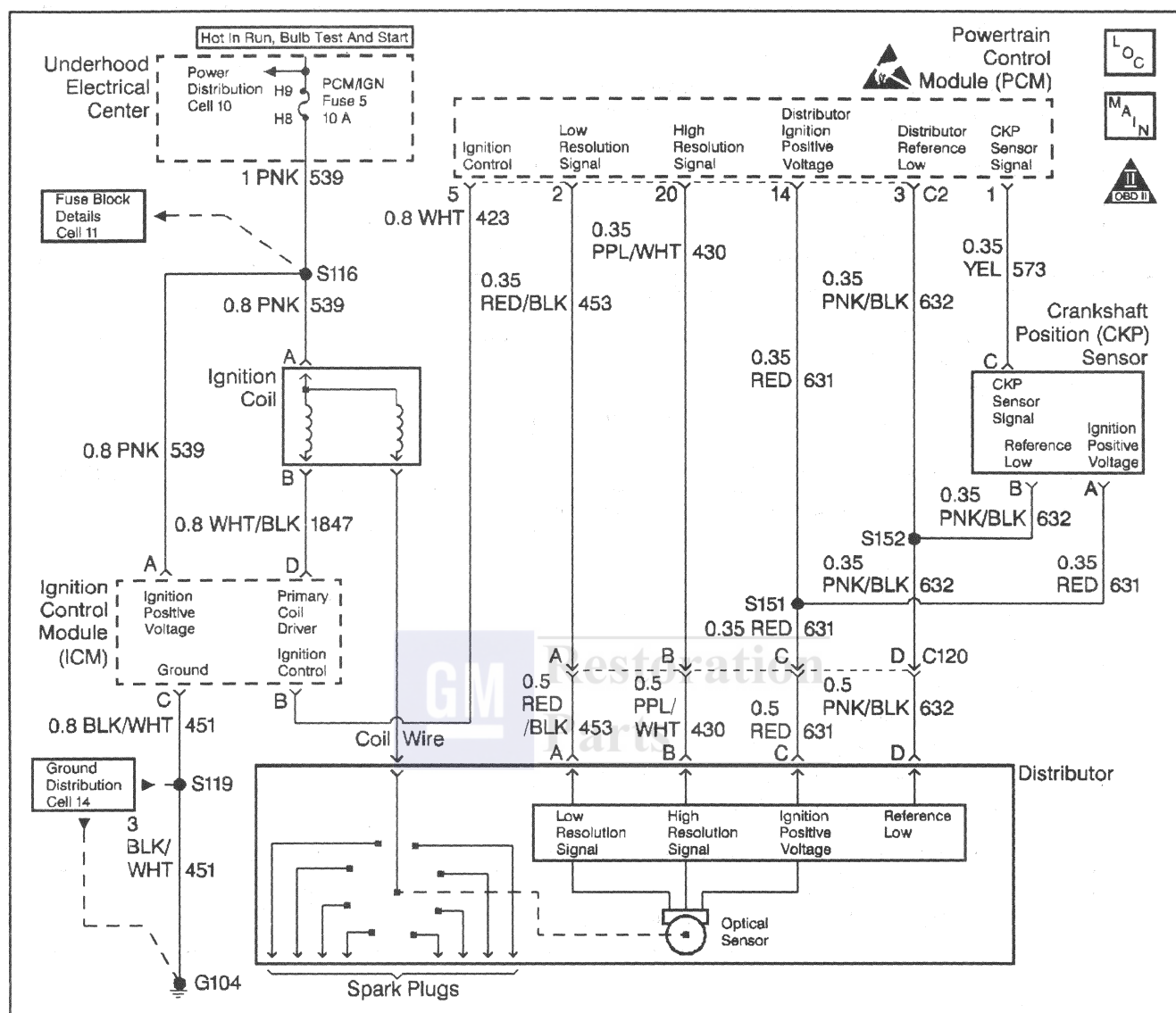
DTC P0332 Knock Sensor Circuit Bank2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If an engine knock can be heard, repair the engine mechanical problem before proceeding with this diagnostic. 1. Start the engine and allow it to reach normal operating temperature. 2. Install the scan tool. 3. Using the scan tool, monitor KS Activity. Does the scan tool indicate YES?	—	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0332 KS Circuit Low Bank 2
4	1. Disconnect knock sensor electrical connector. 2. Using a DVM (J 39200), measure voltage between the KS signal circuit and ground. Does the DVM indicate voltage at the specified value?	5.0 V	Go to Step 5	Go to Step 8
5	1. Measure the resistance of the knock sensor by connecting the DVM between the sensor terminal and the engine block. 2. Set DVM to 400K indicates scale. Is resistance of the knock sensor within the specified range?	93K–107K Ω	Go to Step 6	Go to Step 9
6	1. Turn the ignition OFF. 2. Connect DVM to Knock Sensor and ground. 3. Set DVM to AC voltage scale. 4. Tap on engine while observing signal indicated on DVM. Is any signal indicated on the DVM while tapping on the engine near the Knock Sensor?	—	Go to Step 7	Go to Step 9
7	Check the KS signal circuit for a poor terminal connection at the knock sensor. Was a problem found and corrected?	—	Go to Step 12	Go to Step 10

DTC P0332 Knock Sensor Circuit Bank2 (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Turn the ignition ON, check the KS signal circuit between the PCM and the knock sensor connector for the following: • An open. • A short to voltage. • A short to ground. Was a problem found and corrected?	—	Go to Step 12	Go to Step 10
9	Replace the Knock Sensor. Refer to <i>Knock Sensor</i> . Is the action complete?	—	Go to Step 12	—
10	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Check the KS signal circuit for a poor terminal connection at the PCM. Was a problem found and corrected?	—	Go to Step 12	Go to Step 11
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0335 Crankshaft Position (CKP) Sensor CKT



30389

Circuit Description

The Crankshaft Position Sensor is mounted in the engine front cover assembly and works in conjunction with a 4X reluctor wheel on the front of the crankshaft. The CKP sensor has a B+ power supply, a ground and a signal circuit.

As the crankshaft rotates, the reluctor wheel teeth interrupt a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a signal which is read by the PCM. The PCM uses this signal to accurately measure crankshaft velocity which is a variable used to detect misfire. This sensor is not used for spark or fueling. For this diagnostic the PCM monitors the Crankshaft Position Sensor signal, and the Low Resolution and the High Resolution signals from the

distributor. During normal operation, at the falling edge of a Crankshaft Sensor signal pulse (signal voltage transitions to low), the PCM starts counting High Resolution pulses. The counter will increase until the PCM detects the leading edge of the next Low Resolution signal pulse (voltage transitions to high). The PCM monitors the number of High Resolution counts to verify proper CKP sensor operation. The scan tool parameter that displays the results of this calculation is CKP:Lo Resolution Angle. The value displayed is the number of degrees that the camshaft deviates [either advanced (+) or retarded (-)] from its normal alignment with the crankshaft. During normal operation, on a vehicle with little or no timing chain wear, the value displayed would be near 0° Dev.

Conditions for Setting the DTC

- Engine Speed between 500 and 4000 RPM (LT1), 675 and 4000 RPM (LT4)
- Ignition Voltage between 9 and 17 volts
- CKP:Lo Resolution Angle goes outside of the range from -21° Dev to $+51^{\circ}$ Dev No signal from the CKP sensor will also cause this condition.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

The following mechanical problems may cause this DTC to set:

- Poor connections/terminal tension at the sensor.
- Excessive timing chain/gear wear.
- Excessive distributor drive backlash or other mechanical distributor problem.
- Crankshaft reluctor wheel damage or improper installation.
- Engine front cover assembly damage.
- The sensor coming in contact with the reluctor wheel.

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail.

Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. Crankshaft RPM should be similar to Engine Speed within approximately ± 75 RPM.

Important: During hard acceleration these two parameters can differ widely from each other due to time variances in the PCMs internal calculating processes. This difference could show up in a snapshot. If other parameters indicate a hard acceleration condition, the difference in the two values should be disregarded.

5. If there is excessive timing chain/gear wear, the camshaft has a tendency to retard on acceleration and to advance on deceleration. This parameter will indicate a positive value as the crankshaft accelerates, then flip to a negative value as the crankshaft decelerates. This may be more apparent while driving the vehicle than it is under a no-load situation.
6. If the reluctor wheel keyway moves off of the key in the crankshaft before the damper hub is completely installed, it is possible to pinch the reluctor wheel in an incorrect position. This will cause the CKP: Lo Res Angle parameter to be skewed. If the distributor drive pin is not properly indexed into the distributor and then the distributor is drawn into place with the mounting bolts, the CKP:Lo Res Angle parameter will be skewed. Check the condition of the distributor shaft for evidence of this condition.
7. The parameter Cyl Mode Misfire Index is the difference in crankshaft deceleration from one reference period to the next (in counts). On a perfect engine this value would equal zero, however, due to normal variations in engine operation, a value less than 1000 is acceptable. In this diagnostic table, Cyl Mode Misfire Index is being used to detect erratic signals from the CKP sensor. The following conditions should be met before using this parameter:
 - Engine idling at normal operating temperature.
 - All accessories OFF.
 - No apparent engine misfire. DTC P0300 may or may not be set since that diagnostic relies on data from this sensor. If the engine is misfiring, this needs to be corrected before proceeding. Refer to *Symptoms*.
11. With the signal generator set to 54 mph, the Crankshaft RPM should indicate approximately 900 RPM.

DTC P0335 Crankshaft Position (CKP) Sensor CKT

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Is DTC P1371 or P1373 also set?	—	Go to that DTC Table first	Go to Step 3
3	1. Start the engine. 2. Using the scan tool, monitor Crankshaft RPM. Is RPM indicated?	—	Go to Step 4	Go to Step 9
4	Using the scan tool, monitor CKP: Lo Res Angle. The actual value may fluctuate, but should remain within the range shown. Is the value within the range specified?	-10° Dev to +7° Dev	Go to Step 7	Go to Step 5
5	While observing CKP: Lo Res Angle, Quickly rev the engine once and allow it to return to idle. Does the CKP: Lo Res Angle change from a positive value on acceleration to a negative value on deceleration?	—	Go to Step 15	Go to Step 6
6	Does the CKP: Lo Res Angle appear to be fixed at or near a value outside the specified range?	- 10° Dev to +7° Dev	Go to Step 16	Go to Step 7
7	Important: Review the information in the Test Description before proceeding. Using the scan tool, monitor Cyl Mode Misfire Index (in the Misfire data list) with the engine idling. Typically this value should remain below 1000. Is the value below the specified value?	1000	Go to Step 8	Go to Step 12
8	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 9	Go to Diagnostic Aids- DTC P0335 Crankshaft Position Sensor Circuit
9	1. Turn the ignition ON, engine OFF. 2. Disconnect the Crankshaft Position Sensor harness connector. 3. Connect a test light (J 34142-B) from the ignition feed circuit in the Crankshaft Position Sensor harness connector to battery ground. Is the test light ON?	—	Go to Step 10	Go to Step 17

DTC P0335 Crankshaft Position (CKP) Sensor CKT (cont'd)

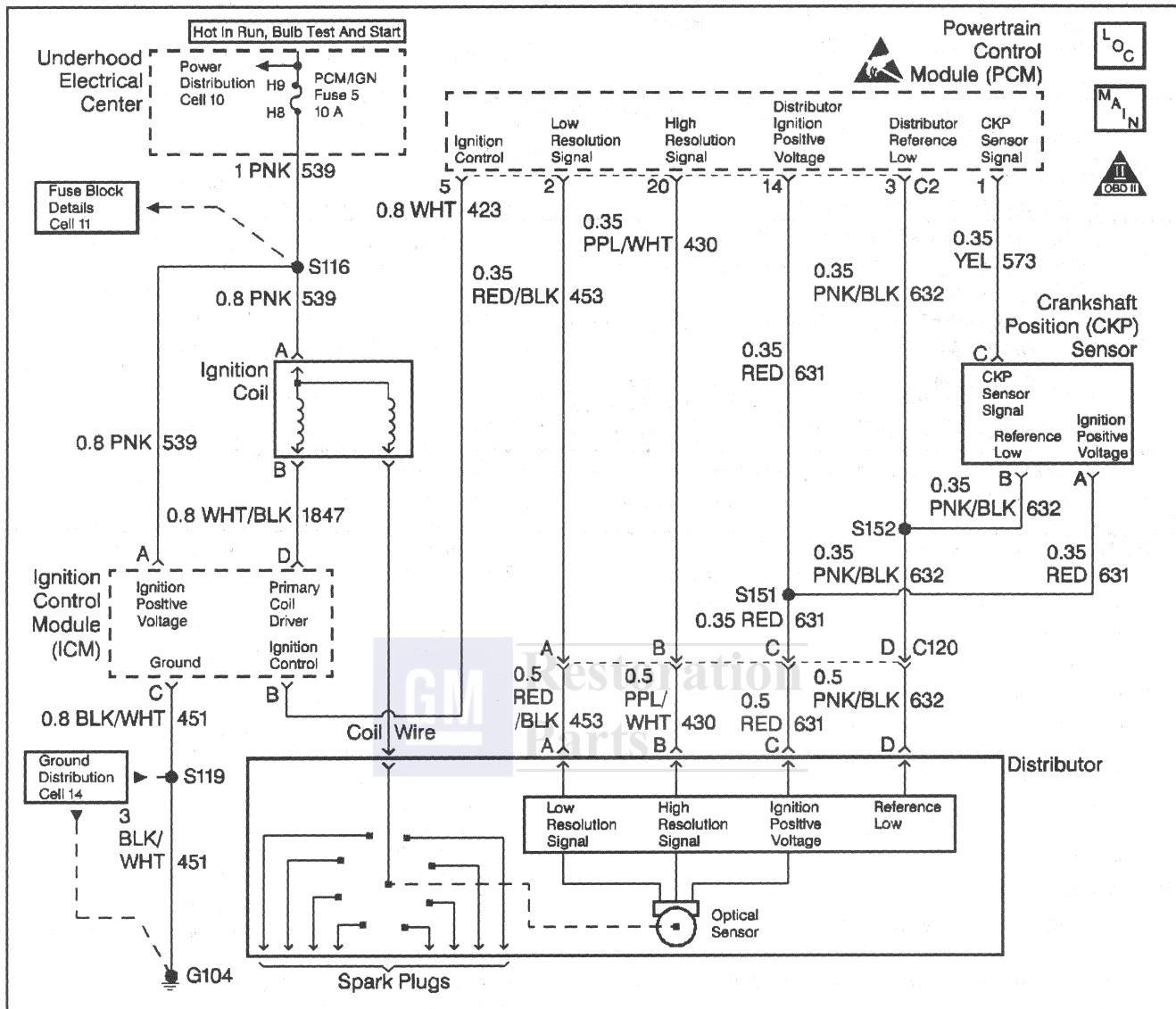
Step	Action	Value(s)	Yes	No
10	Connect a test light (J 34142-B) between terminal A and terminal B in the Crankshaft Position Sensor harness connector. Is the test light ON?	—	Go to Step 11	Go to Step 19
11	1. Install the Signal Generator Tester (J 33431-B) to the signal circuit in the Crankshaft Position Sensor harness connector (one terminal connected to the signal circuit and the other to ground). 2. Turn the ignition ON, Tester ON and set to generate a 54 mph signal. 3. Using the scan tool, monitor Crankshaft RPM. Does the scan tool indicate Crankshaft RPM?	—	Go to Step 17	Go to Step 13
12	Visually inspect the Crankshaft Position Sensor for the following conditions: - Physical damage. - Loose or improper installation. - Wiring routed too closely to secondary ignition components. - Poor connections/terminal tension at the sensor and/or the PCM. Was a problem found and corrected?	—	Go to Step 23	Go to Step 21
13	1. Turn the ignition OFF. 2. Disconnect PCM connector C1. 3. Using DVM J 39200, check continuity of the signal circuit from the sensor harness connector to the PCM connector. Does the DVM indicate continuity?	5 Ω	Go to Step 14	Go to Step 20
14	Using the J 39200, measure the resistance between the signal circuit and ground. Does the DVM indicate infinite resistance?	—	Go to Step 22	Go to Step 20
15	Check for excessive timing chain/gear wear. Refer to <i>Engine Unit Repair, Section 6A</i> . Is the action complete?	—	Go to Step 23	—
16	Check for poor connections/terminal tension at the sensor. If the connections are OK, Check for proper reluctor wheel installation. Refer to <i>Engine Unit Repair, Section 6A</i> . Is the action complete?	—	Go to Step 23	—
17	Check for poor connections/terminal tension at the sensor. Was a problem found and corrected?	—	Go to Step 23	Go to Step 21
18	Repair the ignition feed circuit Is the action complete?	—	Go to Step 23	—
19	Repair the ground circuit Is the action complete?	—	Go to Step 23	—
20	Repair the signal circuit Is the action complete?	—	Go to Step 23	—

DTC P0335 Crankshaft Position (CKP) Sensor CKT (cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the Crankshaft Position Sensor. Refer to <i>Crankshaft Position Sensor</i> . Is the action complete?	—	Go to Step 23	—
22	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 23	—
23	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 24	Go to Step 2
24	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	Go to the applicable DTC table	System OK	



DTC P0336 CKP Sensor Circuit Performance



30389

Circuit Description

The Crankshaft Position Sensor is mounted in the engine front cover assembly and works in conjunction with a 4X reluctor wheel on the front of the crankshaft. The CKP sensor has a B+ power supply, a ground and a signal circuit.

As the crankshaft rotates, the reluctor wheel teeth interrupt a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a signal which is read by the PCM. The PCM uses this signal to accurately measure crankshaft velocity which is a variable used to detect misfire. This sensor is not used for spark or fueling. For this diagnostic the PCM monitors the Crankshaft Position Sensor signal, and the Low Resolution and the High Resolution signals from the

distributor. During normal operation, at the falling edge of a Crankshaft Sensor signal pulse (signal voltage transitions to low), the PCM starts counting High Resolution pulses. The counter will increase until the PCM detects the leading edge of the next Low Resolution signal pulse (voltage transitions to high). The PCM monitors the number of High Resolution counts to verify proper CKP sensor operation. The scan tool parameter that displays the results of this calculation is CKP:Lo Resolution Angle. The value displayed is the number of degrees that the camshaft deviates [either advanced (+) or retarded (-)] from its normal alignment with the crankshaft. During normal operation, on a vehicle with little or no timing chain wear, the value displayed would be near 0° Dev.

Conditions for Setting the DTC

- Engine Speed between 500 and 4000 RPM (LT1), 675 and 4000 RPM (LT4)
- Ignition Voltage between 9 and 17 volts
- CKP:Lo Res Angle goes outside of the range from -10° Dev to $+7^{\circ}$ Dev but is still within the range -21° Dev to $+51^{\circ}$ Dev.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

The following mechanical problems may cause this DTC to set:

- Poor connections/terminal tension at the sensor.
- Excessive timing chain/gear wear.
- Excessive distributor drive backlash or other mechanical distributor problem.
- Crankshaft reluctor wheel damage or improper installation.
- Engine front cover assembly damage.
- The sensor coming in contact with the reluctor wheel.

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail.

Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. Crankshaft RPM should be similar to Engine Speed within approximately ± 75 RPM.

Important: During hard acceleration these two parameters can differ widely from each other due to time variances in the PCMs internal calculating processes. This difference could show up in a snapshot. If other parameters indicate a hard acceleration condition, the difference in the two values should be disregarded.

5. If there is excessive timing chain/gear wear, the camshaft has a tendency to retard on acceleration and to advance on deceleration. This parameter will indicate a positive value as the crankshaft accelerates, then flip to a negative value as the crankshaft decelerates. This may be more apparent while driving the vehicle than it is under a no-load situation.
6. If the reluctor wheel keyway moves off of the key in the crankshaft before the damper hub is completely installed, it is possible to pinch the reluctor wheel in an incorrect position. This will cause the CKP:Lo Res Angle parameter to be skewed. If the distributor drive pin is not properly indexed into the distributor and then the distributor is drawn into place with the mounting bolts, the CKP:Lo Res Angle parameter will be skewed. Check the condition of the distributor shaft for evidence of this condition.
7. The parameter Cyl Mode Misfire Index is the difference in crankshaft deceleration from one reference period to the next (in counts). On a perfect engine this value would equal zero, however, due to normal variations in engine operation, a value less than 1000 is acceptable. In this diagnostic table, Cyl Mode Misfire Index is being used to detect erratic signals from the CKP sensor. The following conditions should be met before using this parameter:
 - Engine idling at normal operating temperature.
 - All accessories OFF.
 - No apparent engine misfire. DTC P0300 may or may not be set since that diagnostic relies on data from this sensor. If the engine is misfiring, this needs to be corrected before proceeding. Refer to *Symptoms*.
11. With the signal generator set to 54 mph, the Crankshaft RPM should indicate approximately 900 RPM.

DTC P0336 CKP Sensor Circuit Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Is DTC P1371 or P1373 also set?	—	Go to that DTC Table first	Go to Step 3
3	1. Start the engine. 2. Using the scan tool, monitor Crankshaft RPM. Is RPM indicated?	—	Go to Step 4	Go to Step 9
4	Using the scan tool, monitor CKP:Lo Res Angle. The actual value may fluctuate, but should remain within the range shown. Is the value within the range specified?	-10° Dev to +7° Dev	Go to Step 7	Go to Step 5
5	While observing CKP:Lo Res Angle, Quickly rev the engine once and allow it to return to idle. Does the CKP:Lo Res Angle change from a positive value on acceleration to a negative value on deceleration?	—	Go to Step 14	Go to Step 6
6	Does the CKP:Lo Res Angle appear to be fixed at or near a value outside the specified range?	- 10° Dev to +7° Dev	Go to Step 15	Go to Step 7
7	Important: Review the information in the Test Description before proceeding. Using the scan tool, monitor Cyl Mode Misfire Index (in the Misfire data list) with the engine idling. Typically this value should remain below 1000. Is the value below the specified value?	1000	Go to Step 8	Go to Step 12
8	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 9	Go to Diagnostic Aids-DTC P0335 Crankshaft Position Sensor Circuit
9	1. Turn the ignition ON, engine OFF. 2. Disconnect the Crankshaft Position Sensor harness connector. 3. Connect a test light (J 34142-B) from the ignition feed circuit in the Crankshaft Position Sensor harness connector to battery ground. Is the test light ON?	—	Go to Step 10	Go to Step 17

DTC P0336 CKP Sensor Circuit Performance (cont'd)

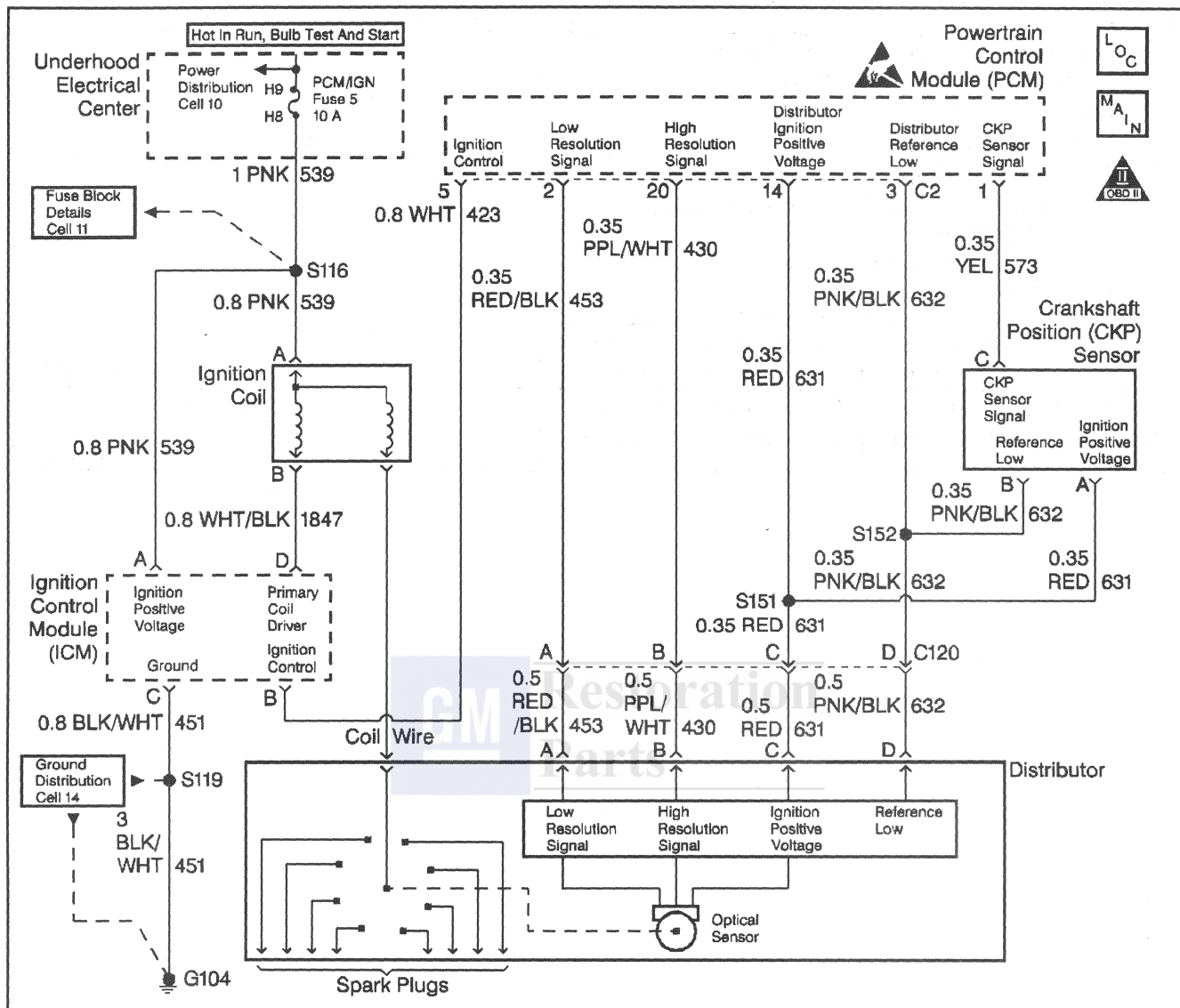
Step	Action	Value(s)	Yes	No
10	Connect a test light (J 34142-B) from the ignition feed circuit to the ground circuit in the Crankshaft Position Sensor harness connector. Is the test light ON?	—	Go to Step 11	Go to Step 18
11	1. Install the Signal Generator Tester (J 33431-B) to the signal circuit in the Crankshaft Position Sensor harness connector (one terminal connected to the signal circuit and the other to ground). 2. Ignition ON, Tester ON and set to generate a 54 mph signal. 3. Using the scan tool, monitor Crankshaft RPM. Does the scan tool indicate Crankshaft RPM?	—	Go to Step 16	Go to Step 13
12	Visually inspect the Crankshaft Position Sensor for the following conditions: - Physical damage. - Loose or improper installation. - Wiring routed too closely to secondary ignition components. - Poor connections/terminal tension at the sensor and/or the PCM. Was a problem found and corrected?	—	Go to Step 22	Go to Step 20
13	1. Turn the ignition OFF. 2. Disconnect PCM connector C1. 3. Using DVM J 39200, check continuity of the signal circuit from the sensor harness connector to the PCM connector. Does the DVM display the value shown (or lower)?	5 Ω	Go to Step 21	Go to Step 19
14	Check for excessive timing chain/gear wear. Refer to <i>Engine Unit Repair, Section 6A</i> . Is the action complete?	—	Go to Step 22	—
15	Check for poor connections/terminal tension at the sensor. If the connections are OK, Check for proper reluctor wheel installation. Refer to <i>Engine Unit Repair, Section 6A</i> . Is the action complete?	—	Go to Step 22	—
16	Check for poor connections/terminal tension at the sensor. Was a problem found and corrected?	—	Go to Step 22	Go to Step 20
17	Repair the ignition feed circuit Is the action complete?	—	Go to Step 22	—
18	Repair the ground circuit Is the action complete?	—	Go to Step 22	—
19	Repair the signal circuit Is the action complete?	—	Go to Step 22	—
20	Replace the Crankshaft Position Sensor. Is the action complete?	—	Go to Step 22	—

DTC P0336 CKP Sensor Circuit Performance (cont'd)

Step	Action	Value(s)	Yes	No
21	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	<i>Go to Step 22</i>	—
22	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 23</i>	<i>Go to Step 2</i>
23	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0372 DI High Resolution Circuit



30389

Circuit Description

The distributor ignition system supplies two timing inputs to the PCM, a high resolution signal (180 pulses per one crankshaft revolution) and a low resolution signal (4 pulses per one crankshaft revolution). The high resolution and low resolution circuits toggle between 0 and 5 volts as the camshaft turns. The PCM can determine if one of the timing inputs is not being received by comparing the two inputs.

The following malfunctions to the high resolution circuit will cause a DTC P0372 to set:

- An open.
- A short to voltage.
- A short to ground.
- A defective ignition module within the distributor.

Conditions for Setting the DTC

- The PCM detects low resolution pulses but no high resolution pulses.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If DTC P1351 and/or DTC P1361 is also set with a DTC P0372, and no external fault can be found, replace the PCM. If only DTC P0372 is set and the distributor connections are OK, replace the distributor.
- If distributor components must be replaced, check distributor vent system operation.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This verifies if the malfunction is present. The engine may experience a extremely long crank time if the high resolution circuit is open, shorted to B+, or shorted to ground.
3. Using Freeze Frame Data may aid in locating an intermittent condition.
4. Normal voltage may vary slightly from the specified value. A value that is significantly higher or lower indicates a problem. This step isolates the circuit between the PCM and the test connector.
5. Normal voltage may vary slightly from the specified value. A value that is significantly higher or lower indicates a problem. This step isolates the circuit between the test connector and the distributor.

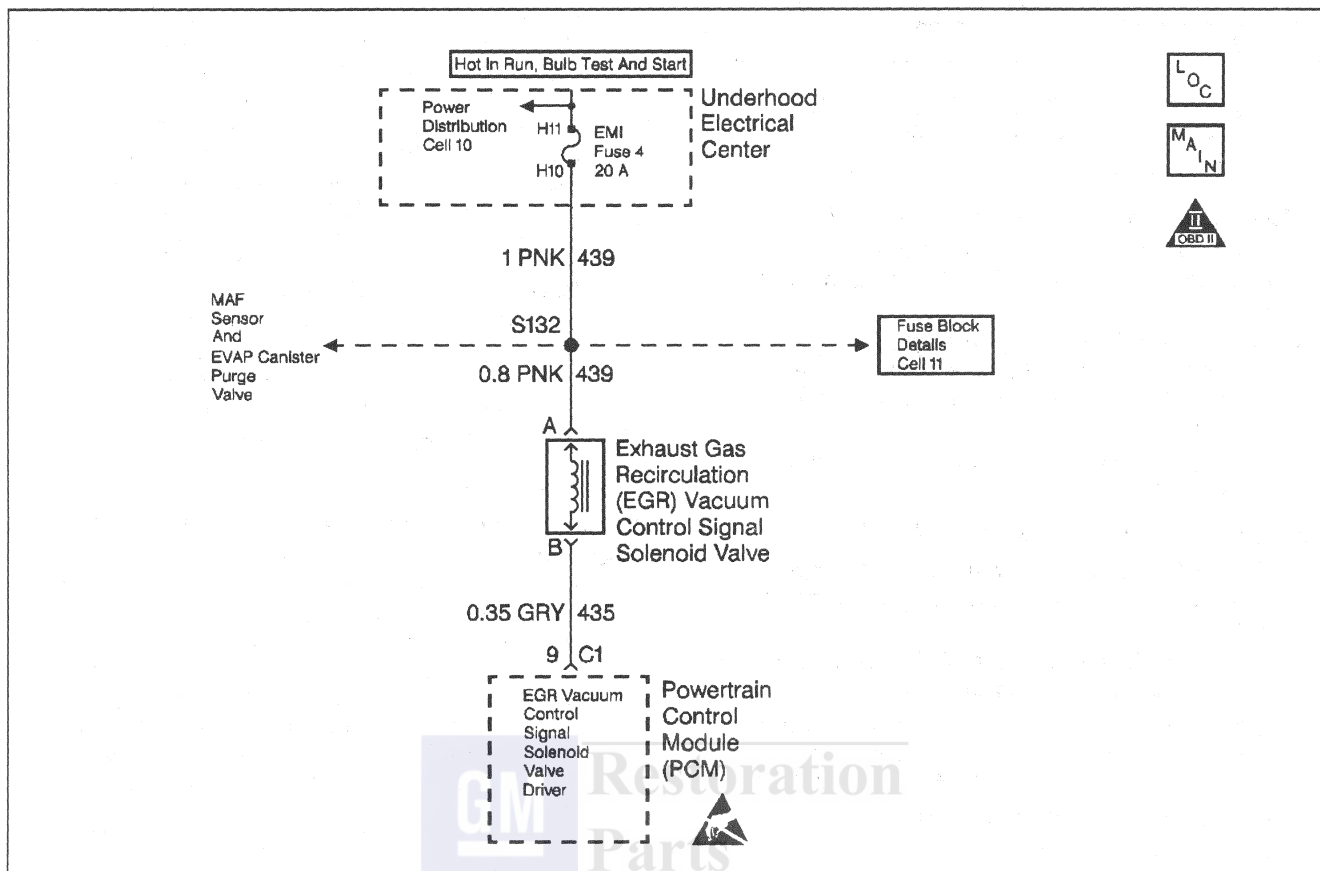
DTC P0372 DI High Resolution Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine and allow it to reach normal operating temperature. 2. Install scan tool 3. Using a scan tool, monitor High Res Signal. Does the scan tool indicate Inactive?	—	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0372 DI High Resolution Circuit
4	1. Turn the ignition OFF. 2. Disconnect ignition system test connector. 3. Turn the ignition ON, use a DVM (J 39200) on DC volts scale, measure voltage on terminal B at the PCM side of the ignition test connector. Does the DVM indicate the voltage specified?	5 V	Go to Step 5	Go to Step 8

DTC P0372 DI High Resolution Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Reconnect ignition system test connector. 3. Disconnect Distributor connector. 4. Turn the ignition ON, use a DVM (J 39200) on DC volts scale, measure voltage on terminal B of Distributor electrical connector. Does the DVM indicate voltage specified?	5 V	Go to Step 11	Go to Step 6
6	Is voltage higher than the specified value?	5 V	Go to Step 7	Go to Step 12
7	Repair the short to voltage on the High Resolution signal circuit from the PCM to the ignition system test connector. Is the action complete?	—	Go to Step 14	—
8	Is voltage higher than the specified value?	5V	Go to Step 10	Go to Step 9
9	Repair the open or grounded High Resolution circuit from the ignition system test connector to the PCM. Was the condition found and repaired?	—	Go to Step 14	Go to Step 13
10	Repair the short to voltage on High resolution signal circuit from ignition system test connector to Distributor. Is the action complete?	—	Go to Step 14	—
11	Repair the faulty Distributor connection or faulty Distributor. Is the action complete?	—	Go to Step 14	—
12	Repair the open or grounded High Resolution circuit from the ignition system test connector to the Distributor. Was the condition found and repaired?	—	Go to Step 14	Go to Step 13
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0400 EGR System



30406

Circuit Description

Vacuum to the Exhaust Gas Recirculation (EGR) valve is controlled by the EGR vacuum control signal solenoid valve. The vacuum signal to the EGR valve is regulated by varying the duty cycle (on-time) of the solenoid valve. The duty cycle is calculated by the PCM based on data from the ECT sensor, the MAF sensor and RPM. The PCM uses engine coolant temperature (ECT) and intake air temperature (IAT) to determine when to enable the EGR system. If the ambient temperature is cool when the vehicle is started, IAT is below 15°C (59°F), the PCM will wait longer before enabling the EGR, the EGR will not be enabled until ECT reaches 82°C (180°F). In warmer ambient temperatures, the PCM will allow the EGR system to operate earlier in the warm up cycle [If IAT is above 15°C (59°F) at start up, EGR will be enabled when ECT reaches 60°C (140°F). EGR operation is prevented under the following additional conditions:

- Transmission is in Park/Neutral
- Throttle Angle is less than a predetermined value
- At wide open throttle (WOT)

The PCM tests the EGR system operation during specific driving conditions.

Conditions for Setting the DTC

Enabling Conditions:

- DTCs P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0601, P0719, P0724 not set.
- Coolant above 27°C (81°F)
- Vehicle speed above 14 mph
- Baro above 95 kPa
- RPM between 500 and 900
- IAC steady
- MAP less than 24 kPa
- A/C clutch, TCC, Brake switch, no transitions

Test Conditions:

Decel Mode Test

- TP Sensor below 1%
- Not in DFCO
- EGR duty cycle = 0%
- The expected change in MAP is less than a predetermined amount when the PCM commands EGR ON during the test.
- MAP within the range shown in the table (depends on altitude) and steady.

Baro (kPa)	Map Range for Test (kPa)	
100	30	60
95	25	55
90	20	50
85	15	45
80	10	40

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Suction from shop exhaust hoses can alter back pressure and may affect the operation of the EGR valve during in-stall testing. This DTC can be set by a leaking exhaust system because an exhaust leak alters back pressure. Thoroughly check the exhaust system for leaks. Refer to *Section 6F, Exhaust System*.
- Vacuum lines should be thoroughly checked for proper routing. The vacuum source goes to the orifice side of the solenoid valve. Refer to the Vehicle Emissions Control Information label.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- A leaking EGR valve pipe assembly will cause an exhaust leak and can reduce EGR flow volume. Refer to *Section 6A, Engine On-Vehicle Service* if this condition is noted.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

10. **Intake Passage:** Turn the engine OFF. Remove the EGR valve from the manifold. Plug the exhaust side hole with a suitable stopper. With the intake side hole open, attempt to start the engine. If the engine runs at a very high idle (up to 3000 RPM is possible), or starts and stalls, the EGR passages are not restricted. If the engine starts and idles normally, the EGR intake side passage in the intake manifold is restricted. Refer to *EGR System* for more information.

Exhaust Passage: With the EGR valve still removed, plug the intake side hole with a suitable stopper. With the exhaust side hole open and the engine running, check for the presence of exhaust gas. If no exhaust gas is present, the EGR exhaust side passage in the intake manifold is restricted. Refer to *EGR System* for more information.

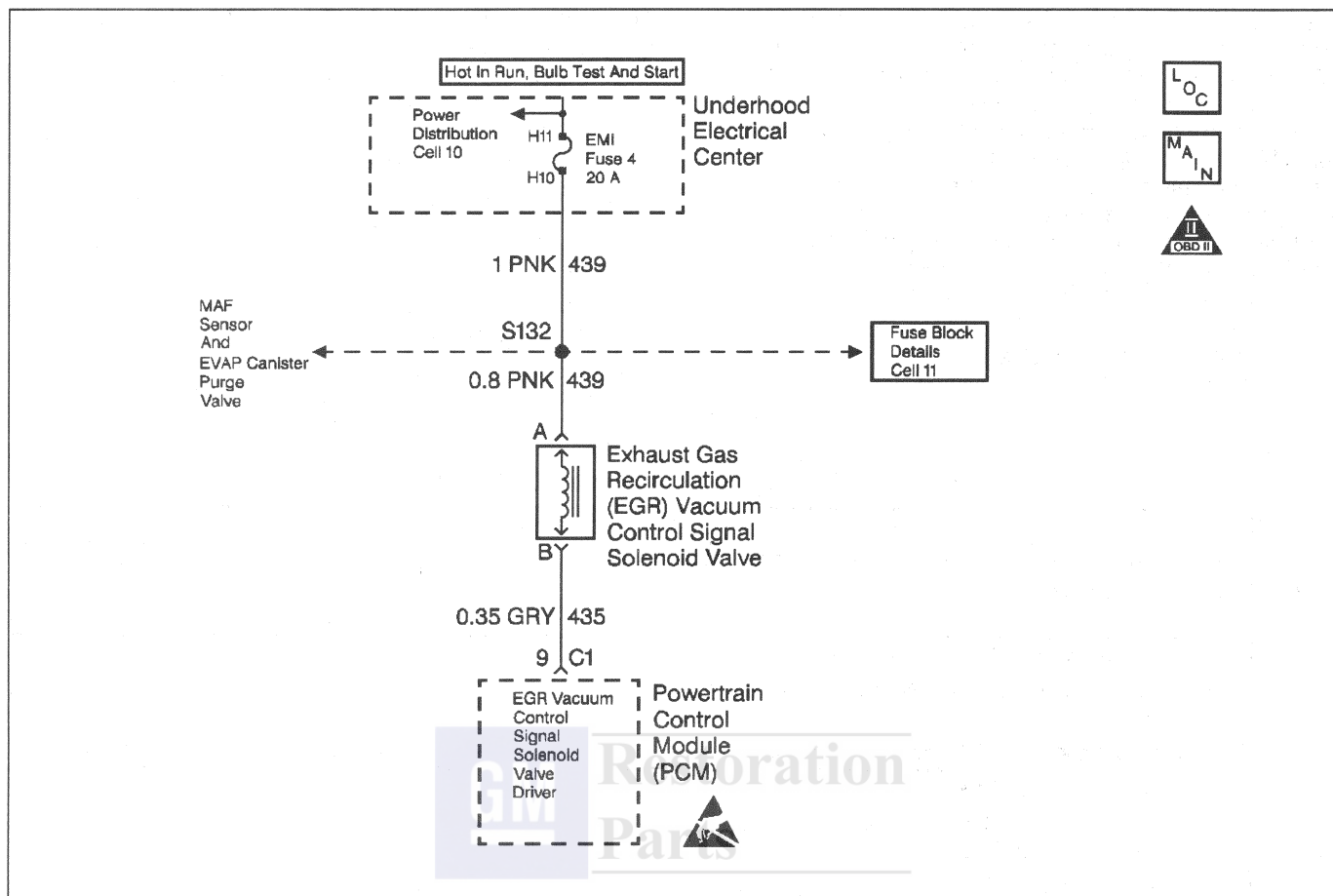
DTC P0400 EGR System

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start and idle the engine until normal operating temperature is reached. 2. Using the scan tool, command the EGR Duty Cycle to 100% and then back to 0%. Does the engine RPM decrease and/or the engine idle roughly with an EGR Duty Cycle of 100% and then Engine RPM/idle quality return to normal when the duty cycle is returned to 0%?	—	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0400 EGR System
4	Manually lift the EGR valve diaphragm. Does the engine RPM decrease and/or the engine idle roughly?	—	Go to Step 5	Go to Step 10
5	1. Disconnect the vacuum harness at the solenoid valve. 2. Connect a vacuum gauge to the manifold side of the harness and check the vacuum supply to the solenoid valve. Is the vacuum greater than the minimum value shown, at 2000 RPM?	25 kPa (7 inch Hg)	Go to Step 6	Go to Step 11
6	1. Turn the engine OFF. 2. Rotate the vacuum harness and connect only the manifold vacuum side to the solenoid valve. 3. Connect a vacuum gauge to the other port on the solenoid valve. 4. Start the engine. 5. Using the scan tool, command the EGR solenoid valve ON and OFF while observing the vacuum gauge. Does the vacuum gauge indicate vacuum when the solenoid is ON and bleed off when the solenoid is OFF?	—	Go to Step 7	Go to Step 13
7	1. Reconnect the vacuum harness to the solenoid valve. 2. Using the scan tool, command the EGR solenoid valve ON and OFF while observing the vacuum gauge. Does the vacuum gauge indicate vacuum when the solenoid is ON and bleed off when the solenoid is OFF?	—	Go to Step 8	Go to Step 12

DTC P0400 EGR System (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Connect a vacuum pump to the EGR valve. 3. Observe the EGR valve diaphragm while applying vacuum. Does the diaphragm move freely and hold vacuum for at least 20 seconds?	—	Go to Step 9	Go to Step 14
9	1. Apply 34 kPa (10 inch Hg) vacuum to the EGR valve. 2. Start the engine and immediately observe the gauge on the vacuum pump. Does the EGR valve diaphragm move to the seated position and vacuum drop from the pump gauge while starting the engine?	—	Go to Step 15	Go to Step 14
10	Repair plugged or restricted EGR passages. Refer to <i>EGR System</i> for more information. Is the action complete?	—	Go to Step 16	—
11	Repair the plugged vacuum port or faulty vacuum line. Is the action complete?	—	Go to Step 16	—
12	Repair the faulty vacuum line to the EGR valve. Is the action complete?	—	Go to Step 16	—
13	Replace the solenoid valve. Is the action complete?	—	Go to Step 16	—
14	Replace the EGR valve. Is the action complete?	—	Go to Step 16	—
15	Check for any of the following conditions which may cause insufficient EGR flow: • Partially clogged EGR passages • Restricted or damaged EGR pipe • Non OEM, modified or faulty exhaust system components Is the action complete?	—	Go to Step 16	—
16	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 17	Go to Step 2
17	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0403 EGR Solenoid Control Circuit



30406

Circuit Description

Ignition voltage is supplied directly to the EGR vacuum control signal solenoid valve. The PCM controls the solenoid by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 25.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the solenoid operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above .75 Amp).
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

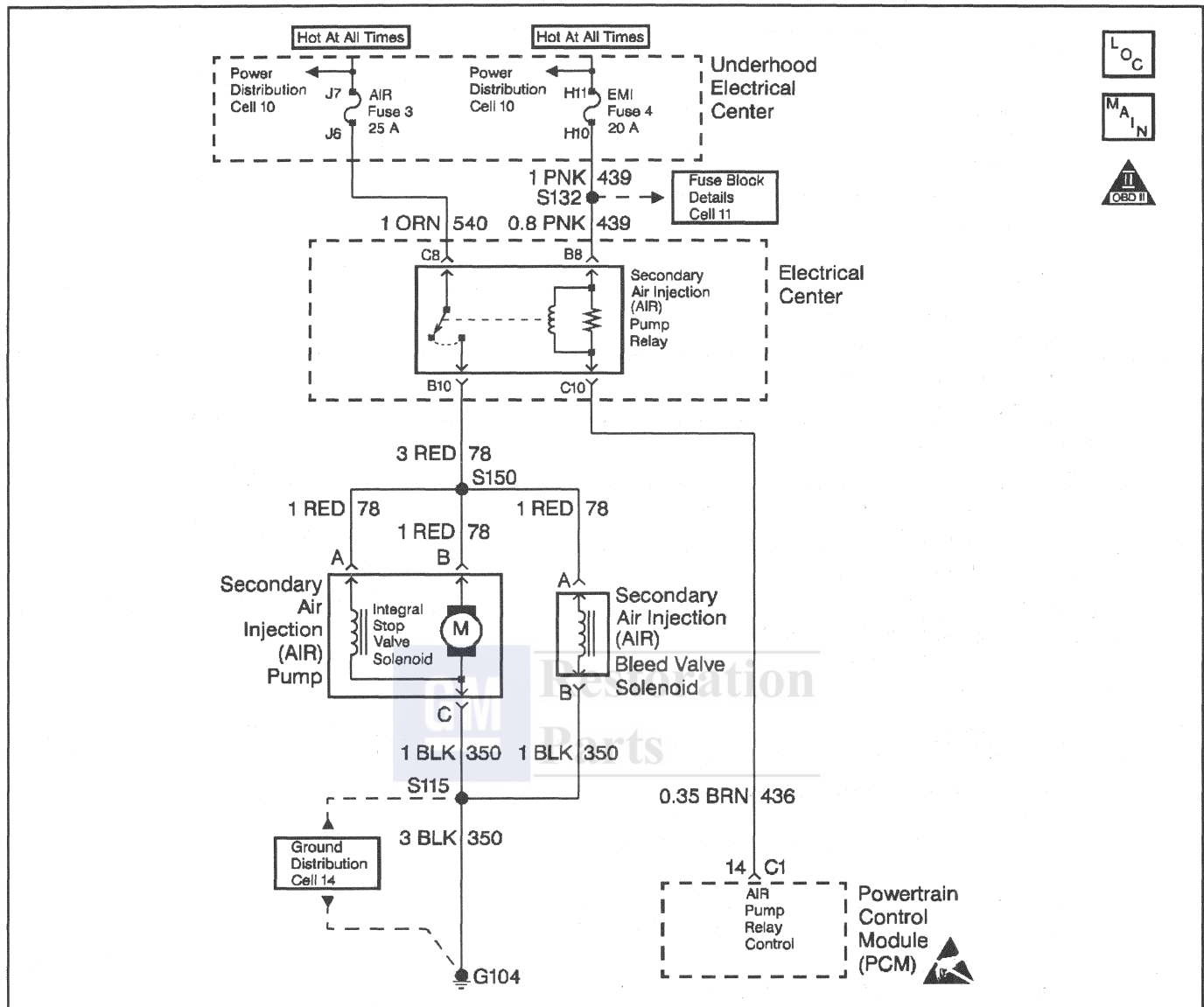
DTC P0403 EGR Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the solenoid ON and OFF. Does the solenoid turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the solenoid control circuit 3. Turn the ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Using DVM J 39200, measure resistance from the solenoid control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10
5	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Connect test light J 34142-B between the terminals in the solenoid harness connector. 4. Turn the ignition ON. 5. Using a Scan tool, command the solenoid ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	1. With the test light connected to ground, probe the ignition feed circuit in the solenoid harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 11

DTC P0403 EGR Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the PCM connector containing the solenoid control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector. Does the solenoid operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the solenoid. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair the faulty solenoid control circuit. Is the action complete?	—	Go to Step 14	—
11	Repair the faulty solenoid ignition feed circuit. Is the action complete?	—	Go to Step 14	—
12	Replace the solenoid Is the action complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0410 AIR System



30415

Circuit Description

An AIR pump is used on this vehicle to lower tail pipe emissions on start-up. The PCM supplies a ground to the AIR pump relay, which energizes the AIR pump.

The PCM will run two tests using the HO2S voltages to diagnose the AIR system. Both tests have two parts.

Test one consists of the following:

Part 1

When the AIR pump is enabled, the PCM monitors the HO2S voltage. If the HO2S voltages go below a threshold, the PCM interprets this as an indication that the AIR system is operational.

Part 2

When the AIR pump is disabled, the PCM monitors the HO2S voltages. The HO2S voltages should increase above a threshold and switch normally.

If the PCM did not sense more than a predetermined amount of HO2S rich switches, a malfunction will be reported. If both of these test indicate a pass, no further action is taken. If one of the above tests failed or is inconclusive, the diagnostic will proceed to test two.

Test two consist of the following:

Part 1

During this test the PCM will activate the AIR pump during closed loop operation. When the AIR is activated, the PCM will monitor the HO2S voltages and short term fuel trim values for both banks of the engine. If the AIR system is operating properly, the HO2S voltages should go low and the short term fuel trim should go high.

Part 2

The PCM checks that the HO2S voltages return to above a rich threshold when the air pump is disabled.

If the PCM determines that the HO2S voltages for *both* banks did not respond as expected during the tests, DTC P0410 will set. If only one sensor responded, the PCM will set either a DTC P1415 or P1416 to indicate on which bank the AIR system is inoperative.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0116, P0117, P0118, P0133, P0135, P0153, P0155, P0171, P0172, P0174, P0175, not set.
- Engine operating about 2 seconds.

Test 1

- TP angle not moving more than 1%.
- Engine load less than 6.6%.
- Engine air flow less than 26 grams per second.
- Air fuel ratio greater than 13:1.
- ECT less than 115°C (239°F).
- HO2S bias voltage between 365 mV and 513 mV.
- HO2S voltage does not go below 400 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go below 417 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)
- HO2S voltage does not go above 722 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go above 700 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)

Test 2

- Engine operating longer than 200 seconds.
- Engine speed greater than 600 RPM.
- Maximum air flow 17 gm/s.
- Engine coolant temperature between 60°C (140°F) and 115°C (239°F).
- IAT greater than 10°C (50°C).
- Ignition voltage greater than 11.0 volts.
- Engine load less than 5.5%.
- HO2S voltage does not go below 222 mV within 1.5 seconds.
- Short term fuel trim does not go above a predetermined amount.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If the #3 underhood fuse is open, inspect AIR system for water intrusion. Inspect the AIR pump for water. Check the AIR check valves for proper operation. Refer to *Air Check Valve and Pipes* or *Air Check Valve and Pipes* for procedure.
- The AIR vacuum bleed system contains a one way check valve. If the system checks out OK, make sure this valve is not stuck closed, restricted or blocked. The check valve is in-line in the hose that goes to the vacuum bleed valve.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
6. This checks whether B+ supply is available at the integral stop valve at the AIR pump.

9. This step begins a test of the vacuum bleed portion of the system. Normal engine operation can cause vacuum to build up within the AIR pipes and hoses. If there is vacuum present in the system when the PCM commands the AIR pump ON, the integral stop valve within the AIR pump may not be able to overcome this vacuum and no air will enter the system. The AIR vacuum bleed solenoid valve is designed to open whenever the AIR pump is commanded ON, to eliminate this problem.

DTC P0410 AIR System

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the engine OFF, Ignition ON. 3. Using a scan tool, enable the AIR pump. Does the AIR pump turn ON?	—	Go to Step 6	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect AIR pump relay. 3. Turn the ignition ON, engine OFF. 4. Using a test light (J 34142-B) to ground, probe B+ (switch side of relay) supply circuit to relay. Does the test light illuminate?	—	Go to Step 4	Go to Step 14
4	1. Turn the ignition OFF. 2. Reconnect AIR pump relay. 3. Disconnect electrical connector from AIR pump. 4. Using a test light (J 34142-B), probe terminal A of AIR pump electrical connector to battery ground. 5. Turn the ignition ON, engine OFF. 6. Using a scan tool, enable the AIR pump. Does the test light illuminate?	—	Go to Step 5	Go to Step 22
5	1. Using a test light (J 34142-B), probe terminal A of the AIR pump electrical connector to terminal C of the AIR pump electrical connector. 2. Using a scan tool, enable the AIR pump. Does the test light illuminate?	—	Go to Step 31	Go to Step 23
6	1. Turn the ignition OFF. 2. Disconnect the AIR pump electrical connector. 3. Using a test light (J 34142-B), probe terminal B of the AIR pump electrical connector to battery ground. 4. Turn the ignition ON, engine OFF. 5. Using a scan tool, enable the AIR pump. Does the test light illuminate?	—	Go to Step 7	Go to Step 24

DTC P0410 AIR System (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Reconnect the AIR pump electrical connector. 3. Disconnect the AIR pump outlet hose. 4. Turn the ignition ON. 5. Using a scan tool, enable the AIR pump. Is air present at the AIR pump outlet?	—	Go to Step 8	Go to Step 31
8	Check for a restriction or blockage in AIR hoses/pipes between the AIR pump and the point where the system branches to both sides of the engine. Was a problem found and corrected?	—	Go to Step 35	Go to Step 9
9	1. Remove the vacuum bleed valve line from the tee in the AIR pump outlet hose. 2. Connect this vacuum line to a hand held vacuum pump and apply approximately 5 inch Hg vacuum. Does the vacuum hold?	—	Go to Step 10	Go to Step 13
10	Using a scan tool, enable the AIR pump. Does the vacuum bleed off?	—	Go to Diagnostic Aids- AIR System	Go to Step 11
11	1. Turn the ignition OFF. 2. Disconnect the vacuum bleed valve electrical connector. 3. Connect a test light across the terminals in the vacuum bleed valve harness connector. 4. Turn the ignition ON, engine OFF. 5. Using a scan tool, command the AIR pump ON and OFF. Does the test light illuminate?	—	Go to Step 33	Go to Step 12
12	1. With the test light connected to ground, probe the power feed circuit in the vacuum bleed valve harness connector. 2. Using a scan tool, command the AIR pump ON and OFF. Does the test light illuminate?	—	Go to Step 26	Go to Step 25
13	Check the vacuum hose to the valve for cracks, splits or other damage. Was a problem found and corrected?	—	Go to Step 35	Go to Step 33
14	Repair the B+ supply circuit to relay. Is the action complete?	—	Go to Step 35	—
15	Check the fuse for the battery feed circuit to the relay. Is the fuse OK?	—	Go to Step 16	Go to Step 17
16	Using a test light to ground, check for power at the fuse. Is there power to the fuse?	—	Go to Step 27	Go to Step 28
17	Using a test light to B+, probe the relay battery feed circuit in the relay connector. Is the test light OFF?	—	Go to Step 18	Go to Step 29

DTC P0410 AIR System (cont'd)

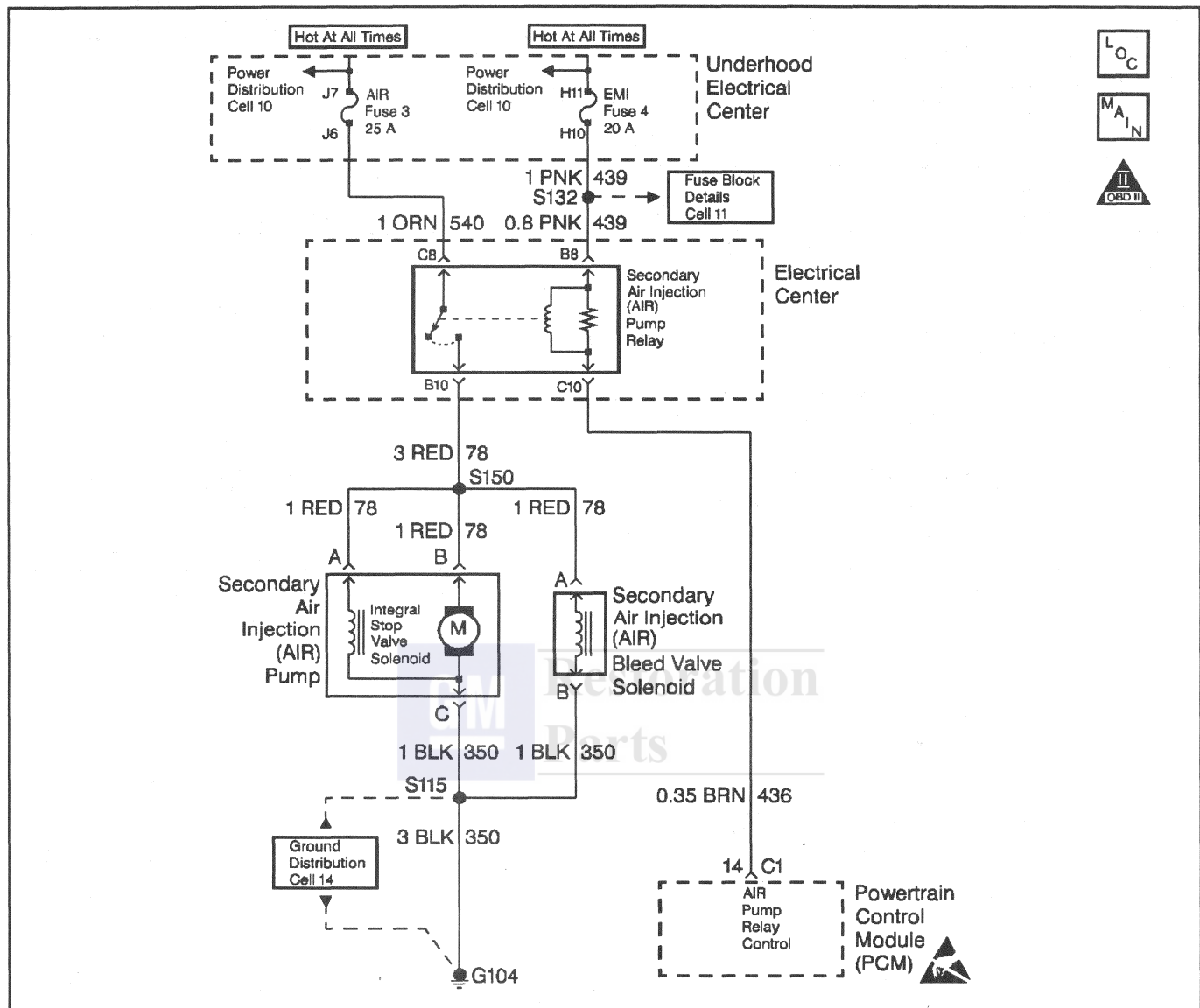
Step	Action	Value(s)	Yes	No
18	1. Install a new fuse. 2. Disconnect the AIR pump electrical connector and the vacuum bleed solenoid valve electrical connector. 3. Using a test light to B+, probe the power feed circuit in the vacuum bleed solenoid valve harness connector. Is the test light OFF?	—	Go to Step 19	Go to Step 30
19	1. Using a test light connected to ground probe the power feed circuit in the vacuum bleed solenoid valve harness connector. 2. Using a scan tool, enable the AIR pump. Does the test light illuminate?	—	Go to Step 20	Go to Step 32
20	1. Reconnect the AIR pump. 2. Using a scan tool, enable the AIR pump. Did the fuse open?	—	Go to Step 34	Go to Step 21
21	1. Reconnect the vacuum bleed solenoid valve. 2. Using a scan tool, enable the AIR pump. Did the fuse open?	—	Go to Step 33	Go to Symptoms
22	Repair the open circuit between the AIR pump and the AIR pump relay. Is the action complete?	—	Go to Step 35	—
23	Repair the faulty ground connection or open AIR pump ground circuit. Is the action complete?	—	Go to Step 35	—
24	Repair the open circuit from terminal B of the AIR pump to the splice. Is the action complete?	—	Go to Step 35	—
25	Repair the open vacuum bleed solenoid valve power circuit between the solenoid electrical connector and the splice. Is the action complete?	—	Go to Step 35	—
26	Repair the open vacuum bleed solenoid valve ground circuit. Is the action complete?	—	Go to Step 35	—
27	Repair the open circuit between the fuse and the relay. Is the action complete?	—	Go to Step 35	—
28	Repair the power feed circuit to the fuse. Is the action complete?	—	Go to Step 35	—
29	Repair the short to ground between the fuse and the relay. Is the action complete?	—	Go to Step 35	—
30	Repair the short to ground between the relay and the AIR pump/vacuum bleed solenoid valve. Is the action complete?	—	Go to Step 35	—
31	Check the AIR pump electrical connections. Was a problem found and corrected?	—	Go to Step 35	Go to Step 34

DTC P0410 AIR System (cont'd)

Step	Action	Value(s)	Yes	No
32	Replace the AIR pump relay. Is the action complete?	—	Go to Step 35	—
33	Replace the vacuum bleed solenoid valve. Is the action complete?	—	Go to Step 35	—
34	Replace the AIR pump. Is the action complete?	—	Go to Step 35	—
35	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 36	Go to Step 2
36	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0412 AIR Relay Control Circuit



30415

Circuit Description

Ignition voltage is supplied directly to the AIR injection pump relay coil. The PCM controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The relay is used to control the high current flow to the AIR injection pump. This allows the PCM driver to only have to handle the relatively low current used by the relay.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the

Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the relay operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above 0.75 Amp).
5. It is important to identify and test the relay coil terminals to avoid improper diagnosis.
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P0412 AIR Relay Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a scan tool, command the relay ON and OFF. Does the relay turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the relay control circuit. 3. Ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the relay control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Using DVM J 39200, measure resistance from the relay control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10

DTC P0412 AIR Relay Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Connect test light J 34142-B between the relay coil terminals in the relay harness connector. 4. Turn the ignition ON. 5. Using a scan tool, command the relay ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	With the test light connected to ground, probe the ignition feed circuit in the relay harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 11
7	1. Turn the ignition OFF. 2. Reconnect the relay. 3. Disconnect the PCM connector containing the relay control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the relay control circuit in the PCM harness connector. Does the relay operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the relay. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair the faulty relay control circuit. Is the action complete?	—	Go to Step 14	—
11	Repair the faulty relay ignition feed circuit. Is the action complete?	—	Go to Step 14	—
12	Replace the relay. Is the action complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0420 TWC System Low Efficiency Bank1

Circuit Description

In order to maintain a reasonably low emissions of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), a three-way catalytic converter is used. The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas. This reaction converts them into harmless water vapor and carbon monoxide. The catalyst also reduces NOx, converting it to nitrogen. The PCM has the capability to monitor this process using Bank 1 HO2S #2. Bank 1 HO2S #2, located in the exhaust stream past the three-way catalytic converter, produces an output signal which indicates the oxygen storage capacity of the catalyst. This determines the catalysts ability to convert exhaust emissions effectively. If the catalyst is functioning correctly, the Bank 1 HO2S #2 signal will be far less active than that produced by Bank 1 HO2S #1. If a problem exists which causes the PCM to detect excessive Bank 1 HO2S #2 activity outside of an acceptable range for an extended period of time, the PCM will set DTC P0420. This indicates that the three-way catalytic converters oxygen storage capacity is below a threshold considered acceptable.

Conditions for Setting the DTC

- No MAF, MAP, ECT, Left Bank HO2S, Misfire, Left Bank Fuel Trim, Injector, VSS, IAC, Engine coolant fan(s), Transmission DTCs set.
- Engine operating.
- Engine coolant temperature greater than 51°C (124°F).
- Vehicle speed is between 32 km/h (20 mph) and 121 km/h (75 mph).
- Throttle angle greater than 2%.
- Engine speed less than 3500 RPM.

- MAP between 25 kPa and 80 kPa.
- Air flow is between 15 gm/s and 100 gm/s.
- Closed loop fuel control enabled.
- The PCM determines oxygen storage capability of the catalytic converter has degraded below a calibrated threshold.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

4. Before replacing the Three Way Catalytic Converter, make sure that any conditions which may have caused the catalyst to be damaged have been corrected.

DTC P0420 TWC System Low Efficiency Bank1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Are any other DTCs set?	—	Go to the applicable DTC table	Go to Step 3
3	Check for the following conditions: • Verify that the three-way catalytic converter is an original equipment part. • Inspect the three-way catalytic converter for damage (dents, severe discoloration caused by excessive temperature, holes, etc.). • Insure that internal three-way catalytic converter rattle caused by damaged catalyst is not present. • Inspect exhaust system for leaks, damage, or loose or missing hardware (area from converter to HO2S #2 primarily). • Insure that the HO2S #1 and the HO2S #2 are secure and that their pigtails and wiring are not damaged or contacting the exhaust. Was a problem found and corrected?	—	Go to Step 5	Go to Step 4
4	Replace converter. Is the action complete?	—	Go to Step 5	—
5	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 6	Go to Step 2
6	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0430 TWC System Low Efficiency Bank2

Circuit Description

In order to maintain a reasonably low emissions of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), a three-way catalytic converter is used. The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas. This reaction converts them into harmless water vapor and carbon monoxide. The catalyst also reduces NOx, converting it to nitrogen. The PCM has the capability to monitor this process using Bank 2 HO2S #2. Bank 2 HO2S #2, located in the exhaust stream past the three-way catalytic converter, produces an output signal which indicates the oxygen storage capacity of the catalyst. This determines the catalysts ability to convert exhaust emissions effectively. If the catalyst is functioning correctly, the Bank 2 HO2S #2 signal will be far less active than that produced by Bank 2 HO2S #1. If a problem exists which causes the PCM to detect excessive Bank 2 HO2S #2 activity outside of an acceptable range for an extended period of time, the PCM will set DTC P0430. This indicates that the three-way catalytic converters oxygen storage capacity is below a threshold considered acceptable.

Conditions for Setting the DTC

- No MAF, MAP, ECT, Left Bank HO2S, Misfire, Left Bank Fuel Trim, Injector, VSS, IAC, Engine coolant fan(s), Transmission DTCs set.
- Engine operating.
- Engine coolant temperature greater than 51 °C (124 °F).
- Vehicle speed is between 32 km/h (20 mph) and 121 km/h (75 mph).
- Throttle angle greater than 2%.
- Engine speed less than 3500 RPM.

- MAP between 25 kPa and 80 kPa.
- Air flow is between 15 gm/s and 100 gm/s.
- Closed loop fuel control enabled.
- The PCM determines oxygen storage capability of the catalytic converter has degraded below a calibrated threshold.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Test Description

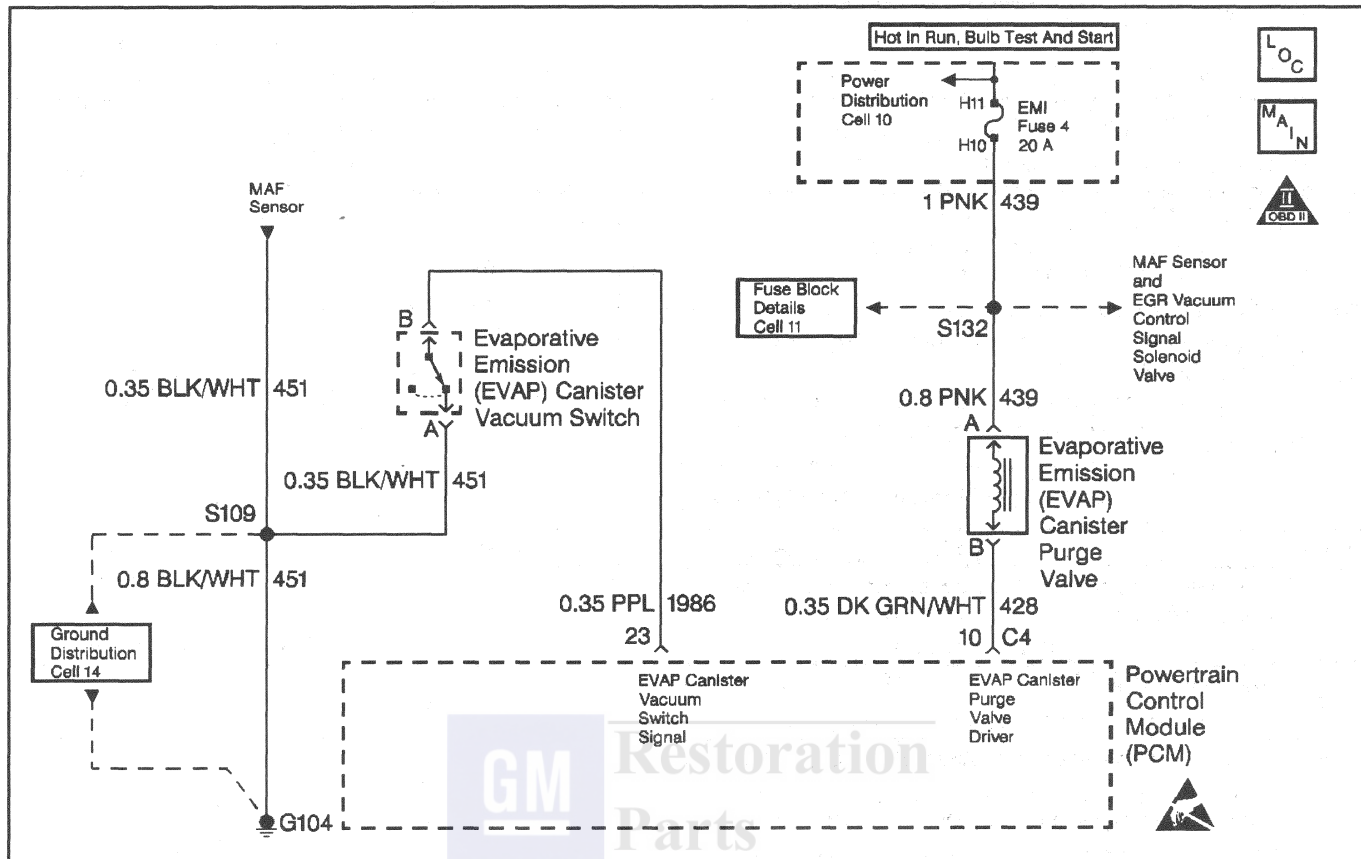
Number(s) below refer to step numbers on the diagnostic table.

4. Before replacing the Three Way Catalytic Converter, make sure that any conditions which may have caused the catalyst to be damaged have been corrected.

DTC P0430 TWC System Low Efficiency Bank2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	<i>Go to Step 2</i>	<i>Go to Powertrain OBD System Check</i>
2	Are any other DTCs set?	—	<i>Go to the applicable DTC table</i>	<i>Go to Step 3</i>
3	Check for the following conditions: • Verify that the three-way catalytic converter is an original equipment part. • Inspect the three-way catalytic converter for damage (dents, severe discoloration caused by excessive temperature, holes, etc.). • Insure that internal three-way catalytic converter rattle caused by damaged catalyst is not present. • Inspect exhaust system for leaks, damage, or loose or missing hardware (area from converter to HO2S #2 primarily). • Insure that the HO2S #1 and the HO2S #2 are secure and that their pigtailed and wiring are not damaged or contacting the exhaust. Was a problem found and corrected?	—	<i>Go to Step 5</i>	<i>Go to Step 4</i>
4	Replace converter. Is the action complete?	—	<i>Go to Step 5</i>	—
5	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 6</i>	<i>Go to Step 2</i>
6	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	<i>Go to the applicable DTC table</i>	System OK

DTC P0441 EVAP System No Flow During Purge



30414

Circuit Description

The EVAP vacuum switch is a normally closed switch connected to ground, mounted in the vacuum line between the EVAP canister and the EVAP solenoid. 12 volts is supplied to the switch through a pull-up resistor in the PCM. When the PCM commands the EVAP canister purge solenoid valve open (purge ON) and engine vacuum draws the evaporative emissions from the canister, the EVAP vacuum switch opens (signal voltage high) providing feedback to the PCM that the EVAP system is operating. When the PCM commands purge OFF, the EVAP vacuum switch closes (signal voltage low) confirming purging has ceased.

Conditions for Setting the DTC

- DTCs P0100, P0101, P0102, P0103, P0106, P0323, P0325, P0327, P0332, P0335, P0336, P0372, P0400, P0403, P0410, P0412, P0420, P0430, P0441, P0443, P0500, P0502, P0503, P0506, P0507, P0530, P0531, P0719, P0758, P1415, P1642, P1652 not set.
- ECT less than 115°C (239°F)
- IAT greater than 3°C (37°F)

- Engine speed between 800 and 3000 RPM
- TP Angle between 2% and 50%
- MAP between 33 and 77 kPa
- BARO greater than 77 kPa
- Purge duty cycle above 60%
- The PCM detects low signal voltage on the EVAP vacuum switch signal circuit when the PCM is commanding purge ON.
- Fault present for 5 seconds

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Before replacing any components, visually/physically check for the following:

- Mis-routed harness.
- Rubbed through wire insulation.

- Broken wire inside the insulation.
- Kinked or damaged vacuum hoses.
- Physically damaged system components.
- Inspect components and vacuum lines for traces of carbon or other contaminants. The presence of foreign material may be causing a restriction in the system or preventing the solenoid valve from closing properly. Either condition may cause a DTC to set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. DTC P0443 indicates that the purge control solenoid may not be operating correctly. This condition must be corrected first.

DTC P0441 EVAP System No Flow During Purge

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If DTC P0443 is set, refer to that DTC first. 1. Turn the ignition ON, engine OFF. 2. Using the scan tool, check the EVAP vacuum switch status. Does the scan tool indicate the EVAP vacuum switch has No Purge?	—	Go to Step 3	Go to Step 5
3	1. Start the engine. 2. Using the scan tool, command the EVAP canister purge solenoid valve ON while observing the EVAP vacuum switch status. Does the scan tool indicate Purge when the solenoid is commanded ON?	—	Go to Diagnostic Aids- EVAP System	Go to Step 4
4	1. Turn the engine OFF. 2. Disconnect the purge hose from the EVAP vacuum switch (the vacuum line from the canister). 3. Connect a vacuum gauge to the canister side of the EVAP switch. 4. Start the engine. 5. Using the scan tool, command the EVAP canister purge solenoid valve ON while observing the vacuum gauge. Does the vacuum gauge indicate close to normal engine vacuum when the solenoid is commanded ON?	—	Go to Step 5	Go to Step 7
5	Disconnect the EVAP vacuum switch harness connector. Does the scan tool indicate Purge?	—	Go to Step 9	Go to Step 6

DTC P0441 EVAP System No Flow During Purge (cont'd)

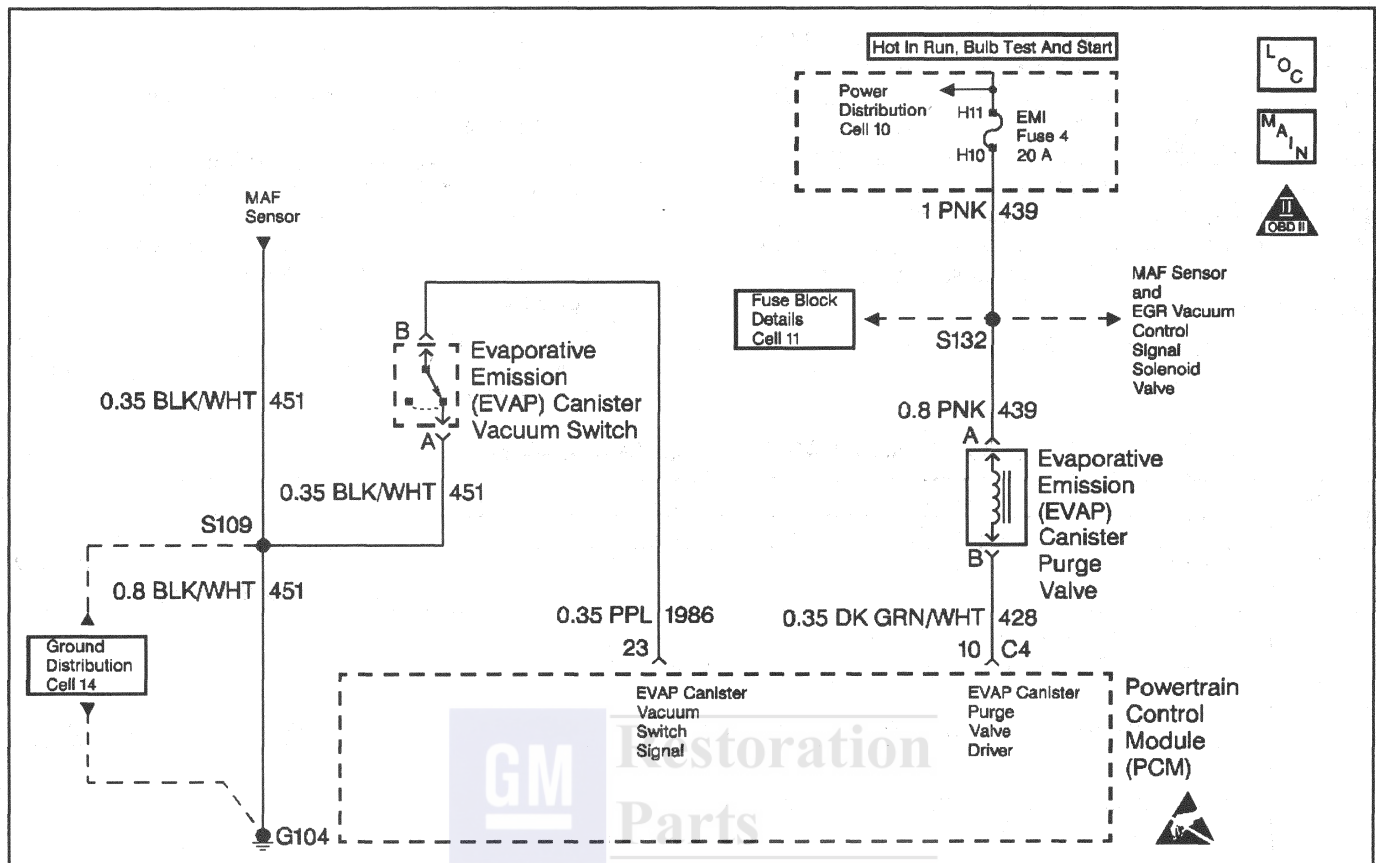
Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Using DVM J 39200, check for continuity between the EVAP vacuum switch signal circuit and ground. Does the DVM indicate infinite resistance?	—	Go to Step 10	Go to Step 12
7	Disconnect the vacuum harness from the EVAP canister purge solenoid valve and connect a vacuum gauge to the manifold side of the vacuum harness. Is normal manifold vacuum indicated?	—	Go to Step 8	Go to Step 13
8	1. Rotate the vacuum harness connector enough to reconnect only the manifold vacuum supply hose to the solenoid valve. 2. Connect the vacuum gauge to the other port on the solenoid valve. 3. Using the scan tool, command the EVAP canister purge solenoid valve ON while observing the vacuum gauge. Is vacuum indicated when the EVAP canister purge solenoid valve is ON?	—	Go to Step 14	Go to Step 15
9	Replace EVAP vacuum switch. Refer to <i>EVAP Purge Vacuum Switch</i> . Refer to <i>EVAP System Cleaning</i> for cleaning procedure of EVAP system before replacing the EVAP vacuum switch. Is the action complete?	—	Go to Step 16	—
10	Check connections at the PCM. Was a problem found and corrected?	—	Go to Step 16	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 16	—
12	Repair signal circuit shorted to ground. Is the action complete?	—	Go to Step 16	—
13	Check for the following conditions: - Blocked or restricted manifold vacuum port. - Restricted, kinked or leaking hose between the EVAP solenoid and the intake manifold, Refer to <i>EVAP System Cleaning</i> for cleaning procedure of EVAP system. Was a problem found and corrected?	—	Go to Step 16	Go to Step 14
14	Repair restricted, kinked or leaking hose between the EVAP solenoid and the EVAP vacuum switch, Refer to <i>EVAP System Cleaning</i> for cleaning procedure of EVAP system. Is the action complete?	—	Go to Step 16	—

DTC P0441 EVAP System No Flow During Purge (cont'd)

Step	Action	Value(s)	Yes	No
15	Replace the EVAP solenoid. Refer to <i>EVAP Canister Purge Solenoid Valve</i> . Refer to <i>EVAP System Cleaning</i> for cleaning procedure of EVAP system before replacing the EVAP solenoid. Is the action complete?	—	Go to Step 16	—
16	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 17	Go to Step 2
17	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0443 EVAP Purge Solenoid Control Circuit



Circuit Description

Ignition voltage is supplied directly to the EVAP canister purge solenoid valve. The PCM controls the solenoid by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 25.5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the solenoid operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above .75 Amp).
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

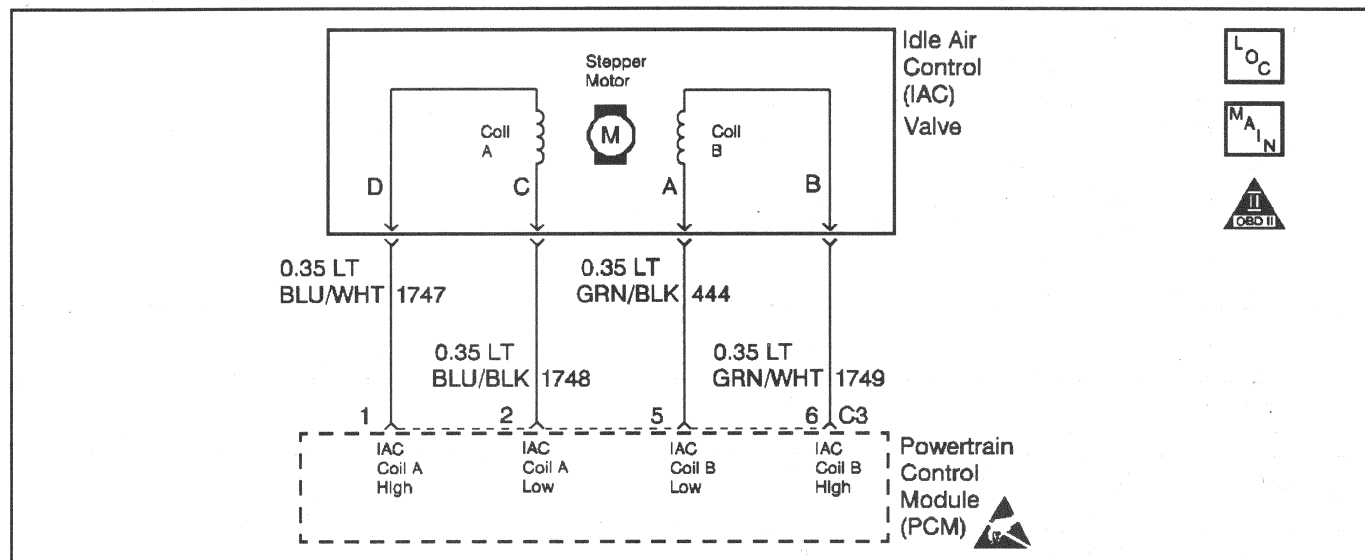
DTC P0443 EVAP Purge Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the solenoid ON and OFF. Does the solenoid turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the solenoid control circuit 3. Ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Using DVM J 39200, measure resistance from the solenoid control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10
5	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Connect test light J 34142-B between the terminals in the solenoid harness connector. 4. Turn the ignition ON. 5. Using a Scan tool, command the solenoid ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	With the test light connected to ground, probe the ignition feed circuit in the solenoid harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 11

DTC P0443 EVAP Purge Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the PCM connector containing the solenoid control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector. Does the solenoid operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the solenoid. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair the faulty solenoid control circuit. Is the action complete?	—	Go to Step 14	—
11	Repair the faulty solenoid ignition feed circuit. Is the action complete?	—	Go to Step 14	—
12	Replace the solenoid Is the action complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0506 Idle System Low - IAC Responding



30418

Circuit Description

The Idle Air Control valve is a PCM controlled stepper motor located on the throttle body. The stepper motor drives a valve pintle which protrudes into a passage that bypasses the throttle plates. To decrease idle speed, the PCM commands the IAC valve pintle to extend. As the pintle approaches its seat, bypass air flow is reduced and idle speed decreases. To increase idle speed, the PCM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle plates. One of the PCMs uses for the IAC system is to maintain a desired idle speed, which can vary depending on input to the PCM and other criteria. If the PCM detects engine speed is outside the IAC systems range of control at idle, it will perform an active test while the vehicle is being driven. During this test the PCM commands the IAC valve to move while monitoring MAF. If the expected change in MAF is detected, IAC valve operation is verified. Since idle RPM was out of IAC System control and the IAC valve is operational, DTC P0506 is set. If no change in MAF were to occur, it would be determined that the IAC valve is not functional. If idle RPM was out of IAC System control and the IAC valve did not operate, DTC P1508 would be set.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0122, P0123, P0174, P0175, P0300, P0325 not set.
- Engine running for at least 25 seconds.
- Coolant temperature greater than 60°C (140°F)
- IAT greater than -10°C (14°F)

- Baro greater than 77 kPa
- System voltage between 10 and 17 volts
- Vehicle speed less than 1 mph
- Throttle Angle 0%
- Idle speed below desired RPM
- Conditions met for 1 sec

Then

- Vehicle speed is between 20 and 77 mph.
- MAF between 13 and 35 gm/s
- TPS steady
- RPM steady
- Conditions met for 5 seconds

The active test will then be performed.

- If a 6 gm/s change in MAF is detected, DTC P0506 will be set.
- If a 6 gm/s change in MAF is not detected, DTC P1508 will be set.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included

in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

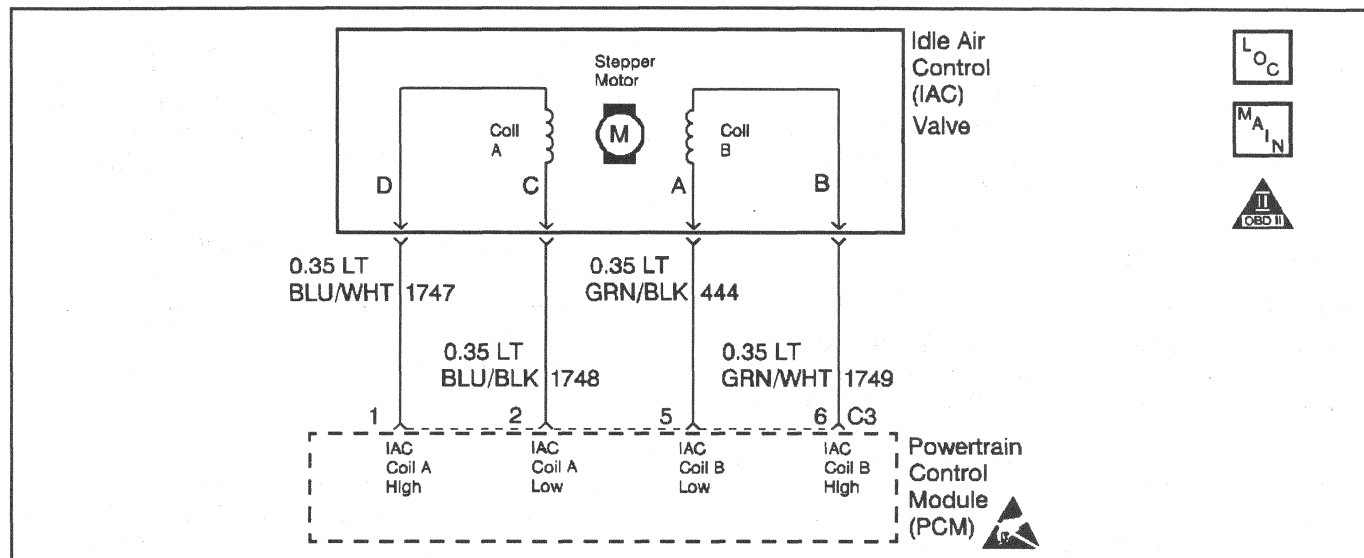
Number(s) below refer to step numbers on the diagnostic table.

- Determines whether or not the engine can achieve the commanded RPM, and if not, whether the RPM is too high or too low.

DTC P0506 Idle System Low - IAC Responding

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine. 2. Using a scan tool, command RPM up to 1500, down to 500 up to 1500 and then EXIT. Does the engine speed correspond (within 50 RPM) with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	Is the engine RPM too high (greater than 50 RPM above Desired RPM)?	—	Go to Step 4	Go to Step 5
4	Check for the following conditions: • Vacuum leaks. • Throttle plates not closing properly. • Faulty PCV valve. Is the action complete?	—	Go to Step 6	—
5	Check for the following conditions: • Excessive deposits in throttle body. • Parasitic load on engine (ie: transmission problem etc.). Is the action complete?	—	Go to Step 6	—
6	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 7	Go to Step 2
7	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0507 Idle System High - IAC Responding



30418

Circuit Description

The Idle Air Control valve is a PCM controlled stepper motor located on the throttle body. The stepper motor drives a valve pintle which protrudes into a passage that bypasses the throttle plates. To decrease idle speed, the PCM commands the IAC valve pintle to extend. As the pintle approaches its seat, bypass air flow is reduced and idle speed decreases. To increase idle speed, the PCM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle plates. One of the PCMs uses for the IAC system is to maintain a desired idle speed, which can vary depending on input to the PCM and other criteria. If the PCM detects engine speed is outside the IAC systems range of control at idle, it will perform an active test while the vehicle is being driven. During this test the PCM commands the IAC valve to move while monitoring MAF. If the expected change in MAF is detected, IAC valve operation is verified. Since idle RPM was out of IAC System control and the IAC valve is operational, DTC P0507 is set. If no change in MAF were to occur, it would be determined that the IAC valve is not functional. If idle RPM was out of IAC System control and the IAC valve did not operate, DTC P1509 would be set.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0122, P0123, P0174, P0175, P0300, P0325 not set.
- Engine running for at least 25 seconds.
- Coolant temperature greater than 60°C (140°F)
- IAT greater than -10°C (14°F)

- Baro greater than 77 kPa
- System voltage between 10 and 17 volts
- Vehicle speed less than 1 mph
- Throttle Angle 0%
- Idle speed below desired RPM
- Conditions met for 1 sec

Then

- Vehicle speed is between 20 and 77 mph.
- MAF between 13 and 35 gm/s
- TP Sensor steady
- RPM steady
- Conditions met for 5 seconds

The active test will then be performed.

- If a 6 gm/s change in MAF is detected, DTC P0507 will be set.
- If a 6 gm/s change in MAF is not detected, DTC P1509 will be set.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data

can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether or not the engine can achieve the commanded RPM, and if not, whether the RPM is too high or too low.

DTC P0507 Idle System High - IAC Responding

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine. 2. Using a scan tool, command RPM up to 1500, down to 500 up to 1500 and then EXIT. Does the engine speed correspond (within 50 RPM) with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	Is Engine RPM too high (greater than 50 RPM above Desired RPM)?	—	Go to Step 4	Go to Step 5
4	Check for the following conditions: • Vacuum leaks. • Throttle plates not closing properly. • Faulty PCV valve. Is the action complete?	—	Go to Step 6	—
5	Check for the following conditions: • Excessive deposits in throttle body. • Parasitic load on engine (ie: transmission problem etc.). Is the action complete?	—	Go to Step 6	—
6	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 7	Go to Step 2
7	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0530 A/C Refrigerant Pressure Sensor Circuit

Circuit Description

The A/C system uses an A/C refrigerant pressure sensor mounted in the high side of the A/C system to monitor A/C refrigerant pressure. The PCM utilizes this information to turn ON the engine coolant fans when the A/C refrigerant pressure is high.

The A/C refrigerant pressure sensor operates much like other 3-wire sensors. A 5.0 volt reference is supplied to the sensor and returned to the PCM on the signal circuit. As A/C pressure increases or decreases, the resistance of the sensor changes and varies the amount of signal returning to the PCM.

The PCM monitors the A/C refrigerant pressure sensor signal circuit and can determine when A/C pressure is too high or too low. When pressures are out of range (high or low) for a predetermined time, the PCM will disable the A/C compressor clutch and set a DTC P0530. When a DTC P0530 is set, the PCM will disable the A/C compressor clutch so compressor damage does not occur.

Conditions for Setting the DTC

- A/C refrigerant pressure sensor indicates A/C refrigerant pressure is below -8.0 psi for 5.0 seconds.
- A/C refrigerant pressure sensor indicates A/C refrigerant pressure is above 448 psi for 5.0 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

If the test did not fail this ignition cycle, move related electrical harnesses and connectors while monitoring a scan tool.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Normal A/C voltage is between 1 and 1.8 volts. If A/C voltage is within range, review freeze frame data to determine when DTC P0530 set.
4. If A/C pressure/voltage stays high after disconnecting the A/C refrigerant pressure sensor electrical connector, indicates the signal circuit is shorted to a voltage.
6. Checks for a good ground circuit.
7. Checks the integrity of A/C refrigerant pressure sensor signal circuit.
10. If the 5 volt reference circuit has been checked thoroughly (for opens, shorts too ground, PCM connections etc.) and checks OK, then replace the PCM.
11. If the ground circuit has been checked thoroughly for opens and PCM connections are OK, then replace the PCM.

Important: Be sure to inspect PCM engine grounds for being secure and clean.

DTC P0530 A/C Refrigerant Pressure Sensor Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a scan tool, monitor A/C High Side. Does the scan tool indicate A/C High Side between the specified values?	0.1 V to 1.8 V	Go to Step 3	Go to Step 4
3	1. Turn the ignition ON, engine OFF, review freeze frame data and note parameters. 2. Operate the vehicle within freeze frame conditions as noted. Did the test fail this ignition cycle while operating the vehicle in the conditions that were noted?	—	Go to Step 4	Go to Diagnostic Aids-DTC P0530 A/C Refrigerant Pressure Sensor Circuit

DTC P0530 A/C Refrigerant Pressure Sensor Circuit (cont'd)

Step	Action	Value(s)	Yes	No
4	Disconnect the A/C refrigerant pressure sensor electrical connector. Does the scan tool indicate the A/C High Side less than the specified value?	1.0 V	Go to Step 5	Go to Step 9
5	Using a DVM (J 39200), measure voltage from the A/C refrigerant pressure sensor 5.0 volt reference circuit to battery ground. Does the DVM indicate voltage at the specified value?	5.0 V	Go to Step 6	Go to Step 10
6	Using a DVM (J 39200), measure voltage from the A/C refrigerant pressure sensor 5.0 volt reference circuit to sensor ground circuit. Does the DVM indicate voltage at the specified value?	5.0 V	Go to Step 7	Go to Step 11
7	Using a jumper wire, jumper 5.0 volt reference circuit to A/C refrigerant pressure sensor signal circuit. Does the scan tool indicate the A/C High Side at the specified value?	5.0 V	Go to Step 8	Go to Step 12
8	Repair the faulty A/C refrigerant pressure sensor connection or faulty sensor. Is the action complete?	—	Go to Step 13	—
9	Repair the A/C refrigerant pressure sensor signal circuit shorted to voltage. Is the action complete?	—	Go to Step 13	—
10	Repair 5.0 volt reference circuit to A/C refrigerant pressure sensor. Is the action complete?	—	Go to Step 13	—
11	Repair ground circuit to A/C refrigerant pressure sensor. Is the action complete?	—	Go to Step 13	—
12	Repair signal circuit to A/C refrigerant pressure sensor. Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0531 A/C Refrigerant Pressure CKT Performance

Circuit Description

The PCM can determine if the A/C clutch is engaged or not engaged through the A/C clutch status line. If the PCM has grounded the A/C relay control circuit, current can flow through the A/C relay to the A/C compressor clutch and back to the PCM on the A/C status circuit.

The PCM monitors the A/C clutch status circuit and can determine when the clutch has cycle from ON to OFF. As the A/C compressor cycles OFF, the PCM will record A/C refrigerant pressure from the A/C refrigerant pressure sensor. If the PCM does not detect an increase from the A/C refrigerant pressure sensor when the A/C clutch cycles back ON, a DTC P0531 will set. This condition can occur if the A/C refrigerant pressure sensor is fixed at one value.

Conditions for Setting the DTC

The PCM does not detect an A/C refrigerant pressure change of more than 4.0 psi when the A/C clutch has been cycled OFF for 10.0 seconds, then ON for 10.0 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.

- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

Inspect the harness going to the A/C clutch and going to the PCM for intermittent connections. While the engine is operating with the A/C enabled, move related electrical connectors and harnesses. This may aid in locating an intermittent fault. The scan tool failure records buffer feature may also help locate a fault. Drive the vehicle in the conditions that were noted from failure record data.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Checks if the PCM is able to turn the A/C compressor ON.
3. Checks for an A/C refrigerant pressure sensor that is at a fixed value (stuck).
4. An intermittent open A/C clutch status circuit, can cause the PCM to wrongly detect the A/C clutch cycling. When the PCM falsely detects the clutch cycling ON and OFF and the clutch is remaining ON, a DTC P0531 will set since no refrigerant pressure change was detected. So before replacing the A/C refrigerant pressure sensor, inspect the A/C clutch status circuit.
5. If the scan tool indicates that the A/C clutch is ON, check connections at the compressor first.
6. If the B+ supply circuit to the A/C relay is intermittent, the PCM A/C clutch status circuit may not detect voltage when A/C is commanded ON. So inspect relay connections and operation.

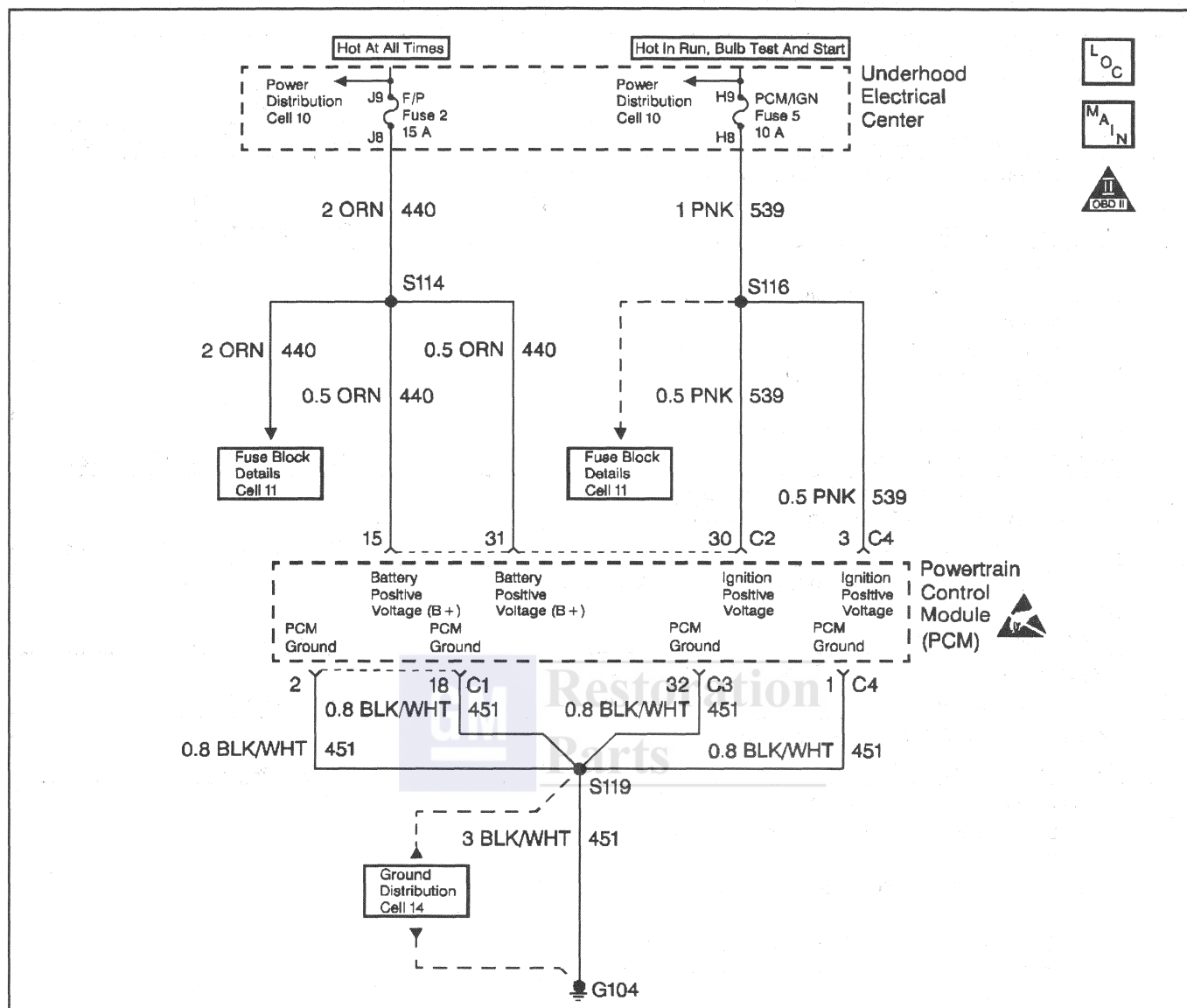
DTC P0531 A/C Refrigerant Pressure CKT Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If DTCs P0530, P1545, and P1546 are set, use those tables. 1. Start and idle the engine. 2. Turn the A/C ON. Does the A/C clutch engage?	—	Go to Step 3	Go to Step 5
3	1. Using a scan tool, observe A/C High Side pressure display on the Engine 1 Data List. 2. Turn the A/C OFF for 10 seconds. 3. Turn the A/C ON for 10 seconds. Did the A/C High Side pressure increase more than the specified value when the A/C controls were turned ON?	4 psi	Go to Diagnostic Aids-DTC P0531 A/C Refrigerant Pressure Sensor Performance	Go to Step 4

DTC P0531 A/C Refrigerant Pressure CKT Performance (cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the faulty A/C refrigerant pressure sensor connection or faulty sensor. Is the action complete?	—	Go to Step 12	—
5	Does the scan tool indicate A/C clutch ON?	—	Go to Step 7	Go to Step 6
6	Repair intermittent A/C clutch circuit from the A/C relay to the splice. Is the action complete?	—	Go to Step 12	—
7	1. Turn the ignition OFF 2. Disconnect the A/C compressor clutch harness connector. 3. Using a test light (J 34142-B), probe the A/C compressor clutch B+ supply circuit to battery ground. 4. Start the engine and turn the A/C ON. Does the test light illuminate?	—	Go to Step 8	Go to Step 10
8	Using a test light, probe the A/C compressor clutch B+ supply circuit to the A/C compressor clutch ground circuit. Does the test light illuminate?	—	Go to Step 9	Go to Step 11
9	Repair the faulty A/C clutch connection or open A/C clutch coil. Is the action complete?	—	Go to Step 12	—
10	Repair the open or shorted A/C clutch B+ supply circuit. Is the action complete?	—	Go to Step 12	—
11	Repair the open A/C clutch ground circuit. Is the action complete?	—	Go to Step 12	—
12	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0562 System Voltage Low



30386

Circuit Description

The PCM continuously monitors system voltage. System voltage information is taken from the PCM's ignition feed circuits. Since voltages below 8.0 Volts or above 17.1 Volts, could cause improper system operation and/or component damage, the PCM operates in a default mode if a PCM Voltage DTC is set. If system voltage is low the PCM will raise the idle speed to increase generator output. If system voltage is high, the PCM disables most outputs to protect the hardware. Class 2 Serial Data is shut down when system voltage is below 9.2 Volts or above 16.0 Volts. A scan tool will not display data if system voltage is outside this range. Because of this, a DVM must be used to monitor system voltage when checking to see if the fault is currently present.

Conditions for Setting the DTC

- Engine running.
- The PCM senses system voltage below 8.0 Volts.
- Condition present for 6 seconds.

Action Taken When the DTC Sets

- DTC P0562 will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.
- High idle speed.
- The transmission defaults to third gear.
- TCC operation is inhibited.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- Extremely low voltage (below 7.5 Volts) may cause the loss of serial data and the MIL may not function. An open ignition feed circuit will cause a no start and the MIL will not illuminate. Low system voltage may cause other DTCs to set.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the

information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Checks the Charging system under load at idle. Voltage should remain above 8.0 Volts.

DTC P0562 System Voltage Low

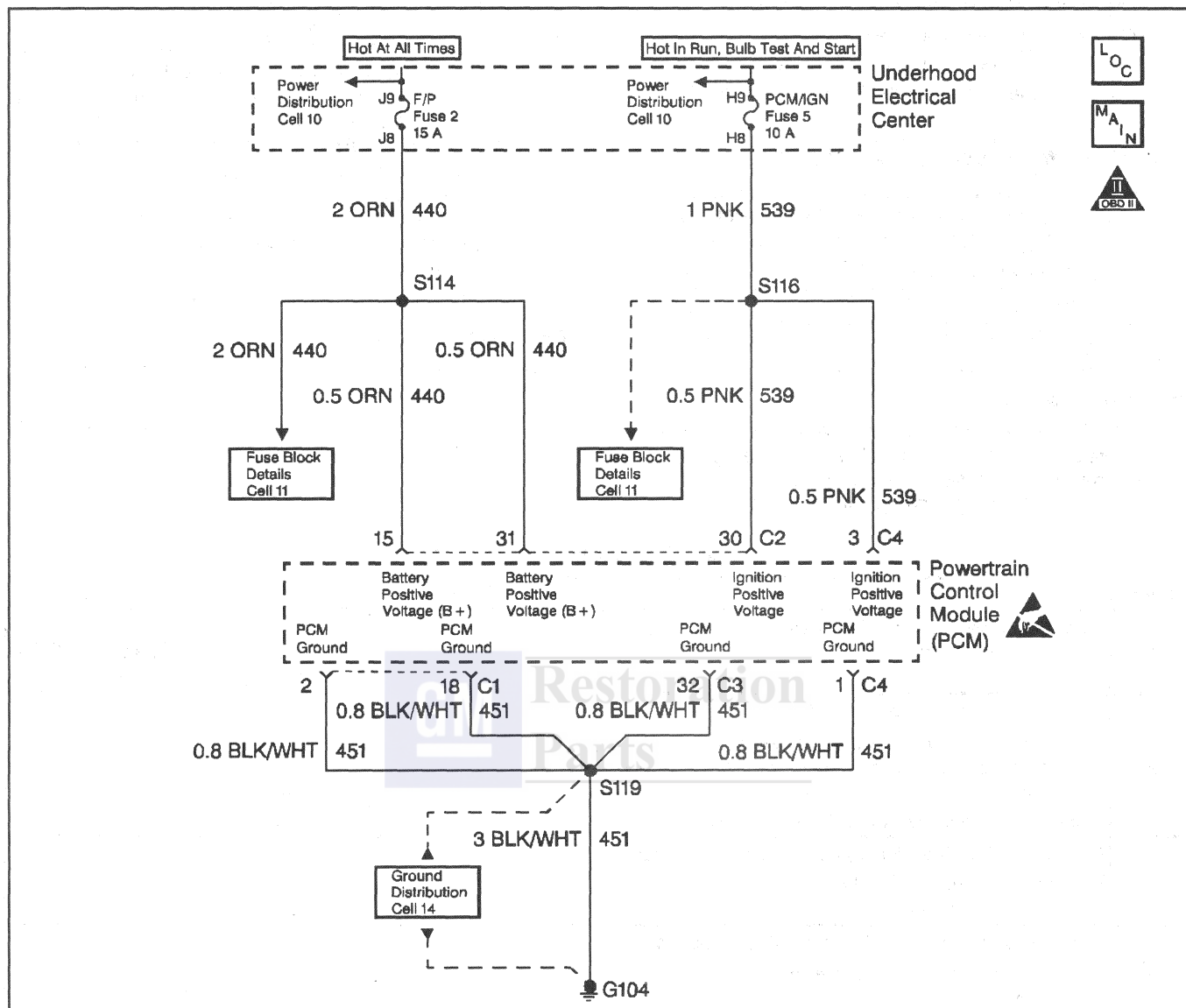
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine. 2. Load the electrical system by turning on the headlights and high blower. 3. Using a DVM (J 39200), measure battery voltage at the battery. Is battery voltage less than the value shown?	8.0 V	Go to Service Category Starting/ Charging	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the PCM Connector C4. 3. Turn the ignition ON. Using a DVM (J 39200), measure voltage at terminal C4-3. Is the voltage less than the value shown?	8.0 V	Go to Step 7	Go to Step 4
4	Check for faulty connections at the PCM. Was a problem found and corrected?	—	Go to Step 8	Go to Step 5
5	1. Turn the ignition OFF. 2. Reconnect the PCM. 3. Turn the ignition ON. 4. Using the scan tool, select ENG DTC, DTC Info, FAIL THIS IGN. Is this DTC displayed?	—	Go to Step 6	DTC is intermittent. Go to Diagnostic Aids- DTC P0562 System Voltage Low.
6	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 8	—
7	Repair the faulty ignition feed circuit to the PCM. Is the action complete?	—	Go to Step 8	—

DTC P0562 System Voltage Low (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 9</i>	<i>Go to Step 2</i>
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P0563 System Voltage High



30386

Circuit Description

The PCM continuously monitors system voltage. System voltage information is taken from the PCM's ignition feed circuits. Since voltages below 8.0 Volts or above 17.1 Volts, could cause improper system operation and/or component damage, the PCM operates in a default mode if a PCM Voltage DTC is set. If system voltage is low the PCM will raise the idle speed to increase generator output. If system voltage is high, the PCM disables most outputs to protect the hardware. Class 2 Serial Data is shut down when system voltage is below 9.2 Volts or above 16.0 Volts. A scan tool will not display data if system voltage is outside this range. Because of this, a DVM must be used to monitor system voltage when checking to see if the fault is currently present.

Conditions for Setting the DTC

- Engine running.
- The PCM senses system voltage above 17.1 Volts.
- Condition present for 6 seconds.

Action Taken When the DTC Sets

- DTC P0563 will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

- Most PCM outputs will be disabled.
- The transmission defaults to third gear.
- TCC operation is inhibited.
- During the time the fault is present, the PCM will cycle the fans ON and OFF every few seconds.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- Check the generator voltage sense circuit for high resistance or loose connections. These could cause an intermittent overcharging condition. Refer to *Charging/Starting* for circuit details.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Checks for excessive generator output. Voltage should remain below 17.1 Volts.

DTC P0563 System Voltage High

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn all the accessories OFF. 2. Using a DVM (J 39200), measure battery voltage at the battery while running the engine above 2000 RPM. Is battery voltage less than the value shown?	17.1 V	Go to Diagnostic Aids-DTC P0563 System Voltage High	Go to Step 3
3	Repair Starting/Charging system. Refer to Service Category <i>Starting/ Charging</i> . Is the repair completed?	—	Go to Step 4	—
4	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 5	Go to Step 2
5	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0601 PCM Memory**Circuit Description**

The PCM EEPROM contains data which is essential to running the engine and transmission. The PCM continuously checks the integrity of this data.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- If no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- If no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Replace the PCM even if this DTC exists only in history.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Replace the PCM even if this DTC exists only in history.

DTC P0601 PCM Memory

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 3	—
3	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 4	Go to Step 2
4	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P0602 PCM Not Programmed**Circuit Description**

This DTC indicates that the PCM's internal EEPROM has not been flashed with any vehicle software. If a service PCM is installed and not flashed, the engine will not run. The purpose of this DTC is to indicate that the engine cranks but will not run situation is due to an un-flashed PCM.

Conditions for Setting the DTC

No software data is present in the PCM.

Action Taken When the DTC Sets

- DTC P0602 will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- Fuel pump is disabled.
- Injector pulsewidth is set to 0.
- The PCM may record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Test Description

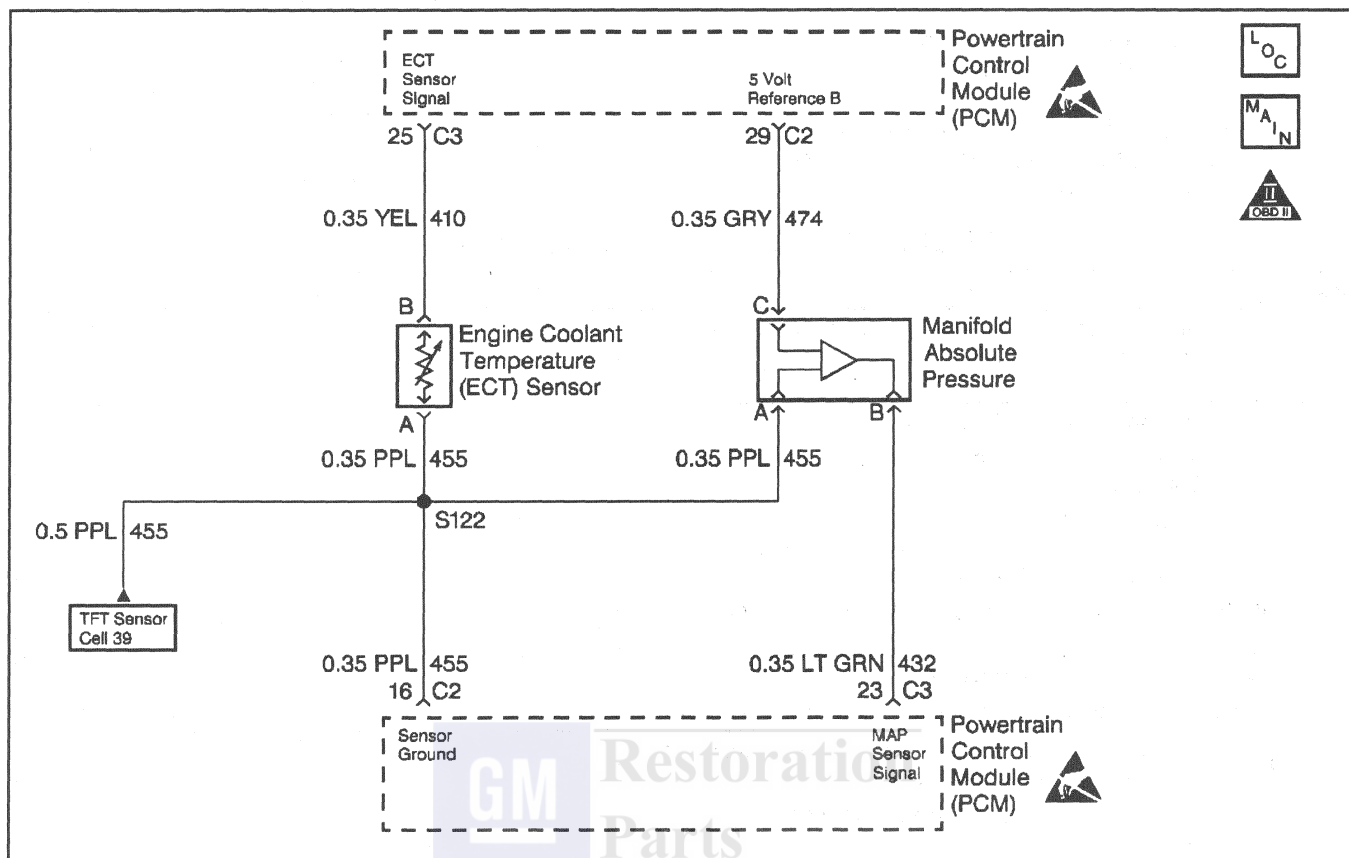
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. If the flashing routine fails, verify that the equipment used is functioning properly and that all cable connections are clean and tight. Also make sure that the software you are attempting to download is correct for the PCM being flashed. If everything checks out OK, and a second attempt fails, the PCM is faulty.

DTC P0602 PCM Not Programmed

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Flash the PCM with the correct software. Refer to <i>PCM Replacement/Programming</i> . Does DTC P0602 reset.	—	Go to Step 3	Go to Step 5
3	Verify that the equipment being used is functioning properly and that all cable connections are clean and tight. Attempt to flash the PCM again. Does DTC P0602 reset.	—	Go to Step 4	Go to Step 5
4	Replace the PCM. Is the action complete?	—	Go to Step 5	—
5	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 6	Go to Step 2
6	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1107 MAP Sensor CKT Intermittent Low Voltage



30394

Circuit Description

The Manifold Absolute Pressure (MAP) sensor is mounted to the top of the intake manifold. The MAP sensor measures pressure changes within the intake manifold which are an indication of engine load. The MAP sensor has a 5.0 volt reference, a ground and a signal circuit.

The MAP sensor contains a diaphragm which changes resistance based on pressure. When manifold pressure is low (high vacuum) sensor output voltage is low. When manifold pressure is high (low vacuum) sensor output voltage is high. MAP sensor voltage (depending on altitude) can range from 1.0–1.5 volts at idle (high vacuum) to 4.0 – 4.9 volts at wide open throttle (low vacuum). When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- No TP sensor DTCs set.
- MAP less than 0.24 volts.
- All conditions are met for 0.3 second.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

An intermittent DTC can be caused by electromagnetic interference (EMI). Inspect related circuits for being too close to secondary ignition wires and the alternator.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).

- Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
- Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
- Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.

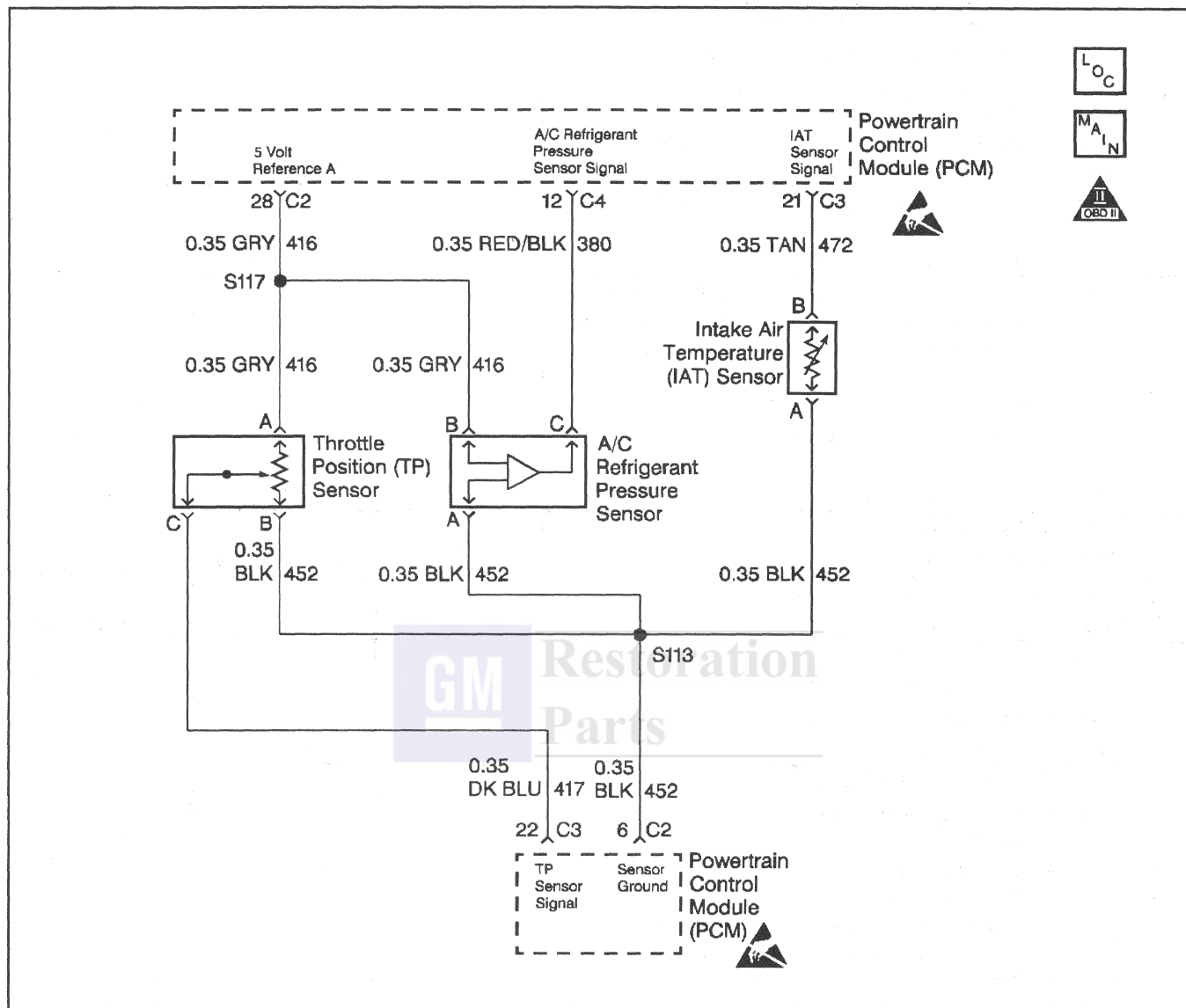
DTC P1107 MAP Sensor CKT Intermittent Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a scan tool, select MAP from the Engine 1 Data List. 3. Move the MAP sensor electrical connector, the harness and the PCM connectors (by hand only) while observing the scan tool display. Is the MAP value affected by moving the harness or connectors?	—	Go to Step 10	Go to Step 3
3	With the ignition ON, engine OFF. Is the MAP sensor reading greater than the value shown?	85 kPa	Go to Step 4	Go to Step 11
4	1. Remove the MAP sensor from the intake manifold but leave the electrical harness connected. 2. Connect a hand operated vacuum pump to the MAP sensor. 3. Observe the MAP display while slowly applying vacuum up to 20 inch Hg as indicated on the pump gauge. Each 1 inch of vacuum applied should result in a 3 to 4 kPa drop in the MAP sensor value on the scan tool and the value should change smoothly with each increase in vacuum. Did the MAP value change smoothly through the entire range of the test without any erratic readings?	—	Go to Step 11	Go to Step 5
5	With 20 inch Hg vacuum applied to the MAP sensor, is the MAP sensor reading the same or less than the value shown?	34 kPa	Go to Step 6	Go to Step 11
6	Disconnect the vacuum source from the MAP sensor. Does the MAP sensor reading return to its original value?	—	Go to Step 7	Go to Step 11
7	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids

DTC P1107 MAP Sensor CKT Intermittent Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Check MAF harness for incorrect routing. • Near secondary ignition or components. • Other high current components. Such as solenoids, relays and motors. 2. If incorrect routing is found, correct harness routing. Was a problem found and corrected?	—	Go to Step 14	Go to Step 9
9	Check for a plugged or leaking vacuum supply to the MAP sensor. Was a problem found and corrected?	—	Go to Step 13	Go to Step 12
10	Check for the following conditions and repair as necessary: • Electrical connector terminals for poor connections, improper contact tension or poor terminal to wire connection. • Rubbed through wire insulation. • Broken wire inside the insulation. • Mis-routed harness. Is the action complete?	—	Go to Step 14	—
11	Replace the MAP sensor. Is the action complete?	—	Go to Step 14	—
12	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1111 IAT Sensor CKT Intermittent High Voltage



Circuit Description

The Intake Air Temperature (IAT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The IAT sensor is located in the air intake passage of the engine air induction system. The IAT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine intake air temperature.

When the intake air is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the intake air

is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature).

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- DTC(s) P0100, P0102, P0103, P0117, P0118, P0500, P0502, P0503 not set.
- Engine operating longer than 100 seconds.
- Engine Coolant Temperature greater than 0°C (32°F).
- Intake Air Temperature is less than -35°C (-31°F).

- Vehicle speed less than 11 km/h (7 mph).
- Mass Air Flow less than 15 grams per second.
- All conditions met for 0.3 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. If DTC P0113 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set.

3. When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).
 - Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.
4. When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
5. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. If this DTC runs and passes the diagnostic, the scan tool will not indicate any information under DTC Status.

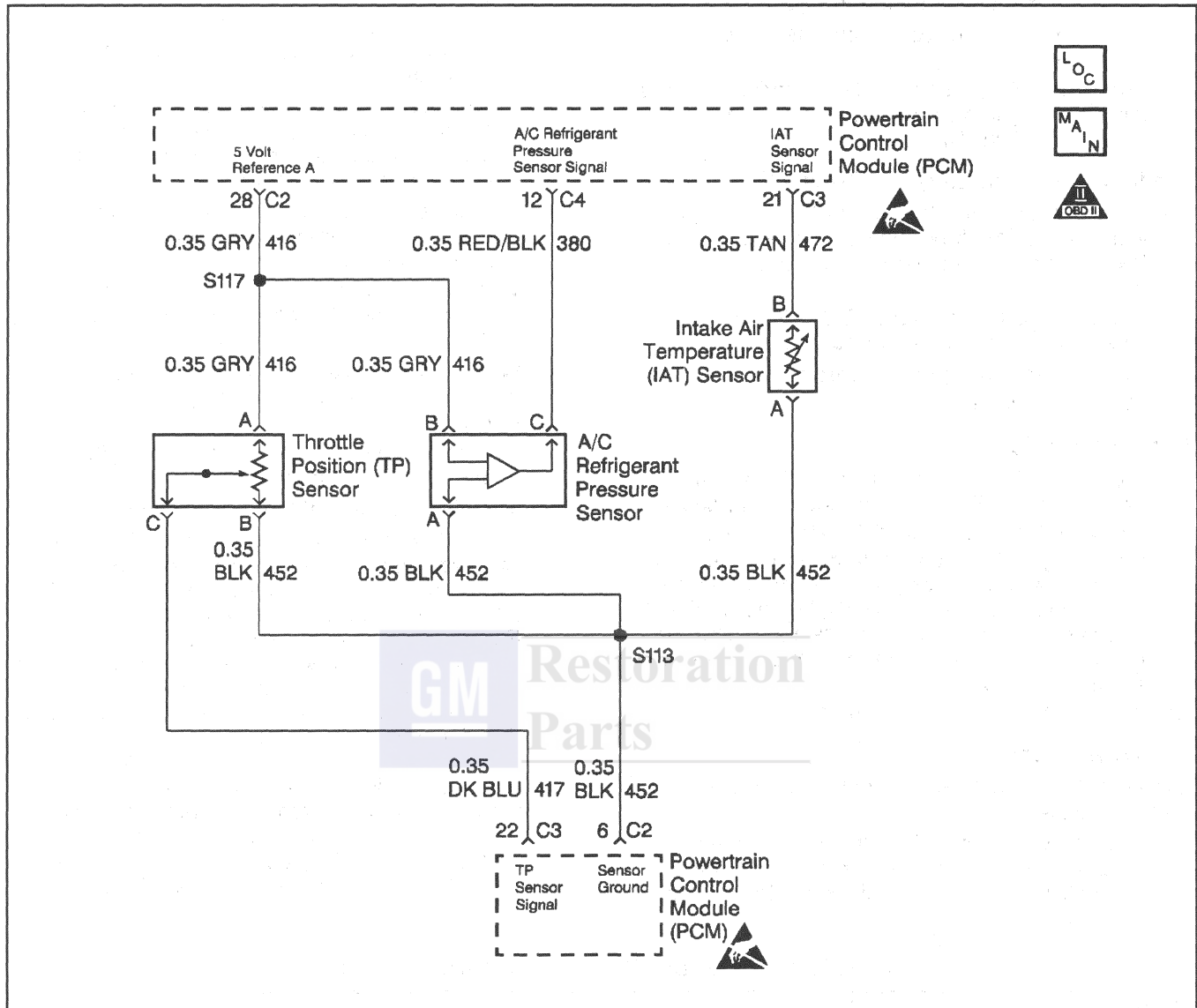
DTC P1111 IAT Sensor CKT Intermittent High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Engine idling. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0113. Did DTC P0113 fail this ignition cycle?	—	Go to DTC P0113 IAT Sensor Circuit High Voltage	Go to Step 3

DTC P1111 IAT Sensor CKT Intermittent High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does the sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does the sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair damage connectors/terminals following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1112 IAT Sensor CKT Intermittent Low Voltage



30393

Circuit Description

The Intake Air Temperature (IAT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The IAT sensor is located in the air intake passage of the engine air induction system. The IAT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine intake air temperature.

When the intake air is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the intake air

is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature).

When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- DTC(s) P0100, P0102, P0103, P0117, P0118, P0500, P0502, P0503 not set.
- Engine operating longer than 30 seconds.
- Vehicle speed greater than 40 km/h (25 mph).
- Intake Air Temperature greater than 150°C (302°F).
- All conditions met for 0.3 second.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. If DTC P0112 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set.

3. When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).
 - Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.
4. When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
5. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. If this DTC runs and passes the diagnostic, the scan tool will not indicate any information under DTC Status.

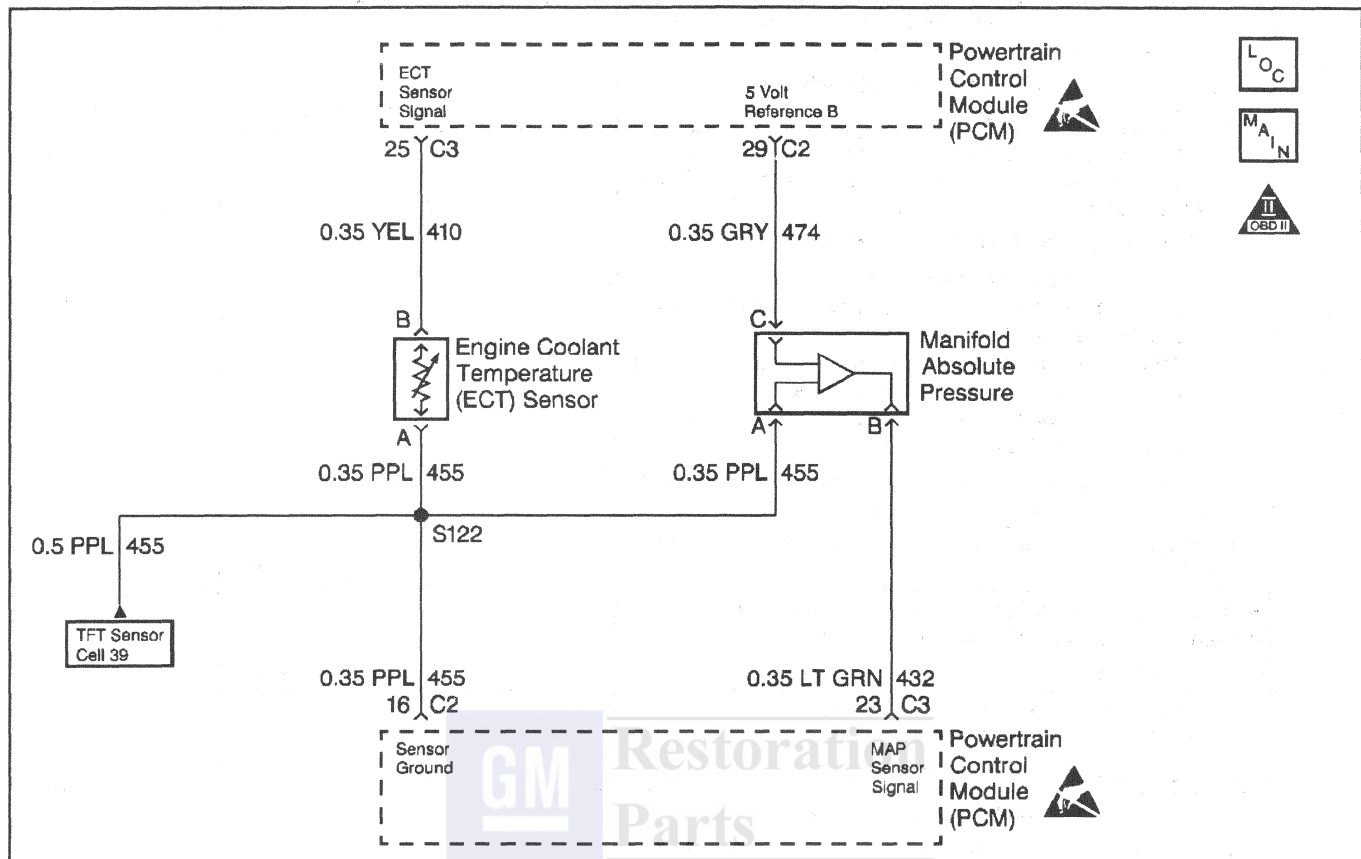
DTC P1112 IAT Sensor CKT Intermittent Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0112. Did DTC P0112 fail this ignition cycle?	—	Go to DTC P0112 IAT Sensor Circuit Low Voltage	Go to Step 3
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does the sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4

DTC P1112 IAT Sensor CKT Intermittent Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does the sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair damage connectors/terminals following Repair Procedures in <i>Electrical Diagnosis</i> (8A Cell 5). Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring following Repair Procedures in <i>Electrical Diagnosis</i> (8A Cell 5). Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1114 ECT Sensor CKT Intermittent Low Voltage



30394

Circuit Description

The Engine Coolant Temperature (ECT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The ECT sensor is mounted in the engine coolant pump housing. The ECT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine coolant temperature.

When the coolant is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the coolant is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature). At normal operating temperature, the voltage should measure about 1.5–2.0 volts at the PCM.

When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- Engine operating longer than 20 seconds.
- The PCM indicates Engine Coolant Temperature greater than 151 °C (304 °F).

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- An intermittent DTC can be caused by electromagnetic interference (EMI). Inspect related circuits for being too close to secondary ignition wires and the alternator.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- If DTC P0117 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set.
- When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).

- Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.
- When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
 - Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. If this DTC runs and passes the diagnostic, the scan tool will not indicate any information under DTC Status.

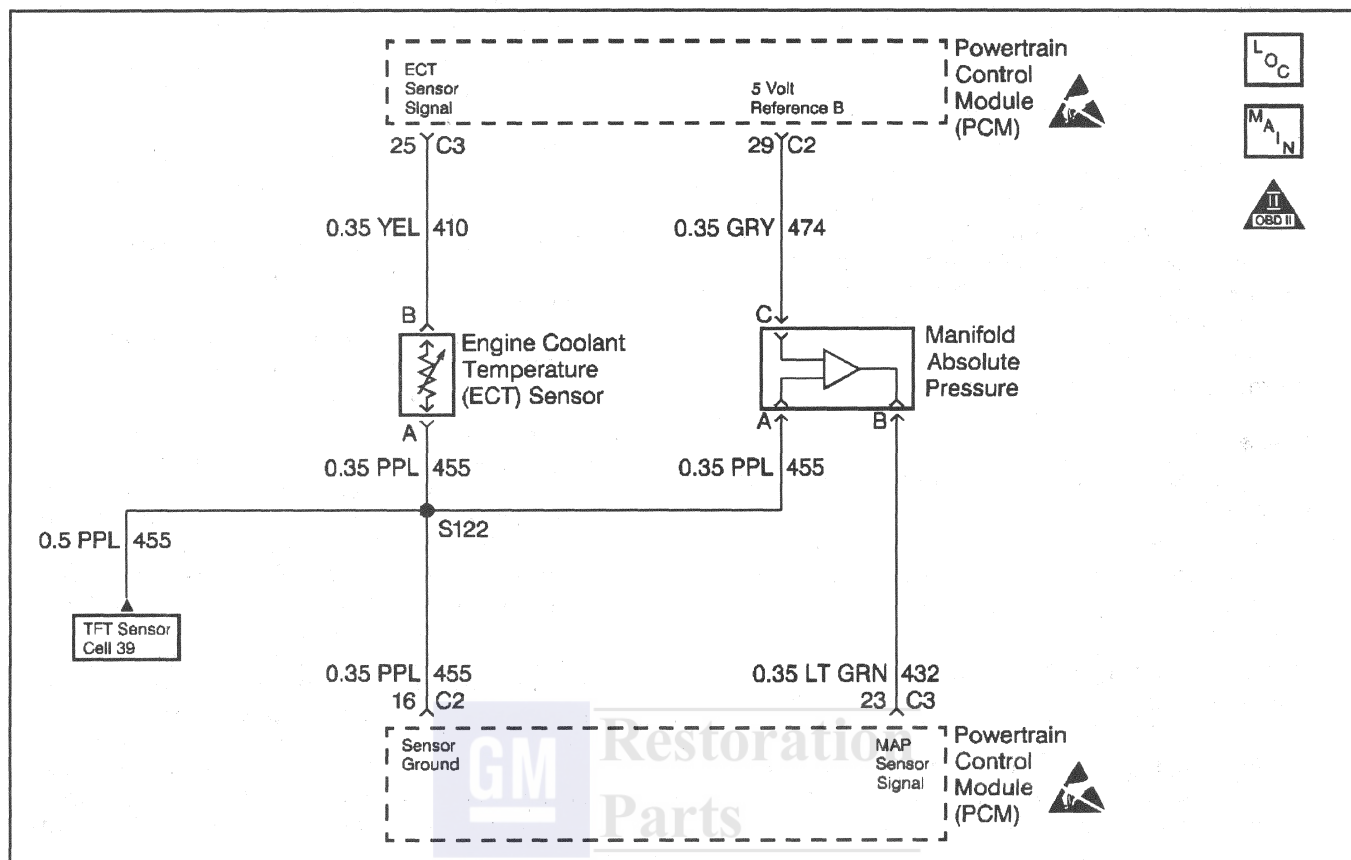
DTC P1114 ECT Sensor CKT Intermittent Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0117. Did DTC P0117 fail this ignition cycle?	—	Go to DTC P0117 ECT Sensor Circuit Low Voltage	Go to Step 3
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does the sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5

DTC P1114 ECT Sensor CKT Intermittent Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair damage connectors/terminals following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all the circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1115 ECT Sensor CKT Intermittent High Voltage



30394

Circuit Description

The Engine Coolant Temperature (ECT) sensor contains a semiconductor device which changes resistance based on temperature (a thermistor). The ECT sensor is mounted in the engine coolant pump housing. The ECT sensor has a signal circuit and a ground circuit. The PCM applies a voltage (about 5.0 volts) on the signal circuit to the sensor. The PCM monitors changes in this voltage caused by changes in the resistance of the sensor to determine coolant temperature.

When the coolant is cold, the sensor (thermistor) resistance is high, and the PCM's signal voltage is only pulled down a small amount through the sensor to ground. Therefore, the PCM will sense a high signal voltage (low temperature). When the coolant is warm, the sensor resistance is low, and the signal voltage is pulled down a greater amount. This causes the PCM to sense a low signal voltage (high temperature). At normal operating temperature, the voltage should measure about 1.5–2.0 volts at the PCM.

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

- Engine operating longer than 20 seconds.
- The PCM indicates Engine Coolant Temperature less than -40°C (-40°F) for 0.3 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- An intermittent DTC can be caused by electromagnetic interference (EMI). Inspect related circuits for being too close to secondary ignition wires and the alternator.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other. If the temperatures are not within 3°C (5°F), refer to *Temperature Vs Resistance Table*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- If DTC P0118 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set.
- When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).

- Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.
- When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
 - Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. If this DTC runs and passes the diagnostic, the scan tool will not indicate any information under DTC Status.

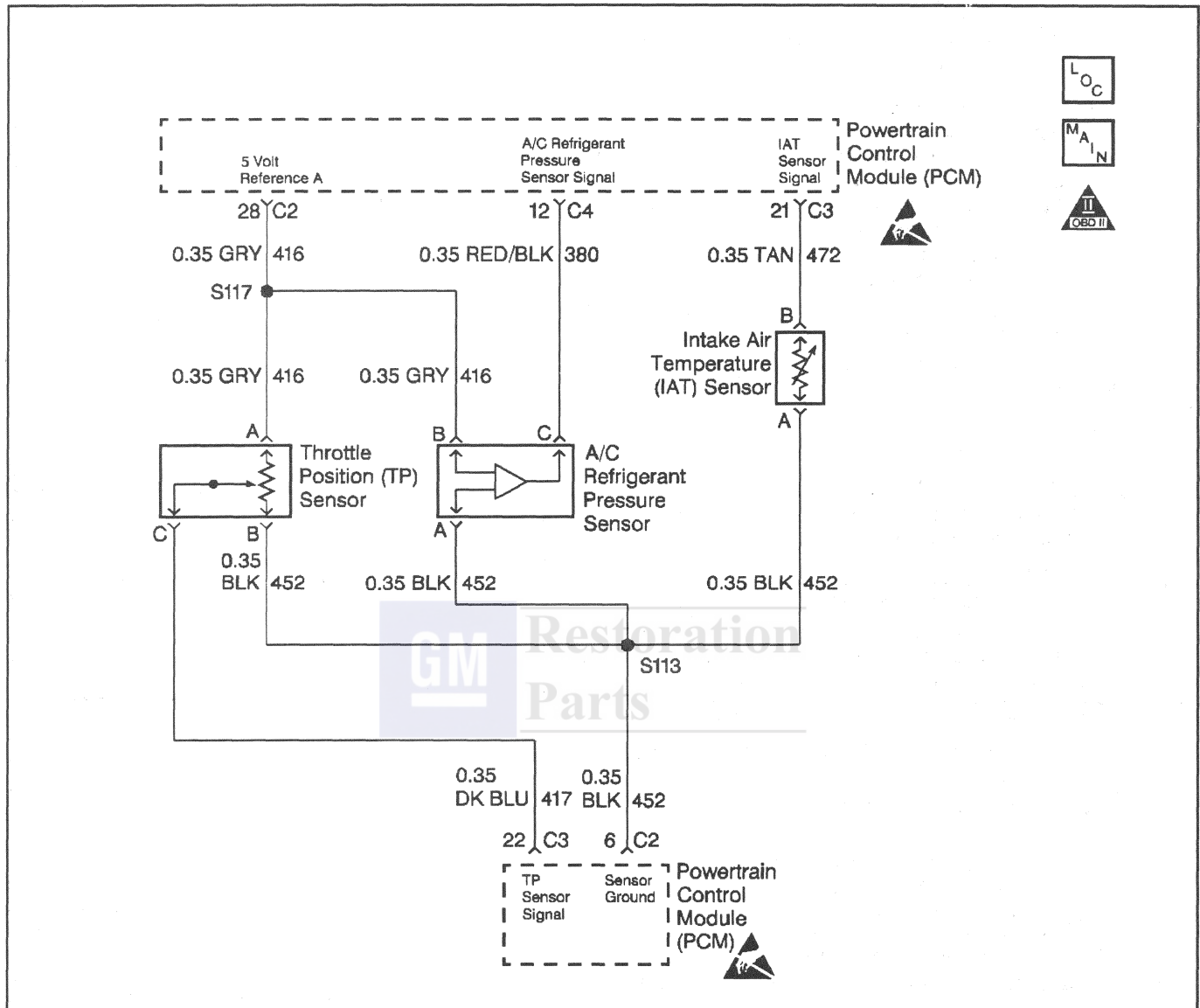
DTC P1115 ECT Sensor CKT Intermittent High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0118. Did DTC P0118 fail this ignition cycle?	—	Go to DTC P0118 ECT Sensor Circuit High Voltage	Go to Step 3
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does the sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5

DTC P1115 ECT Sensor CKT Intermittent High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair damage connectors/terminals following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring following Repair Procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all the circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1121 TP Sensor CKT Intermittent High Voltage



Circuit Description

The Throttle Position (TP) sensor is a potentiometer. The TP sensor is mounted to the right side of the throttle body. The TP sensor provides a voltage signal that changes relative to throttle blade angle. This signal voltage is one of the most important inputs used by the PCM. The TP sensor has a 5.0 volt reference, a ground and a signal circuit. TP sensor Signal voltage should be about 0.6 volt at idle. The TP sensor voltage should increase to above 4.0 volts at wide open throttle (WOT).

When the PCM senses a signal voltage higher than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

TP sensor voltage is greater than 4.8 volts for 0.3 second.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

An intermittent DTC can be caused by electromagnetic interference (EMI). Inspect related circuits for being too close to secondary ignition wires and the alternator.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. If DTC P0123 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set.
3. When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).

- Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
 - Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
 - Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.
4. When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
 5. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. If this DTC runs and passes the diagnostic, the scan tool will not indicate any information under DTC Status.

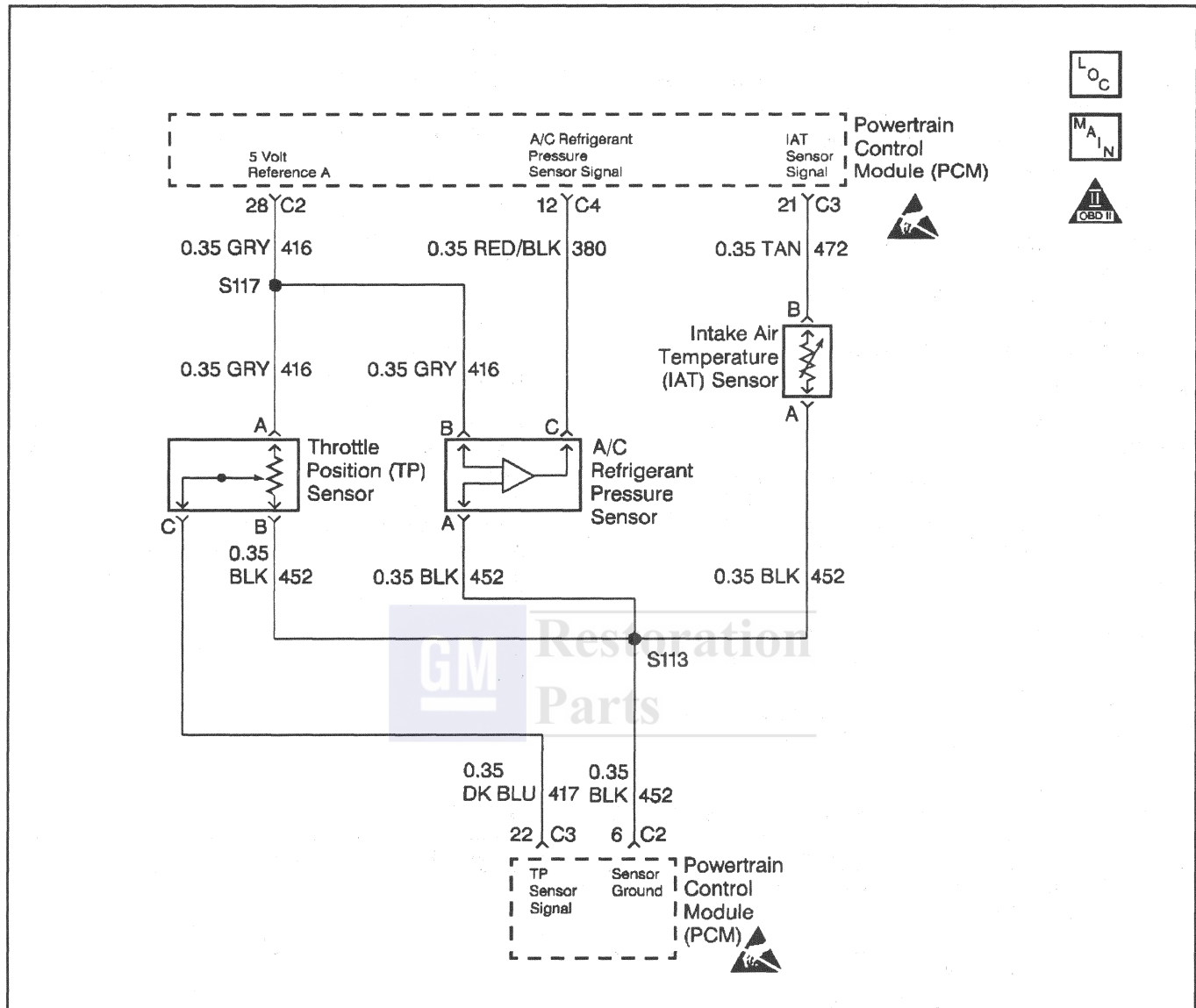
DTC P1121 TP Sensor CKT Intermittent High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0123. Did DTC P0123 fail this ignition cycle?	—	Go to DTC P0123 TP Sensor Circuit High Voltage	Go to Step 3
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5

DTC P1121 TP Sensor CKT Intermittent High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair damage connectors/terminals following repair procedures in <i>Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
7	Repair faulty wiring following repair procedures in <i>Electrical Diagnosis (8A Cell 5)</i>. Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all related circuits and connectors. 2. If all the circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1122 TP Sensor CKT Intermittent Low Voltage



30393

Circuit Description

The Throttle Position (TP) sensor is a potentiometer. The TP sensor is mounted to the right side of the throttle body. The TP sensor provides a voltage signal that changes relative to throttle blade angle. This signal voltage is one of the most important inputs used by the PCM. The TP sensor has a 5.0 volt reference, a ground and a signal circuit. TP sensor Signal voltage should be about 0.6 volt at idle. The TP sensor voltage should increase to above 4.0 volts at wide open throttle (WOT). When the PCM senses a signal voltage lower than the normal operating range of the sensor, this DTC will set.

Conditions for Setting the DTC

TP sensor voltage is less than 0.2 volts for 0.3 second.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

An intermittent DTC can be caused by electromagnetic interference (EMI). Inspect related circuits for being too close to secondary ignition wires and the alternator.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. If DTC P0122 failed this ignition, indicates a hard failure is present. When a hard failure is present, both the hard and intermittent DTCs will set. The engine must be operating longer than 30 seconds before checking if the DTC set.
3. When moving related connectors, visually/physically inspect connectors for the following:
 - Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).

- Improperly formed or damaged terminals. All connector terminals in the related circuits should be carefully reformed or replaced to insure proper contact tension.
- Poor terminal to wire connection. Inspect for poor crimps, crimping over wire insulation rather than the wire.
- Dirt or corrosion on terminals. Inspect connector seals for being there and for being damaged.

4. When moving related wiring harnesses, visually/physically inspect wiring for the following:
 - Wire insulation that is rubbed through, causing an intermittent short.
 - Wiring broken inside the insulation.
5. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

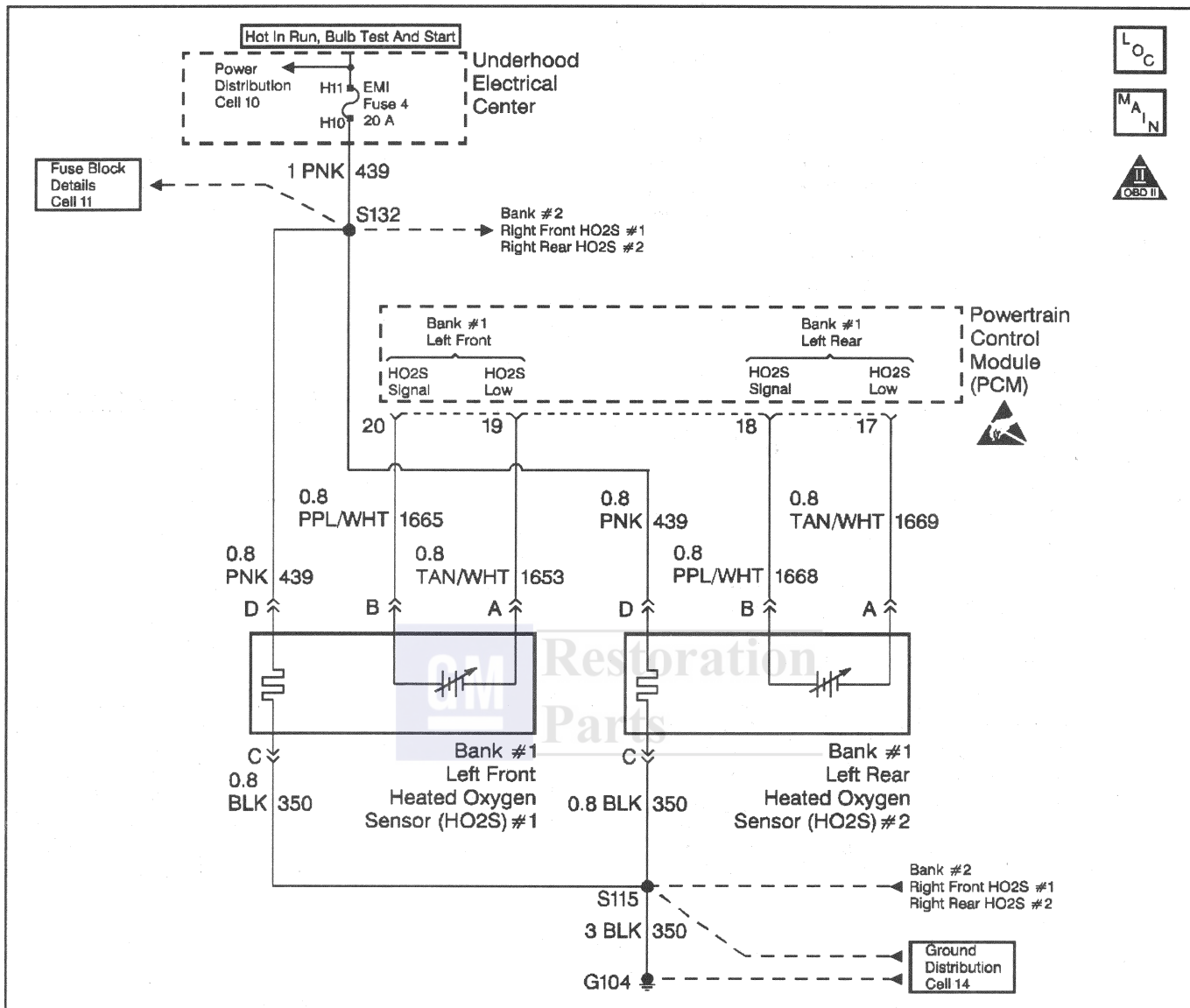
DTC P1122 TP Sensor CKT Intermittent Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0122. Did DTC P0122 fail this ignition cycle?	—	Go to DTC P0122 TP Sensor Circuit Low Voltage	Go to Step 2
3	1. Install the scan tool. 2. Turn the ignition ON, engine OFF. 3. Using a scan tool, observe affected sensor value while moving related harness connectors (at component and PCM). Does sensor value change abruptly while a related connector is being moved?	—	Go to Step 6	Go to Step 4
4	Using a scan tool, observe affected sensor value while moving related wiring harnesses. Does sensor value change abruptly while moving related electrical harnesses?	—	Go to Step 7	Go to Step 5

DTC P1122 TP Sensor CKT Intermittent Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 8	Go to Diagnostic Aids
6	Repair the damaged connectors/terminals following repair procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
7	Repair the faulty wiring following repair procedures in <i>Electrical Diagnosis (8A Cell 5)</i> . Is the action complete?	—	Go to Step 9	—
8	1. Re-inspect all the related circuits and connectors. 2. If all the circuits have been check thoroughly and no faults can be found, replace the sensor/component. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1133 HO2S Insufficient Switching Bank1Sensor1



30395

Circuit Description

The PCM monitors the Heated Oxygen Sensor (HO2S) activity for 100 seconds. During this monitor period the PCM counts the number of times that the HO2S switches from rich to lean and lean to rich. When the PCM determines that the HO2S did not switch enough times, a DTC P1133 will set.

A lean to rich switch is determined when the HO₂S voltage changes from less than 300 mV to greater than 600 mV. A rich to lean switch is determined when the HO₂S voltage changes from more than 600 mV to less than 300 mV.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0123, P0200, P0372, P1371 not set.
- System operating in Closed Loop
- Engine speed greater than 1000 RPM but less than 1700 RPM.
- MAF between 12 gm/s and 28 gm/s.
- The PCM determines that within 100 seconds the HO2S lean to rich switches are less than 40 and rich to lean switches are less than 30.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- A malfunction in the HO2S heater circuits will cause a DTC P1133 to set. Check HO2S heater circuits for intermittent opens/connections.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run.
3. When DTCs P1133 and P1153 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6 to 12 inches away from the HO2S can cause a DTC to set.
6. Checks whether a good ground circuit is available.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicon and all silicone sealant is a non silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

DTC P1133 HO2S Insufficient Switching Bank1Sensor1

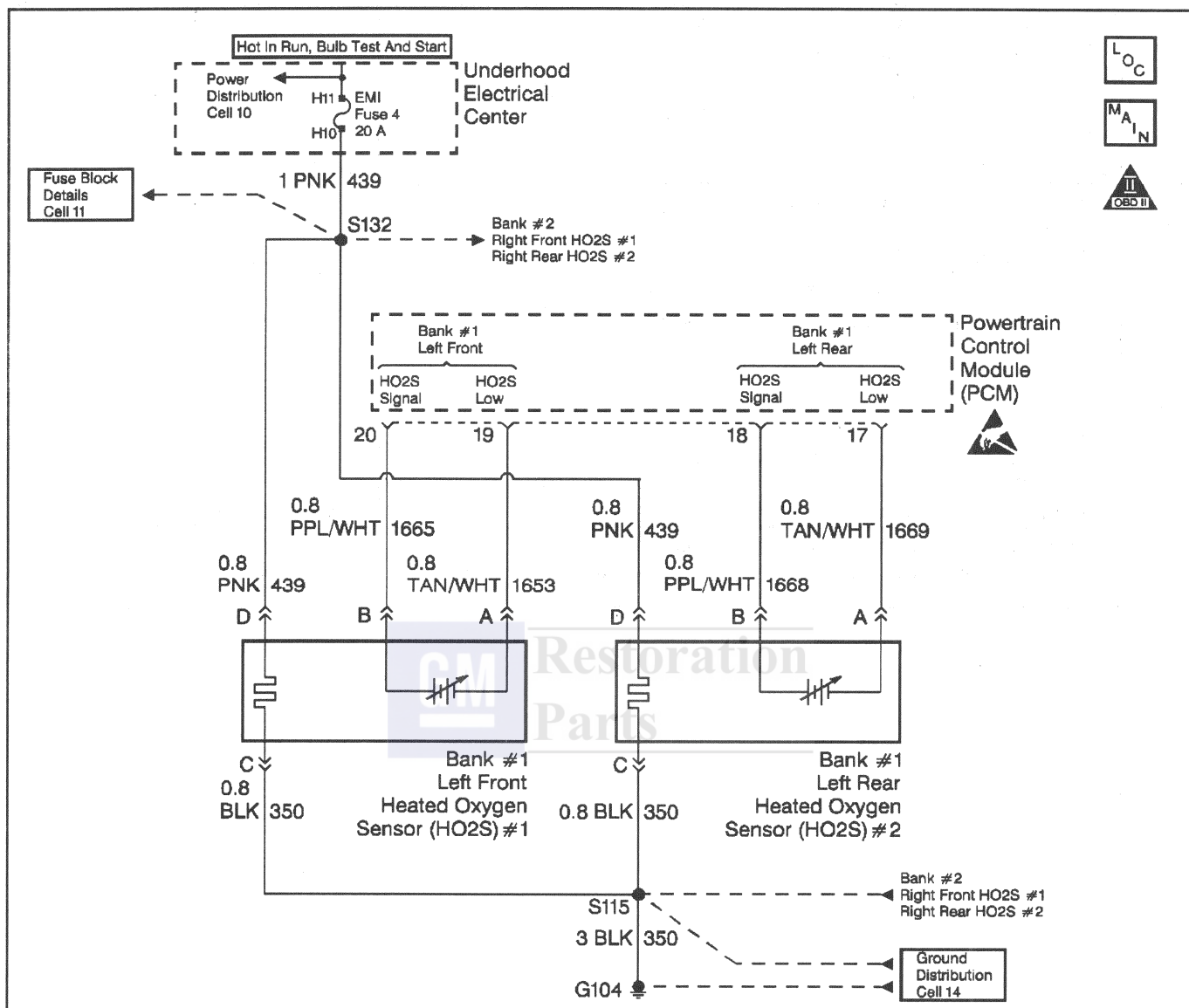
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P1153), refer to those DTCs before proceeding with this diagnostic table. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within the parameters specified under Conditions for setting the DTC in the supporting text. 4. Using a scan tool, monitor FAIL THIS IGN. under DTC Info. Does the scan tool indicate DTC P1133 test failed?	—	Go to Step 3	Go to Diagnostic Aids- DTC P1133 HO2S Insufficient Switching Bank 1 Sensor 1
3	Did scan tool also indicate P1153 test failed?	—	Go to Step 8	Go to Step 4
4	1. Inspect the exhaust system for leaks. Refer to <i>Exhaust System Diagnosis</i>. 2. If an exhaust leak is found, repair as necessary. Was an exhaust leak isolated?	—	Go to Step 2	Go to Step 5
5	Visually/physically inspect the following items: • Ensure that the Bank 1 HO2S 1 is securely installed. • Check for corrosion on terminals. • Check terminal tension (at Bank 1 HO2S 1 and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect the Bank 1 HO2S 1 and jumper the HO2S low (PCM side) signal circuit to ground. 2. Using a scan tool, monitor the Bank 1 HO2S 1 voltage. Does the scan tool indicate voltage within specified values?	375–525 mV	Go to Step 7	Go to Step 10
7	1. Jumper the Bank 1 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using a scan tool, monitor the Bank 1 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200 mV	Go to Step 12	Go to Step 11
8	Important: Before replacing a sensor, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Replace the affected Heated Oxygen Sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
9	Repair condition as necessary. Is the action complete?	—	Go to Step 13	—

DTC P1133 HO2S Insufficient Switching Bank1Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
10	Repair open Bank 1 HO2S 1 low signal circuit or grounded Bank 1 HO2S 1 high signal circuit. Is the action complete?	—	Go to Step 13	—
11	Repair open Bank 1 HO2S 1 high signal circuit or faulty PCM connections. Is the action complete?	—	Go to Step 13	—
12	Replace Bank 1 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1134 HO2S Transition Time Ratio Bank1 Sensor1



30395

Circuit Description

The PCM monitors the Heated Oxygen Sensor (HO2S) activity. During the monitor period the PCM counts the number of times that the HO2S responds from rich to lean and from lean to rich and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. The PCM then divides the rich to lean average by the lean to rich average to obtain a ratio. If the HO2S ratio is not within range, a DTC P1134 will be set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0125, P0200, P0372 not set.

- System operating in Closed Loop
- Engine speed greater than 1000 RPM but less than 1700 RPM.
- MAF between 12 gm/s and 28 gm/s.
- The PCM determines that the HO2S transition time ratio is not at the expected value.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run.
3. When DTCs P1134 and P1154 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6 to 12 inches away from the HO2S can cause a DTC to set.
6. Checks whether a good ground circuit is available.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicon and all silicone sealant is a none silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

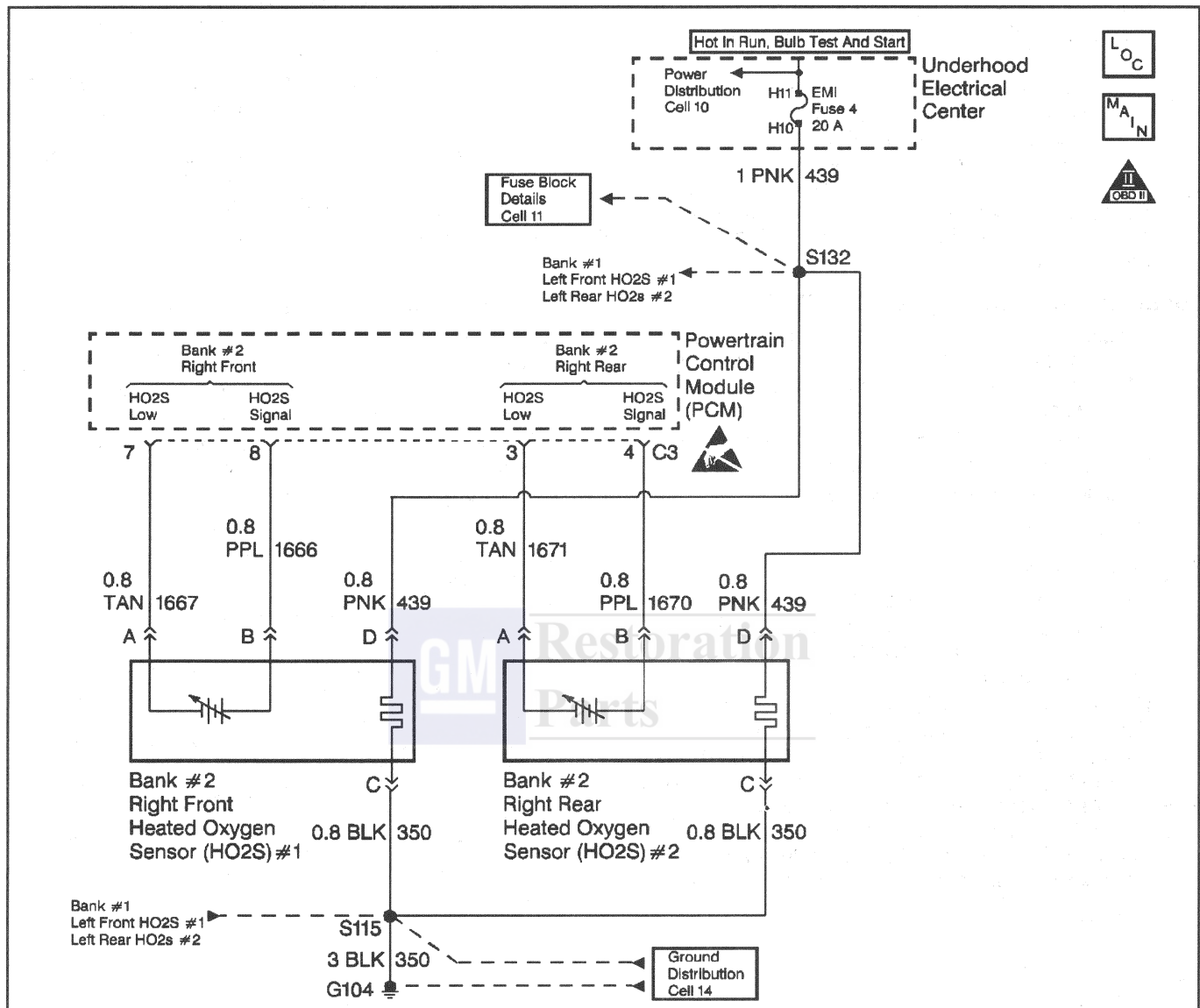
DTC P1134 HO2S Transition Time Ratio Bank1 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P1153), refer to those DTCs before proceeding with this diagnostic table. 1. Install the scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within the parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor FAIL THIS IGN. under DTC Status. Does the scan tool indicate DTC P1133 test failed?	—	Go to Step 3	Go to Diagnostic Aids
3	Did the scan tool also indicate P1153 test failed?	—	Go to Step 8	Go to Step 4
4	1. Inspect the exhaust system for leaks. Refer to <i>Exhaust System Diagnosis</i> . 2. If an exhaust leak is found, repair as necessary. Was an exhaust leak isolated?	—	Go to Step 2	Go to Step 5

DTC P1134 HO2S Transition Time Ratio Bank1 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: • Ensure that the Bank 1 HO2S 1 is securely installed. • Check for corrosion on the terminals. • Check terminal tension (at Bank 1 HO2S 1 and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect Bank 1 HO2S 1 and jumper HO2S low (PCM side) signal circuit to ground. 2. Using a scan tool, monitor Bank 1 HO2S 1 voltage. Does the scan tool indicate voltage within specified values?	375–525 mV	Go to Step 7	Go to Step 10
7	1. Jumper Bank 1 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using a scan tool, monitor Bank 1 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200 mV	Go to Step 12	Go to Step 11
8	Important: Before replacing a sensor, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Replace the affected Heated Oxygen Sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
9	Repair the condition as necessary. Is the action complete?	—	Go to Step 13	—
10	Repair the open Bank 1 HO2S 1 low signal circuit or grounded Bank 1 HO2S 1 high signal circuit. Is the action complete?	—	Go to Step 13	—
11	Repair the open Bank 1 HO2S 1 high signal circuit or faulty PCM connections. Is the action complete?	—	Go to Step 13	—
12	Replace Bank 1 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1153 Insufficient Switching Bank2 Sensor1



30396

Circuit Description

The PCM monitors the Heated Oxygen Sensor (HO2S) activity for 100 seconds. During this monitor period the PCM counts the number of times that the HO2S switches from rich to lean and lean to rich. When the PCM determines that the HO2S did not switch enough times, a DTC P1153 will set.

A lean to rich switch is determined when the HO2S voltage changes from less than 300 mV to greater than 600 mV. A rich to lean switch is determined when the HO2S voltage changes from more than 600 mV to less than 300 mV.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0131, P0200, P0372 not set.
- System operating in Closed Loop
- Engine speed greater than 1000 RPM but less than 1700 RPM.
- MAF between 12 gm/s and 28 gm/s.
- The PCM determines that within 100 seconds the HO2S lean to rich switches are less than 30 and rich to lean switches are less than 20.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- A malfunction in the HO2S heater circuits will cause a DTC P1153 to set. Check HO2S heater circuits for intermittent opens/connections.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles

the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run.
3. When DTCs P1133 and P1153 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6 to 12 inches away from the HO2S can cause a DTC to set.
6. Checks whether a good ground circuit is available.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicon and all silicone sealant is a non silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

DTC P1153 Insufficient Switching Bank2 Sensor1

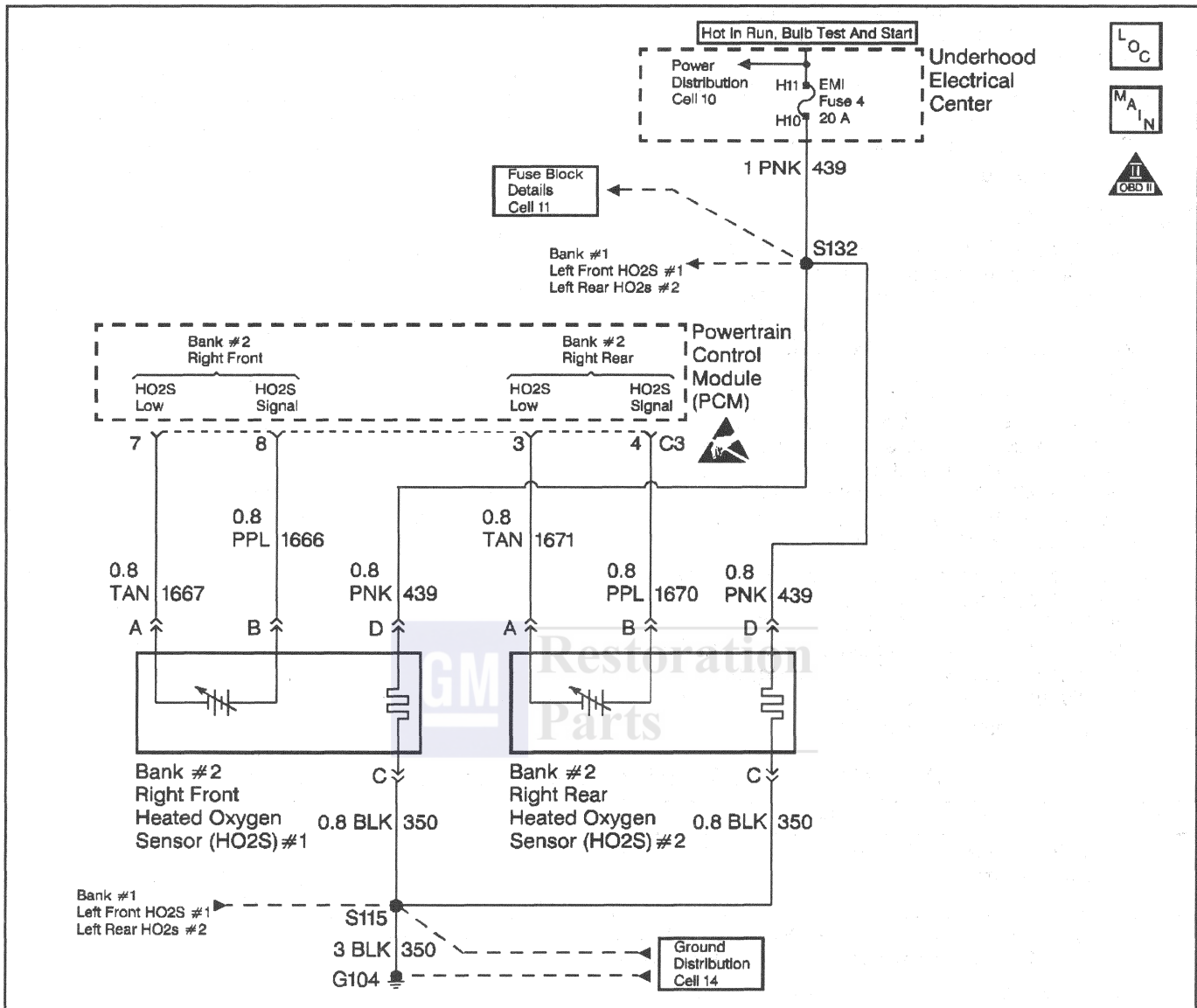
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P1133), refer to those DTCs before proceeding with this diagnostic table. 1. Install scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor FAIL THIS IGN. under DTC Info. Does the scan tool indicate DTC P1153 test failed?	—	Go to Step 3	Go to Diagnostic Aids
3	Did scan tool also indicate P1133 test failed?	—	Go to Step 8	Go to Step 4
4	1. Inspect the exhaust system for leaks. Refer to <i>Exhaust System Diagnosis</i>. 2. If an exhaust leak is found, repair as necessary. Was an exhaust leak isolated?	—	Go to Step 2	Go to Step 5
5	Visually/physically inspect the following items: • Ensure that the Bank 2 HO2S 1 is securely installed. • Check for corrosion on terminals. • Check terminal tension (at Bank 2 HO2S 1 and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect Bank 2 HO2S 1 and jumper HO2S low (PCM side) signal circuit to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage. Does the scan tool indicate voltage within specified values?	375–525 mV	Go to Step 7	Go to Step 10
7	1. Jumper Bank 2 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200 mV	Go to Step 12	Go to Step 11
8	Important: Before replacing a sensor, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Replace the affected Heated Oxygen Sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
9	Repair the condition as necessary. Is the action complete?	—	Go to Step 13	—
10	Repair the open Bank 2 HO2S 1 low signal circuit or grounded Bank 2 HO2S 1 high signal circuit. Is the action complete?	—	Go to Step 13	—

DTC P1153 Insufficient Switching Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the open Bank 2 HO2S 1 high signal circuit or faulty PCM connections. Is the action complete?	—	Go to Step 13	—
12	Replace the Bank 2 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1154 HO2S Transition Time Ratio Bank2 Sensor1



30396

Circuit Description

The PCM continuously monitors the Heated Oxygen Sensor (HO2S) activity for 100 seconds. During the monitor period the PCM counts the number of times that the HO2S responds from rich to lean and from lean to rich and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. The PCM then divides the rich to lean average by the lean to rich average to obtain a ratio. If the HO2S ratio is not within range, a DTC P1154 will be set.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0107, P0108, P0117, P0118, P0125, P0200, P0372 not set.

- System operating in Closed Loop
- Engine speed greater than 1000 RPM but less than 1700 RPM.
- MAF between 12 gm/s and 28 gm/s.
- The PCM determines that the HO2S transition time ratio is not at the expected value.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- An oxygen supply inside the HO2S is necessary for proper operation. This supply of oxygen is provided through the HO2S wires. All HO2S wires and connections should be inspected for breaks or contamination. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5)*.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines if the fault is present. This test may take 5 minutes for the diagnostic to run. For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
3. When DTCs P1134 and P1154 are set at the same time, is good indication that a fuel contamination problem is present.
4. An exhaust leak 6 to 12 inches away from the HO2S can cause a DTC to set.
6. Checks whether a good ground circuit is available.
7. Checks the integrity of the signal circuit to the PCM.
8. Certain RTV silicone gasket materials give off vapors that can contaminate the HO2S. There is also a possibility of silicone contamination caused by silicone in fuel. If it appears that the sensors are contaminated by silicon and all silicone sealant is a non silicone base, advise customer to try a different fuel company. A fuel filler restrictor missing, indicates leaded fuel may have been used.

DTC P1154 HO2S Transition Time Ratio Bank2 Sensor1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: If any DTCs are set (Except P1134), refer to those DTCs before proceeding with this diagnostic table. 1. Install scan tool. 2. Start and idle the engine until normal operating temperature is reached. 3. Operate the vehicle within parameters specified under Conditions for Setting the DTC in the supporting text. 4. Using a scan tool, monitor FAIL THIS IGN. under DTC Info. Does the scan tool indicate DTC P1154 test failed?	—	Go to Step 3	Go to Diagnostic Aids
3	Did scan tool also indicate P1134 test failed?	—	Go to Step 8	Go to Step 4
4	1. Inspect the exhaust system for leaks. Refer to <i>Exhaust System Diagnosis</i>. 2. If an exhaust leak is found, repair as necessary. Was an exhaust leak isolated?	—	Go to Step 2	Go to Step 5

DTC P1154 HO2S Transition Time Ratio Bank2 Sensor1 (cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect the following items: • Ensure that the Bank 2 HO2S 1 is securely installed. • Check for corrosion on terminals. • Check terminal tension (at Bank 2 HO2S and at the PCM). • Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to Step 9	Go to Step 6
6	1. Disconnect Bank 2 HO2S 1 and jumper HO2S low (PCM side) signal circuit to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage on the Engine 1 Data List. Does the scan tool indicate voltage within specified values?	375–525 mV	Go to Step 7	Go to Step 10
7	1. Jumper Bank 2 HO2S 1 high and low (PCM side) signal circuits to ground. 2. Using a scan tool, monitor Bank 2 HO2S 1 voltage. Does the scan tool indicate voltage below specified value?	200 mV	Go to Step 12	Go to Step 11
8	Important: Before replacing a sensor, the cause of the contamination must be determined and corrected. Check for the following conditions: • Fuel contamination. • Use of improper RTV sealant. • Engine oil/coolant consumption. Replace the affected Heated Oxygen Sensor. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
9	Repair the condition as necessary. Is the action complete?	—	Go to Step 13	—
10	Repair the open Bank 2 HO2S 1 low signal circuit or grounded Bank 2 HO2S 1 high signal circuit. Is the action complete?	—	Go to Step 13	—
11	Repair the open Bank 2 HO2S 1 high signal circuit or faulty PCM connections. Is the action complete?	—	Go to Step 13	—
12	Replace the Bank 2 HO2S 1. Refer to <i>Heated Oxygen Sensor (HO2S)</i> . Is the action complete?	—	Go to Step 13	—
13	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 14	Go to Step 2
14	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1171 Fuel System Lean During Acceleration

Circuit Description

The PCM can identify if the vehicle's fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). When the power enrichment mode of operation is requested during Closed Loop operation (by heavy acceleration), the PCM will provide more fuel to the engine. Under these conditions, the PCM should detect a rich condition.

Conditions for Setting the DTC

- DTCs P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0410, P0412, P1112, P1114, P1121, P1153, P1155 not set.
- The engine is operating in Closed Loop.
- Not in fuel cut off mode.
- The PCM detects lean oxygen sensor voltage for 3 seconds during power enrichment mode.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- A restricted fuel filter can supply adequate amounts of fuel at idle but may not be able to supply enough fuel during heavy acceleration. A vapor lock condition can also set this DTC.
- If it is not possible to cause this DTC to re-set, it may have been caused by the customer running the vehicle out of fuel.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Wrap a shop towel around the fuel pressure connector to absorb any small amount of fuel leakage that may occur when installing the gauge. With the ignition ON, pump pressure should be 284–325 kPa (41–47 psi). This pressure is controlled by spring pressure within the regulator assembly. Pressure below 284 kPa (41 psi) may cause hard starting cold and poor driveability. Low enough pressure will cause the engine not to run at all. Restricted flow may allow the engine to run at idle, or at low speeds, but may cause a surge and stall when more fuel is required, as when accelerating or driving at high speeds. Low fuel pressure under heavy acceleration conditions may set this DTC.

DTC P1171 Fuel System Lean During Acceleration

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. If any HO2S DTC is set, go to that table first. 2. Install Fuel Pressure Gauge J 34730-1. Refer to <i>Fuel System Diagnosis</i> . 3. Ignition OFF for 10 seconds, A/C OFF. 4. Turn the ignition ON. The fuel pump will run for about 2 seconds. It may be necessary to cycle the ignition ON more than once to obtain maximum pressure. 5. Note fuel pressure with pump running. Pressure should be within the range shown. When the pump stops, the pressure may vary slightly then should hold steady. Is the pressure correct and does it hold?	284–325 kPa (41–47 psi)	Go to Step 3	Go to Fuel System Diagnosis
3	Check for the following conditions: • Restricted in-line fuel filter. • Restricted/damaged fuel pressure line. • Restricted/clogged fuel pump strainer. Was a problem found and corrected?	—	Go to Step 5	Go to Step 4
4	Replace faulty fuel pump. Is the action complete?	—	Go to Step 5	—
5	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 6	Go to Step 2
6	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1222 Injector Control Circuit Intermittent

Circuit Description

The PCM will enable an injector on the intake stroke of each cylinder. Individual cylinder fuel control is referred to as Sequential Multiport Fuel Injection (SFI).

Ignition voltage is supplied directly to the fuel injectors. The PCM controls each injector by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be (refer to *Injectors* for schematic) low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The PCM will monitor each injector circuit for the following:

- A grounded circuit.
- An open circuit.
- A circuit shorted to voltage.
- An injector that is open.
- An injector that is shorted or has low resistance.

When the PCM detects any of the above malfunctions, a DTC P0200/P1222 will set and the driver will be disabled.

Conditions for Setting the DTC

- Ignition voltage greater than 10.0 volts.
- The PCM detects the wrong voltage potential on any injector driver circuits for less than 0.5 second.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If an injector is disconnected while the engine is operating and a DTC P0200 sets, the injector driver will be disabled for the entire ignition cycle.
- When the injector driver is disabled, an engine misfire will be apparent and a misfire DTC will set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. If the misfire counters do not appear to indicate a specific cylinder, check the injector power feed circuit for an intermittent open. This includes the injector fuses themselves as well as the connections within the fuse panel.
5. If moving the related circuitry does not cause the counter to increment, an injector coil which opens intermittently when hot can cause this DTC to set. Refer to *Fuel Injector Coil Test*.

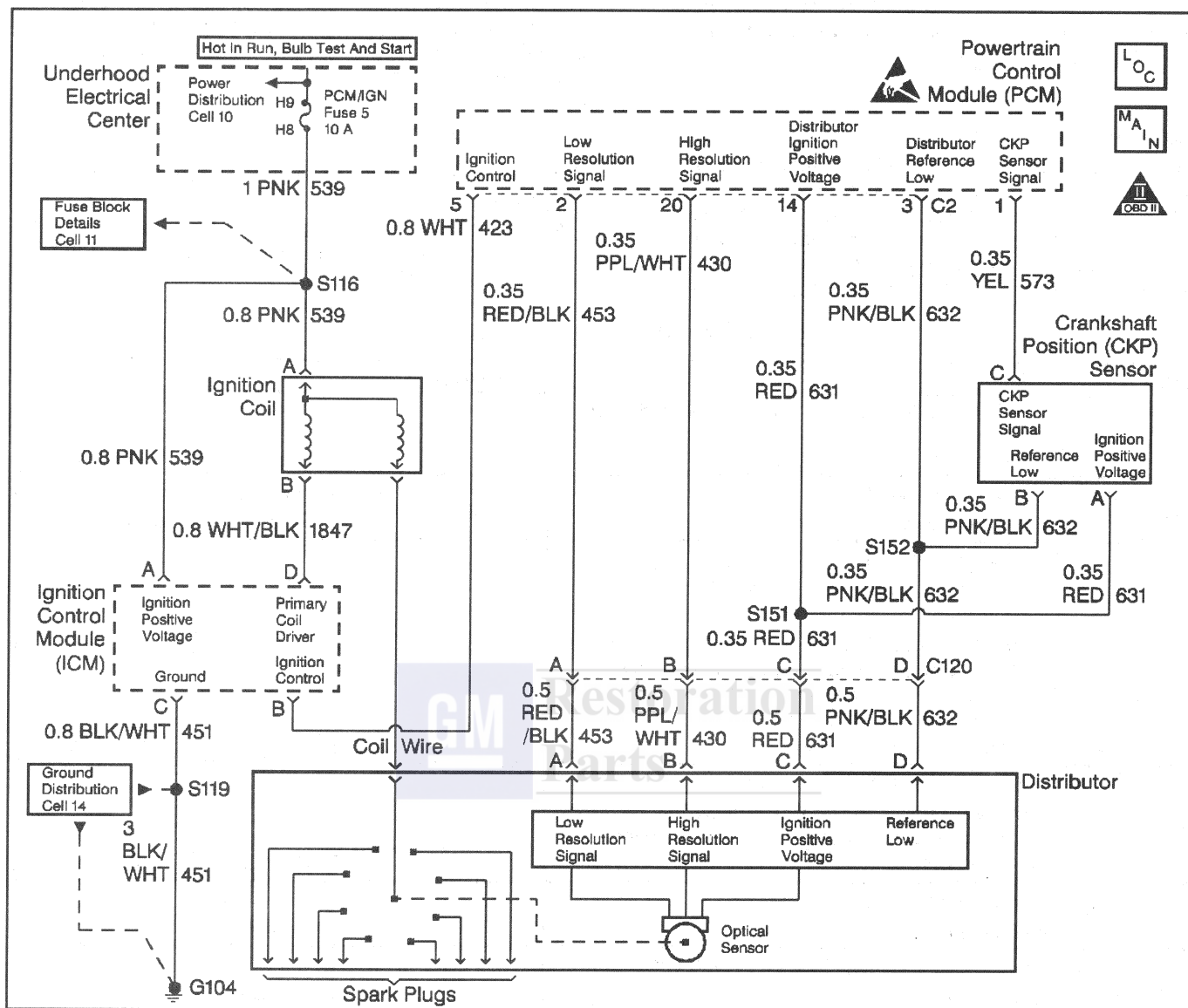
DTC P1222 Injector Control Circuit Intermittent

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go To Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine. 3. Using a scan tool, monitor Failed This Ignition under DTC Status for DTC P0200. Did DTC P0200 fail this ignition cycle?	—	Go to DTC P0200 Injector Control Circuit	Go to Step 3
3	Using a scan tool, monitor the Misfire Hist. Counters on the Misfire Data List (There are a total of 8 counters. One counter per cylinder.) Do any of the Misfire Hist. counters indicate a number other than 0.0 counts?	—	Go to Step 5	Go to Step 4
4	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 5	Go to Diagnostic Aids
5	1. Start the engine and idle. 2. Using a scan tool, observe Misfire Curr counter for the affected cylinder while moving related harness connectors (At injector and PCM). Does Misfire Curr counter value start incrementing when a related connector is being moved?	—	Go to Step 6	Go to Fuel Injector Coil Test
6	1. Turn the ignition OFF. 2. Disconnect the injector harness connector for the affected cylinder. 3. Using a test light (J 34142-B) connected to ground, probe the ignition feed circuit in the injector harness connector. 4. Turn the ignition ON. 5. Observe the test light, while moving related harness connectors. Does the test light blink?	—	Go to Step 9	Go to Step 7

DTC P1222 Injector Control Circuit Intermittent (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector C1. 3. Using a jumper, ground the injector control circuit for the affected cylinder at the PCM harness connector. 4. Using a test light connected to B+, probe the injector control circuit for the affected cylinder at the injector harness connector. 5. Observe the test light, while moving related harness connectors. Does the test light blink?	—	Go to Step 8	Go to Step 10
8	Repair the injector driver circuit to isolated injector. Is the action complete?	—	Go to Step 11	—
9	Repair the injector ignition feed circuit to isolated injector. Is the action complete?	—	Go to Step 11	—
10	Re-inspect all the related circuits and connections. Was a problem found and corrected?	—	Go to Step 11	Go to Fuel Injector Coil Test
11	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 12	Go to Step 2
12	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1351 IC Circuit High Voltage



30389

Circuit Description

The distributor ignition system provides two timing inputs to the PCM, a high resolution signal (180 pulses per crankshaft revolution) and a low resolution signal (4 pulses per crankshaft revolution). One of the PCM's uses for these signals is to calculate spark timing. This timing signal is sent to the ignition coil module on the IC circuit. Each pulse on the IC circuit triggers the coil module to fire the ignition coil. The secondary ignition voltage then travels through the distributor to the spark plug. The IC signal voltage ranges from about 0.5 volt to 4.5 volts.

Conditions for Setting the DTC

The PCM detects voltage on the IC circuit in excess of 4.6 volts during cranking.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter

can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

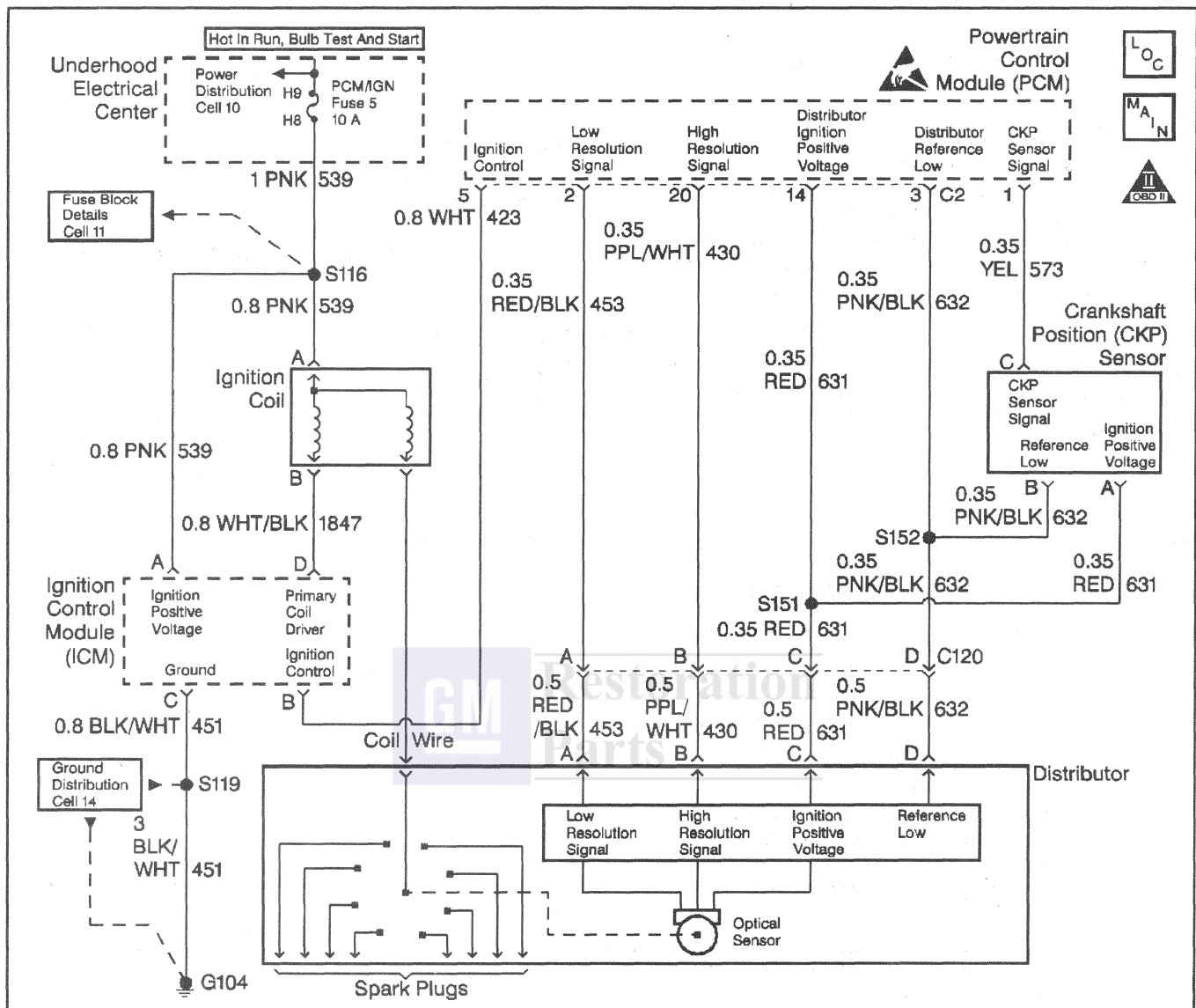
Number(s) below refer to step numbers on the diagnostic table.

3. The voltage fluctuates. This feature on the DVM will capture the minimum and maximum voltage of the signal.

DTC P1351 IC Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Attempt to start the engine. Does the engine start?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the Ignition Coil Module harness connector. 3. Using a DVM (J 39200) on DC scale, 40 volt range and Peak Min/Max, measure the voltage between the Ignition Coil Module harness connector terminal B and ground during cranking. Is the voltage within the range shown?	1.0–4.0 V	Go to Step 4	Go to Step 5
4	1. Turn the ignition ON, engine OFF. 2. With a test light (J 34142–B) connected to B+, probe Ignition Coil Module harness connector terminal C. Is the test light ON?	—	Go to Step 7	Go to Step 6
5	Repair the IC circuit. Is the action complete?	—	Go to Step 8	—
6	Repair the open Ignition Coil Module ground circuit. Is the action complete?	—	Go to Step 8	—
7	Replace the faulty Ignition Coil Module. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1361 IC Circuit Low Voltage



30389

Circuit Description

The distributor ignition system provides two timing inputs to the PCM, a high resolution signal (180 pulses per crankshaft revolution) and a low resolution signal (4 pulses per crankshaft revolution). One of the PCMs uses for these signals is to calculate spark timing. This timing signal is sent to the ignition coil module on the IC circuit. Each pulse on the IC circuit triggers the coil module to fire the ignition coil. The secondary ignition voltage then travels through the distributor to the spark plug. The IC signal voltage ranges from about 0.5 volt to 4.5 volts.

Conditions for Setting the DTC

The PCM detects 84 crankshaft revolutions without any IC activity during cranking.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.

- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter

can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

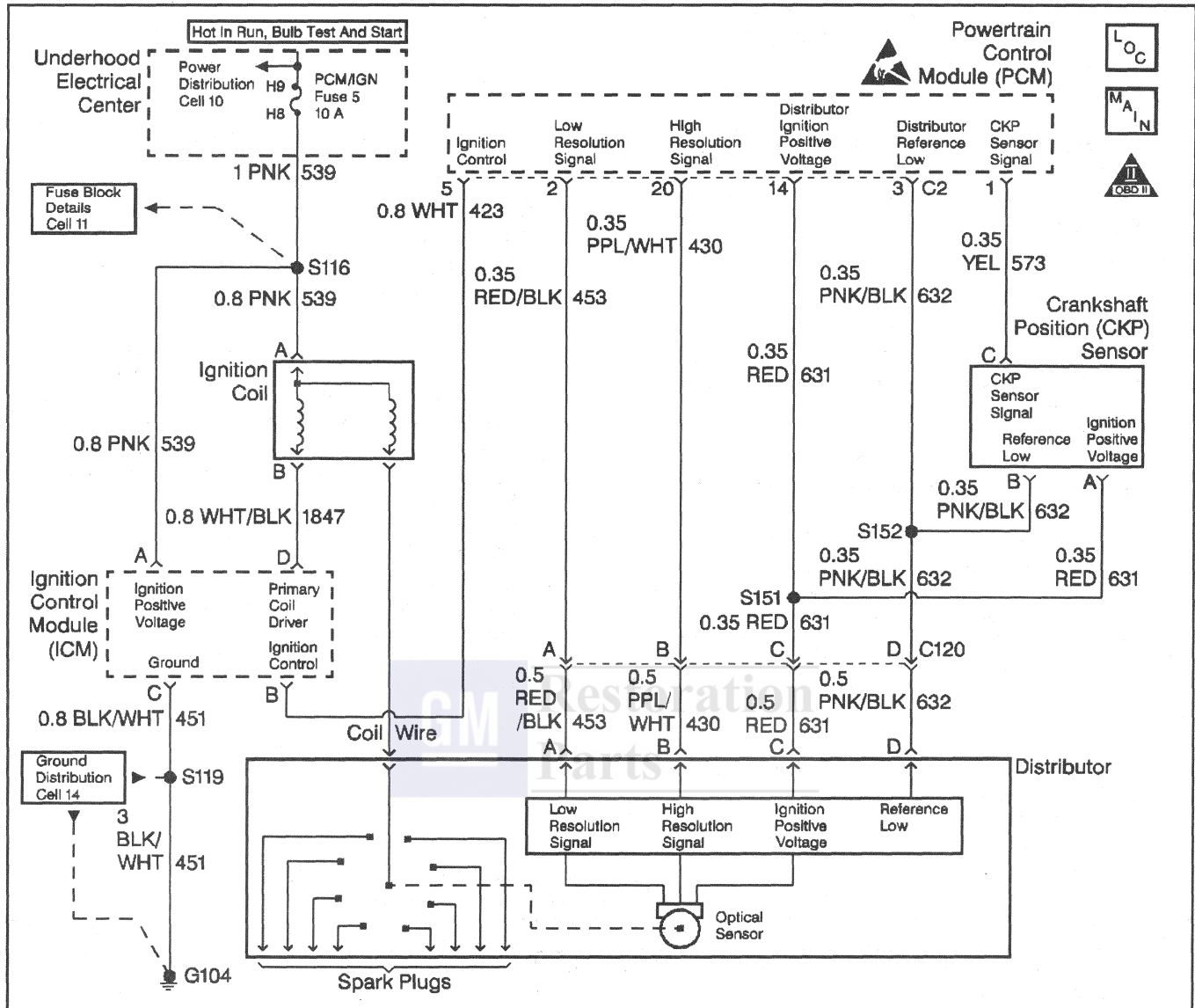
Number(s) below refer to step numbers on the diagnostic table.

3. The voltage fluctuates. This feature on the DVM will capture the minimum and maximum voltage of the signal.

DTC P1361 IC Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Attempt to start the engine. Does the engine start?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the Ignition Coil Module harness connector. 3. Using a DVM (J 39200) on DC scale, 40 volt range and PEAK MIN/MAX, measure the voltage between the Ignition Coil Module harness connector terminal B and ground during cranking. Is the voltage within the range shown?	1.0–4.0 V	Go to Step 4	Go to Step 5
4	1. Turn the ignition ON, engine OFF. 2. With a test light (J 34142–B) connected to B+, probe Ignition Coil Module harness connector terminal C. Is the test light ON?	—	Go to Step 7	Go to Step 6
5	Repair the IC circuit. Is the action complete?	—	Go to Step 8	—
6	Repair the open Ignition Coil Module ground circuit. Is the action complete?	—	Go to Step 8	—
7	Replace the faulty Ignition Coil Module. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1371 DI Low Resolution Circuit



30389

Circuit Description

The distributor ignition system supplies two timing inputs to the PCM, a high resolution signal (180 pulses per one crankshaft revolution) and a low resolution signal (4 pulses per one crankshaft revolution). The PCM can determine if one of the timing inputs is not being received by comparing the two inputs. If the PCM detects the high resolution timing pulse without detecting the low resolution timing pulse, DTC P1371 will set.

The high and low resolution circuits toggle between 0 and 5 volts as the camshaft turns. The following malfunctions to the low resolution circuit will cause a DTC P1371 to set:

- An open.
- A short to voltage.
- A short to ground.
- A defective ignition module within the distributor.

Conditions for Setting the DTC

- The PCM detects a predetermined amount of high resolution pulses before detecting any low resolution pulses.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- For any test that requires probing the PCM or a component harness connector, must use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent damage to the harness connector terminals.
- DTC P1371 will set if the high and low resolution circuits are shorted together. Before replacing any components, inspect the low and high resolution circuits for being shorted.
- When an intermittent DTC P1371 occurs, a misfire will be apparent. To locate an intermittent, use the scan tools snapshot feature. Try to duplicate the conditions under which the misfire is present. When reviewing captured data, watch for any abnormal high and low resolution timing pulses.
- If DTC P1351 and/or DTC P1361 is also set with a DTC P1371, and no external fault can be found, replace the PCM. If only DTC P1371 is set and the distributor connections are OK, replace the distributor.

- If distributor components must be replaced, check distributor vent system operation. Refer to *Distributor Ignition System*.
- If a DTC P1371 is not present and a no start condition is present, Refer to *Engine Cranks but Does Not Run*.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. This step verifies if the malfunction is active. If the engine starts, the malfunction is not present at this time.
3. If the harness and connections check out OK, but the engine stalls after reaching higher operating temperatures, return to Step 2 and test the system while the fault is present.
4. Normal voltage may vary slightly from the specified value. A value that is significantly higher or lower indicates a problem. This step isolates the circuit between the test connector and the PCM.
5. Normal voltage may vary slightly from the specified value. A value that is significantly higher or lower indicates a problem. This step isolates the circuit between the test connector and the distributor.

DTC P1371 DI Low Resolution Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Using the scan tool, monitor Engine Speed. 3. Crank the engine. Does the scan tool indicate RPM while cranking the engine?	—	Go to Step 3	Go to Step 4
3	1. Start the engine. 2. With the engine running, move related harnesses and connectors between the distributor and the PCM. Does the engine cut out or stall while moving the various components.	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the ignition system test connector. 3. Turn the ignition ON, use a DVM (J 39200) on DC volts scale, measure voltage on terminal A at the PCM side of the ignition test connector. Does the DVM indicate the voltage specified?	5 V	Go to Step 5	Go to Step 8

DTC P1371 DI Low Resolution Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Reconnect the ignition system test connector. 3. Disconnect Distributor connector. 4. Turn the ignition ON, use a DVM (J 39200) on DC volts scale, measure voltage on terminal A of Distributor electrical connector. Does the DVM indicate voltage specified?	5 V	Go to Step 11	Go to Step 6
6	Is voltage higher than the specified value?	5 V	Go to Step 7	Go to Step 12
7	Repair the short to voltage on Low Resolution signal circuit from PCM to ignition system test connector. Is the action complete?	—	Go to Step 15	—
8	Is the voltage higher than the specified value?	5 V	Go to Step 10	Go to Step 9
9	Repair the open or grounded Low Resolution circuit from the ignition system test connector to the PCM. Was the condition found and repaired?	—	Go to Step 15	Go to Step 14
10	Repair the short to voltage on Low resolution signal circuit from ignition system test connector to Distributor. Is the action complete?	—	Go to Step 15	—
11	Repair the faulty Distributor connection or faulty Distributor. Is the action complete?	—	Go to Step 15	—
12	Repair the open or grounded Low Resolution circuit from ignition system test connector to the Distributor. Was the condition found and repaired?	—	Go to Step 15	Go to Step 14
13	Repair the harness/connections as necessary. Is the action complete?	—	Go to Step 15	—
14	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 15	—
15	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 16	Go to Step 2
16	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1380 ABS DTC Rough Road Data Unstable

Circuit Description

The PCM detects engine misfire by detecting variations in crankshaft deceleration between firing strokes. For accurate detection of engine misfire, the PCM must be able to distinguish between crankshaft deceleration caused by actual misfire and deceleration caused by rough road conditions. The ABS Brake System can detect if the vehicle is on a rough road based on wheel acceleration/deceleration data supplied by the wheel speed sensors. If the ABS system detects rough road above a predetermined threshold, this information is sent to the PCM via serial data (UART). The PCM can then take the rough road into account when calculating misfire. Even if the ABS is malfunctioning and cannot detect rough roads, the misfire diagnostic will continue to run. However, if a misfire DTC is set, this additional DTC will also set indicating that rough road data was not available during the misfire calculation due to an ABS System malfunction.

Conditions for Setting the DTC

- DTCs P0100, P0102, P0103, P0122, P0123, P0335, P0336, P0742 not set.
- Vehicle speed above 5 mph.
- Light to moderate engine load.
- Engine misfire detected (DTC P0300 set).
- An ABS system malfunction exists preventing the PCM from receiving rough road detection data.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) after two consecutive drive trips that the misfire diagnostic runs and fails. This DTC can only set if the MIL is already ON for misfire.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the misfire diagnostic runs and does not fail.
- If no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

1. The ABS system must be serviced before diagnosing for misfire, because actual engine misfire may or may not exist. The following two examples illustrate how this DTC can be set with or without actual engine misfire:
 - There was actual engine misfire during an ABS system malfunction.
 - The vehicle was driven on a rough road, the ABS system could not detect this due to a malfunction, and the PCM interpreted the variations in crankshaft speed caused by the rough road as misfire.

DTC P1380 ABS DTC Rough Road Data Unstable

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to <i>Brakes, Antilock Brake System (ABS)</i>	Go to <i>Powertrain OBD System Check</i>

DTC P1381 Misfire Detected No EBCM/PCM Serial Data

Circuit Description

The PCM detects engine misfire by detecting variations in crankshaft deceleration between firing strokes. For accurate detection of engine misfire, the PCM must be able to distinguish between crankshaft deceleration caused by actual misfire and deceleration caused by rough road conditions. The ABS Brake System can detect if the vehicle is on a rough road based on wheel acceleration/deceleration data supplied by the wheel speed sensors. If the ABS system detects rough road above a predetermined threshold, this information is sent to the PCM via serial data (UART). The PCM can then take the rough road into account when calculating misfire. Even if serial data communication between the ABS System and the PCM is malfunctioning and the PCM can not receive rough road data, the misfire diagnostic will continue to run. However, if a misfire DTC is set, this additional DTC will also set indicating that rough road data was not available during the misfire calculation due to a serial data malfunction.

Conditions for Setting the DTC

- Vehicle speed above 10 mph.
- Engine speed below 3500 RPM.
- Light to moderate engine load.
- Engine misfire detected (DTC P0300 set).
- A serial data malfunction exists preventing the PCM from receiving rough road detection data.
- Conditions met for 20 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) after two consecutive drive trips that the misfire diagnostic runs and fails. This DTC can only set if the MIL is already ON for misfire.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the misfire diagnostic runs and does not fail.
- If no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

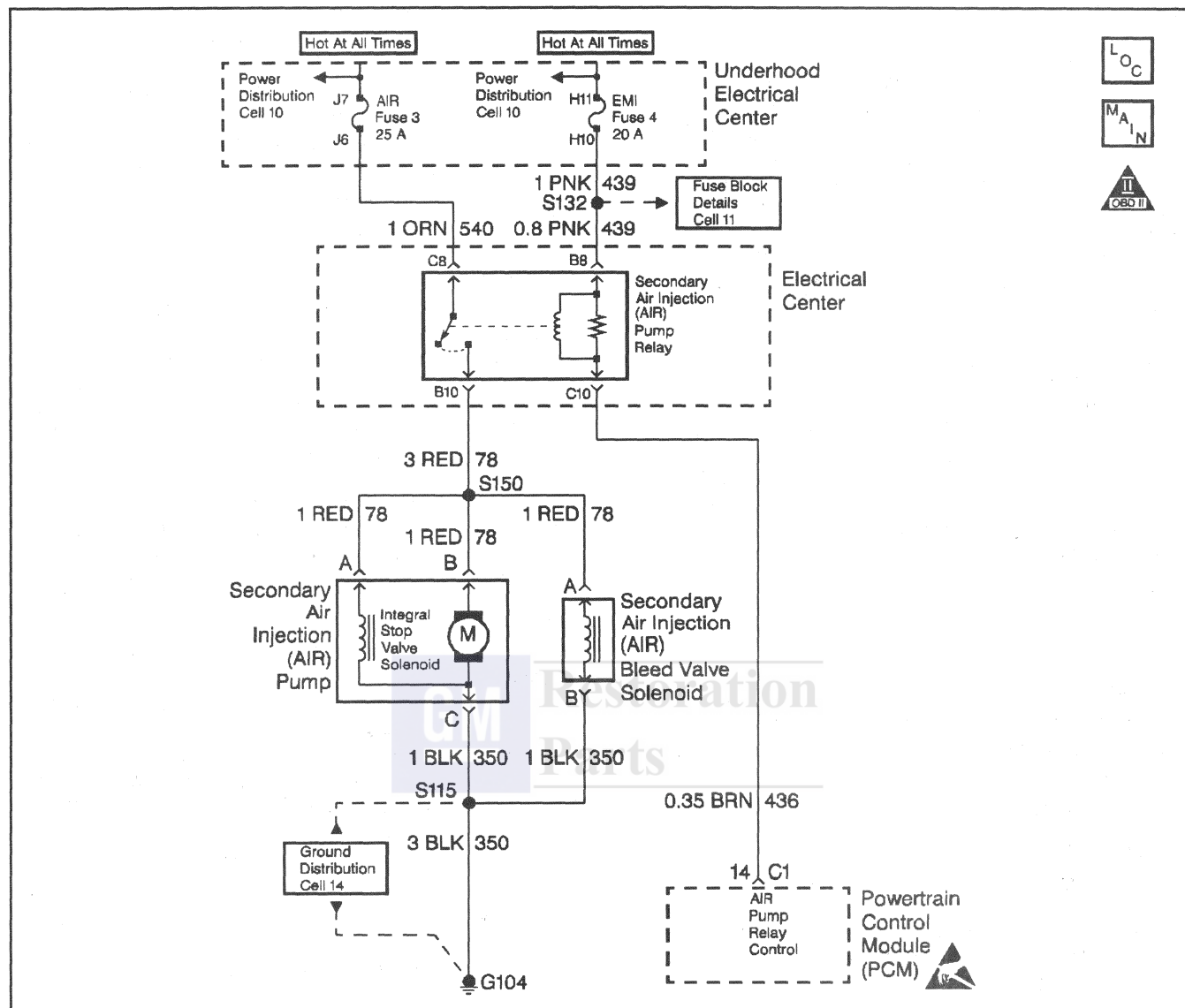
Number(s) below refer to step numbers on the diagnostic table.

1. The serial data circuit (UART) must be serviced before diagnosing for misfire, because actual engine misfire may or may not exist. The following two examples illustrate how this DTC can be set with or without actual engine misfire:
 - There was actual engine misfire during a serial data circuit malfunction.
 - The vehicle was driven on a rough road, the PCM could not receive this data from the ABS system due to a serial data circuit malfunction, and the PCM interpreted the variations in crankshaft speed caused by the rough road as misfire.

DTC P1381 Misfire Detected No EBCM/PCM Serial Data

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to <i>Brakes, Antilock Brake System (ABS)</i>	Go to <i>Powertrain OBD System Check</i>

DTC P1415 AIR System Bank1



30415

Circuit Description

An AIR pump is used on this vehicle to lower tail pipe emissions on start-up. The PCM supplies a ground to the AIR pump relay, which energizes the AIR pump.

The PCM will run two tests using the HO2S voltages to diagnose the AIR system. Both tests have two parts.

Test one consists of the following:

Part 1

When the AIR pump is enabled, the PCM monitors the HO2S voltage. If the HO2S voltages go below a threshold, the PCM interprets this as an indication that the AIR system is operational.

Part 2

When the AIR pump is disabled, the PCM monitors the HO2S voltages. The HO2S voltages should increase above a threshold and switch normally.

If the PCM did not sense more than a predetermined amount of HO2S rich switches, a malfunction will be reported. If both of these test indicate a pass, no further action is taken. If one of the above tests failed or is inconclusive, the diagnostic will proceed to test two.

Test two consist of the following:

Part 1

During this test the PCM will activate the AIR pump during closed loop operation. When the AIR is activated, the PCM will monitor the HO2S voltages and short term fuel trim values for both banks of the engine. If the AIR system is operating properly, the HO2S voltages should go low and the short term fuel trim should go high.

Part 2

The PCM checks that the HO2S voltages return to above a rich threshold when the air pump is disabled.

If the PCM determines that the HO2S voltages for *both* banks did not respond as expected during the tests, DTC P0410 will set. If only one sensor responded, the PCM will set either a DTC P1415 or P1416 to indicate on which bank the AIR system is inoperative.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0116, P0117, P0118, P0133, P0135, P0153, P0155, P0171, P0172, P0174, P0175, not set.
- Engine operating about 2 seconds.

Test 1

- TP angle not moving more than 1%.
- Engine load less than 6.6%.
- Engine air flow less than 26 grams per second.
- Air fuel ratio greater than 13:1.
- ECT less than 115°C (239°F).
- HO2S bias voltage between 365 mV and 513 mV.
- HO2S voltage does not go below 400 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go below 417 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)
- HO2S voltage does not go above 722 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go above 700 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)

Test 2

- Engine operating longer than 200 seconds.
- Engine speed greater than 600 RPM.
- Maximum air flow 17 gm/s.
- Engine coolant temperature between 60°C (140°F) and 115°C (239°F).
- IAT greater than 10°C (50°C).
- Ignition voltage greater than 11.0 volts.
- Engine load less than 5.5%.
- HO2S voltage does not go below 222 mV within 1.5 seconds.
- Short term fuel trim does not go above a predetermined amount.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Casting flash in the exhaust manifold may restrict the amount of air flow necessary to affect the HO2S voltage. If this is suspected, remove the air pipe from the manifold and inspect the passage.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- For intermittents, refer to *Symptoms*.

Test Description

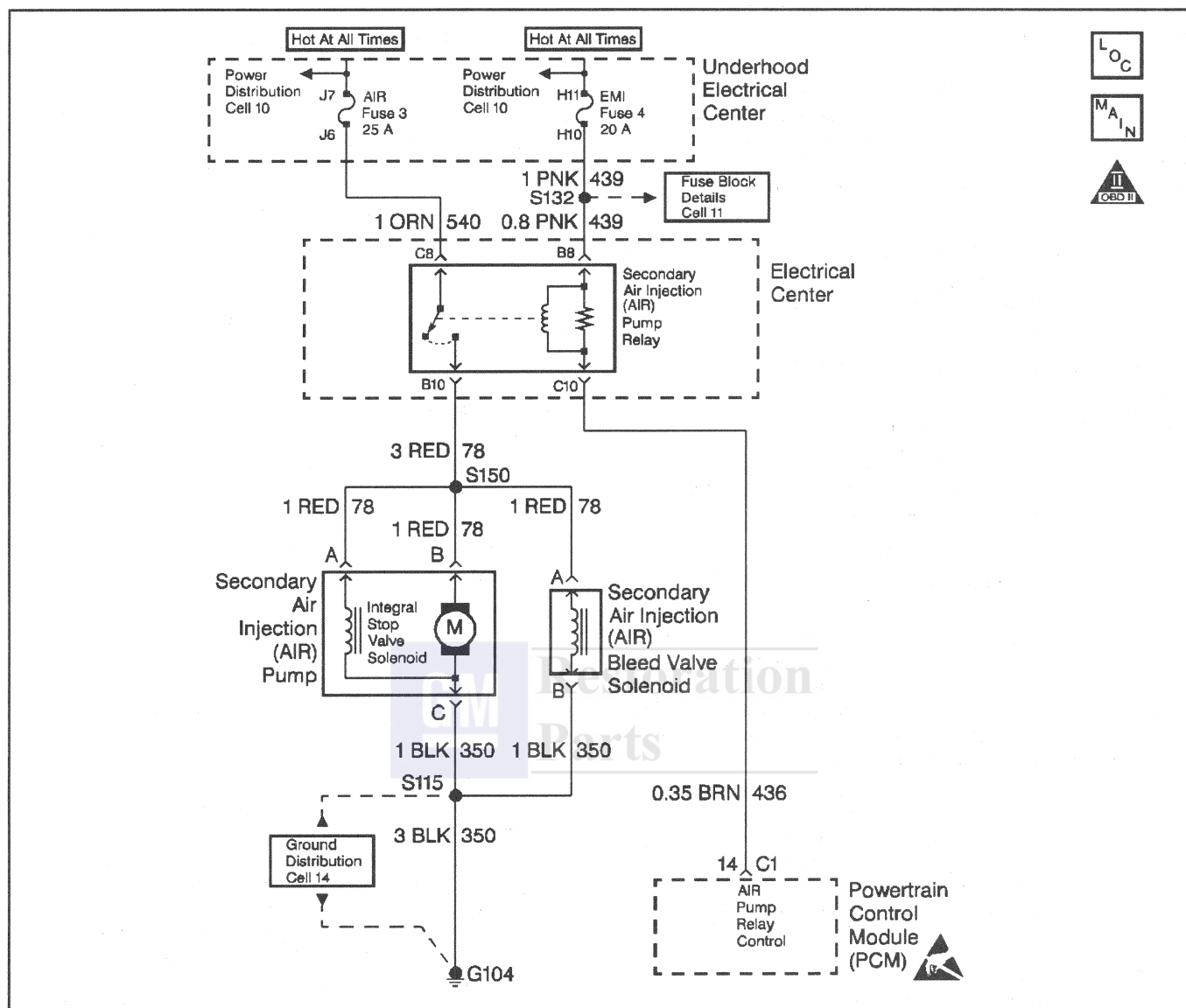
Number(s) below refer to step numbers on the diagnostic table.

3. A check valve that flows in both directions will cause heat damage to components.

DTC P1415 AIR System Bank1

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine Closed Loop. 3. Turn all the accessories OFF. 4. Using a scan tool, monitor the Bank1 Sensor 1 (Left Front) HO2S voltage display on the Engine 1 Data List. 5. Using a scan tool, enable the AIR pump. 6. Observe and note the Bank1 Sensor 1 (Left Front) HO2S voltage, as the AIR pump is enabled. Does the HO2S voltage drop below the specified value?	350 mV	Go to Diagnostic Aids	Go to Step 3
3	Visually/physically inspect all hoses and pipes for: • Being connected. • Clamps are secure on pipes and hoses. • No kinks, holes, or pinched hoses/pipes. • Components with evidence of heat damage. Did all the above check OK?	—	Go to Step 4	Go to Step 6
4	1. Disconnect the hose from the check valve at the left exhaust manifold. 2. Using a scan tool, enable the AIR pump. Is air present at the hose outlet?	—	Go to Step 7	Go to Step 5
5	Repair the restriction or blockage in AIR hoses/pipes between the left exhaust manifold and the point where the system branches to both sides of the engine. Is the action complete?	—	Go to Step 8	—
6	Repair the condition found. Is the action complete?	—	Go to Step 8	—
7	Replace the check valve. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1416 AIR System Bank2



30415

Circuit Description

An AIR pump is used on this vehicle to lower tail pipe emissions on start-up. The PCM supplies a ground to the AIR pump relay, which energizes the AIR pump.

The PCM will run two tests using the HO₂S voltages to diagnose the AIR system. Both tests have two parts.

Test one consists of the following:

Part 1

When the AIR pump is enabled, the PCM monitors the HO₂S voltage. If the HO₂S voltages go below a threshold, the PCM interprets this as an indication that the AIR system is operational.

Part 2

When the AIR pump is disabled, the PCM monitors the HO₂S voltages. The HO₂S voltages should increase above a threshold and switch normally.

If the PCM did not sense more than a predetermined amount of HO₂S rich switches, a malfunction will be reported. If both of these tests indicate a pass, no further action is taken. If one of the above tests failed or is inconclusive, the diagnostic will proceed to test two.

Test two consists of the following:

Part 1

During this test the PCM will activate the AIR pump during closed loop operation. When the AIR is activated, the PCM will monitor the HO₂S voltages and short term fuel trim values for both banks of the engine. If the AIR system is operating properly, the HO₂S voltages should go low and the short term fuel trim should go high.

Part 2

The PCM checks that the HO2S voltages return to above a rich threshold when the air pump is disabled.

If the PCM determines that the HO2S voltages for *both* banks did not respond as expected during the tests, DTC P0410 will set. If only one sensor responded, the PCM will set either a DTC P1415 or P1416 to indicate on which bank the AIR system is inoperative.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0116, P0117, P0118, P0133, P0135, P0153, P0155, P0171, P0172, P0174, P0175, not set.
- Engine operating about 2 seconds.

Test 1

- TP angle not moving more than 1%.
- Engine load less than 6.6%.
- Engine air flow less than 26 grams per second.
- Air fuel ratio greater than 13:1.
- ECT less than 115°C (239°F).
- HO2S bias voltage between 365 mV and 513 mV.
- HO2S voltage does not go below 400 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go below 417 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)
- HO2S voltage does not go above 722 mV for 19 seconds (Engine coolant temperature less than 75°C (167°F) when the engine is started.) or HO2S voltage does not go above 700 mV for 7 seconds (Engine coolant temperature greater than 75°C (167°F) when the engine is started.)

Test 2

- Engine operating longer than 200 seconds.
- Engine speed greater than 600 RPM.
- Maximum air flow 17 gm/s.
- Engine coolant temperature between 60°C (140°F) and 115°C (239°F).
- IAT greater than 10°C (50°C).
- Ignition voltage greater than 11.0 volts.
- Engine load less than 5.5%.
- HO2S voltage does not go below 222 mV within 1.5 seconds.
- Short term fuel trim does not go above a predetermined amount.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- Casting flash in the exhaust manifold may restrict the amount of air flow necessary to affect the HO2S voltage. If this is suspected, remove the air pipe from the manifold and inspect the passage.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- For intermittents, refer to *Symptoms*.

Test Description

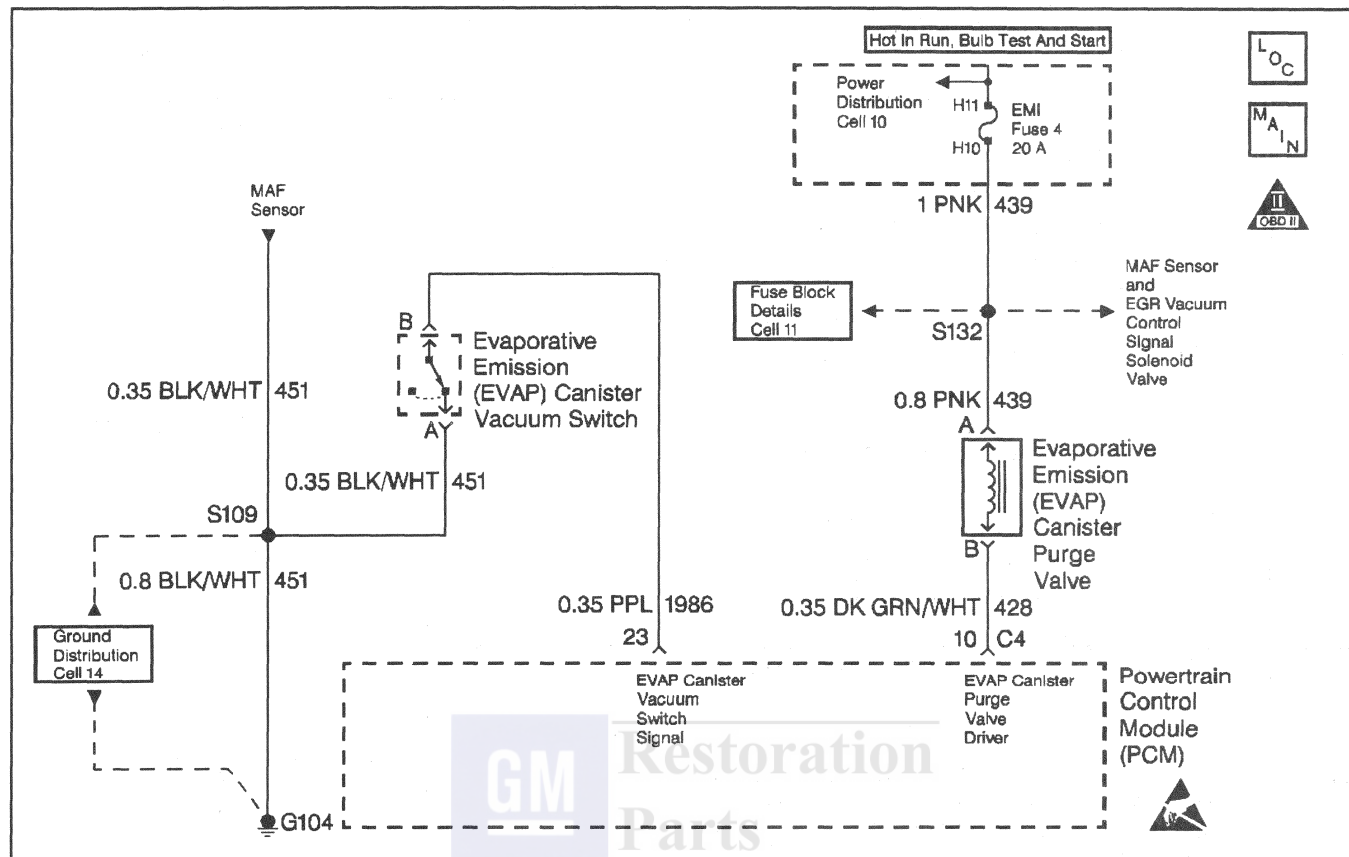
Number(s) below refer to step numbers on the diagnostic table.

3. A check valve that flows in both directions will cause heat damage to components.

DTC P1416 AIR System Bank2

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install scan tool. 2. Engine idling in Closed Loop. 3. Turn all accessories OFF. 4. Using a scan tool, monitor the Bank 2 Sensor 1 (Right Front) HO2S voltage display on the Engine 1 Data List. 5. Using a scan tool, enable the AIR pump. 6. Observe and note the Bank 2 Sensor 1 (Right Front) HO2S voltage, as the AIR pump is enabled. Does the HO2S voltage drop below the specified value?	350 mV	Go to Diagnostic Aids	Go to Step 3
3	Visually/physically inspect all hoses and pipes for: • Being connected. • Clamps are secure on pipes and hoses. • No kinks, holes, or pinched hoses/pipes. • Components with evidence of heat damage. Did all the above check OK?	—	Go to Step 4	Go to Step 6
4	1. Disconnect the hose from the check valve at the right exhaust manifold. 2. Using a scan tool, enable the AIR pump. Is air present at the hose outlet?	—	Go to Step 7	Go to Step 5
5	Repair restriction or blockage in AIR hoses/pipes between the right exhaust manifold and the point where the system branches to both sides of the engine. Is the action complete?	—	Go to Step 8	—
6	Repair the condition found. Is the action complete?	—	Go to Step 8	—
7	Replace the check valve. Is the action complete?	—	Go to Step 8	—
8	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1441 EVAP System Flow During Non-Purge



30414

Circuit Description

The EVAP vacuum switch is a normally closed switch connected to ground, mounted in the vacuum line between the EVAP canister and the EVAP solenoid. 12 volts is supplied to the switch through a pull-up resistor in the PCM. When the PCM commands the EVAP canister purge solenoid valve open (purge ON) and engine vacuum draws the evaporative emissions from the canister, the EVAP vacuum switch opens (signal voltage high) providing feedback to the PCM that the EVAP system is operating. When the PCM commands purge OFF, the EVAP vacuum switch closes (signal voltage low) confirming purging has ceased.

Conditions for Setting the DTC

- DTCs P0100, P0101, P0102, P0103, P0106, P0323, P0325, P0327, P0332, P0335, P0336, P0372, P0400, P0403, P0410, P0412, P0420, P0430, P0441, P0443, P0500, P0502, P0503, P0506, P0507, P0530, P0531, P0719, P0758, P1415, P1642, P1652 not set.
- ECT less than 115°C (239°F)
- IAT greater than 3°C (37°F)

- Engine speed between 500 and 3000 RPM
- TP Angle less than 50%
- MAP less than 70 kPa
- BARO greater than 77 kPa
- Purge not enabled
- The PCM detects high signal voltage on the EVAP vacuum switch signal circuit when the PCM is not commanding purge ON.
- Fault present for 5 seconds

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Before replacing any components, visually/physically check for the following:

- Mis-routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

- Kinked or damaged vacuum hoses.
- Physically damaged system components.
- Inspect components and vacuum lines for traces of carbon or other contaminants. The presence of foreign material may be causing a restriction in the system or preventing the solenoid valve from closing properly. Either condition may cause a DTC to set.

For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

- Since the vacuum switch only requires a vacuum of only a few inches of *water* to operate (a very small unit of vacuum), a properly operating switch will transition even with the canister end of the hose disconnected and un-plugged.

DTC P1441 EVAP System Flow During Non-Purge

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: This DTC will set if the vacuum lines at the EVAP purge solenoid are reversed. Refer to under hood emission label for proper routing. 1. Turn the ignition ON, engine OFF. 2. Using the scan tool, check the EVAP vacuum switch status. Does the scan tool indicate, EVAP vacuum switch No Purge.	—	Go to Step 3	Go to Step 6
3	1. Start the engine. 2. Using the scan tool, check the EVAP vacuum switch status. Does the EVAP vacuum switch status change to Purge when the engine is started?	—	Go to Step 19	Go to Step 4
4	1. Start the engine. Increase the Idle speed to 1500 RPM. 2. Using the scan tool, command the EVAP canister purge solenoid valve ON and OFF while observing the EVAP vacuum switch status. Important: When the EVAP solenoid is commanded ON then OFF, the scan tool display should change from Purge to No Purge almost immediately. Does the scan tool indicate No Purge within the time period indicated?	5 seconds	Go to Diagnostic Aids- EVAP System	Go to Step 5

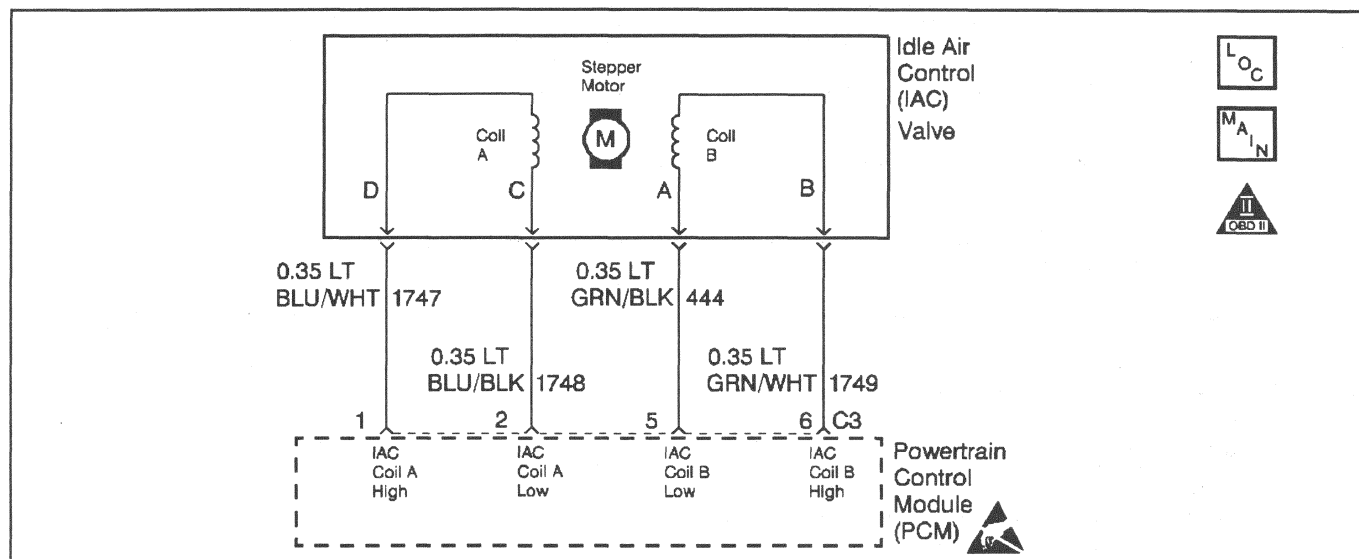
DTC P1441 EVAP System Flow During Non-Purge (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the engine OFF. 2. Disconnect the purge hose from the canister (the vacuum line from the EVAP vacuum switch). Refer to <i>EVAP Canister</i> . 3. Start the engine. Increase the Idle speed to 1500 RPM. 4. Using the scan tool, command the EVAP canister purge solenoid valve ON and OFF while observing the EVAP vacuum switch status. Important: When the EVAP solenoid is commanded ON then OFF, the scan tool display should change from Purge to No Purge almost immediately. Does the scan tool indicate No Purge within the time period indicated?	5 seconds	Go to Step 11	Go to Step 12
6	1. Disconnect the EVAP vacuum switch harness connector. 2. With a test light (J 34142-B) connected to B+, probe the ground circuit at the EVAP vacuum switch harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 13
7	Connect a fused jumper wire between the EVAP vacuum switch harness connector terminals. Does the scan tool indicate EVAP vacuum switch No Purge?	—	Go to Step 14	Go to Step 8
8	Using a DVM (J 39200) connected to ground, measure voltage at the signal circuit of the EVAP vacuum switch harness connector. Does the DVM indicate voltage near the specified value?	B+	Go to Step 18	Go to Step 9
9	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Using a DVM J 39200, check for continuity between the EVAP vacuum switch signal circuit and ground. Does the DVM indicate infinite resistance?	—	Go to Step 10	Go to Step 16
10	Using DVM J 39200, check continuity of the EVAP vacuum switch signal circuit from the vacuum switch harness connector to the PCM connector. Does the DVM indicate resistance is less than the specified value?	5 Ω	Go to Step 20	Go to Step 17
11	Replace the EVAP canister. Refer to <i>EVAP Canister</i> . The EVAP system must be inspected and/or cleaned before replacing any component. Is the action complete?	—	Go to Step 21	—
12	Repair restricted or kinked hose between canister and EVAP vacuum switch. Refer to <i>EVAP System Cleaning</i> for cleaning procedure. Is the action complete?	—	Go to Step 21	—
13	Repair the open ground circuit. Is the action complete?	—	Go to Step 21	—
14	Check connections at the EVAP vacuum switch. Was a problem found and corrected?	—	Go to Step 21	Go to Step 15

DTC P1441 EVAP System Flow During Non-Purge (cont'd)

Step	Action	Value(s)	Yes	No
15	Important: Contamination can cause the switch to fail. Refer to <i>EVAP System Cleaning</i> for inspection/cleaning procedures. Replace the EVAP vacuum switch. Refer to <i>EVAP Purge Vacuum Switch</i> . Is the action complete?	—	Go to Step 21	—
16	Repair the shorted signal circuit to ground. Is the action complete?	—	Go to Step 21	—
17	Repair the open signal circuit. Is the action complete?	—	Go to Step 21	—
18	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 21	Go to Step 20
19	Important: Contamination can cause the solenoid to fail open. Refer to <i>EVAP System Cleaning</i> for inspection/cleaning procedures. Replace the EVAP canister purge solenoid valve, refer to <i>EVAP Canister Purge Solenoid Valve</i> . Is the action complete?	—	Go to Step 21	—
20	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 21	—
21	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 22	Go to Step 2
22	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1508 IAC System Low RPM



30418

Circuit Description

The Idle Air Control valve is a PCM controlled stepper motor located on the throttle body. The stepper motor drives a valve pintle which protrudes into a passage that bypasses the throttle plates. To decrease idle speed, the PCM commands the IAC valve pintle to extend. As the pintle approaches its seat, bypass air flow is reduced and idle speed decreases. To increase idle speed, the PCM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle plates. One of the PCMs uses for the IAC system is to maintain a desired idle speed, which can vary depending on input to the PCM and other criteria. If the PCM detects engine speed is outside the IAC systems range of control at idle, it will perform an active test while the vehicle is being driven. During this test the PCM commands the IAC valve to move while monitoring MAF. If no change in MAF is detected, the IAC valve is not functioning. If idle RPM was out of IAC System control and the IAC valve does not operate, DTC P1508 is set. If the expected change in MAF had been detected, IAC valve operation would have been verified. Since idle RPM was out of IAC System control but the IAC valve was operational, DTC P0506 would be set.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0122, P0123, P0174, P0175, P0300, P0325 not set.
- Engine running for at least 25 seconds.
- Coolant temperature greater than 60°C (140°F)
- IAT greater than -10°C (14°F)

- Baro greater than 77 kPa
- System voltage between 10 and 17 volts
- Vehicle speed less than 1 mph
- Throttle Angle 0%
- Idle speed below desired RPM
- Conditions met for 1 sec

Then

- Vehicle speed is between 20 and 77 mph.
- MAF between 13 and 35 gm/s
- TPS steady
- RPM steady
- Conditions met for 5 seconds

The active test will then be performed.

- If a 6 gm/s change in MAF is detected, DTC P0506 will be set.
- If a 6 gm/s change in MAF is not detected, DTC P1508 will be set.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included

in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether or not the engine can achieve the commanded RPM, and if not, whether the RPM is too high or too low.

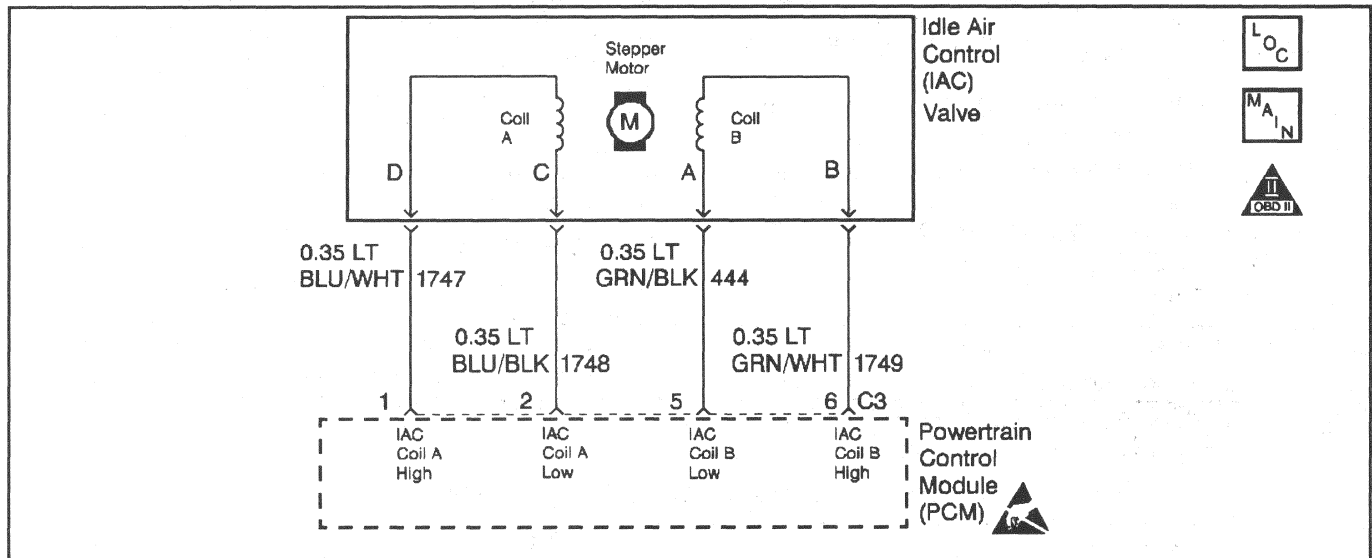
DTC P1508 IAC System Low RPM

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine. 2. Using the scan tool, command the RPM up to 1500, down to 500, up to 1500, and then EXIT. Does the engine speed correspond (within 50 RPM) with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC harness connector and install the appropriate IAC node light from kit J 37027-A. 3. Start the engine. 4. Using the scan tool, command the RPM up to 1500, down to 500 and up to 1500 while observing the node light. Does both of the LEDs on the node light cycle red and green, but never OFF?	—	Go to Step 4	Go to Step 5
4	Important: During the following test it is possible to overextend the IAC valve pintle until it falls out of the worm drive. If this occurs, manually screw the pintle shaft into the worm drive about 2 turns to get it started, align the keyways on the shaft with the keys in the housing and gradually retract the pintle using the IAC driver tool. 1. Turn the ignition OFF. 2. Remove the IAC valve. 3. Connect the IAC valve to the IAC Driver tool from kit J 37027-A. 4. Hold the IAC valve with a finger over the pintle in case it is over extended. Using the driver tool retract and extend the pintle. Does the pintle move steadily with each flash of the IAC driver light?	—	Go to Step 6	Go to Step 7

DTC P1508 IAC System Low RPM (cont'd)

Step	Action	Value(s)	Yes	No
5	Check for the following conditions: - Faulty connection - Open circuit - Short to ground - Short to B+ Is the action complete?	—	Go to Step 8	—
6	Check the IAC passages. Is the action complete?	—	Go to Step 8	—
7	Replace the IAC valve. Refer to <i>IAC Valve</i> . Is the action complete?	—	Go to Step 8	—
8	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1509 IAC System High RPM



30418

Circuit Description

The Idle Air Control valve is a PCM controlled stepper motor located on the throttle body. The stepper motor drives a valve pintle which protrudes into a passage that bypasses the throttle plates. To decrease idle speed, the PCM commands the IAC valve pintle to extend. As the pintle approaches its seat, bypass air flow is reduced and idle speed decreases. To increase idle speed, the PCM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle plates. One of the PCMs uses for the IAC system is to maintain a desired idle speed, which can vary depending on input to the PCM and other criteria. If the PCM detects engine speed is outside the IAC systems range of control at idle, it will perform an active test while the vehicle is being driven. During this test the PCM commands the IAC valve to move while monitoring MAF. If no change in MAF is detected, the IAC valve is not functioning. If idle RPM was out of IAC System control and the IAC valve does not operate, DTC P1509 is set. If the expected change in MAF had been detected, IAC valve operation would have been verified. Since idle RPM was out of IAC System control but the IAC valve was operational, DTC P0507 would be set.

Conditions for Setting the DTC

- DTCs P0107, P0108, P0122, P0123, P0174, P0175, P0300, P0325 not set.
- Engine running for at least 25 seconds.
- Coolant temperature greater than 60°C (140°F)
- IAT greater than -10°C (14°F)

- Baro greater than 77 kPa
- System voltage between 10 and 17 volts
- Vehicle speed less than 1 mph
- Throttle Angle 0%
- Idle speed below desired RPM
- Conditions met for 1 sec

Then

- Vehicle speed is between 20 and 77 mph.
- MAF between 13 and 35 gm/s
- TP Sensor steady
- RPM steady
- Conditions met for 5 seconds

The active test will then be performed.

- If a 6 gm/s change in MAF is detected, DTC P0507 will be set.
- If a 6 gm/s change in MAF is not detected, DTC P1509 will be set.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. The first time the diagnostic fails, this information will be stored in Failure Records. If the diagnostic reports a failure on the second consecutive drive trip, the operating conditions at the time of failure will be written to Freeze Frame and the Failure record will be updated.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included

in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Determines whether or not the engine can achieve the commanded RPM, and if not, whether the RPM is too high or too low.

DTC P1509 IAC System High RPM

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Start the engine. 2. Using the scan tool, command the RPM up to 1500, down to 500, up to 1500, and then EXIT. Does the engine speed correspond (within 50 RPM) with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC harness connector and install the appropriate IAC node light from kit J 37027-A. 3. Start the engine. 4. Using the scan tool, command the RPM up to 1500, down to 500 and up to 1500 while observing the node light. Does both of the LEDs on the node light cycle red and green, but never OFF?	—	Go to Step 4	Go to Step 5
4	Important: During the following test it is possible to overextend the IAC valve pintle until it falls out of the worm drive. If this occurs, manually screw the pintle shaft into the worm drive about 2 turns to get it started, align the keyways on the shaft with the keys in the housing and gradually retract the pintle using the IAC driver tool. 1. Turn the ignition OFF. 2. Remove the IAC valve. 3. Connect the IAC valve to the IAC Driver tool from kit J 37027-A. 4. Hold the IAC valve with a finger over the pintle in case it is over extended. Using the driver tool retract and extend the pintle. Does the pintle move steadily with each flash of the IAC driver light?	—	Go to Step 6	Go to Step 7

DTC P1509 IAC System High RPM (cont'd)

Step	Action	Value(s)	Yes	No
5	Check for the following conditions: - Faulty connection - Open circuit - Short to ground - Short to B+ Is the action complete?	—	Go to Step 8	—
6	Check the IAC passages. Is the action complete?	—	Go to Step 8	—
7	Replace the IAC valve. Refer to <i>IAC Valve</i> . Is the action complete?	—	Go to Step 8	—
8	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 9	Go to Step 2
9	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1539 A/C Clutch Status Circuit High Voltage

Circuit Description

When the PCM detects that A/C has been requested, the PCM will activate the A/C clutch relay. When the relay is activated, voltage should be present at both the A/C compressor clutch and the A/C clutch status terminal at the PCM.

If the PCM detects voltage on the A/C clutch status terminal when the A/C has not been requested a DTC P1539 will set.

A short to voltage at any point in the A/C status circuit, or the A/C relay contacts are stuck, will set a DTC P1539. For the A/C system schematic refer to *A/C Controls - C60* or *A/C Controls - C67 and C68*.

Conditions for Setting the DTC

Voltage is detected on the A/C status circuit for more than 5.0 seconds after the PCM has disengaged the A/C clutch relay.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.

- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

- The A/C status circuit goes to the A/C compressor clutch and to the A/C clutch relay. Inspect all circuits going to these components.
- For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Checks if the malfunction is present. If the scan tool displays A/C status ON, indicates the PCM has detected a voltage on the A/C status circuit with the A/C OFF.
3. If the scan tool displayed YES in the RAN column and INT in the FAIL column, indicates an intermittent condition is present. Inspect A/C status circuit for an intermittent short to B+. Refer to *Symptoms*. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
4. If the scan tool displays that the test passed, indicates that the relay is shored internally.

DTC P1539 A/C Clutch Status Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Engine idling with A/C OFF. 3. Using a scan tool, monitor A/C Status display on the Engine 1 Data List. Does the scan tool indicate A/C Status as ON?	—	Go to Step 4	Go to Step 3
3	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Remove the A/C clutch relay. 3. Start and idle the engine for 30 seconds. 4. Using a scan tool, select DTC Info, FAIL THIS IGN. Does the scan tool indicate DTC P1539 failed?	—	Go to Step 5	Go to Step 6
5	Repair the A/C clutch status circuit (shorted to B+). Is the action complete?	—	Go to Step 7	—
6	Repair the faulty A/C clutch relay. Refer to <i>A/C Clutch Relay replacement</i> . Is the action complete?	—	Go to Step 7	—
7	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 8	Go to Step 2
8	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1545 A/C Clutch Relay Control Circuit

Circuit Description

Ignition voltage is supplied directly to the A/C compressor clutch relay coil. The PCM controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The relay is used to control the high current flow to the A/C compressor clutch. This allows the PCM driver to only have to handle the relatively low current used by the relay. For the A/C system schematic refer to *A/C Controls - C60* or *A/C Controls - C67 and C68*.

Conditions for Setting the DTC

- DTCs P0106, P0113, P0500, P0502, P0560, P0562, P1133, P1135, P1136, P1153, P1154, P1532, P1539, P1543 not set.
- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 25.5 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the relay operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above 0.75 Amp).
5. It is important to identify and test the relay coil terminals to avoid improper diagnosis.
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1545 A/C Clutch Relay Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the relay ON and OFF. Does the relay turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the relay control circuit. 3. Turn the ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the relay control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Using DVM J 39200, measure resistance from the relay control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10
5	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Connect the test light J 34142-B between the relay coil terminals in the relay harness connector. 4. Turn the ignition ON. 5. Using a Scan tool, command the relay ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	With the test light connected to ground, probe the battery feed circuits in the relay harness connector. Is the test light ON both terminals?	—	Go to Step 7	Go to Step 11
7	1. Turn the ignition OFF. 2. Reconnect the relay. 3. Disconnect the PCM connector containing the relay control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the relay control circuit in the PCM harness connector. Does the relay operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the relay. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair faulty relay control circuit. Is the action complete?	—	Go to Step 14	—
11	Repair the faulty relay battery feed circuit. Is the action complete?	—	Go to Step 14	—

DTC P1545 A/C Clutch Relay Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the relay. Is the action complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1546 A/C Clutch Status Circuit Low Voltage

Circuit Description

When the PCM detects that A/C has been requested, the PCM will activate the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C compressor clutch and the A/C clutch status circuit at the PCM. For the A/C system schematic refer to *A/C Controls - C60* or *A/C Controls - C67 and C68*.

Conditions for Setting the DTC

The PCM has commanded the A/C ON and no voltage is detected on the A/C clutch status line for more than 5.0 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the ignition is cycled and the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. A problem that may prevent the compressor from engaging may or may not cause a DTC P1546.
3. If the scan tool displays that the A/C Status is ON, indicates that the status circuit is OK.
4. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
5. Checks whether ignition voltage is available at the relay.
6. Determines if the A/C relay is at fault or the A/C status circuit is at fault. If the A/C clutch engages, indicates that the A/C Status circuit is OK.

DTC P1546 A/C Clutch Status Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start and idle the engine with the A/C ON. Does the A/C clutch operate properly?	—	Go to Step 3	Go to Step 5
3	Using a scan tool, monitor A/C Status display on the Engine 1 Data List. Does the scan tool indicate A/C Status as ON?	—	Go to Step 4	Go to Step 8
4	1. Turn the ignition ON, engine OFF, review Freeze Frame and/or Failure Records data for this DTC and note parameters. 2. Turn the ignition OFF for 15 seconds. 3. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame/Failure Records as possible. Special operating conditions that need to be met before the PCM will run this diagnostic, where applicable, are listed in Conditions for Setting the DTC. 4. Using the scan tool, select DTC, Specific, then enter the DTC number which was set. Does the scan tool indicate that this diagnostic failed this ignition?	—	Go to Step 5	Go to Diagnostic Aids
5	1. Turn the ignition OFF 2. Disconnect A/C clutch relay. 3. Turn the ignition ON, engine OFF. 4. Probe the ignition feed circuit at the A/C relay terminal (switch side of relay) with a test light (J 34142-B) to ground. Does the test light illuminate?	—	Go to Step 6	Go to Step 9
6	Using a fused jumper wire, jump the ignition feed circuit to the A/C clutch status circuit at the A/C clutch relay electrical harness. Does the A/C clutch engage?	—	Go to Step 7	Go to Step 10
7	Repair the faulty A/C clutch relay connection or faulty A/C clutch relay. Refer to <i>A/C Relay replacement</i> . Is the action complete?	—	Go to Step 12	—
8	Repair the open A/C clutch status circuit from the splice to the PCM. Was the condition found and corrected?	—	Go to Step 12	Go to Step 11
9	Repair the open ignition feed circuit to A/C relay. Is the action complete?	—	Go to Step 12	—
10	Repair the open in A/C status circuit from A/C relay to splice. Is the action complete?	—	Go to Step 12	—
11	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 12	—

DTC P1546 A/C Clutch Status Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
12	- Using the scan tool, select DTC, Clear Info. - Start the engine and idle at normal operating temperature. - Select DTC, Specific, then enter the DTC number which was set. - Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	<i>Go to Step 13</i>	<i>Go to Step 2</i>
13	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1641 FC Relay 1 Control Circuit**Circuit Description**

Ignition voltage is supplied directly to the Cooling Fan relay coil. The PCM controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The relay is used to control the high current flow to the cooling fan motors. This allows the PCM driver to only have to handle the relatively low current used by the relay. For the Cooling Fan schematic, refer to *Fan Controls-w/o VO8*.

Conditions for Setting the DTC

- DTCs P0117, P0118, P1539 not set.
- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the relay operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above .75 Amp).
5. It is important to identify and test the relay coil terminals to avoid improper diagnosis.
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1641 FC Relay 1 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the relay ON and OFF. Does the relay turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the relay control circuit. 3. Turn the ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the relay control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Using DVM J 39200, measure the resistance from the relay control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10
5	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Connect test light J 34142-B between the relay coil terminals in the relay harness connector. 4. Turn the ignition ON. 5. Using a Scan tool, command the relay ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	With the test light connected to ground, probe the ignition feed circuit in the relay harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 11
7	1. Turn the ignition OFF. 2. Reconnect the relay. 3. Disconnect the PCM connector containing the relay control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the relay control circuit in the PCM harness connector. Does the relay operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the relay. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair the faulty relay control circuit. Is the repair complete?	—	Go to Step 14	—
11	Repair the faulty relay ignition feed circuit. Is the repair complete?	—	Go to Step 14	—

DTC P1641 FC Relay 1 Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the faulty relay. Is the replacement complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1642 FC Relay 2 Control Circuit

Circuit Description

Ignition voltage is supplied directly to the Cooling Fan relay coil. The PCM controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The relay is used to control the high current flow to the cooling fan motors. This allows the PCM driver to only have to handle the relatively low current used by the relay. For the Cooling Fan schematic, refer to *Fan Controls-w/o VO8* or *Fan Controls-With VO8*.

Conditions for Setting the DTC

- DTCs P0117, P0118, P1539 not set.
- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the Malfunction Indicator Lamp (MIL) when the diagnostic runs and fails.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.
- The injector will be disabled for the entire ignition cycle.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Listen for an audible click when the relay operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm the coil may open (Amps drop to 0), or short (goes above .75 Amp).
5. It is important to identify and test the relay coil terminals to avoid improper diagnosis.
13. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1642 FC Relay 2 Control Circuit

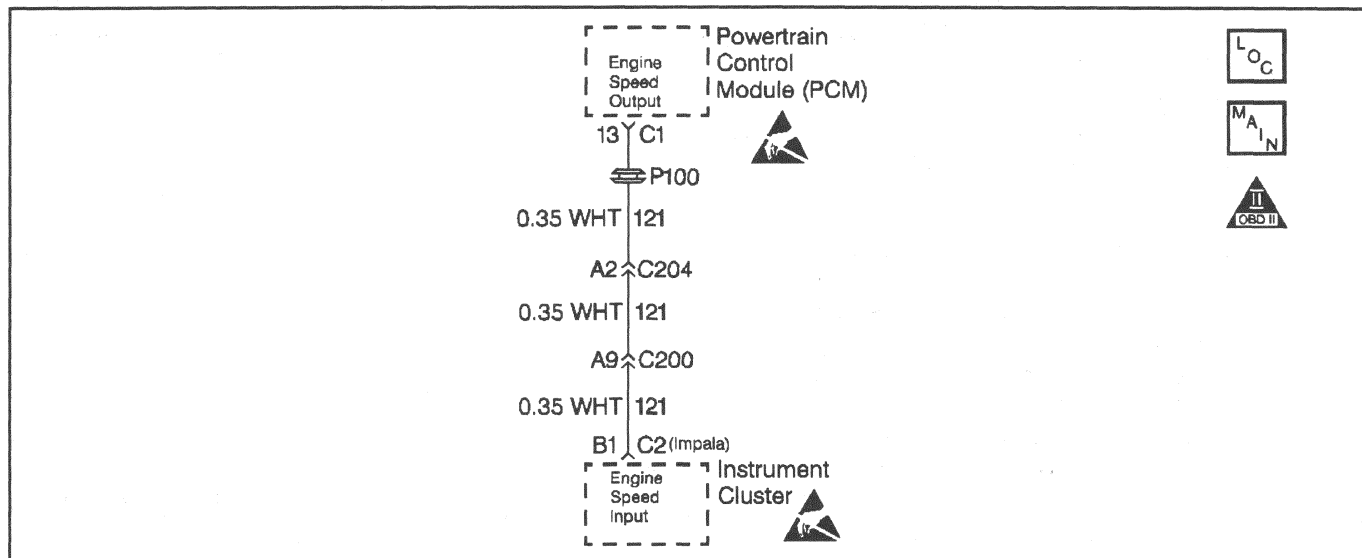
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the relay ON and OFF. Does the relay turn ON and OFF with each command?	—	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the relay control circuit. 3. Turn the ignition ON. 4. Using DVM J 39200 on 10 Amp scale, measure current from the relay control circuit in the PCM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value shown (but not 0)?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Using DVM J 39200, measure the resistance from the relay control circuit in the PCM harness connector to ground. Does the DVM display infinite resistance?	—	Go to Step 12	Go to Step 10
5	1. Turn the ignition OFF. 2. Disconnect the relay. 3. Connect test light J 34142-B between the relay coil terminals in the relay harness connector. 4. Turn the ignition ON. 5. Using a Scan tool, command the relay ON and OFF. Does the test light turn ON and OFF with each command?	—	Go to Step 8	Go to Step 6
6	With the test light connected to ground, probe the ignition feed circuit in the relay harness connector. Does the test light illuminate?	—	Go to Step 7	Go to Step 11
7	1. Turn the ignition OFF. 2. Reconnect the relay. 3. Disconnect the PCM connector containing the relay control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the relay control circuit in the PCM harness connector. Does the relay operate?	—	Go to Step 9	Go to Step 10
8	Check the connections at the relay. Was a problem found and corrected?	—	Go to Step 14	Go to Step 12
9	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 14	Go to Step 13
10	Repair the faulty relay control circuit. Is the repair complete?	—	Go to Step 14	—
11	Repair the faulty relay ignition feed circuit. Is the repair complete?	—	Go to Step 14	—

DTC P1642 FC Relay 2 Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the faulty relay. Is the replacement complete?	—	Go to Step 14	—
13	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 14	—
14	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 15	Go to Step 2
15	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1643 Engine Speed Output Circuit



30390

Circuit Description

Voltage is applied to the Engine Speed Output circuit by the PCM. The PCM creates the Vehicle Speed Output signal by rapidly grounding this circuit via an internal switch called a driver. The driver operates at the same rate as the Low Resolution signal input. The other components on this circuit recognize the voltage being pulled to ground as an indication of engine speed.

The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 25.5 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

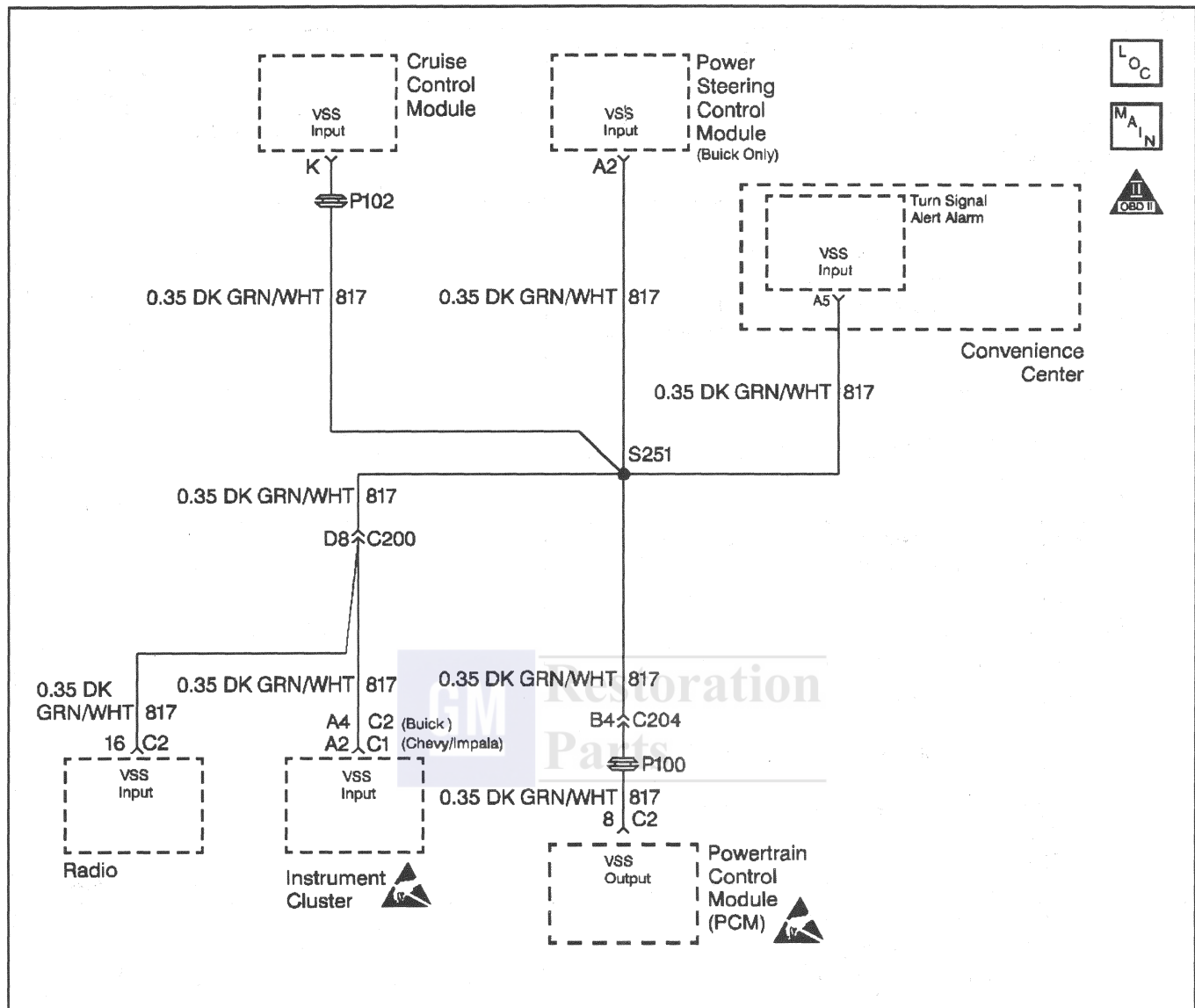
Number(s) below refer to step numbers on the diagnostic table.

3. Further circuit diagnosis may require I/P removal. The circuit from the PCM to the tachometer must be checked for being open, shorted to ground or voltage. If no trouble is found, follow the appropriate I/P diagnostic procedure.

DTC P1643 Engine Speed Output Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	With the engine running, does the vehicles tachometer indicate engine RPM?	—	No trouble found. Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect PCM connector C1. 3. Install the Signal Generator Tester (J 33431-B) to PCM harness connector terminal C1-13 (one terminal connected to terminal C1-13 and the other to ground). 4. Turn the ignition ON, Tester ON and set to generate a tachometer signal. Does the vehicles tachometer indicate an RPM reading?	—	Go to Step 4	Further diagnosis of circuit required. Go to Repair Procedure in Electrical Diagnosis (8A Cell 82)
4	Check for faulty connections at the PCM. Was a problem found and corrected?	—	Go to Step 6	Go to Step 5
5	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 6	—
6	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 7	Go to Step 2
7	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1652 VSS Output Circuit



30397

Circuit Description

Voltage is applied to the Vehicle Speed Output circuit by the various components which use vehicle speed data. The PCM creates the Vehicle Speed Output signal by rapidly grounding this circuit via an internal switch called a driver. The driver operates at the same rate as the VSS signal input. The various components recognize the voltage being pulled to ground as an indication of vehicle speed.

The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low

(near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 25.5 seconds.

Action Taken When the DTC Sets

- The DTC will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed. For intermittents, refer to *Symptoms*.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

3. Further circuit diagnosis may require I/P removal. The circuit from the PCM to the speedometer must be checked for being open, shorted to ground or voltage. If no trouble is found, follow the appropriate I/P diagnostic procedure.

DTC P1652 VSS Output Circuit

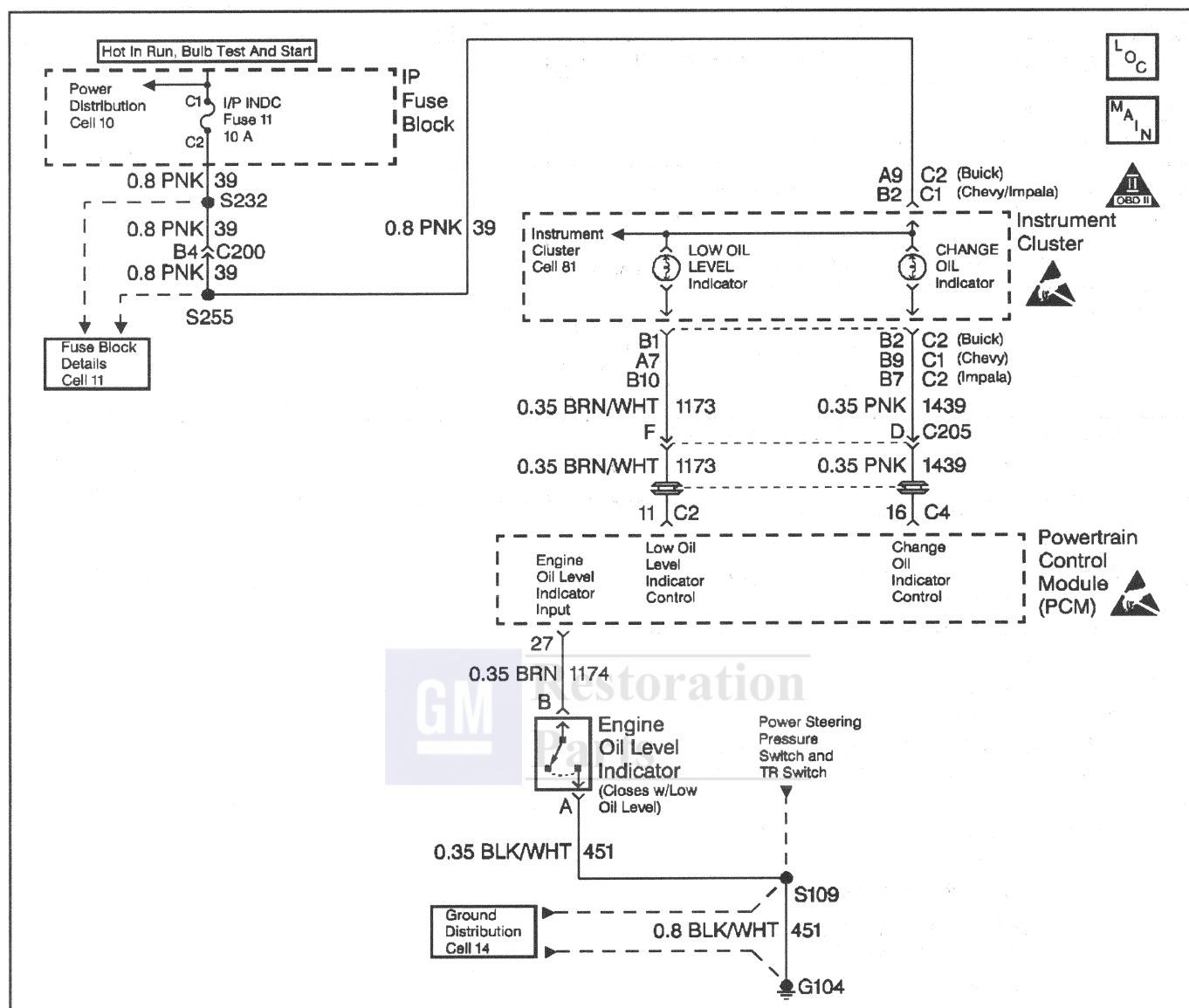
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Important: Do Not perform this test without supporting the lower control arms so that the drive axles are in a normal horizontal position. Running the vehicle with the wheels hanging down at full travel may damage the drive axles. 1. Turn the ignition OFF. 2. Raise the drive wheels. 3. Start the engine. 4. Disable ASR/TCS systems (if so equipped). 5. Engine idling in gear. Does the vehicles speedometer indicate vehicle speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Install the Signal Generator Tester (J 33431-B) to PCM harness connector terminal C2-8 (one terminal connected to terminal C2-8 and the other to ground). 4. Turn the ignition ON, Tester ON and set to generate a vehicle speed signal. Does the vehicles speedometer indicate vehicle speed?	—	Go to Step 4	Further diagnosis of circuit required. Go to- Section 8A-33
4	Check for faulty connections at the PCM. Was a problem found and corrected?	—	Go to Step 6	Go to Step 5

DTC P1652 VSS Output Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	Important: The replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 6	—
6	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 7	Go to Step 2
7	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1653 Oil Level Lamp Control Circuit



30428

Circuit Description

Ignition voltage is supplied directly to the Oil Level Lamp. The PCM controls the lamp by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.

- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- DTC P1653 will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- If no failures are reported by this or any other non-emission related diagnostic.

- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate

vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

Test Description

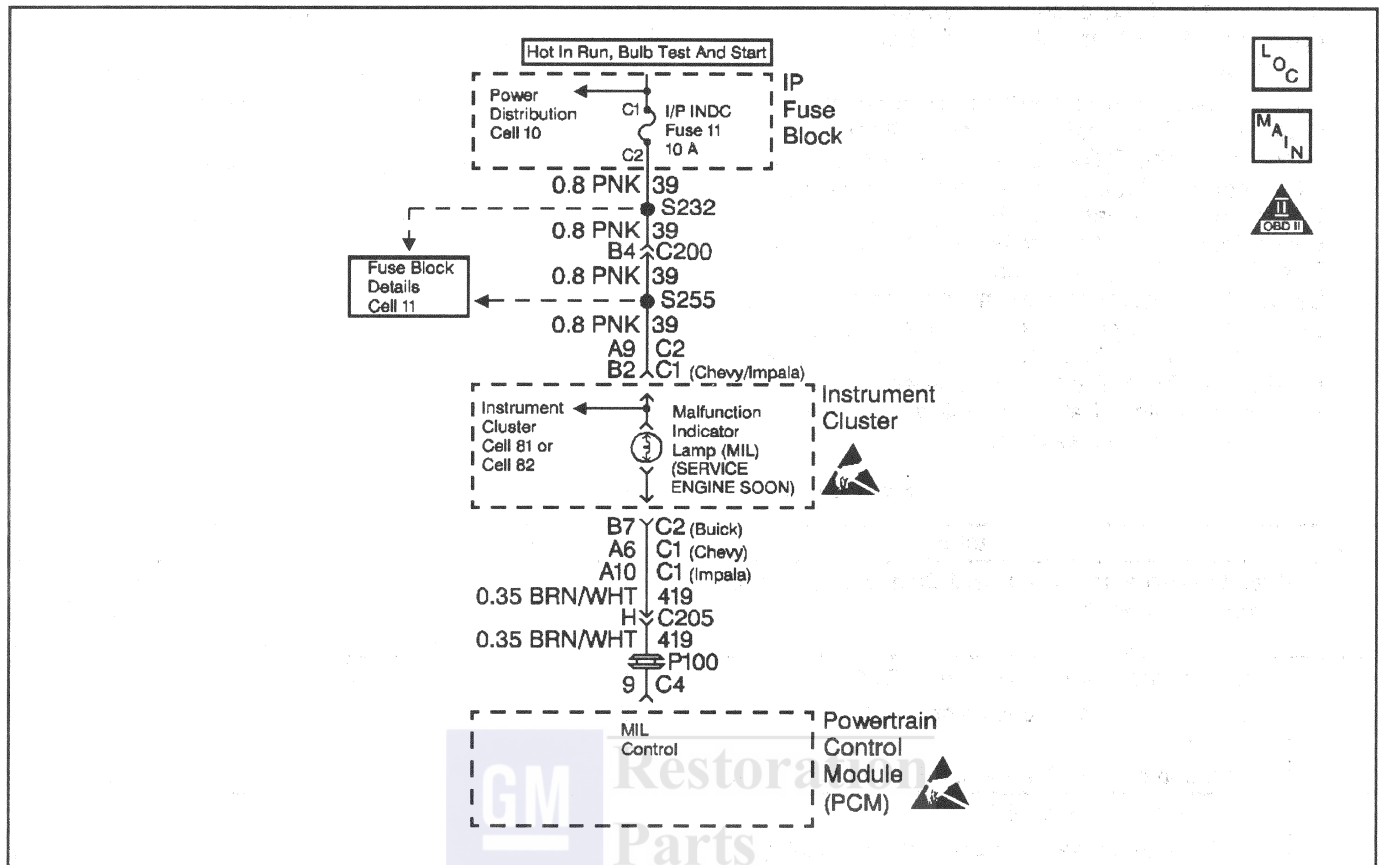
Number(s) below refer to step numbers on the diagnostic table.

2. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
8. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1653 Oil Level Lamp Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using a Scan tool, command the lamp ON and OFF. Does the lamp turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the lamp control circuit. 3. Turn the ignition ON. Is the lamp OFF?	—	Go to Step 4	Go to Step 5
4	With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector. Is the lamp ON?	—	Go to Step 6	Go to Step 7
5	Repair the lamp control circuit for a short to ground. Is the repair complete?	—	Go to Step 9	—
6	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 9	Go to Step 8
7	Check for the following conditions: • Faulty bulb (refer to <i>Section 8A</i>). • Open ignition feed to the bulb (refer to <i>Section 8A</i>). • Control circuit open or shorted to B+. Is the repair complete?	—	Go to Step 9	—
8	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> Replace the PCM. Is the action complete?	—	Go to Step 9	—
9	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK

DTC P1661 MIL Control Circuit



30387

Circuit Description

Ignition voltage is supplied directly to the Malfunction Indicator Lamp. The PCM controls the lamp by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM will turn the Malfunction Indicator Lamp (MIL) driver ON when the diagnostic runs and fails. If the MIL circuit becomes operational, the MIL will be 'ON'. Regardless of whether the MIL actually illuminates or not, DTC P1661 will be stored in the PCM memory.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive drive trips that the diagnostic runs and does not fail.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- A History DTC will clear after forty consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

- If the ignition feed circuit is suspected of being open, check if other bulbs on that circuit illuminate.
- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
8. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1661 MIL Control Circuit

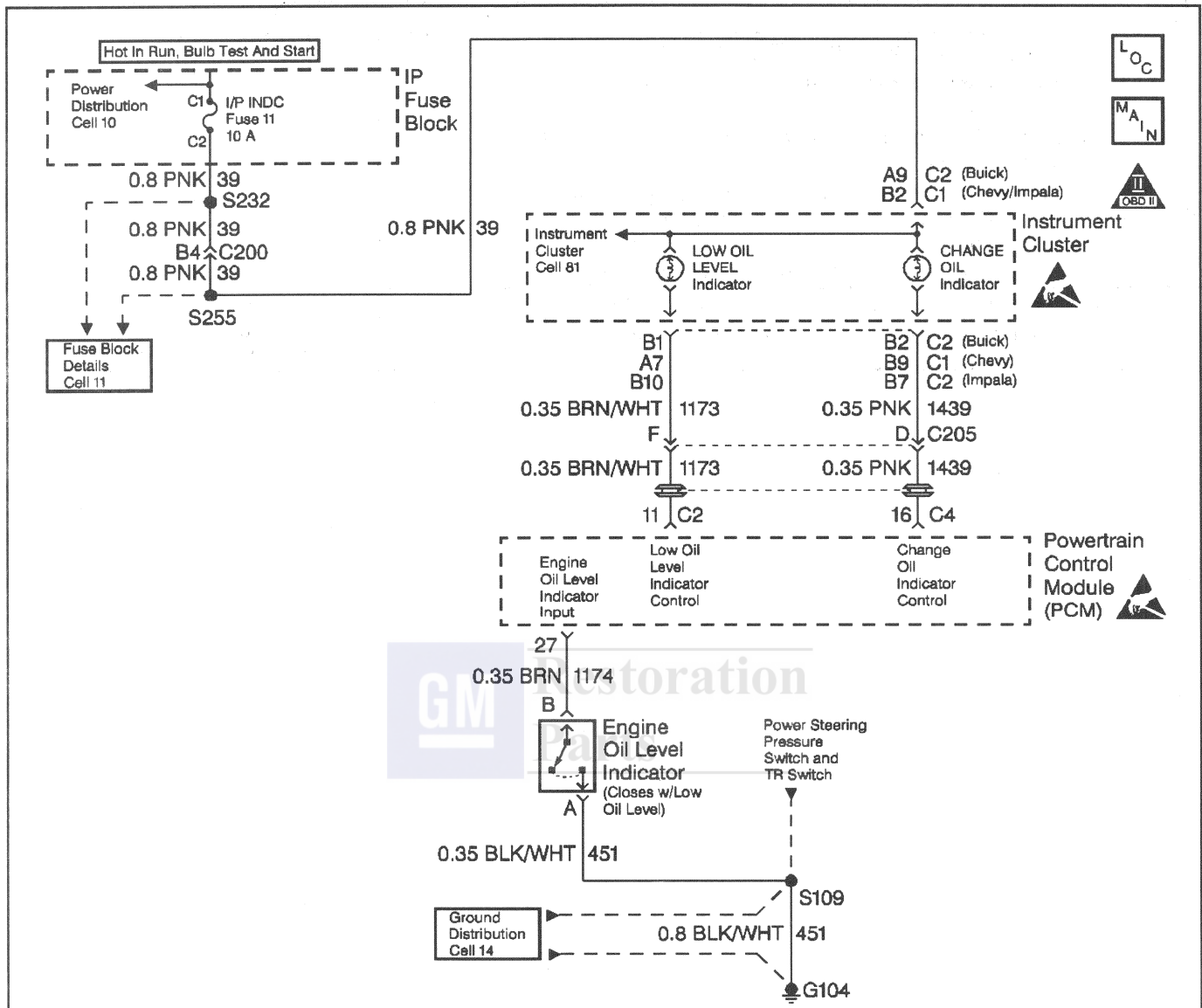
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition ON, engine OFF. 2. Using the Scan tool, command the lamp ON and OFF. Does the lamp turn ON and OFF with each command?	—	Go to Diagnostic Aids - DTC P1661 MIL Control Circuit	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the lamp control circuit. 3. Turn the ignition ON. Is the lamp OFF?	—	Go to Step 4	Go to Step 5
4	With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector. Is the lamp ON?	—	Go to Step 6	Go to Step 7
5	Repair the short to ground in the lamp control circuit. Is the repair complete?	—	Go to Step 9	—
6	Check the connections at the PCM. Was a problem found and corrected?	—	Go to Step 9	Go to Step 8
7	Check for the following conditions: • Faulty bulb • Open ignition feed to the bulb • Control circuit open or shorted to B+. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the repair complete?	—	Go to Step 9	—
8	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	Go to Step 9	—

DTC P1661 MIL Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Using the scan tool, select DTC, Clear Info. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



DTC P1663 Oil Life Lamp Control Circuit



30428

Circuit Description

Ignition voltage is supplied directly to the Change Oil lamp. The PCM controls the lamp by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be low (near 0 volts). When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the DTC to set.

The PCM uses the distance the vehicle has traveled, Engine Coolant Temperature (ECT), engine oil temperature and engine revolutions to calculate oil

life. Once a calibrated value is attained, the PCM will ground the lamp control circuit and the Change Oil lamp will illuminate.

The maximum mileage that can be accumulated before the PCM illuminates the Change Oil lamp is 7500 miles. However, the lamp may come ON sooner depending on engine load and temperature (trailer towing, high ambient temperatures, etc.).

Conditions for Setting the DTC

- Engine speed greater than 600 RPM.
- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- Condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- DTC P1663 will be stored in the PCM memory when the diagnostic runs and fails.
- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in Failure Records.

Conditions for Clearing the MIL/DTC

- If no failures are reported by this or any other non-emission related diagnostic.
- A last test failed (Current DTC) will clear when the diagnostic runs and does not fail.
- PCM battery voltage is interrupted.
- Using a Scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included

in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
8. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be faulty, however, this is an extremely unlikely failure.

DTC P1663 Oil Life Lamp Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the Ignition ON, engine OFF. 2. Using a Scan tool, command the lamp ON and OFF. Does the lamp turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the lamp control circuit. 3. Turn the ignition ON. Is the lamp OFF?	—	Go to Step 4	Go to Step 5
4	With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector. Is the lamp ON?	—	Go to Step 6	Go to Step 7
5	Repair the lamp control circuit for a short to ground. Is the repair complete?	—	Go to Step 9	—
6	Check connections at the PCM. Was a problem found and corrected?	—	Go to Step 9	Go to Step 8
7	Check for the following conditions: • Faulty bulb (refer to Section 8A). • Open ignition feed to the bulb (refer to Section 8A). • Control circuit open or shorted to B+. Is the repair complete?	—	Go to Step 9	—
8	Important: Replacement PCM must be programmed. Refer to PCM Replacement/Programming. Replace the PCM. Is the action complete?	—	Go to Step 9	—

DTC P1663 Oil Life Lamp Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Using the scan tool, select DTC, Clear Info. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text, if applicable. Does the scan tool indicate that this test ran and passed?	—	Go to Step 10	Go to Step 2
10	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the applicable DTC table	System OK



Symptoms

Important Preliminary Checks Before Starting

Before using the Symptom Tables, you should have performed the *Powertrain OBD System Check* and verify all of the following are true:

- The PCM and MIL (Service Engine Soon) are operating correctly.
- There are no DTC(s) stored.
- Scan data is within normal operating range, refer to *Engine Scan Tool Data List*
- Verify the customer complaint, and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Several of the symptom procedures call for a Careful Visual/Physical Check. The importance of this step cannot be stressed too strongly – it can lead to correcting a problem without further checks and can save valuable time. This check should include:

- PCM grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks, and proper connections, as shown on the Vehicle Emission Control Information label. Check thoroughly for any type of leak or restriction.
- Mass Air Flow (MAF) sensor installation. The arrows on the plastic portion of the sensor must point toward the engine.
- Air intake ducts for collapsed or damaged areas.
- Air leaks at throttle body mounting area, Mass Air Flow (MAF) sensor and intake manifold sealing surfaces.
- Ignition wires for cracking, hardness, proper routing and carbon tracking.
- Wiring for proper connections, pinches and cuts.

Intermittents

Problem may or may not turn ON the MIL (Malfunction Indicator Lamp) or store a DTC. DO NOT use the Diagnostic Trouble Code (DTC) tables for intermittent problems. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body (backed out).
- Improperly formed or damaged terminal.

- All connector terminals in the problem circuit should be carefully reformed or replaced to insure proper contact tension.
- Poor terminal to wire connection. This requires removing the terminal from the connector body to check.

Road test the vehicle with a J 39200 Digital Multimeter connected to a suspected circuit. An abnormal voltage when the malfunction occurs, is a good indication that there is a malfunction in the circuit being monitored.

Use a Scan Tool to help detect intermittent conditions. The GM Techline equipment (Scan Tool) have several features that can be used to locate an intermittent condition. Use the following features to find intermittent faults:

- The Snapshot feature can be triggered to capture and store engine parameters within the scan tool when the malfunction occurs. This stored information then can be reviewed by the service technician to see what caused the malfunction.
- Using a Scan Tools Freeze Frame buffer or Failure Records buffer can also aid in locating an intermittent condition. Review and capture the information in the freeze frame or failure record associated with the intermittent DTC being diagnosed. The vehicle can be driven in the conditions that were present when the DTC originally set.

Loss of diagnostic code memory. To check, disconnect MAP sensor and idle engine until the MIL (Malfunction Indicator Lamp) comes ON (The engine speed may require to be increased to 2000 RPM). DTC P0107 should be stored and kept in memory when ignition is turned OFF. If not the PCM is faulty. When this test is completed, DTC P0107 should be cleared from memory.

An intermittent MIL (Malfunction Indicator Lamp) with no stored DTC may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or spark plugs.
- PCM grounds, refer to *PCM wiring diagrams*.

If the intermittent condition exists as a start and then stall, check for DTC(s) relating to the theft deterrent system. Check for improper installation of electrical options such as lights, cellular phones etc.

All Ignition Control (IC) wires should be routed away from secondary ignition wires, distributor, coil, and generator. All wires from the PCM to distributor should have a good connection.

Check for open diode across A/C compressor clutch and for other open diodes.

Hard Start

Checks	Action
DEFINITION: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.	
Preliminary	- Refer to <i>Symptoms</i>, Important Preliminary Checks Before Starting. - Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. - Search for bulletins.
Sensor/System	- Check Engine Coolant Temperature (ECT) sensor for being shifted in value. Connect a Scan Tool and compare Engine Coolant Temperature with Intake Air Temperature on a cold engine. The ECT and IAT should be within $\pm 3^{\circ}\text{C}$ (5°F) of each other. Check the resistance of the ECT sensor if the temperature is out of range with the IAT sensor. Refer to <i>Temperature vs Resistance</i> for resistance specifications. Replace ECT sensor if the resistance is not within the specification. If the sensor is within the specification, repair ECT signal circuit for high resistance. - Check Mass Air Flow sensor installation. A MAF sensor that is installed in the wrong direction, may cause a hard start. Embossed arrows on the MAF sensor indicate air flow and must point toward the engine. Install MAF in the proper direction. Refer to <i>MAF Sensor, On-Vehicle Service</i>. - Using a Scan Tool, monitor TP sensor voltage. The TP sensor voltage should be less than 0.9 volt. If the TP sensor voltage is greater than 0.9 volt, inspect the ASR/TCS adjuster assembly (if so equipped). Also inspect throttle body and accelerator cables for binding. Refer to <i>Adjuster Assembly Throttle And Cruise Control Cables</i>.
Fuel System	- Check fuel pump relay operation – pump should turn ON for 2 seconds when ignition is turned ON. Refer to <i>Fuel Pump Relay Circuit Diagnosis</i>. - A faulty in-tank fuel pump check valve will allow the fuel in the lines to drain back to the tank after engine is stopped. To check for this condition, refer to <i>Fuel System Diagnosis</i>. - Check both injector fuses for being open. An open injector fuse will cause four injectors not to operate. Replace fuse and inspect injector circuits for an intermittent short to ground. - Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. - Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. - Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>.
Ignition System	- Check for proper ignition voltage output with spark tester J 26792. Refer to <i>Distributor Ignition System Check</i>. - Remove spark plugs and check for the following: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. - Check for bare or shorted ignition wires. Refer to <i>Ignition Wire Replacement</i>. - Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. - Spark plugs for proper heat range. Refer to <i>Owners Manual or Section OB</i>. - Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.

Hard Start (cont'd)

Checks	Action
Engine Mechanical	- Excessive oil in combustion chamber—Leaking valve seals. Refer to <i>Engine Mechanical</i>. - Low cylinder compression. Refer to <i>Engine Mechanical</i>. - Combustion chambers for excessive carbon buildup. Clean using Top engine cleaner. Follow instructions on can. - For incorrect basic engine parts. Inspect the following: - Cylinder heads - Camshaft - Pistons, etc. Refer to <i>Engine Mechanical</i>.
Additional Checks	Using a scan tool, check IAC operation.

Surges/Chuggles

Checks	Action
DEFINITION: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.	
Preliminary	- Refer to <i>Symptoms</i>, Important Preliminary Checks Before Starting. - Search for bulletins. - Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. - Be sure driver understands transmission torque converter clutch, and A/C compressor operation as explained in the owners manual. Inform customer how TCC and the A/C clutch operates.
Sensor/System	- Check Heated Oxygen Sensors (HO2S). The Heated Oxygen Sensors (HO2S) should respond quickly to different throttle position, if they do not, check the HO2S for silicon or other contaminants from fuel, or use of improper RTV sealant. The sensors may have a white powdery coating and result in a high but false signal voltage (rich exhaust indication). The PCM will then reduce the amount of fuel delivered to the engine causing a severe driveability problem. For more information, refer to <i>Powertrain Control Module</i>. - Check MAF connections. Repair or replace terminals. Refer to <i>Electrical Diagnosis</i> for wiring repair procedures.
Fuel System	- Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. - Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. - Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. - Check each injector harness is connected to the correct injector/cylinder according to the firing order (firing order: 1-8-4-3-6-5-7-2). Relocate injector harnesses as necessary. - Check items which can cause an engine to run rich (long term fuel trim near -14%). For a rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. - Check items that can cause an engine to run lean (long term fuel trim near 22%). For a lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.

Surges/Chuggles (cont'd)

Checks	Action
Ignition System	- Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. - Check for proper ignition voltage output with spark tester J 26792. Refer to <i>Distributor Ignition System Check</i>. - Remove spark plugs and check for the following: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - An improper spark plug gap will cause a driveability problem. Refer to <i>Spark Plug Gap specification is Section OB</i>. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to Spark Plug Replacement. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the rich condition or <i>Engine Mechanical</i> for the oil fouling condition. - Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. - Spark plugs for proper heat range. Refer to <i>Owners Manual or Section OB</i>. - Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Additional Checks	- Visually (physically) check: Vacuum hoses for splits, kinks, and proper connections and routing as shown on Vehicle Emission Control Information label. - Check TCC operation. TCC applying too soon can cause the engine to spark knock. Refer to <i>Transmission Controls</i>.

Lack of Power, Sluggishness, or Sponginess

Checks	Action
DEFINITION: Engine delivers less than expected power. Little or no increase in speed when the accelerator pedal is pushed down part way.	
Preliminary Checks	- Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. - Search for bulletins. - Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. - Remove and check air filter element for dirt, or for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i> and replace as necessary.
Fuel System Checks	- Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. - Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. - Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. - Check items which can cause an engine to run rich (long term fuel trim near -14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. - Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.

Lack of Power, Sluggishness, or Sponginess (cont'd)

Checks	Action
Sensor/System Checks	Using a scan tool, monitor KS system for excessive spark retard activity. Refer to <i>Knock Sensor System</i>.
Ignition System	- Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. - Check for proper ignition voltage output with spark tester J 26792. Refer to Distributor Ignition System for procedure. - Remove spark plugs and check for the following: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification in Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> or <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. - Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. - Spark plugs for proper heat range. Refer to <i>Owners Manual</i> or <i>Section OB</i>. - Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Mechanical	- Excessive oil in combustion chamber—Leaking valve seals. Refer to <i>Engine Mechanical</i>. - Low cylinder compression. Refer to <i>Engine Mechanical</i>. - For incorrect basic engine parts. Inspect the following: - Camshaft - Cylinder heads - Pistons, etc. Refer to <i>Engine Mechanical</i>.
Additional Checks	- Check exhaust system for possible restrictions. Check for the following: - Inspect exhaust system for damaged or collapsed pipes. - Inspect mufflers for heat distress or possible internal failure. - For possible plugged Three-Way catalytic converters by comparing exhaust system back pressure on each side of engine. Check back pressure by removing AIR check valves near exhaust manifolds. Refer to <i>Restricted Exhaust System Check</i> and <i>Exhaust System</i>. - Check Torque Converter Clutch (TCC) for proper operation. Refer to <i>Transmission Controls</i>. - TC system cable adjuster assembly. Loss of performance can result from an improperly adjusted system which could prevent the throttle from attaining WOT. Refer to <i>Antilock Brake System (ABS) and Traction Control System</i>. Also inspect the throttle body and accelerator cables for binding.

Detonation/Spark Knock

Checks	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.	
Preliminary Checks	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. • If the scan tool readings are normal (refer to supporting text of the Powertrain On-Board Diagnostic (OBD) System Check) and there are no engine mechanical faults. Fill the fuel tank with a premium gasoline that has a minimum octane reading of 92 and re-evaluate vehicle performance.
Fuel System	• Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check items which can cause an engine to run rich (long term fuel trim near -14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. • Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.
Ignition System	• Spark plugs for proper heat range. Refer to <i>Owners Manual or Section OB</i>. • Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Cooling System	Check for obvious overheating problems: • Low engine coolant. • Restricted air flow to radiator, or restricted water flow through radiator. • Inoperative electric cooling fan circuit(s). Refer to <i>Electric Cooling Fan Diagnosis</i>. • Correct coolant solution should be a 50/50 mix of GM 1052753 or equivalent antifreeze coolant and water. Refer to <i>Engine Cooling (6B)</i>.
Engine Mechanical	• Excessive oil in combustion chamber—Leaking valve seals. Refer to <i>Engine Mechanical</i>. • Low cylinder compression. Refer to <i>Engine Mechanical</i>. • Combustion chambers for excessive carbon buildup. Clean using Top engine cleaner. Follow instructions on can. • For incorrect basic engine parts. Inspect the following: – Camshaft – Cylinder heads – Pistons, etc. • Refer to <i>Engine Mechanical</i>.
Additional Checks	• Check Park/Neutral Position (PNP) switch operation. Connect scan tool and monitor PNP signal. The scan tool should indicate P—N— when in park or neutral and —R—OD21 when in any forward gear or reverse. Refer to <i>PNP Switch Check</i>. • Check TCC operation. TCC applying too soon can cause the engine to spark knock. Refer to <i>Transmission Controls</i>.

Hesitation, Sag, Stumble

Checks	Action
DEFINITION: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually more pronounced when first trying to make the vehicle move, as from a stop sign. May cause the engine to stall if severe enough.	
Preliminary	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>.
Sensor/System	• Check MAP sensor operation. • Check EGR for being loose or for a faulty gasket. Check EGR operation for being open all the time. • Using a Scan Tool, monitor TP sensor voltage. The TP sensor voltage should be less than 0.9 volt. If the TP sensor voltage is greater than 0.9 volt, inspect the ASR/TCS adjuster assembly (if so equipped). Also inspect throttle body and accelerator cables for binding. Refer to <i>Adjuster Assembly Throttle And Cruise Control Cables</i>.
Fuel System	• Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check injector fuse(s) (Except F car) for being open. An open injector fuse will cause the injectors not to operate. Replace fuse and inspect injector circuits for an intermittent short to ground. • Perform injector balance test. Refer to <i>Fuel Injector Balance Test</i> for procedure. • Check items which can cause an engine to run rich (long term fuel trim near -14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. • Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.

Hesitation, Sag, Stumble (cont'd)

Checks	Action
Ignition System	- Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. - Check for proper ignition voltage output with spark tester J 26792. Refer to <i>Distributor Ignition System Check</i> for procedure. - Remove spark plugs and check for the following: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification in Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. - Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. - Spark plugs for proper heat range. Refer to <i>Owners Manual or Section OB</i>. - Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Cooling System	Check the engine thermostat for functioning correctly and for proper heat range. Refer to <i>Engine Cooling</i>.
Additional Checks	- Check generator output voltage. Refer to <i>Engine Electrical</i> for procedure. Repair if less than 9 or more than 16 volts. - An EGR valve that is excessively coked, could cause an engine misfire. Remove the EGR valve and clean as necessary. Refer to <i>EGR Valve</i>.

Cuts Out, Misses

Checks	Action
DEFINITION: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. This condition is not normally felt above 1500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or low speed.	
Preliminary	- Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. - Search for bulletins. - Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. - Remove and check air filter element for dirt, or for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i> Replace as necessary.

Cuts Out, Misses (cont'd)

Checks	Action
Fuel System	• Perform injector balance test. Refer to <i>Fuel Injector Balance Test</i> for procedure. • Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check items which can cause an engine to run rich (long term fuel trim near -14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. • Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.
Sensor/System	• Using a scan tool, monitor KS system for excessive spark retard activity.
Ignition System	• Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. • Check for proper ignition voltage output with spark tester J 26792. Refer to Distributor Ignition System for procedure. • Remove spark plugs and check for the following: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification is Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. • Visually/Physically inspect Secondary ignition for the following: – Ignition wires for cross firing. – Ignition wires arcing to ground. – Ignition wires for proper routing. – Distributor cap for cracks or carbon tracking. • Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. • Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. • Spark plugs for proper heat range. Refer to <i>Owners Manual or Section OB</i>. • Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.

Cuts Out, Misses (cont'd)

Checks	Action
Engine Mechanical	• Check engine mechanical for the following: – Check compression. – Sticking or leaking valves. – Worn camshaft lobe(s). – Valve timing. – Bent push rods. – Worn rocker arms. – Broken valve springs. – Excessive oil in combustion chamber—Leaking valve seals. – Low cylinder compression. • For incorrect basic engine parts. Inspect the following: – Camshaft – Cylinder heads – Pistons, etc. Refer to <i>Engine Mechanical</i> for diagnosis procedures.
Additional Checks	• Check exhaust system for possible restrictions. Check for the following: – Inspect exhaust system for damaged or collapsed pipes. – Inspect mufflers for heat distress or possible internal failure. – For possible plugged Three-Way catalytic converters by comparing exhaust system back pressure on each side of engine. Check back pressure by removing AIR check valves near exhaust manifolds. Refer to Restricted Exhaust System Check and Exhaust System. • An engine miss condition can be caused by Electromagnetic Interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a problem exists, check routing of secondary ignition wires, high voltage components (Near Ignition Control circuits). Check distributor ground circuit for being open or loose. • Check for intake and exhaust manifold passages for casting flash. Refer to <i>Engine Mechanical</i>. • An EGR valve that is excessively coked, could cause an engine misfire. Remove the EGR valve and clean as necessary. Refer to <i>EGR Valve</i>.

Poor Fuel Economy

Checks	Action
DEFINITION: Fuel economy, as measured by an actual road test is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in the proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. • Check owners driving habits. • Is A/C ON full time (Defroster mode ON)? – Are tires at correct pressure? – Are excessively heavy loads being carried? – Is acceleration too much, too often? • Remove and check air filter element for dirt, or for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i> Replace as necessary.
Fuel System	• Perform injector balance test. Refer to <i>Fuel Injector Balance Test</i> for procedure. • Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check for incorrect minimum idle speed. Using a scan tool, monitor IAC position. IAC should be between 5 and 50 counts. • Check each injector harness is connected to the correct injector/cylinder according to the firing order (firing order: 1–8–4–3–6–5–7–2). Relocate injector harnesses as necessary. • Check for injectors that are shorted internally. Compare injector resistance. Injector resistance should be within one ohm of each other. Refer to <i>Fuel Injector Coil Test</i>. • Check for fuel in pressure regulator vacuum hose. If fuel is present, replace regulator assembly. Refer to <i>Fuel Pressure Regulator</i>. • Check for foreign material accumulation in the throttle bore, coking on the throttle valve or on the throttle shaft. Also inspect for throttle body tampering. • Check items which can cause an engine to run rich (long term fuel trim near –14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. • Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.
Sensor/System	Check Air intake system and crankcase for air leaks. • Check Crankcase ventilation valve for proper operation. Place finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve. • Check for proper calibration of speedometer. Connect J 33431–B (Signal Generator) to VSS electrical connector. Ignition ON, tester ON and monitor the speedometer. The speedometer should indicate 86 km/h (54 mph). Refer to <i>8A (Cell 33)</i> • Using a Scan Tool, monitor TP sensor voltage. The TP sensor voltage should be less than 0.9 volt. If the TP sensor voltage is greater than 0.9 volt, inspect the ASR/TCS adjuster assembly (if so equipped). Also inspect throttle body and accelerator cables for binding. Refer to <i>Adjuster Assembly Throttle And Cruise Control Cables</i>. • Using a scan tool, monitor KS system for excessive spark retard activity. Refer to <i>Knock Sensor System</i>.

Poor Fuel Economy (cont'd)

Checks	Action
Ignition System	• Check for proper ignition voltage output with spark tester J 26792. Refer to Distributor Ignition System for procedure. • Remove spark plugs and check for the following: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification in Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. • Visually/Physically inspect Secondary ignition for the following: – Ignition wires for cross firing. – Ignition wires arcing to ground. – Ignition wires for proper routing. – Distributor cap for cracks or carbon tracking. • Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. • Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. • Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Cooling System	• Check engine coolant level for being low. Refer to <i>Engine Cooling</i>. • Check engine thermostat for having a faulty part or for wrong heat range. Refer to <i>Engine Cooling</i>.
Engine Mechanical	• Check engine mechanical for the following: – Check compression. – Sticking or leaking valves. – Worn camshaft lobe(s). – Valve timing. – Bent push rods. – Worn rocker arms. – Broken valve springs. – Excessive oil in combustion chamber—Leaking valve seals. – Low cylinder compression. • For incorrect basic engine parts. Inspect for the following: – Camshaft – Cylinder heads – Pistons, etc. Refer to <i>Engine Mechanical</i> for diagnosis procedures.

Poor Fuel Economy (cont'd)

Checks	Action
Additional Checks	• Visually (physically) check: Vacuum hoses for splits, kinks, and proper connections and routing as shown on Vehicle Emission Control Information label. • Check TCC operation. Using a scan tool should indicate an RPM drop, when the TCC is commanded ON. Refer to <i>Transmission Control Systems</i>. • Check exhaust system for possible restriction. Check for the following: – Inspect exhaust system for damaged or collapsed pipes. – Inspect mufflers for heat distress or possible internal failure. – For possible plugged Three-Way catalytic converters by comparing exhaust system back pressure on each side of engine. Check back pressure by removing AIR check valves near exhaust manifolds. Refer to <i>Restricted Exhaust System Check</i>. • An engine miss condition can be caused by Electromagnetic Interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a problem exists, check routing of secondary ignition wires, high voltage components (Near Ignition Control circuits). Check distributor ground circuit for being open or loose. • Check the Traction Control Adjuster Assembly for being out of adjustment? Refer to <i>Adjuster Assembly-Throttle And Cruise Control Cables</i>. • Check PNP switch circuit . Refer to <i>PNP Switch Check</i>, or use the Tech 1 and be sure the scan tool indicates vehicle is in drive with gear selector in drive or overdrive. • Check for faulty motor mounts. Refer to <i>Engine Mechanical</i> for inspection of mounts. • Check for intake and exhaust manifold passages for casting flash. Refer to <i>Engine Mechanical</i>.

Rough, Unstable, or Incorrect Idle, Stalling

Checks	Action
DEFINITION: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Checks	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>. • Remove and check air filter element for dirt, or for being restricted. Refer to <i>Air Filter Element/Air Cleaner Assembly</i> Replace as necessary.
Fuel System	• Perform injector balance test. Refer to <i>Fuel Injector Balance Test</i> for procedure. • Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check for incorrect minimum idle speed. Using a scan tool, monitor IAC position. IAC should be between 5 and 50 counts. • Check each injector harness is connected to the correct injector/cylinder according to the firing order (firing order: 1-8-4-3-6-5-7-2). Relocate injector harnesses as necessary. • Check for injectors that are shorted internally. Compare injector resistance. Injector resistance should be within one ohm of each other. Refer to <i>Fuel Injector Coil Test</i>. • Check for fuel in pressure regulator vacuum hose. If fuel is present, replace regulator assembly. Refer to <i>Fuel Pressure Regulator</i>. • Check for foreign material accumulation in the throttle bore, coking on the throttle valve or on the throttle shaft. Also inspect for throttle body tampering. • Check items which can cause an engine to run rich (long term fuel trim near -14%). For a Rich condition, refer to <i>DTC P0132 HO2S Circuit High Voltage Bank1 Sensor1</i> and <i>DTC P0152 HO2S Circuit High Voltage Bank2 Sensor1</i>. • Check items that can cause an engine to run lean (long term fuel trim near 22%). For a Lean condition, refer to <i>DTC P0131 HO2S Circuit Low Voltage Bank1 Sensor1</i> and <i>DTC P0151 HO2S Circuit Low Voltage Bank2 Sensor1</i>.
Sensor/System	• Check Crankcase ventilation valve for proper operation. Place finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve. • Using a Scan Tool, monitor TP sensor voltage. The TP sensor voltage should be less than 0.9 volt. If the TP sensor voltage is greater than 0.9 volt, inspect the ASR/TCS adjuster assembly (If so equipped). Also inspect throttle body and accelerator cables for binding. Refer to <i>Adjuster Assembly Throttle And Cruise Control Cables</i>. • Using a scan tool, monitor KS system for excessive spark retard activity.

Rough, Unstable, or Incorrect Idle, Stalling (cont'd)

Checks	Action
Ignition System	• Check for proper ignition voltage output with spark tester J 26792. Refer to <i>Distributor Ignition System Check</i> for procedure. • Remove spark plugs and check for the following: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification in Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). <i>Refer to Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. • Visually/Physically inspect Secondary ignition for the following: – Ignition wires for cross firing. – Ignition wires arcing to ground. – Ignition wires for proper routing. – Distributor cap for cracks or carbon tracking. • Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. • Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i> • Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Mechanical	• Check engine mechanical for the following: – Check compression. – Sticking or leaking valves. – Worn camshaft lobe(s). – Valve timing. – Bent push rods. – Worn rocker arms. – Broken valve springs. – Excessive oil in combustion chamber—Leaking valve seals. – Low cylinder compression. • For incorrect basic engine parts. Inspect the following: – Camshaft – Cylinder heads – Pistons, etc. Refer to <i>Engine Mechanical</i> for diagnosis procedures.

Rough, Unstable, or Incorrect Idle, Stalling (cont'd)

Checks	Action
Additional Checks	• Check exhaust system for possible restrictions. Check for the following: – Inspect exhaust system for damaged or collapsed pipes. – Inspect mufflers for heat distress or possible internal failure. – For possible plugged Three-Way catalytic converters by comparing exhaust system back pressure on each side of engine. Check back pressure by removing AIR check valves near exhaust manifolds. Refer to Restricted Exhaust System Check and Exhaust System. • An engine miss condition can be caused by Electromagnetic Interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a problem exists, check routing of secondary ignition wires, high voltage components (Near Ignition Control circuits). Check distributor ground circuit for being open or loose. • Is Traction Control Adjuster Assembly out of adjustment? Refer to <i>Adjuster Assembly–Throttle And Cruise Control Cables</i>. • Check PNP switch circuit . Refer to <i>PNP Switch Check</i>, or use the Tech 1 and be sure the scan tool indicates vehicle is in drive with gear selector in drive or overdrive. • Check for faulty motor mounts. Refer to <i>Engine Mechanical</i> for inspection of mounts. • Check for intake and exhaust manifold passages for casting flash. Refer to <i>Engine Mechanical</i>. • An EGR valve that is excessively coked, could cause an engine misfire. Remove the EGR valve and clean as necessary. Refer to <i>EGR Valve</i>.

Dieseling, Run-On

Checks	Action
DEFINITION: Engine continues to run after key is turned OFF, but runs very rough. If engine runs smooth, check the ignition switch and adjustment.	
Preliminary Checks	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>.
Fuel System	• Inspect injectors for leaking. Refer to <i>Fuel System Diagnosis</i> for procedure.

Backfire

Checks	Actions
DEFINITION: Fuel ignites in the intake manifold, or in the exhaust system, making loud popping noise.	
Preliminary Checks	• Refer to <i>Symptoms, Important Preliminary Checks Before Starting</i>. • Search for bulletins. • Check PCM grounds for being clean, tight and in their proper locations. Refer to <i>PCM wiring diagrams in Electrical Diagnosis</i>.
Fuel System	• Check for low fuel pressure. Refer to <i>Fuel System Diagnosis</i>. • Check for restricted fuel filter. Refer to <i>Fuel System Diagnosis</i>. • Check for contaminated fuel. Refer to <i>Alcohol/Contaminants-in-Fuel Testing Procedure</i>. • Check each injector harness is connected to the correct injector/cylinder according to the firing order (firing order: 1-8-4-3-6-5-7-2). Relocate injector harnesses as necessary.
Sensor/System	• Check EGR for being loose or for a faulty gasket. Check EGR operation for being open all the time. Refer to <i>EGR Valve</i>. • Check Secondary Air Injection (AIR) system. • Check Air intake system and crankcase for air leaks. • Check Crankcase ventilation valve for proper operation. Place finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve. • Check for proper calibration of speedometer. Connect Signal Generator (J 33431-B) to VSS electrical connector. Ignition ON, tester ON and monitor the speedometer. The speedometer should indicate 86 km/h (54 mph). Refer to <i>8A (Cell 33)</i>. • Using a Scan Tool, monitor TP sensor voltage. The TP sensor voltage should be less than 0.9 volt. If the TP sensor voltage is greater than 0.9 volt, inspect the ASR/TCS adjuster assembly (if so equipped). Also inspect throttle body and accelerator cables for binding. Refer to <i>Adjuster Assembly Throttle And Cruise Control Cables</i>. • Using a scan tool, monitor KS system for excessive spark retard activity. Refer to <i>Knock Sensor System</i>.

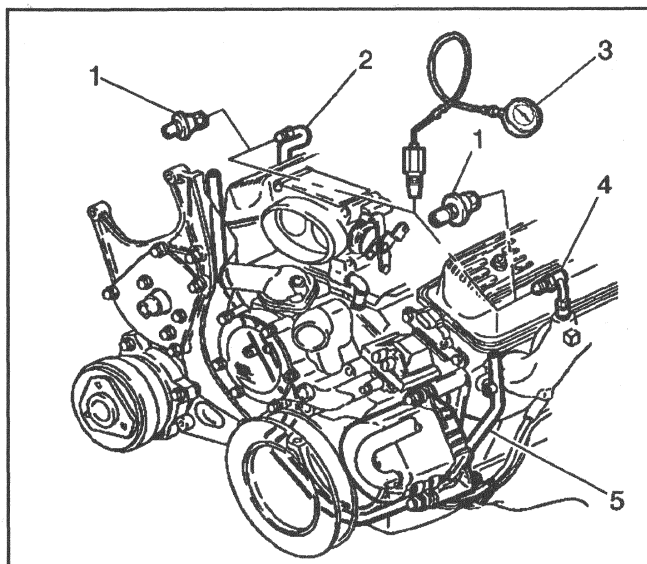
Backfire (cont'd)

Checks	Actions
Ignition System	• Check for proper ignition voltage output with spark tester J 26792. Refer to Distributor Ignition System for procedure. • Check for an intermittent ignition system malfunction in the following circuits: – Intermittent Low resolution circuit. – Intermittent High resolution circuit. – Intermittent Ignition Control circuit. – Using the scan tool's Snapshot feature may help locate an intermittent ignition failure. Review low and high resolution signals. Abnormal low and high resolution signals can cause a backfire on acceleration. Refer to <i>Distributor Ignition System Check</i>. • Remove spark plugs and check for the following: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • An improper spark plug gap will cause a driveability problem. Refer to spark plug gap specification in Section OB. The spark plug gapping should be done using a wire gauge gap tool (J 41319). Refer to <i>Spark Plug Replacement</i>. If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <i>DTC P0172 Fuel Trim System Rich Bank1</i> and <i>DTC P0175 Fuel Trim System Rich Bank2</i> to determine the Rich condition or <i>Engine Mechanical</i> for the oil fouling condition. • Visually/Physically inspect Secondary ignition for the following: – Ignition wires for cross firing. – Ignition wires arcing to ground. – Ignition wires for proper routing. – Distributor cap for cracks or carbon tracking. • Wetting down the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look/listen for arcing or misfiring as water is applied. • Check for loose ignition coil ground. Refer to <i>Distributor Ignition System Check</i>. • Check distributor vent system for being restricted or open. Refer to <i>Distributor Vent System Check</i>.
Engine Cooling System	• Check engine coolant level for being low. Refer to <i>Engine Cooling</i>. • Check engine thermostat for having a faulty part or for wrong heat range. Refer to <i>Engine Cooling</i>.

Backfire (cont'd)

Checks	Actions
Engine Mechanical	• Check engine mechanical: – Check compression. – Sticking or leaking valves. – Worn camshaft lobe(s). – Valve timing. – Bent push rods. – Worn rocker arms. – Broken valve springs. – Excessive oil in combustion chamber–Leaking valve seals. – Low cylinder compression. • For incorrect basic engine parts. Inspect the following: – Camshaft – Cylinder heads – Pistons, etc. • Refer to <i>Engine Mechanical</i> for diagnosis procedures.
Additional Checks	• Visually (physically) check: Vacuum hoses for splits, kinks, and proper connections and routing as shown on Vehicle Emission Control Information label. • Check Intake and exhaust manifold(s) for casting flash. Refer to <i>Engine Mechanical</i>. • Check TCC operation. The scan tool should indicate an RPM drop when the TCC is commanded ON. Refer to <i>Transmission Control Systems</i>. • Check exhaust system for possible restriction. Check the following: – Inspect exhaust system for damaged or collapsed pipes. – Inspect mufflers for heat distress or possible internal failure. – For possible plugged Three-Way catalytic converters by comparing exhaust system back pressure on each side of engine. Check back pressure by removing AIR check valves near exhaust manifolds. Refer to Restricted Exhaust System Check and Exhaust System. • An engine miss condition can be caused by Electromagnetic Interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a problem exists, check routing of secondary ignition wires, high voltage components (Near Ignition Control circuits). Check distributor ground circuit for being open or loose. • Is Traction Control Adjuster Assembly out of adjustment? Refer to <i>Adjuster Assembly–Throttle And Cruise Control Cables</i>. • Check PNP switch circuit . Refer to <i>PNP Switch Check</i>, or use the Tech 1 and be sure the scan tool indicates vehicle is in drive with gear selector in drive or overdrive. • Check for faulty motor mounts. Refer to <i>Engine Mechanical</i> for inspection of mounts. • Check for intake and exhaust manifold passages for casting flash. Refer to <i>Engine Mechanical</i>.

Restricted Exhaust System Check



30001

Legend

- (1) Check Valve
- (2) Bank 2 AIR Pipe
- (3) Exhaust Back Pressure Gauge
- (4) Bank 1 AIR Pipe
- (5) AIR Cross Under Pipe

Restricted Exhaust System Check

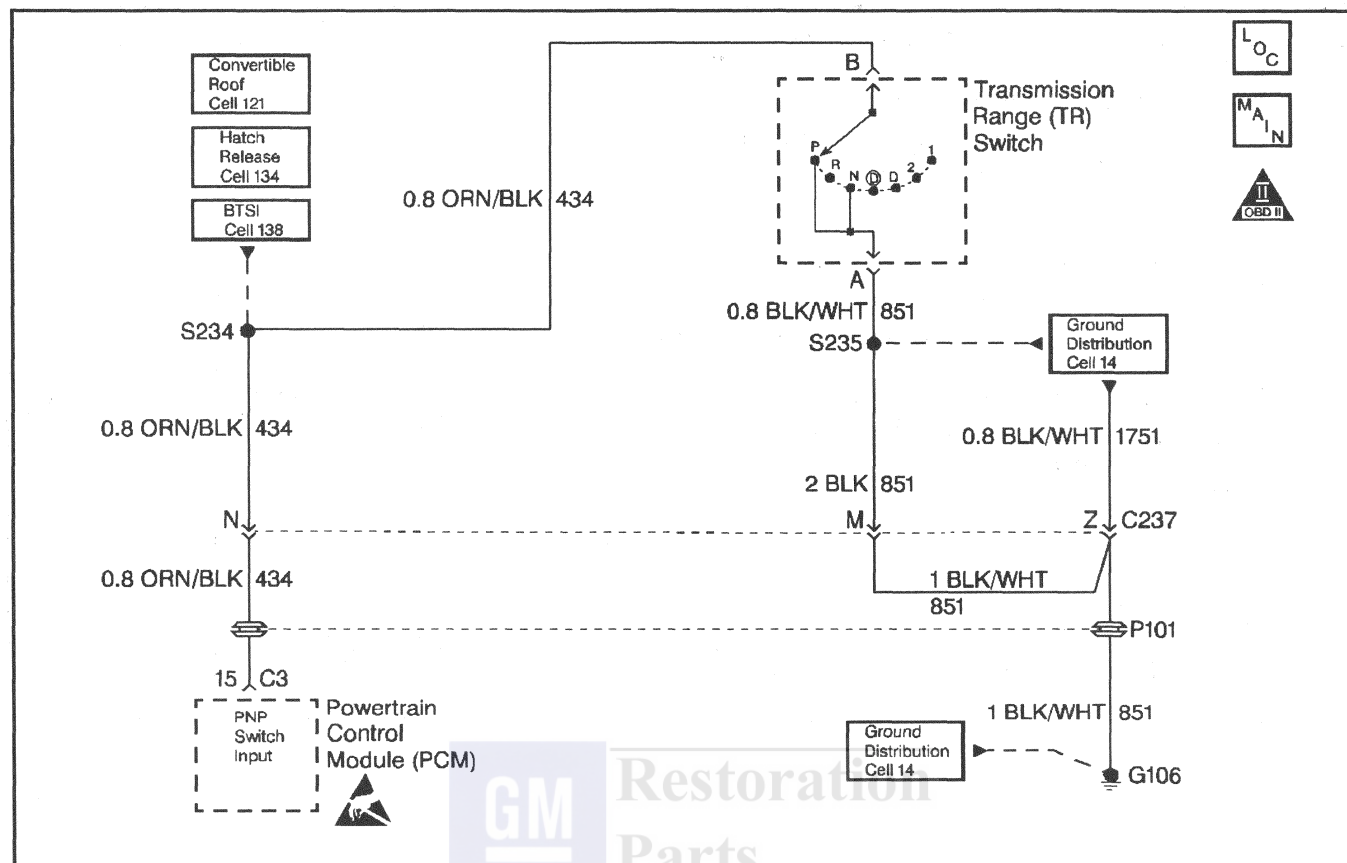
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Remove the AIR check valve on the side of the engine that is suspected of being restricted. 2. Install the Exhaust Back Pressure tester J 35314-A in place of the AIR check valve. 3. Engine idling at normal operating temperature. 4. Observe the exhaust system back pressure reading on the gauge. Does the reading exceed the specified value?	8.6 kPa (1.25 psi)	Go to Step 4	Go to Step 3
3	1. The Exhaust Backpressure Gauge still installed. 2. Increase engine speed to 2000 RPM. 3. Observe the exhaust system back pressure reading on the gauge. Does the reading exceed the specified value?	20.7 kPa (3 psi)	Go to Step 4	If a driveability symptom exists, refer to Symptoms

Restricted Exhaust System Check (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Turn the Engine OFF. 2. Re-install the AIR check valve. 3. Remove the rear HO2S sensor on the side of the engine that is suspected of being restricted. 4. Install the Exhaust Back Pressure tester J 35314-A in place of the HO2S sensor. 5. Start and idle the engine. 6. Increase the engine speed to 2000 RPM. 7. Observe the exhaust system back pressure reading on the gauge. Does the reading exceed the specified value?	20.7 kPa (3 psi)	Go to Step 5	Go to Step 6
5	Repair the restriction in the exhaust system after the Catalytic Converter. Check exhaust system for the following: • Collapsed pipe • Heat distress • Internal muffler failure Is the action completed?	—	System OK	—
6	Replace Catalytic Converter. Refer to <i>Exhaust System</i> Is the action completed?	—	System OK	—



PNP Switch Check



Circuit Description

The Park/Neutral Position (PNP) switch contacts are closed to ground in park and neutral. The PCM applies a voltage (about 12.0 Volts) to the switch. When the gear selector is in park or neutral the PNP switch is closed and the PCM senses low signal voltage (low engine load). When the gear selector is in reverse or a drive range, the PNP switch opens, and the PCM senses high signal voltage (high engine load). The PCM will increase the idle air rate to compensate for the additional load on the engine when the transmission is in gear.

Some of the PCM's other uses for the PNP signal are:

- Vehicle Speed Sensor (VSS) diagnostics
- Exhaust Gas Recirculation (EGR) operation

Diagnostic Aids

- A PNP switch that does not close or an open circuit may cause the engine idle speed to drop when the vehicle is shifted into gear.
- A switch that will not open or the signal circuit shorted to ground will cause the EGR system to be inoperative, possibly resulting in excessive spark knock.
- Inspect all related wiring and connectors including the connections at the PCM. These may cause an intermittent malfunction. Check for damaged, corroded or pushed out terminals.

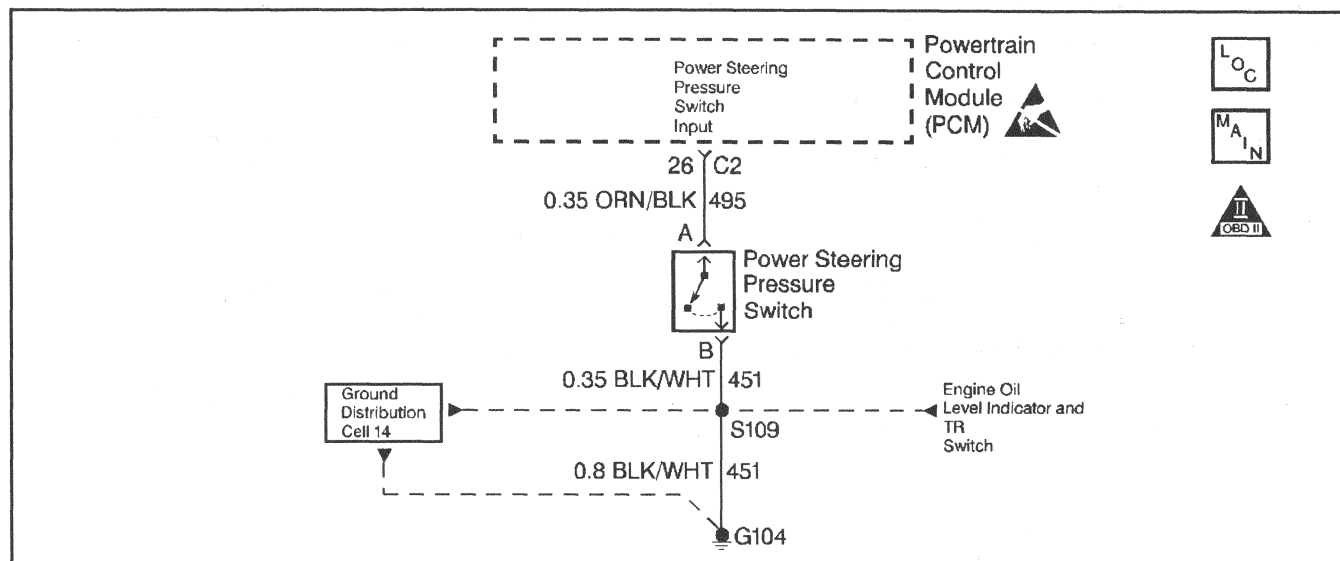
PNP Switch Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Turn the Ignition ON, Engine OFF. 3. Transmission in Park. Does the scan tool indicate Park/Neutral (P-N—)?	—	Go to Step 3	Go to Step 4

PNP Switch Check (cont'd)

Step	Action	Value(s)	Yes	No
3	Shift the transmission into drive. Does the scan tool should indicate Drive (-R-OD21)?	—	Refer to <i>Diagnostic Aids - PNP Switch</i>	<i>Go to Step 7</i>
4	1. Disconnect the Park/Neutral Position switch connector. 2. Using a fused jumper wire, jumper harness connector terminals A and B. Does the scan tool indicate Park/Neutral (P-N—)?	—	<i>Go to Step 10</i>	<i>Go to Step 5</i>
5	Using a fused jumper wire connected to ground, probe terminal B in the PNP switch harness connector. Does the scan tool indicate Park/Neutral (P-N—)?	—	<i>Go to Step 13</i>	<i>Go to Step 6</i>
6	1. Leave fused jumper in place. 2. Ignition OFF. 3. Disconnect the PCM connector C3. 4. Using a test light (J 34142-B) connected to B+, probe the PCM harness connector terminal C3-15. Does The test light illuminate?	—	<i>Go to Step 9</i>	<i>Go to Step 11</i>
7	Disconnect the Park/Neutral Position switch connector. Does the scan tool indicate Drive (-R-OD21)?	—	<i>Go to Step 10</i>	<i>Go to Step 8</i>
8	1. Turn the Ignition OFF. 2. Disconnect the PCM connector C3. 3. Turn the Ignition ON. Does the scan tool indicate Drive (-R-OD21)?	—	<i>Go to Step 12</i>	<i>Go to Step 15</i>
9	Check for faulty connections at the PCM. Was the condition found and corrected?	—	<i>Go to Step 16</i>	<i>Go to Step 15</i>
10	Check for faulty connections at the PNP switch or for the PNP switch for being out of adjustment. Was the condition found and corrected?	—	<i>Go to Step 16</i>	<i>Go to Step 14</i>
11	Repair open PNP signal circuit. Is the repair completed?	—	<i>Go to Step 16</i>	—
12	Repair the PNP signal circuit for a short to ground. Is the repair completed?	—	<i>Go to Step 16</i>	—
13	Repair open PNP ground circuit. Is the repair completed?	—	<i>Go to Step 16</i>	—
14	Replace the PNP switch. Is the repair completed?	—	<i>Go to Step 16</i>	—
15	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the repair completed?	—	<i>Go to Step 16</i>	—
16	Operate the vehicle within the conditions under which the original symptom was noted. Does the system now operate properly?	—	System OK	<i>Go to Step 2</i>

Power Steering Pressure Switch Check



30422

Circuit Description

The Power Steering Pressure (PSP) switch is a normally open pressure switch located in the high pressure (outlet) hose of the power steering system. The PCM applies a voltage (about 12.0 Volts) to the sensor. When power steering pressure is low the PSP switch is open and the PCM senses high signal voltage (low engine load). When power steering pressure is high, such as during parking maneuvers, etc., the PSP switch closes, and the PCM senses low signal voltage (high engine load). The PCM will increase the idle air rate and retard the timing to compensate for the additional load on the engine.

Diagnostic Aids

- A pressure switch that will not close or an open circuit may cause the engine RPM to drop when power steering loads is high.
- A switch that will not open or the signal circuit shorted to ground may have an adverse effect on idle quality.

Inspect all related wiring and connectors including the connections at the PCM. These may cause an intermittent malfunction. Check for damaged, corroded or pushed out terminals.

Power Steering Pressure Switch Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. Start the engine. Does the scan tool indicate PSP switch Normal?	—	Go to Step 3	Go to Step 4
3	Turn the steering wheel and hold momentarily against stop. Does the scan tool indicate PSP switch High Pressure?	—	Go to Diagnostic Aids	Go to Step 6
4	1. Turn the ignition ON, Engine OFF. 2. Disconnect the PSP switch connector. Does the scan tool indicate PSP switch Normal?	—	Go to Step 14	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Using a test light (J34142-B) connected to B+, probe the PCM harness connector terminal C2-26. Is the test light OFF?	—	Go to Step 15	Go to Step 12

Power Steering Pressure Switch Check (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the PSP switch connector. 2. Using a fused jumper wire, jumper the two harness connector terminals together. Does the scan tool indicate PSP switch High Pressure?	—	Go to Step 10	Go to Step 7
7	Using a fused jumper wire connected to ground, probe the signal circuit terminal in the PSP switch harness connector. Does the scan tool indicate PSP switch High Pressure?	—	Go to Step 13	Go to Step 8
8	1. Leave the fused jumper in place. 2. Turn the ignition OFF. 3. Disconnect the PCM connector C2. 4. Using a test light (J 34142-B) connected to B+, probe PCM harness connector terminal C2-26. Does the test light illuminate?	—	Go to Step 9	Go to Step 11
9	Check for faulty connections at the PCM. Was condition found and corrected?	—	Go to Step 16	Go to Step 15
10	Check for faulty connections at the PSP switch. Was condition found and corrected?	—	Go to Step 16	Go to Step 14
11	Repair the open PSP signal circuit. Is the repair complete?	—	Go to Step 16	—
12	Repair the PSP signal circuit for a short to ground. Is the repair complete?	—	Go to Step 16	—
13	Repair open PSP ground circuit. Is the repair complete?	—	Go to Step 16	—
14	Replace the PSP switch. Is the repair complete?	—	Go to Step 16	—
15	Important: The replacement PCM must be reprogrammed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the repair complete?	—	Go to Step 16	—
16	Operate the vehicle within the conditions under which the original symptom was noted. Does the system now operate properly?	—	System OK	Go to Step 2

A/C Request Circuit Check

Circuit Description:

The A/C clutch relay is PCM controlled to delay A/C clutch engagement after the A/C is turned ON. This allows the PCM to adjust engine RPM before the A/C clutch engages. The PCM will engage the A/C clutch any time A/C has been requested unless any of the following conditions exist:

- High coolant temperature.
- Low A/C system pressure.
- High A/C system pressure.
- Wide open throttle.
- High engine RPM.

When the heater and A/C control is placed in the A/C mode, a 12 volt signal is sent to the PCM. When the PCM receives this signal the PCM will ground the A/C clutch relay control circuit to energize the A/C relay. This is shown on the scan tool as A/C request YES.

When a request for A/C has been detected by the PCM, the PCM will ground the A/C clutch relay control circuit, the relay contacts will close, and current will flow through the relay to the A/C compressor clutch.

When A/C request has been detected by the PCM, the cooling fan(s) will be turned ON when A/C pressure is above a predetermined pressure. For the system schematic, refer to *A/C Controls - C60* or *A/C Controls - C67 and C68*.

Diagnostic Aids

Before using this table, be sure no PCM DTC(s) are stored. The PCM will not activate the A/C clutch with a stored DTC.

Test Description

Number(s) below refer to number(s) on the diagnostic table.

2. A/C DTCs will disable the A/C system. Repair A/C DTCs before proceeding.
3. If the scan tool displays A/C request as YES, indicates the request circuit is shorted to a voltage.
5. If the test light did not illuminate, indicates a problem with the request circuit between the A/C pressure switch and the control head or the control head is malfunctioning. Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 67)*.

A/C Request Circuit Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Are any A/C DTCs set?	—	Go to applicable DTC table.	Go to Step 3
3	1. Install the scan tool. 2. Engine idling with A/C OFF. 3. Using a scan tool on the ENG 1 data list, monitor A/C request. Does the scan tool indicate A/C request as YES?	—	Go to Step 9	Go to Step 4
4	Turn the ignition ON and A/C ON. Does the scan tool indicate A/C request as YES?	—	Go to Symptoms	Go to Step 5
5	1. Disconnect the A/C pressure cycling switch. 2. Using a DVM J 39200, probe the A/C request circuit (HVAC side of the of the A/C pressure cycling switch electrical connector.) Does the DVM display near the specified voltage?	B+	Go to Step 6	Go to Repair Procedures in Electrical Diagnosis (8A Cell 67).
6	Using a fused jumper wire, jumper terminals A and B together at the A/C pressure cycling switch harness connector. Does the scan tool indicate A/C request as YES?	—	Go to Step 13	Go to Step 7
7	1. Turn the ignition OFF. 2. Disconnect the PCM connector C2. 3. Check the continuity of A/C request circuit between the PCM and the A/C pressure cycling switch. Is the A/C request circuit open?	—	Go to Step 15	Go to Step 8

A/C Request Circuit Check (cont'd)

Step	Action	Value(s)	Yes	No
8	Is the A/C request circuit shorted to ground?	—	Go to Step 16	Go to Step 12
9	Disconnect the A/C pressure cycling switch. Does the scan tool indicate A/C request as YES?	—	Go to Step 10	Go to Repair Procedures in Electrical Diagnosis (8A Cell 67).
10	Using a test light connected to ground, probe the A/C request circuit at the A/C pressure cycling switch harness connector (PCM side). Does the test light illuminate?	—	Go to Step 11	Go to Step 17
11	Repair the A/C request circuit for a short to voltage. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action completed?	—	System OK	—
12	Check PCM connections. If faulty connections are found, repair as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found and corrected?	—	System OK	Go to Step 17
13	1. Check connections of the A/C pressure cycling switch harness connector. 2. If faulty connections are found, repair as necessary. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Was a problem found and corrected?	—	System OK	Go to Step 14
14	Replace the A/C pressure cycling switch. Is the action completed?	—	System OK	—
15	Repair the open A/C request circuit between the switch and the PCM. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action completed?	—	System OK	—
16	Repair the grounded A/C request circuit between the switch and the PCM. Refer to <i>Repair Procedures in Electrical Diagnosis (8A Cell 5)</i> . Is the action completed?	—	System OK	—
17	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	System OK	—

Electric Cooling Fan Diagnosis

Circuit Description:

The cooling fans are controlled by the PCM based on various inputs. Battery voltage is supplied to the primary and secondary cooling fan relays (switch side). Ignition voltage is supplied to the primary and secondary cooling fan relays (coil side). The PCM controls the cooling fan relays by providing a ground path.

The PCM will enable the engine cooling fans when certain Diagnostic Trouble Codes are set. For the Fan schematic, refer to *Fan Controls-w/o VO8* or *Fan Controls-With VO8*.

Diagnostic Aids

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the warning indicator light, or engine coolant temperature gage indicated overheating. The gage accuracy can also be checked by comparing the Engine Coolant Temperature (ECT) sensor reading using a scan tool and comparing its reading with the

gage reading. If the engine is actually overheating and the gage indicated overheating, but the cooling fan is not coming ON, the Engine Coolant Temperature (ECT) sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating and the cooling fans are ON, the cooling system should be checked, refer to Section 6B.

The PCM will command fan 1 ON at 107°C (225°F) and OFF at 103°C (218°F) and, fan 2 ON at 111°C (232°F) and OFF at 107°C (225°F).

Test Description

Number(s) below refer to number(s) on the diagnostic table.

- The PCM will enable the engine cooling fans when certain Diagnostic Trouble Codes are set. Go to applicable DTC Table first before proceeding with this table.
- Allow engine coolant temperature to cool below 100°C (212°F) before proceeding with diagnosis diagnoses.

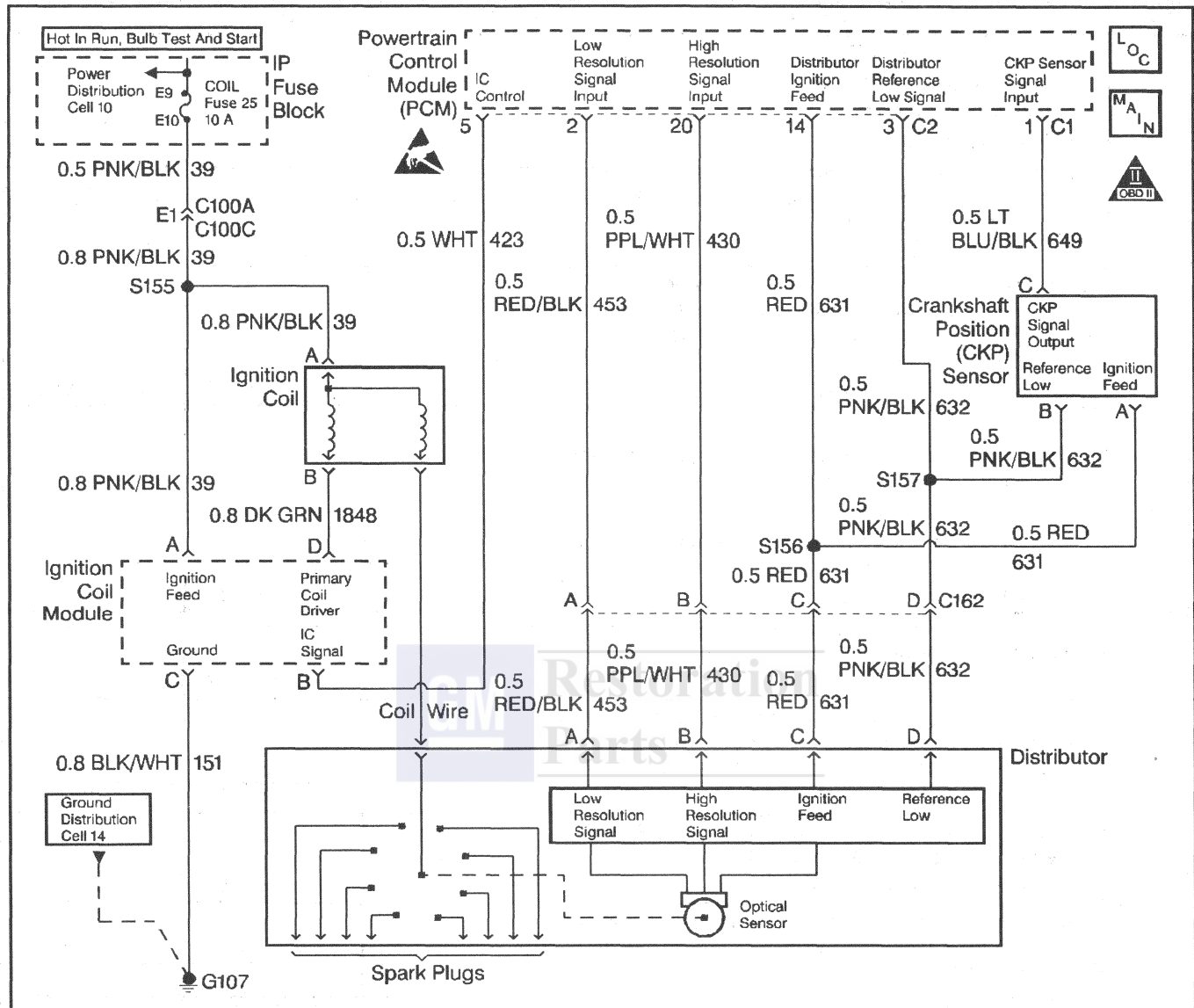
Electric Cooling Fan Functional Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?		<i>Go to Step 2</i>	Go to Powertrain OBD System Check
2	Are any DTCs set?	—	Go to applicable DTC Table	<i>Go to Step 3</i>
3	1. Install the scan tool. 2. The engine coolant temperature must be below the specified value for all the fan diagnoses. 3. Turn the ignition ON, Engine OFF and A/C OFF. Are the cooling fans OFF?	100°C (212°F)	<i>Go to Step 4</i>	<i>Go to Step 6</i>
4	Using a scan tool, command the cooling fan relay(s) ON. Are both cooling fans ON?	—	<i>Go to Step 5</i>	<i>Go to Step 9</i>
5	With the engine idling, turn the A/C ON. Are the cooling fan(s) ON?	—	System OK	Go to A/C request circuit diagnosis
6	Disconnect the cooling fan relay for the cooling fan that is operating. Does the cooling fan stop?	—	<i>Go to Step 7</i>	<i>Go to Step 8</i>
7	Replace the cooling fan relay. Is the action complete?	—	System OK	—
8	Repair the circuit between the fan relay and the fan motor for a short to voltage. Is the action complete?	—	System OK	—

Electric Cooling Fan Functional Check (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Turn the ignition OFF. 2. Disconnect the cooling fan relay for the cooling fan that is not operating. 3. Turn the ignition ON. 4. Using a test light connected to ground, probe the battery feed side of the cooling fan relay electrical harness, contact side. Does the test light illuminate?	—	Go to Step 10	Go to Step 16
10	Using a fused jumper wire, jumper the cooling fan relay electrical harness from the battery feed circuit to the circuit going to the fan motor (leave jumper installed for the remainder of the steps). Does the cooling fan operate?	—	Go to Step 17	Go to Step 11
11	1. Turn the ignition OFF. 2. Disconnect the cooling fan electrical connector for the fan that did not operate. 3. Turn the ignition ON. 4. Connect a test light across the cooling fan electrical connector terminals. Does the test light illuminate?	—	Go to Step 18	Go to Step 12
12	Probe the cooling fan motor harness connector power feed circuit with a test light connected to ground. Does the test light illuminate?	—	Go to Step 13	Go to Step 15
13	Check the connection at the fan motor harness connector. If a faulty connection is found, repair as necessary. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Was a problem found and corrected?	—	System OK	Go to Step 14
14	Repair open fan motor ground circuit. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Is the action complete?	—	System OK	—
15	Repair open power feed circuit between the fan relay and the cooling fan motor. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Is the action complete?	—	System OK	—
16	Repair open battery feed circuit to the fan relay. Refer to Repair Procedures in Electrical Diagnosis (8A Cell 5). Is the action complete?	—	System OK	—
17	Replace the cooling fan relay. Is the action complete?	—	System OK	—
18	Replace the cooling fan motor. Is the action complete?	—	System OK	—

Distributor Ignition System Check



13750

Diagnostic Aids

An ignition coil wire that is open or shorted to ground can cause a no start condition.

Test Description

Number(s) below refer to step number(s) on the diagnostic table.

Important: The battery should be fully charged prior to any tests.

- Checks for proper output from the distributor ignition system. The spark tester requires a minimum of 25,000 volts to fire. This check can be used in case of an ignition miss, because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.

- This test will separate the distributor cap, rotor and ignition wires from the ignition coil to help identify a secondary ignition system problem. It is necessary to unscrew the top terminal on the ST-125 spark tester for a proper fit in the distributor end of the coil wire.
- This will determine if the proper available voltage exists in the primary ignition circuit.
- This check will begin to determine if the PCM is providing a signal to the ignition coil module or not. If the PCM is not providing a signal to the ignition coil module, the problem exists between the distributor and PCM.
- If the PCM is detecting low resolution signal pulses and no IC signal was available at the ignition coil module, a problem exists with the PCM or the circuit to the ignition coil module.

13. If the PCM does not detect low resolution signal pulses, the distributor or distributor to PCM circuitry is most likely the problem. The remaining tests will determine if the proper signals are being sent and received from both the distributor and PCM.

22. A grounded coil circuit will cause the ignition fuse to open, and a no-start condition will occur.

Distributor Ignition System Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Turn the ignition OFF. 2. Disconnect the tachometer (If so equipped.) 3. Remove an ignition wire from a spark plug. 4. Install the spark tester (J 26792.) 5. While cranking the engine, observe the spark tester. Important: If no spark is coming from the ignition wire, check a second ignition wire. A few sparks and then nothing is considered no spark. Is spark jumping the gap at the spark tester?	—	Go to Step 3	Go to Step 4
3	Remove the spark plugs and inspect for being gas fouled. Are the spark plugs gas fouled?	—	Go to Spark Plug Replacement	Go to Fuel System Diagnosis
4	1. Reconnect the ignition wires to spark plugs. 2. Disconnect the coil wire from the distributor. 3. Connect the spark test to the coil wire. 4. While cranking the engine, observe the spark tester. Is spark jumping the gap at the spark tester?	—	Go to Step 19	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the Ignition Coil Module connector. 3. Turn the ignition ON. 4. Using a DVM (J 39200), measure the voltage at the harness terminals A and D to ground. Do both terminals measure less than the specified value?	10.0V	Go to Step 22	Go to Step 6
6	Is there only one terminal below the specified value?	10.0V	Go to Step 23	Go to Step 7
7	1. Connect the DVM to terminal B of the ignition coil module harness and ground. 2. Set the DVM to the AC scale. 3. While cranking the engine, observe the voltage on the DVM. Is the voltage between the specified values?	1.0– 4.0 V	Go to Step 8	Go to Step 12
8	1. Turn the ignition ON. 2. Using a test light (J 34142–B) connected to B+, probe terminal C of the ignition coil module harness connector. Did the test light illuminate?	—	Go to Step 10	Go to Step 9
9	Repair the Ignition Coil Module ground circuit. Is the repair completed?	—	System OK	—
10	1. Inspect the terminals of the ignition coil module harness connector for proper tension. 2. If a poor connection is found, replace the terminals. Was a poor connection found?	—	System OK	Go to Step 11

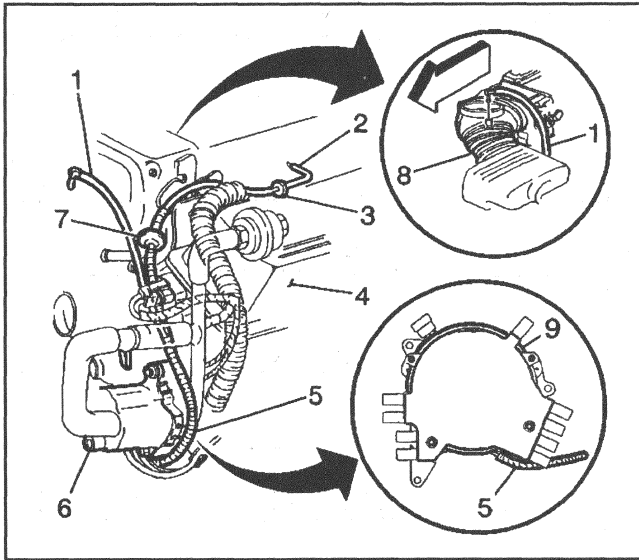
Distributor Ignition System Check (cont'd)

Step	Action	Value(s)	Yes	No
11	Replace the Ignition Coil Module. Is the action completed?	—	System OK	—
12	1. Install the scan tool. 2. Using the scan tool, monitor the low resolution signal on the Engine 1 Data List. 3. Crank the engine for 10.0 seconds. Is a low resolution signal indicated on the scan tool?	—	Go to Step 25	Go to Step 13
13	1. Turn the ignition OFF. 2. Disconnect the distributor electrical connector. 3. Turn the ignition ON. 4. Using a test light (J 34142-B) connected to ground, probe terminal C of the distributor harness connector. Did the test light illuminate?	—	Go to Step 14	Go to Step 27
14	Using a DVM (J 39200), check for continuity between the distributor connector terminal D and ground. Does the circuit have continuity?	—	Go to Step 15	Go to Step 28
15	Using a DVM on the DC scale, measure the voltage at the distributor connector terminal A. Is the voltage at the specified value?	5.0V	Go to Step 16	Go to Step 29
16	Using a DVM on the DC scale, measure the voltage at the distributor connector terminal B. Is the voltage at the specified value?	5.0V	Go to Step 17	Go to Step 18
17	Faulty distributor connection or faulty distributor. Is the repair completed?	—	System OK	—
18	1. Inspect the distributor high resolution circuit for an open. 2. If the circuit is found to be open, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> Was a problem found and corrected?	—	System OK	Go to Step 30
19	Inspect the secondary ignition wires for the following: • Open circuits • Shorted circuits • Poor connections Was a problem found and corrected?	—	System OK	Go to Step 20
20	1. Remove the distributor. Refer Distributor Removal. 2. Inspect cap and rotor for cracks, carbon tracking and interference between the cap and rotor. Refer to Distributor cap, Cover, Rotor and Base Assembly Was a problem found and corrected?	—	System OK	Go to Step 21
21	Replace distributor base assembly. Refer to Distributor cap, Cover, Rotor and Base Assembly. Is the action complete?	—	System OK	—
22	Check the ignition feed circuit to the coil for the following: • Open fuse. • Poor connection at the coil. • Grounded circuit. Did any of the above require a repair?	—	System OK	Go to Step 24

Distributor Ignition System Check (cont'd)

Step	Action	Value(s)	Yes	No
23	1. Inspect the circuit that was less than 10.0 volts for an open or for a grounded circuit. 2. If the circuit is open or grounded, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was an open or grounded circuit located?	—	System OK	Go to Step 24
24	Replace the ignition coil. Is the action complete?	—	System OK	—
25	1. Turn the ignition OFF. 2. Disconnect the PCM electrical connector. 3. Inspect the Ignition Control terminal for proper tension (At the PCM harness.) 4. If a poor connection is found, replace faulty terminal. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was a problem found and corrected?	—	System OK	Go to Step 26
26	1. Inspect the ignition control circuit for an open. 2. If the circuit is found to be open, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was a problem found and corrected?	—	System OK	Go to Step 30
27	1. Inspect the distributor ignition feed circuit for an open. 2. If the circuit is found to be open, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was a problem found and corrected?	—	System OK	Go to Step 30
28	1. Inspect the distributor ground circuit for an open. 2. If the circuit is found to be open, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was a problem found and corrected?	—	System OK	Go to Step 30
29	1. Inspect the distributor low resolution circuit for an open or a grounded circuit. 2. If the circuit is found to be open or grounded, repair it as necessary. Refer to <i>Electrical Diagnosis 8A Cell 5</i> . Was a problem found and corrected?	—	System OK	Go to Step 30
30	Check for a poor connection at the PCM and replace terminal if necessary. Was a problem found and corrected?	—	System OK	Go to Step 31
31	Important: Replacement PCM must be programmed. Refer to <i>PCM Replacement/Programming</i> . Replace the PCM. Is the action complete?	—	System OK	—

Distributor Vent System Check



30050

Legend

- (1) Clean Air Supply Hose (from air intake duct)
- (2) Vacuum Supply from Intake Manifold
- (3) Check Valve
- (4) Rocker Cover
- (5) Vent System Harness
- (6) AIR Pump
- (7) Check Valve Filter
- (8) Air Intake Duct
- (9) Distributor

Circuit Description

The distributor is equipped with a fresh air vent system. When the engine is started, vacuum that the engine produces pulls fresh air in from the air intake duct. A constant supply of fresh air is needed within the distributor. An inoperative distributor vent system may cause premature distributor failure.

Diagnostic Aids

If the check valve/filter or the check valve is installed backwards the system will not function. Verify flow direction is toward the manifold using a hand held vacuum pump at the check valve and the check valve/filter ports. Vacuum should hold in one direction and not the other. If vacuum holds or does not hold in both direction, for either component, that component is faulty.

Test Description

Number(s) below refer to step number(s) on the diagnostic table.

2. Check for a blocked or restricted vacuum source.
5. Check for a blocked, restricted or collapsed hoses. Check the connections at the distributor cap for a blockage. Check for a faulty check valve or check valve/filter.
6. Check for damaged or leaking hoses or connections. Check the seal between the distributor cap and the distributor. Also, check the distributor cap for cracks or other damage.

Distributor Vent System Check

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Disconnect the distributor vacuum hose at the intake manifold. 2. Connect a hand held vacuum pump to the distributor vacuum hose. 3. Apply vacuum and observe vacuum pump gauge. Does the vacuum not build up or bleed off quickly?	—	Go to Step 3	Go to Step 5
3	1. With the vacuum pump still connected, disconnect the distributor clean air supply hose from the air intake duct and plug it with a suitable stopper. 2. Apply 34 kPa (10 in. Hg) of vacuum and observe the vacuum pump gauge. Does the vacuum hold?	—	Go to Step 4	Go to Step 6

Distributor Vent System Check (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Remove the stopper from the clean air supply hose. 2. Disconnect the vacuum pump. 3. Connect the vacuum pump to the clean air supply hose. 4. Apply 34 kPa (10 in. Hg) of vacuum and observe the vacuum pump gauge. Does the vacuum hold?	—	System OK	Go to Step 7
5	Repair the distributor vent system for a blockage or restrictions. Is the action complete?	—	System OK	—
6	Repair the distributor vent system for vacuum leaks. Is the action complete?	—	System OK	—
7	Replace the faulty check valve. Is the action complete?	—	System OK	—

Fuel Tank Leak Check

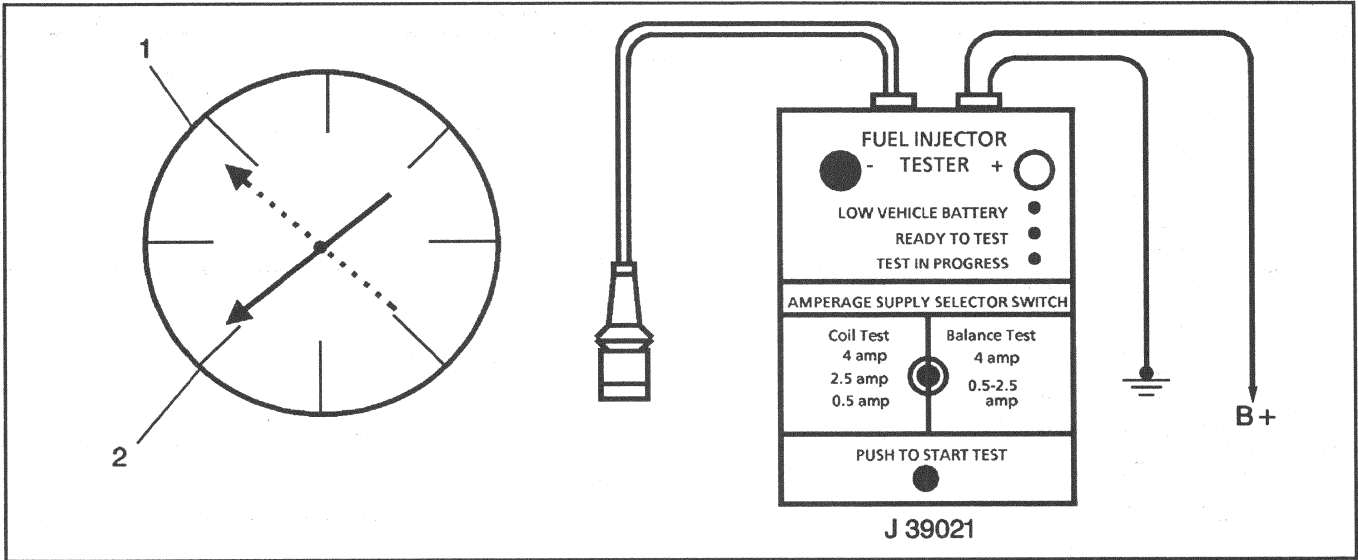
Important:

- Before attempting the Fuel Tank Leak Check place a dry chemical (Class B) fire extinguisher near the work area.
- Before removing the fuel tank for a suspected leak, make sure the fuel pipes are not leaking onto the fuel tank. Once removed, make sure fuel is not leaking around the fuel sender gasket.
- This check requires a fuel sender assembly and a fuel sender gasket to be installed in the fuel tank.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.

3. Drain the fuel tank. Refer to Draining Fuel Tank.
4. Remove the fuel tank. Refer to Fuel Tank and Fuel Filler Pipe Replacement.
5. Cap the fuel feed pipe, the fuel return pipe, and the EVAP pipe on the fuel sender assembly.
6. Connect a piece of hose to the filler pipe nipple and plug the opposite end.
7. Submerge the fuel tank in water or apply a soap solution to the outside of the fuel tank.
8. Apply 35 kPa (5 psi) air pressure to the vent hose on the fuel tank. Air bubbles appearing from the fuel tank indicate a leak.
9. Replace the fuel tank if it is leaking. Refer to Fuel Tank and Fuel Filler Pipe Replacement.

Fuel Injector Balance Test



17713

Legend

- (1) First Reading
- (2) Second Reading

Injector Balance Test Example

Cylinder	1	2	3	4	5	6
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)	131 kPa (21 psi)	130 kPa (10 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)	165 kPa (24 psi)	166 kPa (24 psi)
Average Range: 156–176 kPa (22.5–25.5 psi)	Injector OK	Faulty injector - too much fuel drop	Injector OK	Faulty injector - too little fuel drop	Injector OK	Injector OK

Test Description

Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

- 4. The engine coolant temperature must be below the operating temperature in order to avoid irregular fuel pressure readings due to Hot Soak fuel boiling.

- 5. The fuel pressure should be within the specified range. If the fuel pressure is not within the specified range, go to *Fuel System Diagnosis*
- 6. The fuel pressure should reach a steady value. If the fuel pressure does not reach a steady value, go to *Fuel System Diagnosis*
- 7. If the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading. Refer to the illustration above.

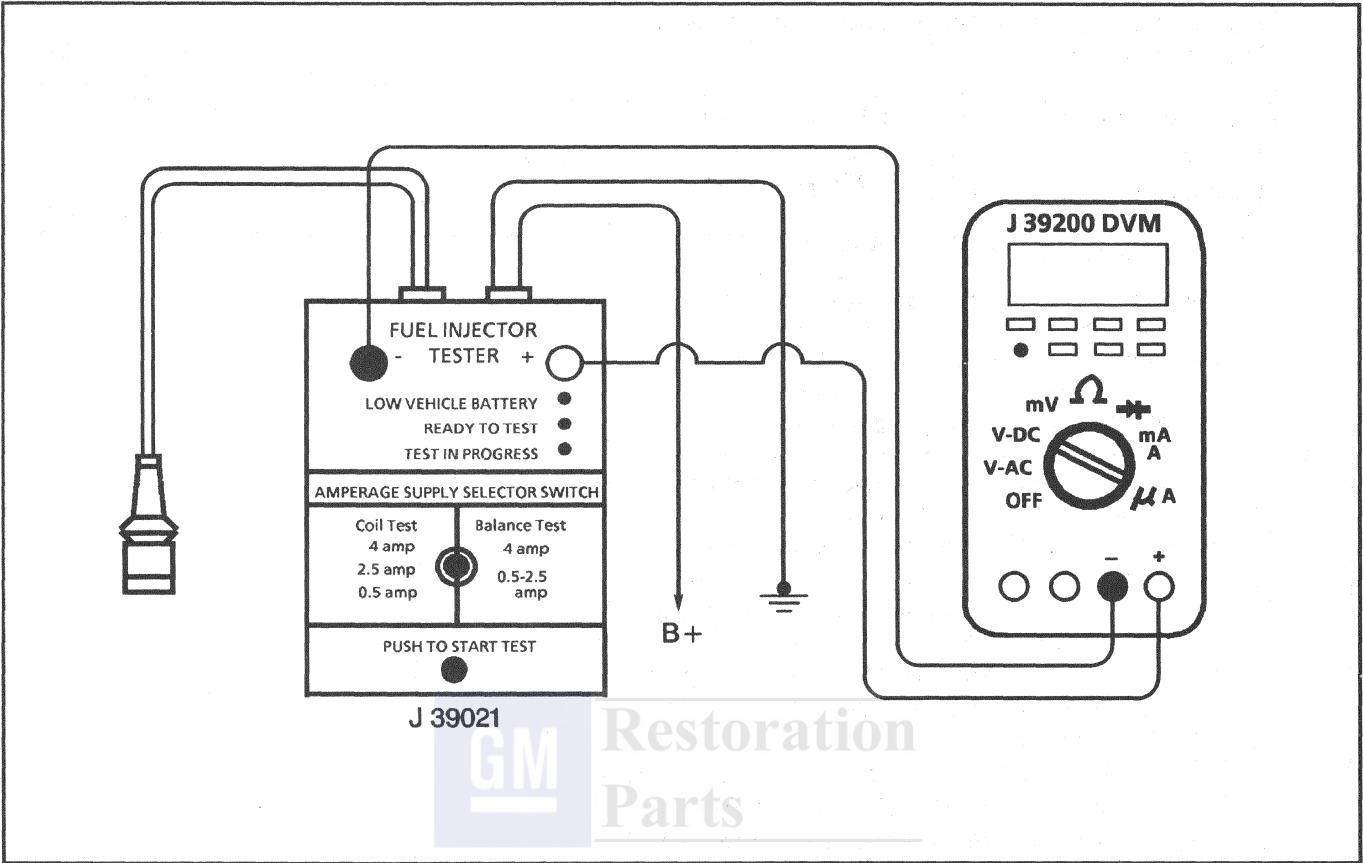
Fuel Injector Balance Test

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	Was the Fuel Injector Coil Test Procedure performed?	—	Go to Step 3	Go to Fuel Injector Coil Test
3	Is the engine coolant temperature above the specified value?	94 °C (201 °F)	Go to Step 4	Go to Step 5
4	Allow the engine to cool below the specified value. Is the engine coolant temperature below the specified value?	94 °C (201 °F)	Go to Step 5	—
5	Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete. 1. Connect the J34730 fuel pressure gauge to the fuel pressure test port. 2. Energize the fuel pump using either the fuel pump test connector or the scan tool. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Bleed the air out of the fuel pressure gauge. 5. Observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified limits?	284–325 kPa (41–47 psi)	Go to Step 6	Go to Fuel System Diagnosis
6	Turn the fuel pump OFF. Does the fuel pressure remain constant?	—	Go to Step 7	Go to Fuel System Diagnosis

Fuel Injector Balance Test (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Connect the J 39021 fuel injector tester to a fuel injector. 2. Set the amperage supply selector switch on the fuel injector tester to the Balance Test 0.5–2.5 amp position. 3. Turn the fuel pump ON then OFF in order to pressurize the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading (refer to (1) in the illustration). 5. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the 2nd pressure reading (refer to (2) in the illustration). 7. Repeat Steps 1 through 6 for each fuel injector. 8. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)		
			Go to Step 8	Go to Symptoms
8	Notice: Do not repeat any portion of this test before running the engine in order to prevent the engine from flooding Re-test any fuel injector that does not meet the specification. Refer to the procedure in Step 7. Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)		
			Go to Step 9	Go to Symptoms
9	Replace the faulty fuel injector(s). Refer to the Fuel Injector procedure. Is the replacement complete?	—	System OK	—

Fuel Injector Coil Test
(ECT Within 10-35 Degrees C)



17707

Test Description

Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

2. The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is NOT between 10°C and 35°C (50°F and 95°F), go to *Fuel Injector Coil Test*
3. The first second of the voltage displayed by the DVM may be inaccurate due to the initial current surge, therefore, record the lowest voltage displayed by the DVM after the first second of the test. The voltage displayed by the DVM should be within the specified range (refer to the Example). The voltage displayed

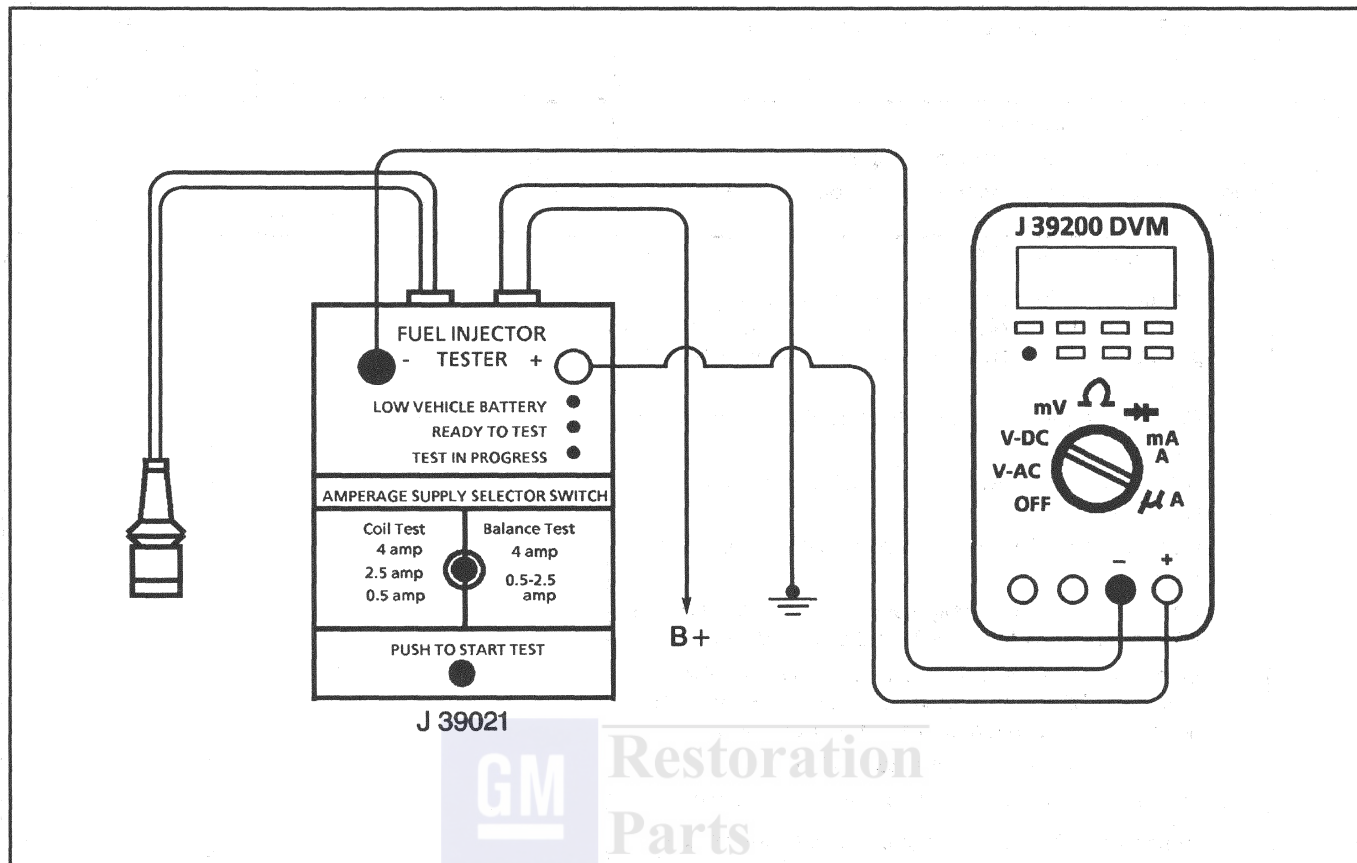
by the DVM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

Resistance Ohms		Voltage Specification at 10°C–35°C (50°F–95°F)	
11.8–12.6		5.7–6.6V	
Fuel Injector Number	Voltage Reading	Pass/Fail	
1	6.3	P	
2	5.9	P	
3	6.2	P	
4	6.1	P	
5	4.8	F	
6	6.0	P	

Fuel Injector Coil Test (ECT Within 10-35 Degrees C)

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature within the specified limits?	10°C–35°C (50°F–95°F)	Go to Step 3	Go to Fuel Injector Coil Test
3	1. Turn the ignition OFF. Notice: In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure. 2. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the J 39200 Digital Volt Meter (DVM) to the fuel injector tester. Refer to the illustration associated with the test description. 7. Set the DVM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector. Important: Check the engine coolant temperature again to ensure that the correct chart is being used. 9. Press the Push to Start Test button on the fuel injector tester. 10. Observe the voltage reading on the DVM. Important: The voltage reading may rise during the test. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat Steps 8 through 11 for each fuel injector. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that do not stabilize) or a voltage reading outside of the specified limits?	5.7–6.6V	Go to Step 4	Go to Fuel Injector Balance Test
4	Replace the faulty fuel injector(s). Refer to the Fuel Injector procedure. Is the replacement complete?	—	Go to Fuel Injector Balance Test	—

Fuel Injector Coil Test (ECT Outside 10-35 Degrees C)



17707

Test Description

Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

- The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is between 10°C–35°C (50°F–95°F), go to *Fuel Injector Coil Test*.
- The first second of the voltage displayed by the DVM may be inaccurate due to the initial current surge, therefore, record the lowest voltage displayed by the DVM after the first second of the test. The voltage displayed by the DVM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector. From the voltages recorded, identify the highest

voltage, excluding any voltages above 9.5 volts. Subtract each voltage that is not above 9.5 volts from the highest voltage. Record each subtracted value (refer to the Example). The subtracted value for any fuel injector must not exceed 0.6 volt. A fuel injector with a subtracted value that is greater than 0.6 volt is considered faulty and must be replaced. A fuel injector with a recorded voltage above 9.5 volts is also considered faulty and must be replaced.

Highest Voltage Reading		Acceptable Subtracted Value Above/Below 10°C–35°C (50°F–95°F)	
7.1 V		0.6 V	
Injector Number	Voltage	Subtracted Value	Pass/Fail
1	9.8	—	F
2	6.6	0.5	P
3	6.9	0.2	P
4	5.8	1.3	F
5	7.0	0.1	P
6	7.1	0.0	P

Fuel Injector Coil Test (ECT Outside 10-35 Degrees C)

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature outside the specified limits?	10°C–35°C (50°F–95°F)	Go to Step 3	Go to Fuel Injector Coil Test
3	1. Turn the ignition OFF. Notice: In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure. 2. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the J 39200 Digital Volt Meter (DVM) to the fuel injector tester. Refer to the illustration associated with the test description. 7. Set the DVM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector. Important: Check the engine coolant temperature again to ensure that the correct chart is being used. 9. Press the Push to Start Test button on the fuel injector tester. 10. Observe the voltage reading on the DVM. Important: The voltage reading may rise during the test. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat Steps 8 through 11 for each fuel injector. 13. Identify the highest voltage reading recorded other than those above 9.5 volts. 14. Subtract any other voltage reading recorded from the highest voltage reading recorded. 15. Repeat Step 14 for all the remaining fuel injectors. Is any value that resulted from subtraction greater than the specified value?	0.6V	Go to Step 4	Go to Fuel Injector Balance Test
4	Replace any fuel injector that had any of the following: • A subtracted value exceeding 0.6 volts. • An initial reading above 9.5 volts. • An erratic reading. Refer to the Fuel Injector Procedure. Is the replacement complete?	—	Go to Fuel Injector Balance Test	—

Alcohol/Contaminants-in-Fuel Testing Procedure

Alcohol-in-fuel can be detrimental to fuel system components and may cause driveability problems such as hesitation, lack of power, stall, no start, etc. The problems may be due to fuel system corrosion and subsequent fuel filter plugging, deterioration of rubber components, and/or air-fuel mixture leaning. Commercial fuel uses various types and concentrations of alcohol. Some types of alcohol are more detrimental to fuel system components than others. If you suspect an excessive amount of alcohol in the fuel as the cause of a driveability condition, use the Alcohol-in-Fuel Testing Procedure to detect the presence of alcohol in the fuel.

Alcohol-in-Fuel Testing Procedure

Draw the fuel sample from the bottom of the tank in order to detect any water present in the tank. The sample should be bright and clear. If the sample appears cloudy, or contaminated with water (as indicated by a water layer at the bottom of the sample), Do Not use this procedure. Go to Fuel System Cleaning.

1. Using a 100 ml cylinder with 1 ml graduation marks, fill with fuel to the 90 ml mark.
2. Add 10 ml of water to bring the total fluid volume to 100 ml. Install a stopper on the cylinder.
3. Shake the cylinder vigorously for 10 to 15 seconds.
4. Carefully loosen the stopper to release the pressure.
5. Close the stopper and shake the cylinder vigorously again for 10 to 15 seconds.
6. Put the graduated cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer (which would now contain both alcohol and water) will be greater than 10 ml. For example, if the volume of the lower layer increases to 15 ml, it indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat greater because this procedure does not extract all of the alcohol from the fuel.



Repair Instructions

PCM Replacement/Programming

Service of the PCM should normally consist of either replacement of the PCM or EEPROM programming. If the diagnostic procedures call for the PCM to be replaced, PCM should be checked first to see if it is the correct part. If it is, remove the faulty PCM and install the new service PCM. The KS module from the old PCM must be transferred to the new PCM.

THE SERVICE PCM EEPROM WILL NOT BE PROGRAMMED. DTC P0601 and P0602 indicates the EEPROM is not programmed or has malfunctioned.

Important: When replacing the production PCM with a service PCM (controller), it is important to transfer the broadcast code and production PCM number to the service PCM label. Do not record on PCM cover. This will allow positive identification of PCM parts throughout the service life of the vehicle.

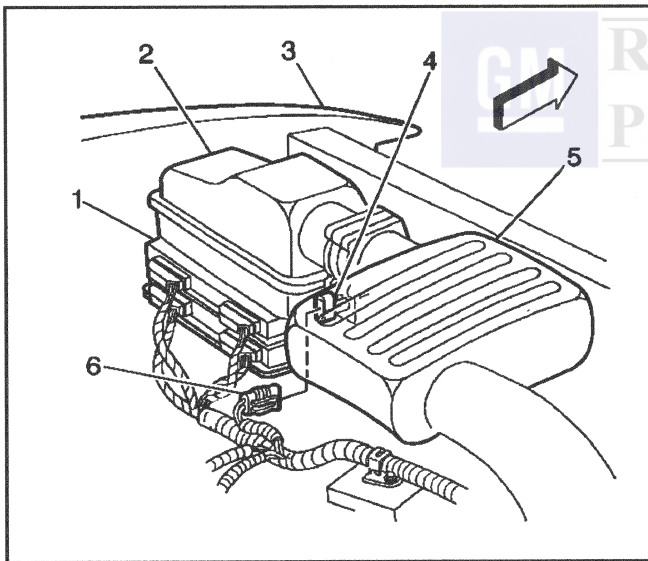
Important: To prevent internal PCM damage, the ignition must be OFF when disconnecting or reconnecting power to PCM (for example, battery cable, PCM pigtail, PCM fuse, jumper cables, etc.).

Removal Procedure

Notice: To prevent possible electrostatic discharge damage to the PCM, do not touch the connector pins or soldered components on the circuit board.

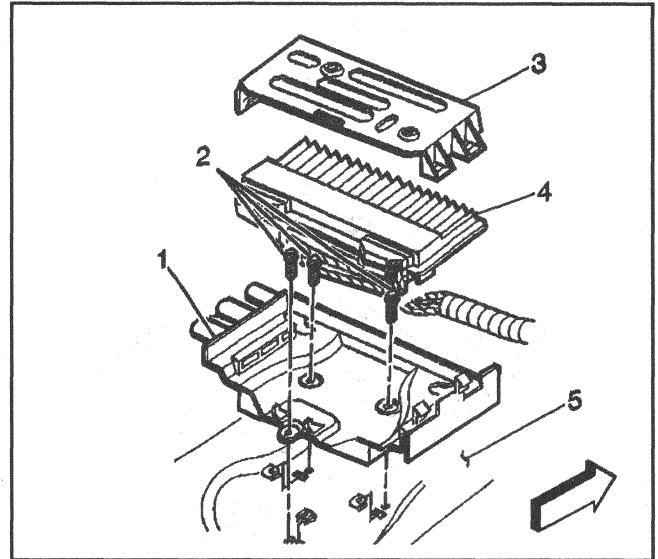
Notice: The ignition should always be OFF when installing or removing the PCM connectors.

1. Remove the air cleaner assembly (2) from the top of the PCM (1).



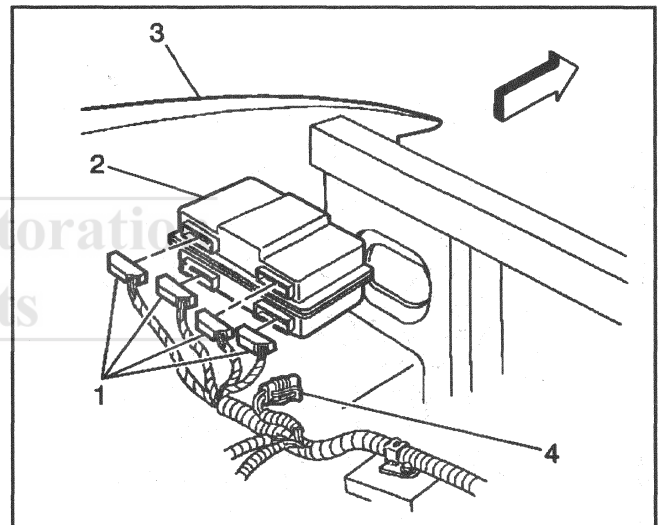
29983

2. Remove the PCM (4) from the PCM mounting hardware (1 and 3).



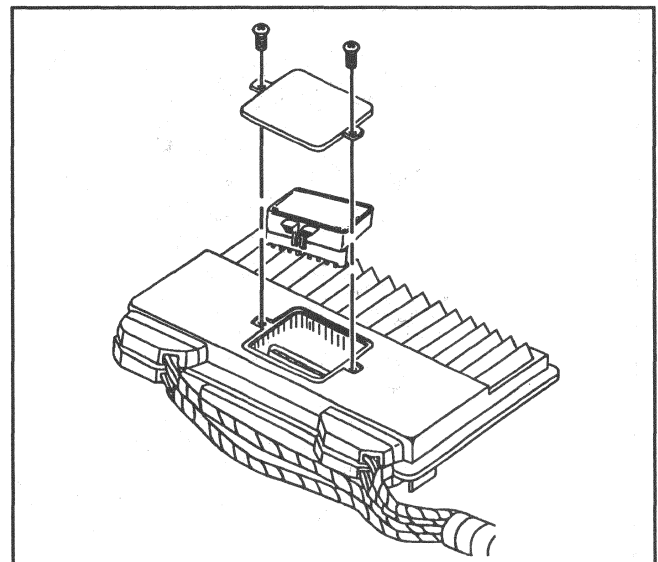
29994

3. Disconnect the Harness connectors (1) from the PCM (2).
4. Remove the PCM (2) from the engine compartment.

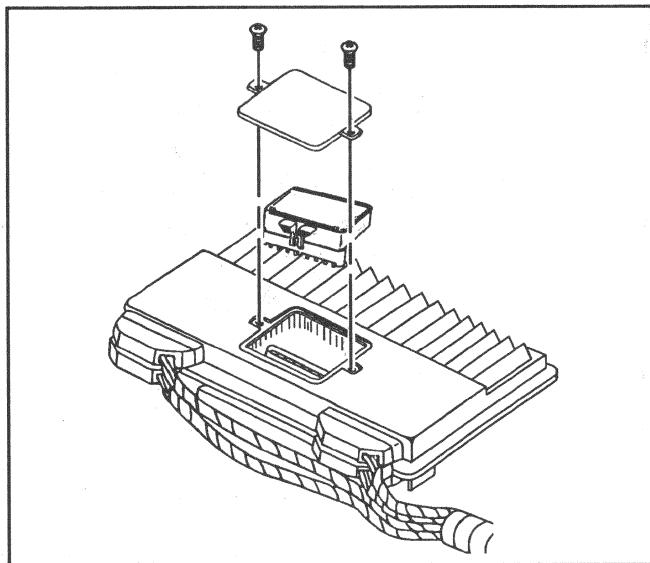


29977

5. Remove the KS Module access cover.
6. Remove the KS Module.



13490



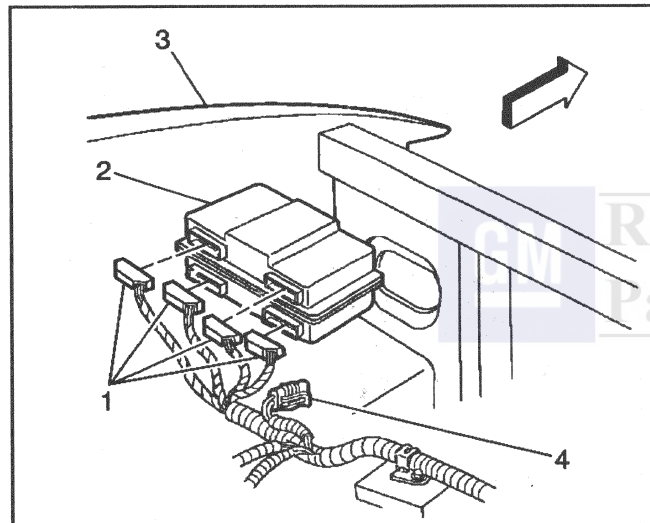
13490

Installation Procedure

Notice: To prevent possible electrostatic discharge damage to the PCM, do not touch the connector pins or soldered components on the circuit board.

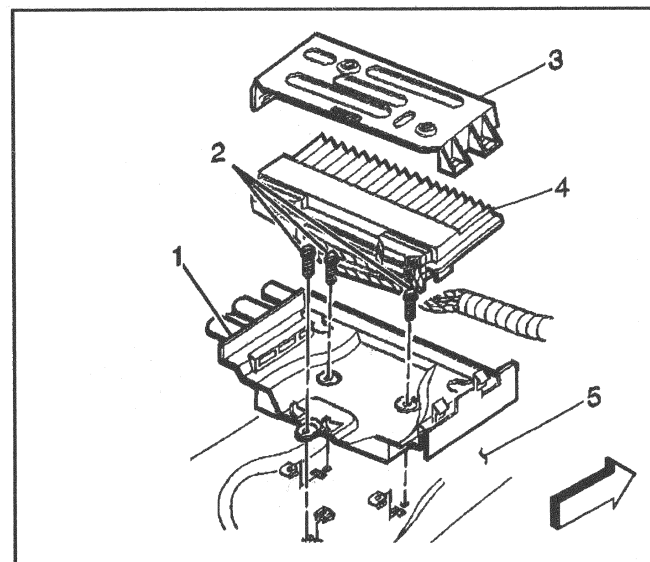
Notice: The ignition should always be OFF when installing or removing the PCM connectors.

1. Install the KS Module into the PCM.
2. Install the KS Module access cover.



29977

3. Connect the Harness Connectors (1) to the PCM (2).
4. Install the PCM into the vehicle.



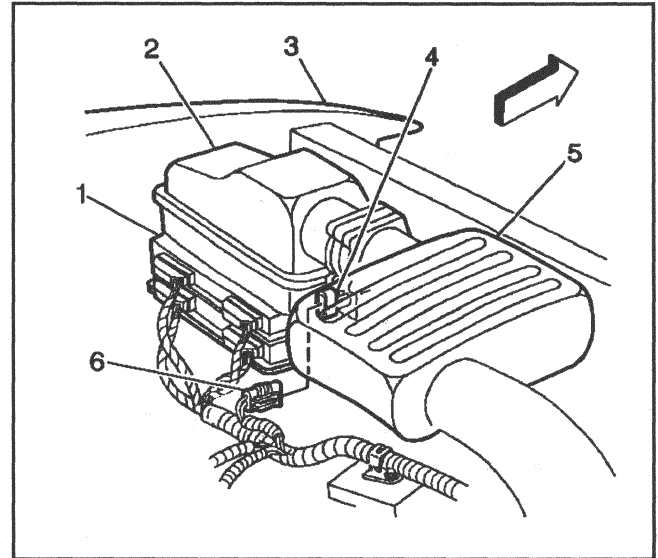
29994

5. Install the PCM mounting hardware (1 and 3) to the PCM (4).

6. Install the air cleaner assembly (2) to the top of the PCM (1).
7. If a new PCM is being installed, program the EEPROM.

EEPROM Programming

1. Setup – Ensure that the following conditions have been met:
 - The battery is fully charged.
 - The ignition is ON.
 - The Vehicle Interface Module cable connection at the DLC is secure.
2. Program the PCM using the latest software matching the vehicle. Refer to Techline terminal/equipment users instructions.
3. If the PCM fails to program, proceed as follows:
 - Ensure that all PCM connections are OK.
 - Check the Techline terminal/equipment for the latest software version.
 - Attempt to program the PCM. If the PCM still cannot be programmed properly, replace the PCM. The replacement PCM must be programmed.



29983

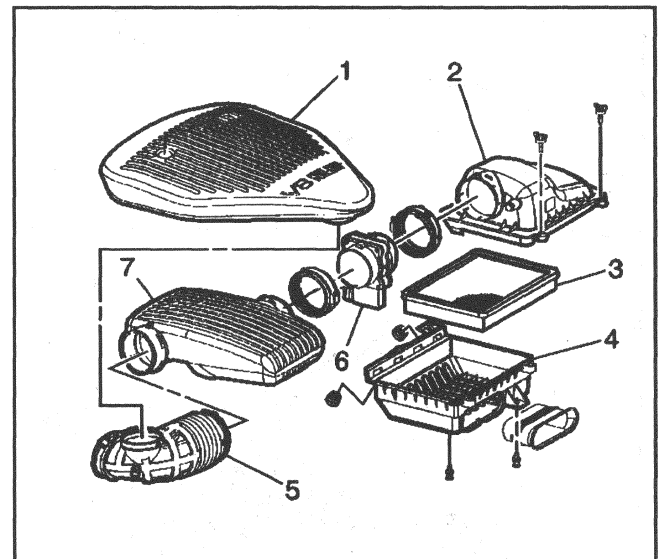
Functional Check

1. Perform On-Board Diagnostic System Check.
2. Start engine and run for one minute.
3. Scan for DTCs using the scan tool.
4. If DTC P0325 sets, the KS module is not fully seated, is missing, or is faulty.

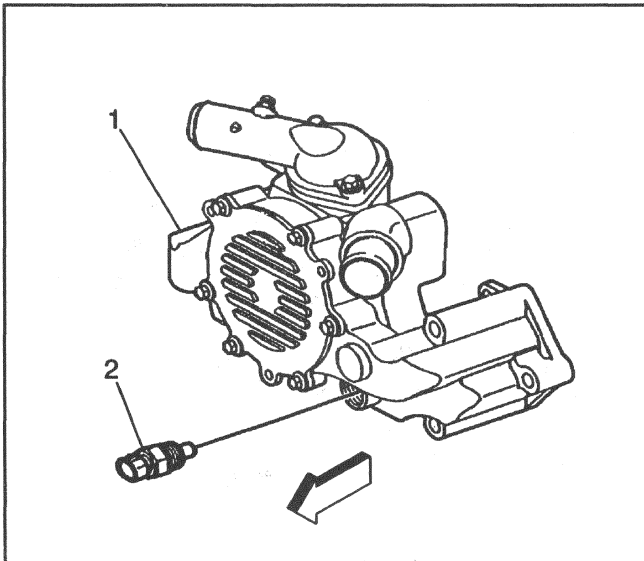
ECT Sensor

Removal Procedure

1. Drain the engine coolant. Refer to Section 6B.
2. Remove the air inlet duct (5).



30029

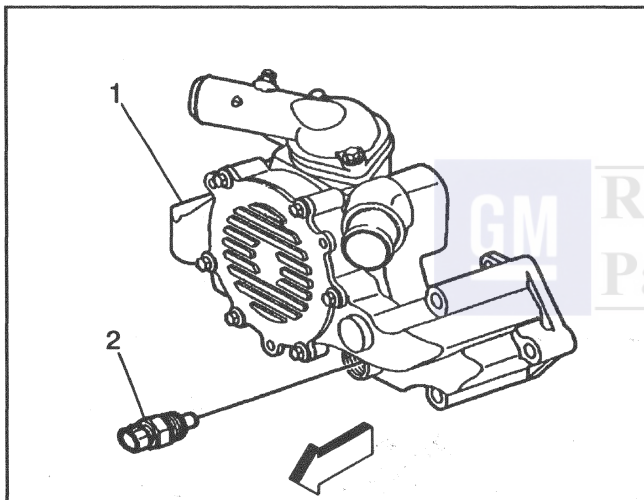


13642

3. Disconnect the electrical connector from the ECT sensor (2).

Important: Care must be taken when handling the Engine Coolant Temperature (ECT) sensor. Damage to the ECT sensor will affect proper operation of the fuel injection system.

4. Remove the ECT sensor (2) from the engine coolant pump (1).



13642

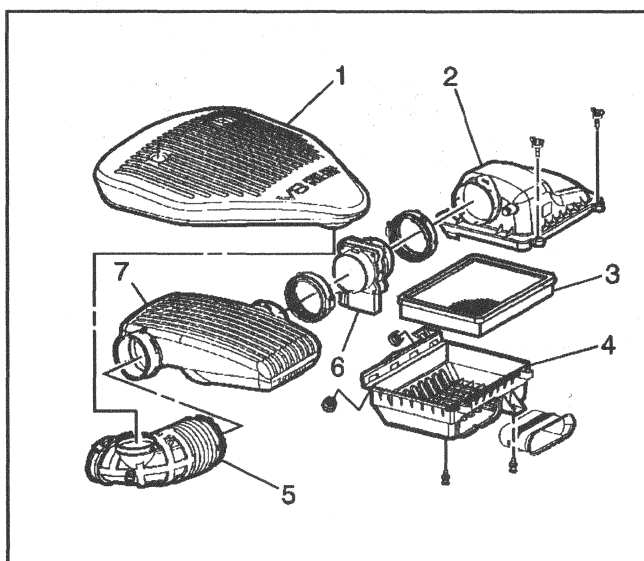
Installation Procedure

Important: Care must be taken when handling the Engine Coolant Temperature (ECT) sensor. Damage to the ECT sensor will affect proper operation of the fuel injection system.

1. Coat the Engine Coolant Temperature (ECT) sensor threads with sealer P/N 1052080 or equivalent.
2. Install the ECT sensor (2) into the engine coolant pump (1).

Tighten

Tighten the ECT sensor to 23 N.m (17 lb ft).



30029

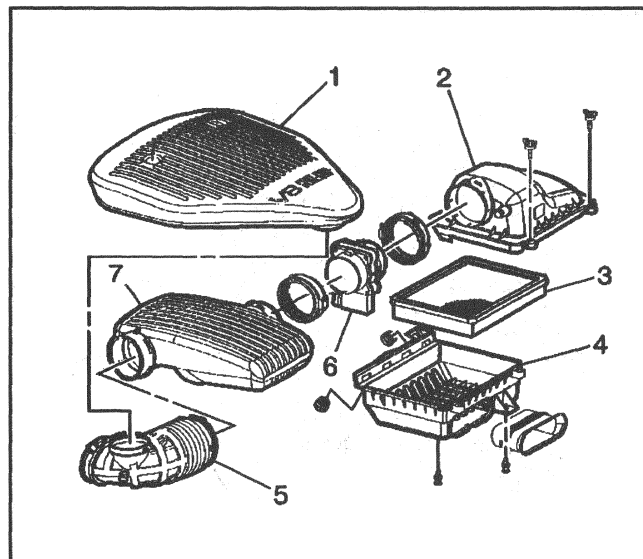
3. Connect the ECT sensor electrical connector.
4. Install the air inlet duct.
5. Refill the engine coolant. Refer to Section 6B.
6. Start the engine and check for leaks.
7. Recheck the engine coolant level.

MAF Sensor

Removal Procedure

Important: Take care when handling the MAF. Do not dent, puncture, or otherwise damage the Honeycomb located at the air inlet end of the MAF. Do not touch the sensing elements or allow anything (including cleaning solvents and lubricants) to come in contact with them. A small amount of GM lubricant (P/N=99855406) may be used on the air duct only, to aid in installation. Do not drop or roughly handle the MAF.

1. Disconnect the MAF sensor electrical connector.
2. Loosen air duct clamps and remove the MAF sensor (6).



30029

Installation Procedure

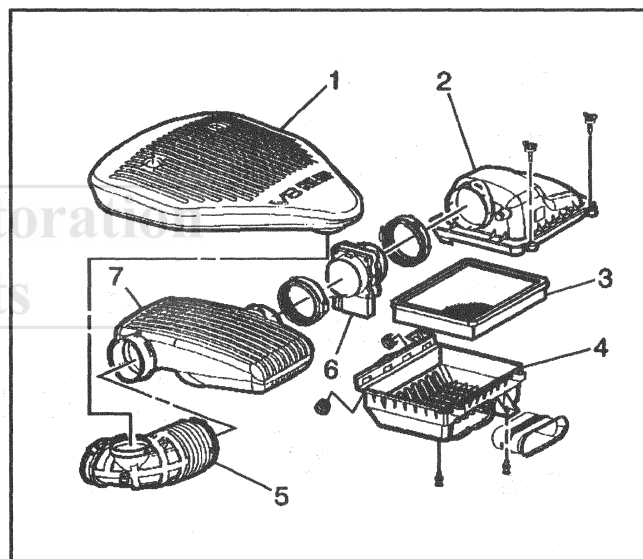
Important: Embossed arrows on MAF sensor indicate proper air flow direction and must point toward the engine.

1. Install the MAF sensor into the air duct.

Tighten

Tighten the air duct clamps to 4 N·m (36 lb in).

2. Connect the electrical connector to the MAF sensor.

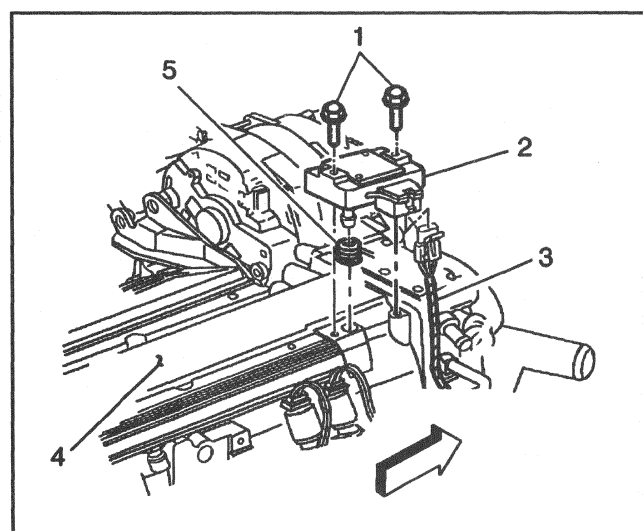


30029

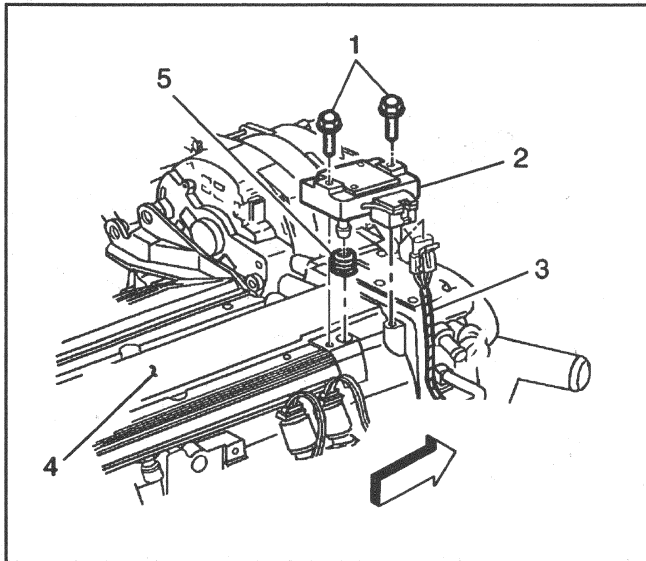
MAP Sensor

Removal Procedure

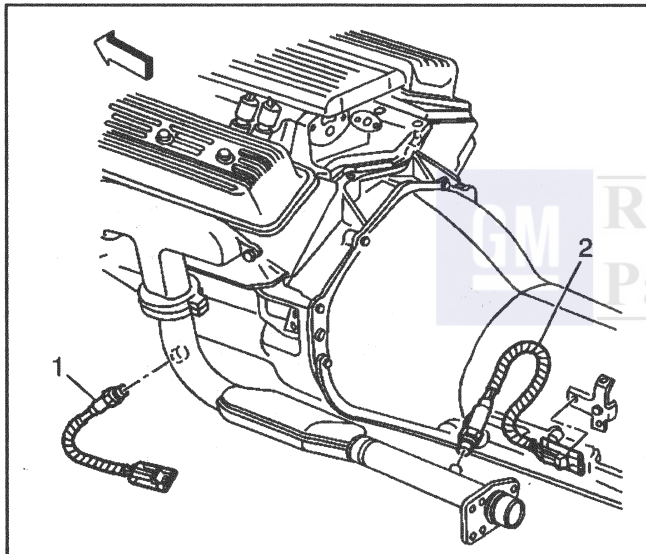
1. Remove the appearance cover.
2. Disconnect the MAP sensor electrical connector (3).
3. Remove the Hold down bolts (1).
4. Remove the MAP sensor (2) from the intake manifold (4).



13485



13485



30087

Installation Procedure

1. Install the New MAP sensor seal (5), lightly coated with clean engine oil.
2. Install the MAP sensor (2) to the intake manifold (4).
3. Install the Hold down bolts (1).

Tighten

Tighten the MAP sensor bolts to 6 N.m (50 lb in)

4. Connect the MAP sensor electrical connector (3).
5. Install the Appearance cover.

Heated Oxygen Sensor (HO2S) Bank 1 Front and Rear Sensors

Notice: The Heated Oxygen Sensors each use a permanently attached pigtail and connector. This pigtail should not be removed from the heated oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the heated oxygen sensor.

Important: Take care when handling the heated oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the heated oxygen sensor/catalyst monitor. A dropped sensor is a bad sensor.

Removal Procedure

Important: The heated oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F). Excessive force may damage threads in exhaust manifold or exhaust pipe. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or its connector. Refer to Section 6F, Exhaust System.

1. Raise the vehicle.
2. Disconnect the left (*front/rear*) HO2S electrical connector.
3. Carefully back out the left (*front/rear*) heated oxygen sensor.

Installation Procedure

Important: A special anti-seize compound is used on the heated oxygen sensor threads. The compound consists of graphite suspended in fluid and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine and if for any reason is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the heated oxygen sensor with anti-seize compound P/N 12377953, or equivalent if necessary.
2. Install the left (*front/rear*) heated oxygen sensor.

Tighten

Tighten the left (*front/rear*) HO2S to 41 N·m (30 lb ft).

3. Connect the left (*front/rear*) HO2S electrical connector.
4. Lower the Vehicle.

Heated Oxygen Sensor (HO2S) Bank 2 Front and Rear Sensors

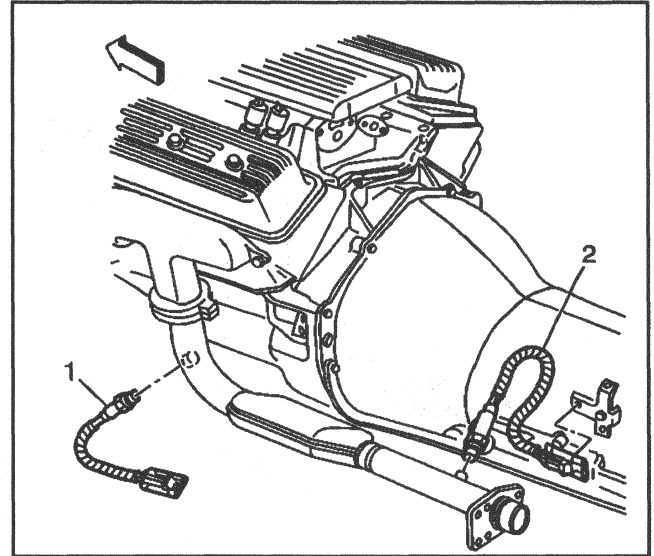
Notice: The Heated Oxygen Sensors each use a permanently attached pigtail and connector. This pigtail should not be removed from the heated oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the heated oxygen sensor.

Important: Take care when handling the heated oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the heated oxygen sensor/catalyst monitor. A dropped sensor is a bad sensor.

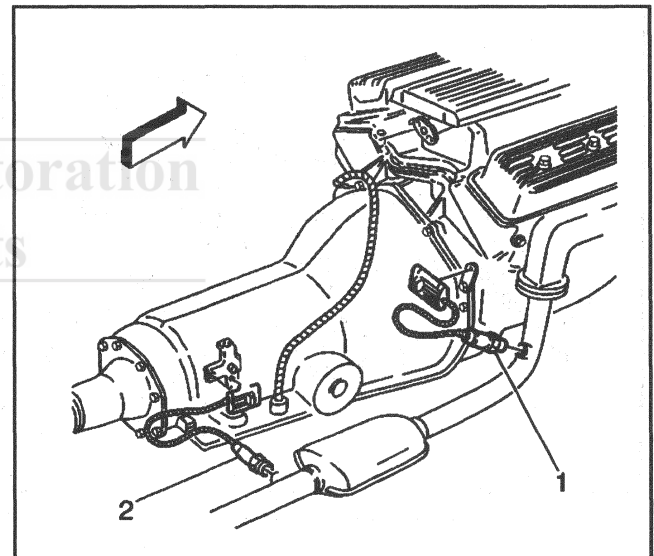
Removal Procedure

Important: The HO2S sensor may be difficult to remove when the engine temperature is below 48°C (120°F). Excessive force may damage threads in exhaust manifold or exhaust pipe. It may be necessary to lower the exhaust system to gain sufficient access to an HO2S and/or its connector. Refer to *Section 6F, Exhaust System*.

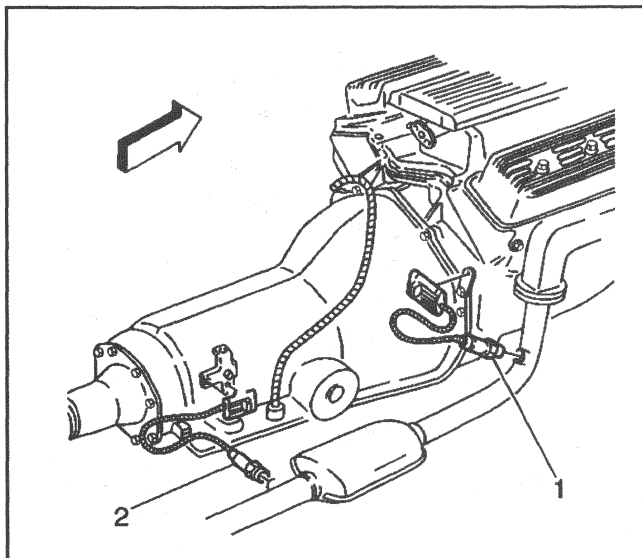
1. Raise the vehicle.
2. Disconnect the right (*front/rear*) HO2S electrical connector.
3. Carefully back out the right (*front/rear*) HO2S from the exhaust.



30087



30080



30080

Installation Procedure

Important: A special anti-seize compound is used on the HO2S sensor threads. The compound consists of graphite suspended in fluid and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine and if for any reason is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the HO2S with anti-seize compound P/N 12377953, or equivalent.
2. Install the right (*front/rear*) HO2S.

Tighten

Tighten the right (*front/rear*) HO2S to 41 N·m (30 lb ft).

3. Connect the right (*front/rear*) HO2S electrical connector.
4. Lower the Vehicle.

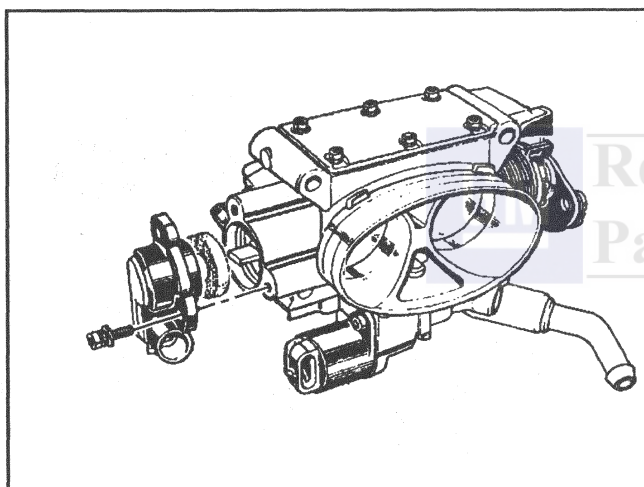
TP Sensor

Removal Procedure

1. Remove the resonator.
2. Disconnect the TP sensor electrical connector.
3. Remove the TP sensor attaching screws.

Notice: The TP sensor is an electrical component. Do Not soak the TP sensor in any liquid cleaner or solvent as damage may result.

4. Remove the TP sensor.



35849

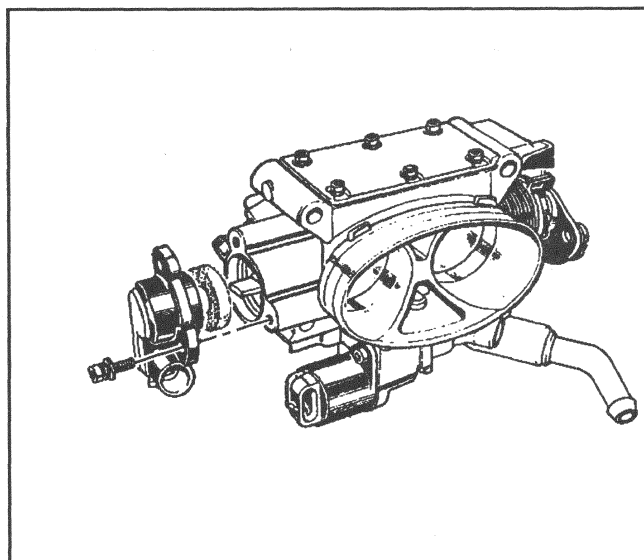
Installation Procedure

1. Install the TP sensor on the throttle body with the throttle valve in the closed position. Make sure the TP sensor lever lines up with the TP sensor drive lever on the throttle shaft.
2. Install the TP sensor attaching screws.

Torque

Tighten the TP sensor attaching screws to 2 N·m (18 lb in).

3. Connect the TP sensor electrical connector.
4. Install the resonator.

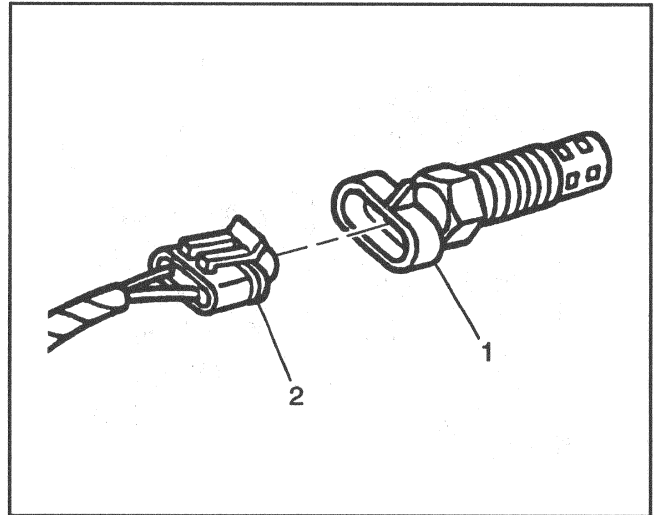


35849

IAT Sensor

Removal Procedure

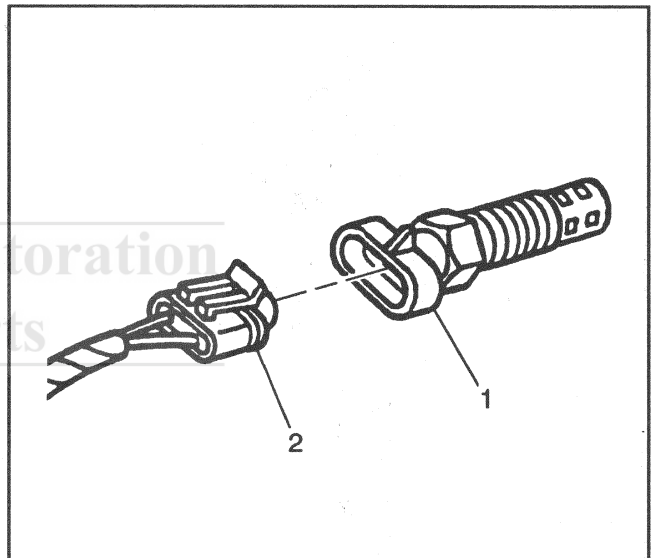
1. Disconnect the IAT sensor electrical connector.
2. Carefully back out IAT sensor from the intake air duct.



13643

Installation Procedure

1. Install the IAT sensor to the intake air duct.
2. Connect the IAT sensor Electrical connector.

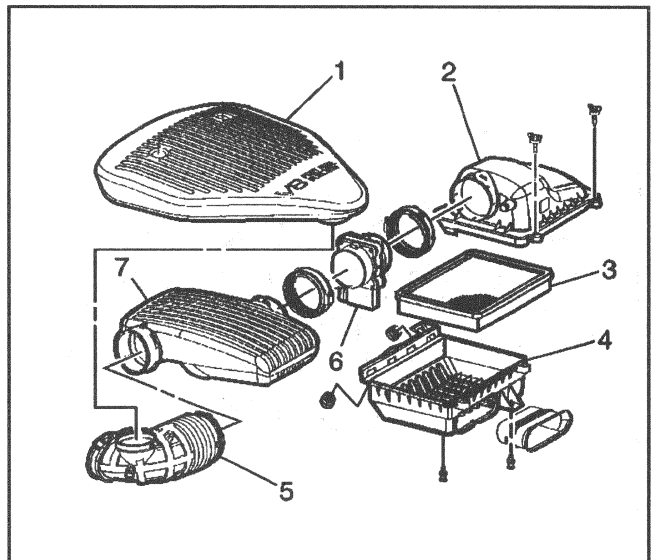


13643

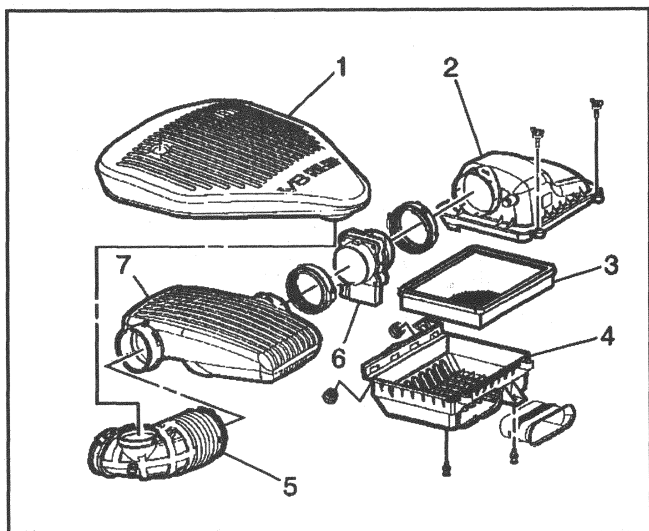
Air Filter Element/Air Cleaner Assembly

Removal Procedure

1. Remove the fasteners from the air cleaner cover (2).
2. Lift the air cleaner cover (2), MAF sensor and the resonator as a unit.
3. Remove the air filter element (3).
4. Inspect the air filter element (3) for dust, dirt and water. Clean or replace if as necessary. Refer to Section OB.



30029

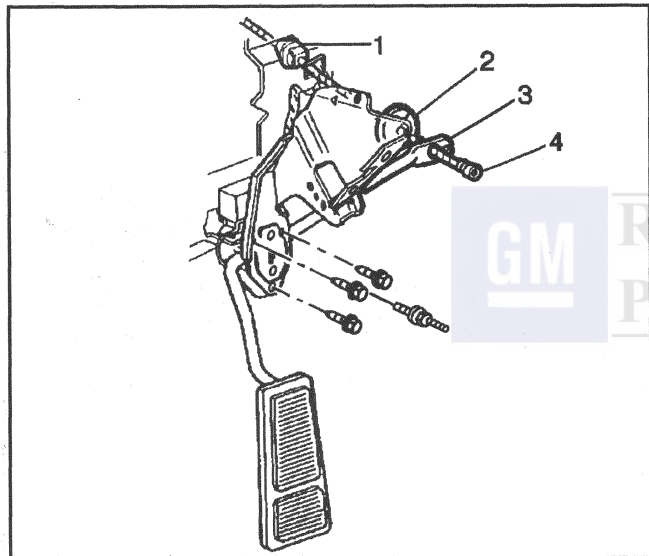


30029

Installation Procedure

Notice: If the Mass Air Flow (MAF) sensor is installed backwards, the system will go rich. An arrow cast into the plastic portion of the sensor indicates proper air flow direction. The arrow must point toward the engine.

1. Install the air filter element (3) into the air cleaner housing (4).
2. Position the air cleaner cover (2), MAF sensor (6) and the resonator (7) back into place.
3. Connect the fasteners to the air cleaner cover (2).
4. Check the clamps at the MAF sensor (6) and tighten as necessary.
5. Check joints between the ducts, resonators and the throttle body for possible leaks. Repair as necessary.

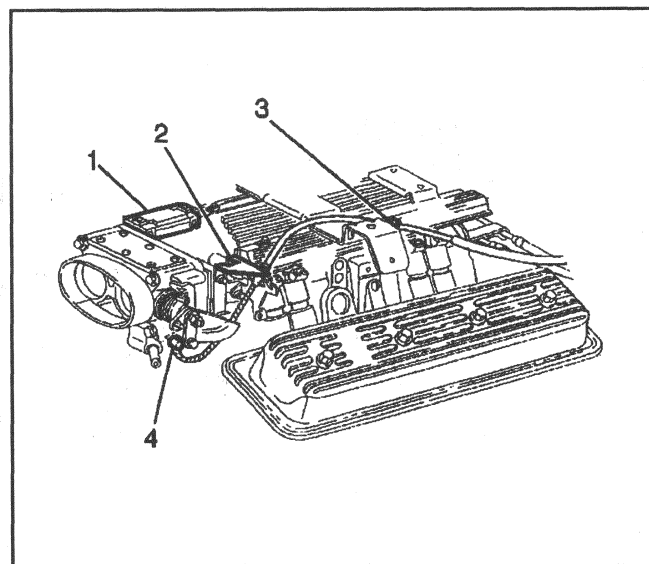


21306

Accelerator Controls (Accelerator Control Cable)

Removal Procedure

1. Disconnect the accelerator cable (4) from the accelerator pedal lever (3).
2. Disconnect the accelerator cable retainer (2).
3. Squeeze the accelerator cable cover tangs (1) and push the cable through the dash panel (bulkhead).
4. Disconnect the accelerator cable (4) from the retaining clip on the resonator bracket (3).
5. Remove the accelerator cable (4) from the accelerator cable bracket (2) and the throttle body (1).

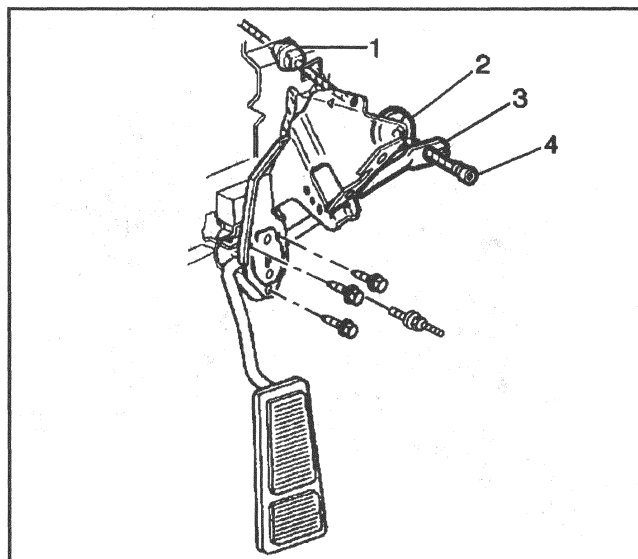


21309

Installation Procedure

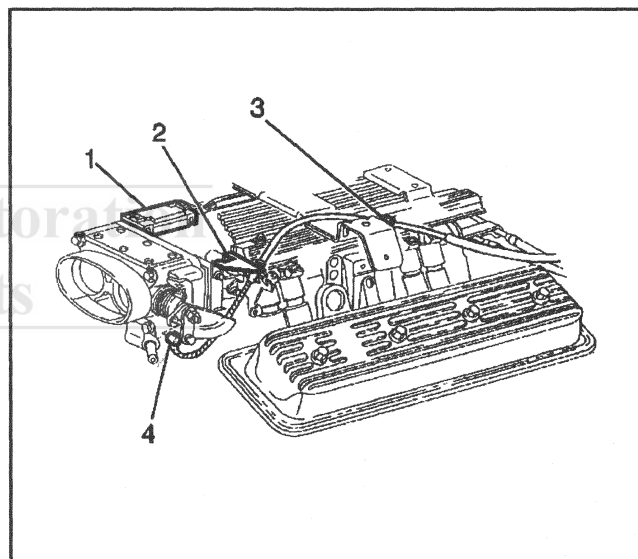
Notice: In order to prevent possible interference and damage, flexible components (hoses, wires, conduits, etc.) must not be routed within 50 mm (2) of moving parts, unless the routing is positively controlled.

1. Install the accelerator cable (4) through the dash panel (bulkhead).
2. Install the accelerator cable retainer (2).
3. Install the accelerator cable (4) on the accelerator pedal lever (3).



21306

4. Install the accelerator cable (4) to the accelerator cable bracket (2) and the throttle body (1).
5. Install the accelerator cable (4) into the retaining clip on the resonator bracket (3).
6. Inspect for complete throttle opening and closing positions by operating the accelerator pedal. The throttle should operate freely without bind between full closed throttle and wide open throttle.
7. Check for poor carpet fit under the accelerator pedal.



21309

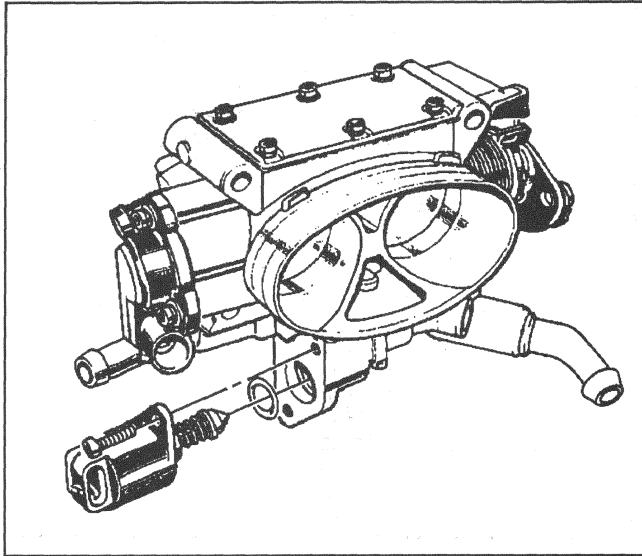
Accelerator Controls (Accelerator pedal)

Removal Procedure

1. Remove the accelerator pedal push on nut.
2. Remove the accelerator pedal from the accelerator pedal lever.

Installation Procedure

1. Install the accelerator pedal and spring to the accelerator pedal lever.
2. Install a new push on nut to the accelerator pedal lever.
3. Inspect for complete throttle opening and closing positions by operating the accelerator pedal. The throttle should operate freely without bind between full closed throttle and wide open throttle.
4. Check for poor carpet fit under the accelerator pedal.



35845

IAC Valve

Removal Procedure

1. Remove the resonator.
2. Disconnect the distributor ventilation vacuum line at the air intake duct.
3. Disconnect the electrical connector from the IAT sensor.
4. Remove the air intake duct.
5. Disconnect the IAC valve electrical connector.
6. Remove the IAC valve attaching screws.
7. Remove the IAC valve.

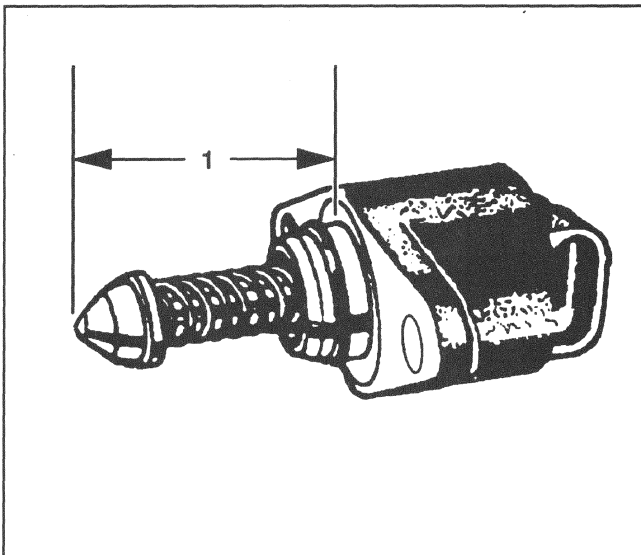
Notice:

- Do Not push or pull on the IAC valve pintle on IAC valves that have been in service. The force required to move the pintle may damage the threads on the worm drive.
 - Do Not soak the IAC valve in any liquid cleaner or solvent, as damage may result.
8. Clean the IAC valve O-ring sealing surface, the pintle valve seat, and the air passage.
 - Clean the IAC valve using GM cleaner 1052626 or GM X-66A. Use a shop towel or parts brush to remove heavy deposits.
 - If the air passage has heavy deposits, remove the throttle body for complete cleaning.
 - Shiny spots on the pintle or seat are normal, and do not indicate misalignment or a bent pintle shaft.
 9. Inspect the IAC valve O-ring for cuts, cracks, or distortion. Replace the O-ring if it is damaged.

Installation Procedure

Important: If installing a new IAC valve, be sure to replace it with an identical part. The pintle shape of the IAC valve and the diameter of the IAC valve are designed for the specific application.

1. Measure the distance between the tip of the IAC valve pintle and the mounting surface (1). If the distance is greater than 28 mm, use finger pressure to slowly retract the pintle. The force required to retract the pintle of a new valve will not cause damage to the valve.



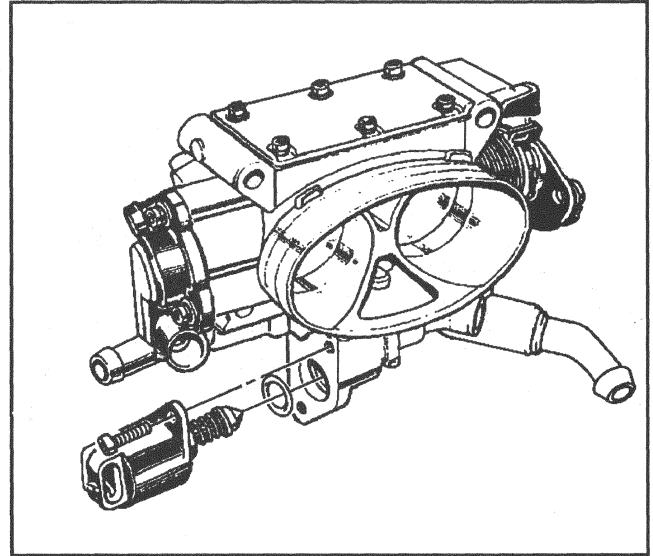
12637

2. Lubricate the IAC valve O-ring with clean engine oil.
3. Install the IAC valve.
4. Apply Loctite 262 to the IAC valve attaching screw threads if necessary.
5. Install the IAC valve attaching screws.

Tighten

Tighten the IAC valve attaching screws to 3 N.m (27 lb in).

6. Connect the IAC valve electrical connector.
7. Install the air intake duct.
8. Connect the IAT sensor electrical connector.
9. Connect the distributor ventilation vacuum line to the air intake duct.
10. Install the resonator.
11. Reset the IAC valve pintle position.
 - 11.1. Depress the accelerator pedal slightly.
 - 11.2. Start the engine.
 - 11.3. Release the accelerator pedal.
 - 11.4. Run the engine for 5 seconds.
 - 11.5. Turn the ignition OFF for 10 seconds.
 - 11.6. Restart the engine.
 - 11.7. Check for proper idle operation.

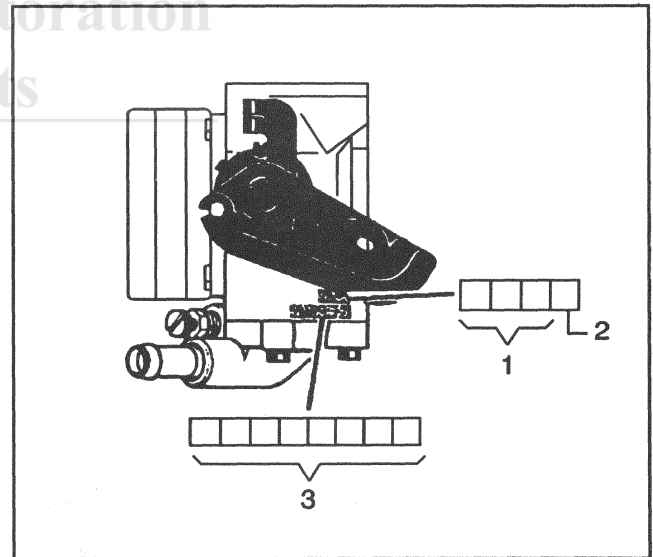


35845

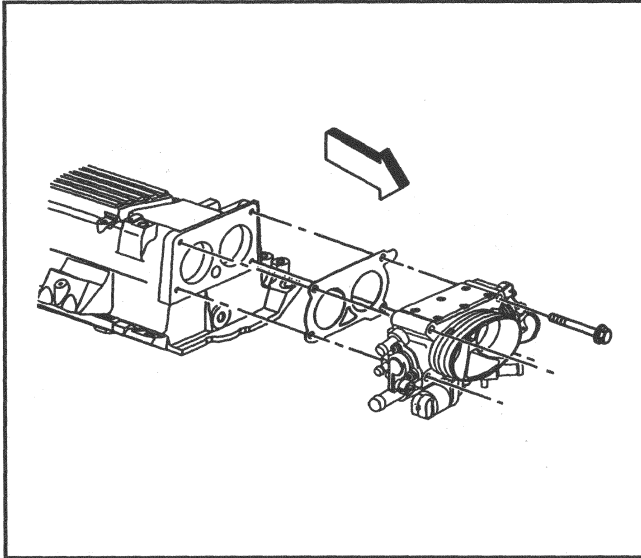
Throttle Body Assembly**Removal Procedure**

An eight-digit part identification number (3) is stamped on the throttle body casting. Refer to this number if servicing, or part replacement is required.

A build date is stamped on the throttle body which indicates the day of year (1) and the year (2) that the throttle body was manufactured.



12654



12592

1. Disconnect the negative battery cable.
2. Partially drain the cooling system.
3. Remove the resonator.
4. Disconnect the electrical connector from the IAT sensor.
5. Disconnect the distributor ventilation vacuum line from the air intake duct.
6. Remove the air intake duct.
7. Disconnect the electrical connectors from the TP sensor and the IAC valve.
8. Disconnect the vacuum lines from the throttle body.
9. Disconnect the coolant hoses from the throttle body.
10. Disconnect the accelerator control cable and the cruise control cable from the throttle body.
11. Remove the throttle body attaching bolts.
12. Remove the throttle body and the gasket. Discard the gasket.

Notice: Use care in cleaning the old gasket material from the machined aluminum surfaces as sharp tools may damage the sealing surfaces.

Important:

- Do Not soak the throttle body in cold immersion type cleaner. The throttle valves have a factory applied sealing compound (DAG material is applied to the outside edge of each valve and the throttle bore) to prevent air bypass at closed throttle. Strong solvents or brushing will remove the material. To clean the throttle body following disassembly, use a spray type cleaner such as GM X-66A or GM 1052626. Use a shop towel to remove heavy deposits.
 - The TP sensor and the IAC valve are electrical components and should NOT come in contact with solvent or cleaner, as damage may result.
13. Clean the gasket sealing surfaces.



Restoration
Parts

Installation Procedure

1. Install the throttle body with a new gasket.
2. Install the throttle body attaching bolts.

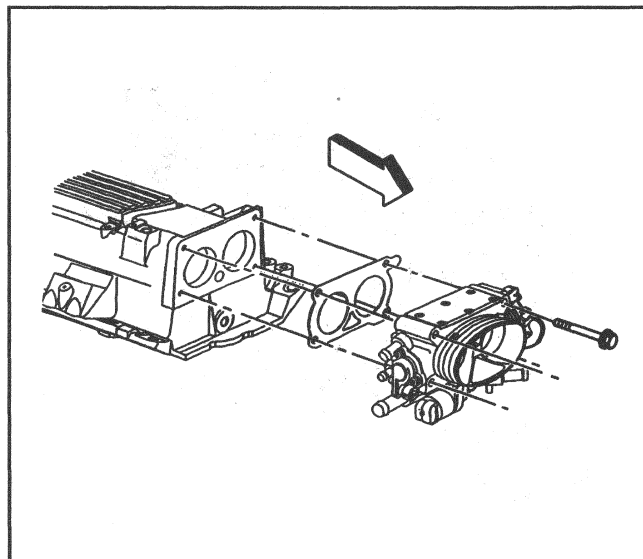
Tighten

Tighten the throttle body attaching bolts to 25 N·m (18 lb ft).

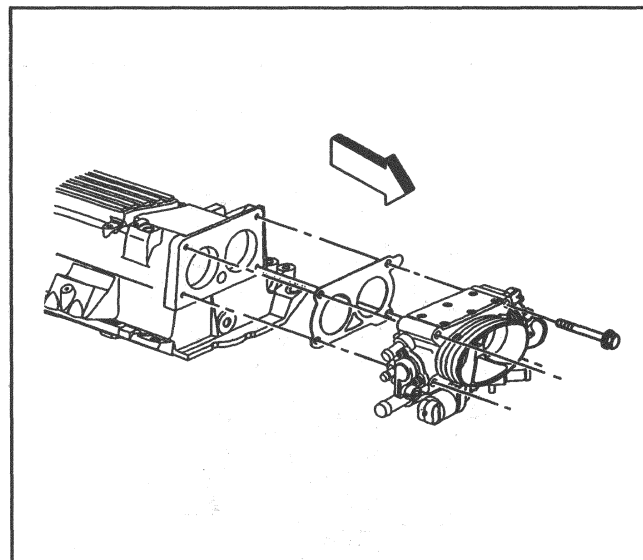
3. Connect the accelerator control cable and the cruise control cable.
4. Connect the coolant hoses to the throttle body.
5. Connect the vacuum lines to the throttle body.
6. Connect the electrical connectors to the TP sensor and the IAC valve.
7. Install the air intake duct.
8. Connect the distributor ventilation vacuum line to the air intake duct.
9. Connect the electrical connector to the IAT sensor.
10. Install the resonator.
11. Refill the cooling system.
12. Connect the negative battery cable.
13. With the engine OFF, check to see that the accelerator pedal is free. Depress the accelerator pedal to the floor and release.
14. Reset the IAC valve pintle position.
 - 14.1. Depress the accelerator pedal slightly.
 - 14.2. Start the engine.
 - 14.3. Release the accelerator pedal.
 - 14.4. Run the engine for 5 seconds.
 - 14.5. Turn the ignition OFF for 10 seconds.
 - 14.6. Restart the engine.
 - 14.7. Check for proper idle operation.

Idle Air Control Valve/Coolant Cover Asm**Removal Procedure**

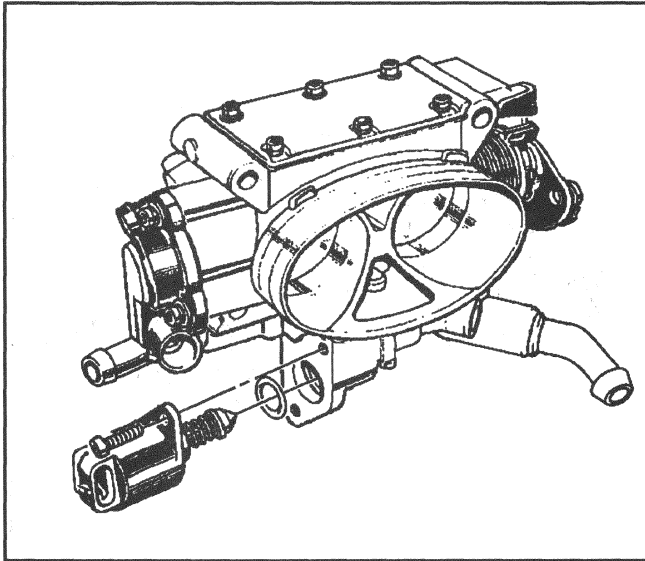
1. Disconnect the negative battery cable.
2. Remove the throttle body from the intake manifold.



12592

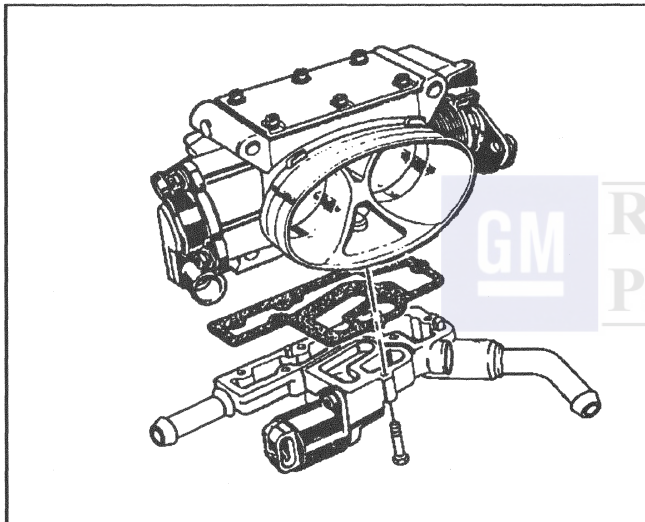


12592



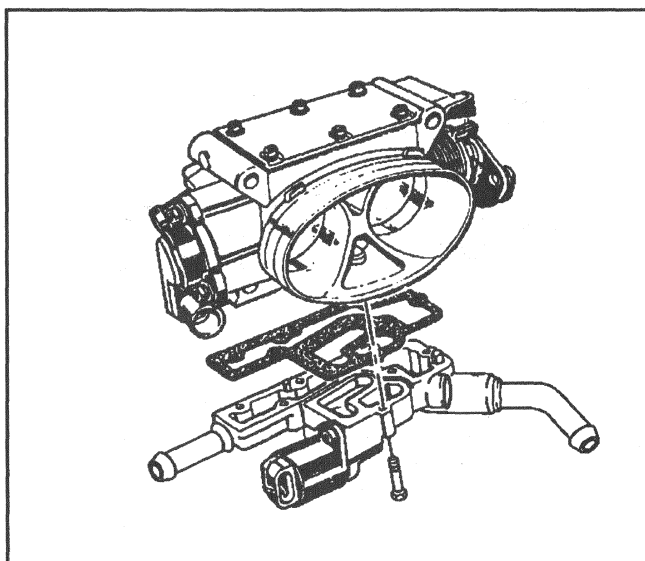
35845

3. Remove the IAC valve.



35848

4. Remove the idle air control valve/coolant cover assembly screws.
5. Remove the idle air control valve/coolant cover assembly and the gasket. Discard the gasket.
6. Clean the gasket sealing surfaces.
7. Inspect the gasket sealing surfaces for corrosion or damage that would cause a coolant leak. Replace the idle air control valve/coolant cover assembly or the throttle body if necessary.



35848

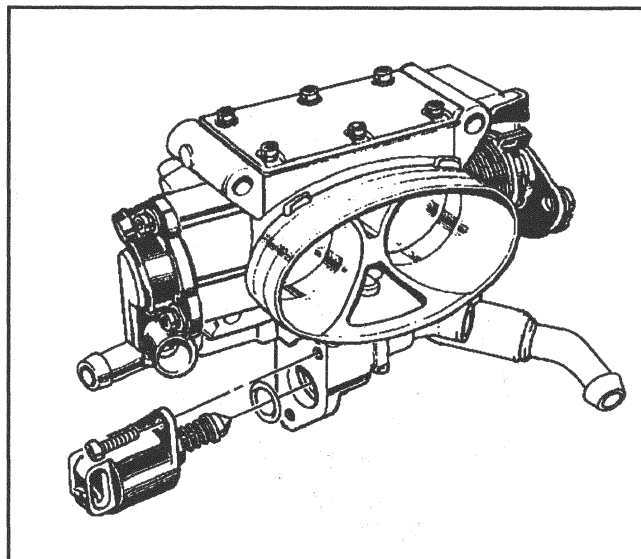
Installation Procedure

1. Install a new gasket.
2. Install the idle air control valve/coolant cover assembly.
3. Install the idle air control valve/coolant cover assembly screws.

Tighten

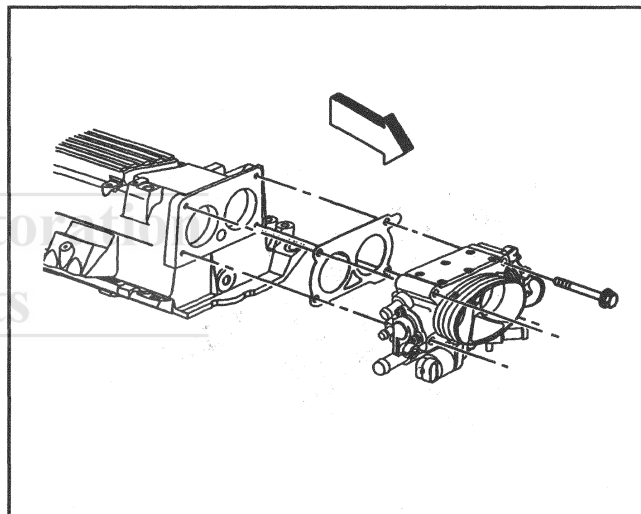
Tighten the idle air control valve/coolant cover assembly screws to 3.2 N·m (28 lb in).

4. Install the IAC valve.



35845

5. Install the throttle body to the intake manifold.
6. Connect the negative battery cable.

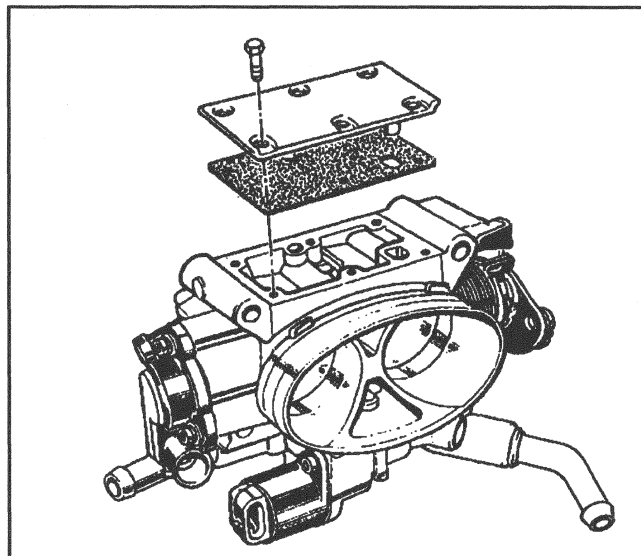


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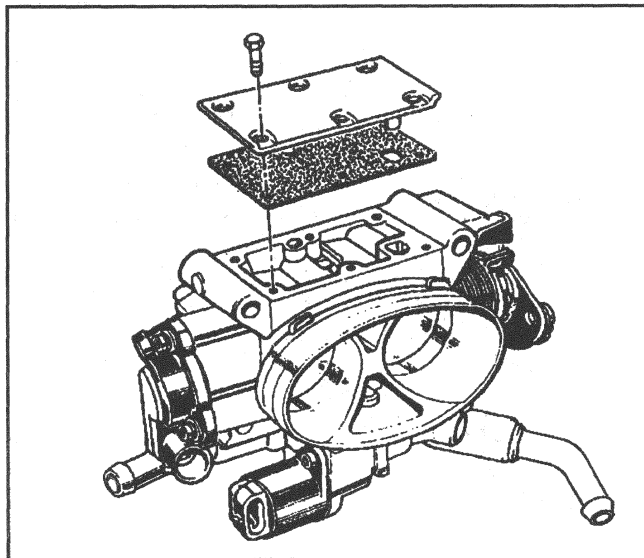
Clean Air Cover and Gasket

Removal Procedure

1. Remove the resonator.
2. Remove the clean air cover attaching screws.
3. Remove the clean air cover and the gasket.
4. Discard the gasket.
5. Clean the gasket sealing surfaces.



35850



35850

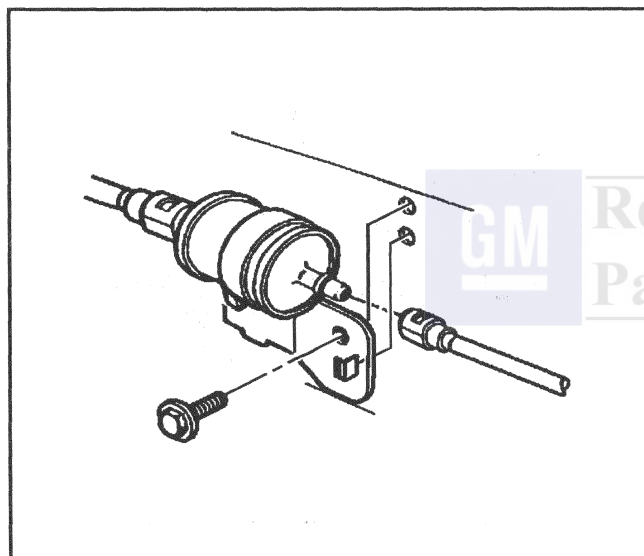
Installation Procedure

1. Install a new gasket.
2. Install the clean air cover.
3. Install the clean air cover attaching screws.

Tighten

Tighten the clean air cover attaching screws to 3.2 N·m (28 lb in).

4. Install the resonator.



12770

In-Line Fuel Filter

Removal Procedure

Important:

- There is no service interval for fuel filter replacement. Only replace a restricted fuel filter.
- Inspect the fuel tank internally and clean the fuel tank if you find a restricted fuel filter.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel System Pressure Relief Procedure.
3. Raise the vehicle.
4. Clean all the fuel filter connections and the surrounding areas before disconnecting the fuel pipes in order to avoid possible contamination of the fuel system.
5. Remove the fuel filter bracket attaching bolt.
6. Disconnect the quick-connect fittings from the fuel filter. Refer to Servicing Quick-Connect Fittings.
7. Remove the fuel filter.

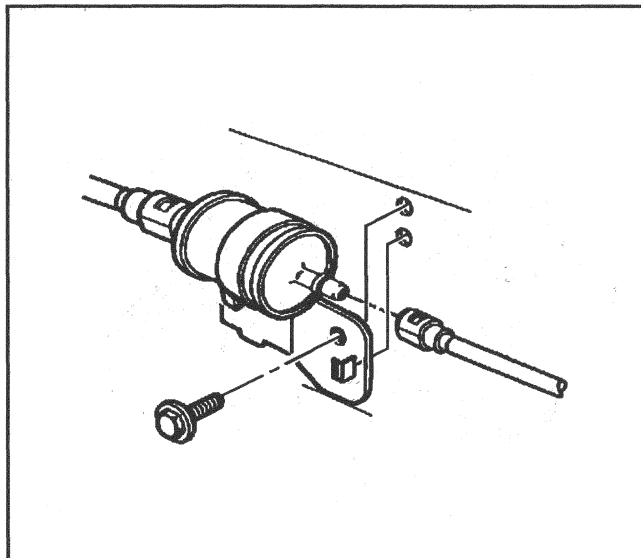
Installation Procedure

1. Remove the protective caps from the new filter.
2. Install the new plastic connector retainers on the filter inlet and outlet tubes. Install the retainers in the same positions as on the old filter noting the direction of fuel flow arrow.
3. Connect the quick-connect fittings to the fuel filter. Refer to Servicing Quick-Connect Fittings.
4. Trap the fuel filter over the return pipe and install the filter to the frame with the attaching bolt.

Tighten

Tighten the fuel filter attaching bolt to 10 N·m (89 lb in).

5. Lower the vehicle.
6. Tighten the fuel filler cap.
7. Connect the negative battery cable.
8. Inspect for leaks.
 - 8.1. Turn the ignition switch ON for 2 seconds.
 - 8.2. Turn the ignition switch OFF for 10 seconds.
 - 8.3. Turn the ignition switch ON.
 - 8.4. Check for fuel leaks.



12770

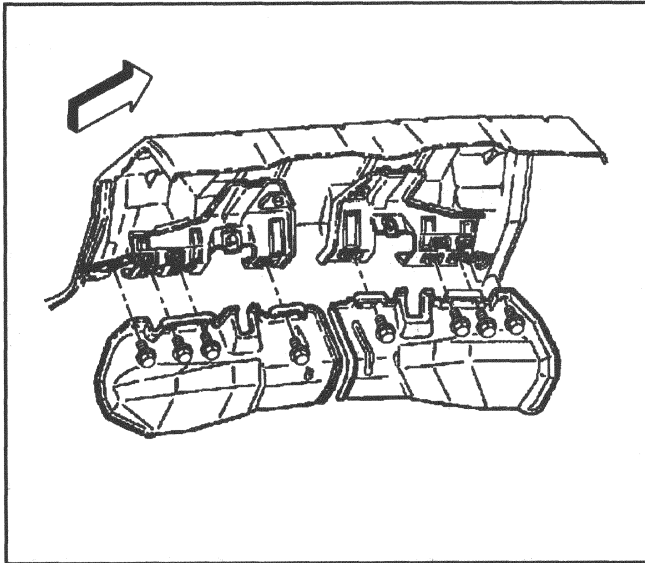
Draining Fuel Tank

Caution:

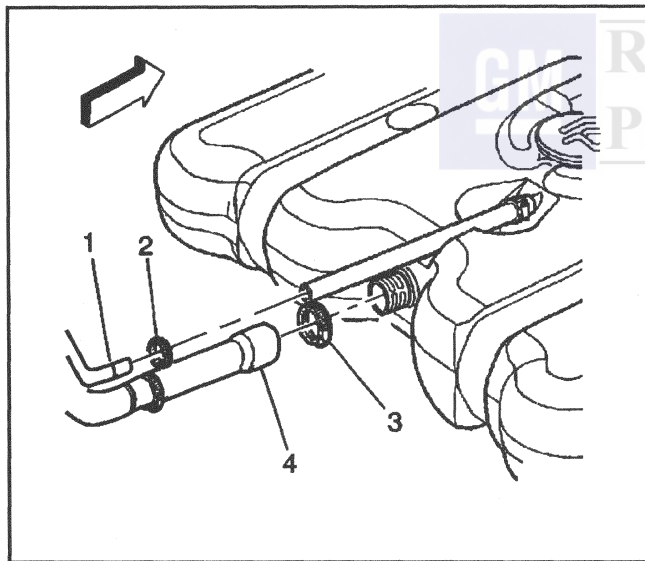
- **Never drain or store fuel in an open container due to the possibility of fire or explosion.**
- **When draining the fuel tank, slowly insert and Do Not force the hand operated pump device in the fuel tank. Forcing the pump device can cause the fuel pump to dislocate from the fuel sender assembly.**

1. Remove the fuel filler cap.
2. Use a hand operated pump device to drain as much fuel through the fuel filler pipe as possible.
3. Install the fuel filler cap.

GM Restoration Parts



12664



12661

Fuel Tank

Removal Procedure

Caution: Provide additional support when a vehicle is on a hoist:

- Before removing parts, support the opposite end. This helps prevent the vehicle from slipping off.
- Before removing major components, chain the vehicle frame to the hoist pads at the same end as the removal. This helps avoid a tip-off.

Failure to follow these precautions could cause vehicle damage, serious personal injury, or death.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Drain the fuel tank. Refer to Draining Fuel Tank.
4. Raise the vehicle.
5. Remove the lower fuel tank shield attaching screws and the lower fuel tank shields from the upper fuel tank shield.
6. Wipe the vent hose connection at the fuel filler vent pipe.
7. Disconnect the vent hose (1) and the clamp (2).
8. Wipe the fuel filler pipe connection at the fuel tank.
9. Disconnect the fuel filler pipe (4) and the clamp (3).

10. Wipe the EVAP hose connection at the fuel sender.

Notice:

- Replace nylon fuel feed or return pipes if the pipe becomes kinked and cannot be straightened.
- Do Not attempt to repair sections of nylon fuel pipes. Replace the pipes if they are damaged.

11. Disconnect the EVAP hose (1) and the clamp (2).
12. Disconnect the fuel feed (3) and the fuel return (4) quick-connect fittings from the fuel sender assembly. Refer to Servicing Quick-Connect Fittings.
13. Disconnect the fuel sender electrical connector.
14. With the aid of an assistant, support the fuel tank.

Notice: Do Not bend the fuel tank straps. Bending the fuel tank straps may damage the straps.

15. Remove the fuel tank strap front attaching bolts and the fuel tank.
16. Place the fuel tank in a suitable work area.
17. If the fuel filler pipe needs to be replaced, remove the fuel filler pipe attaching screws, the ground strap (Wagon only), and the fuel filler pipe.
18. Remove the fuel sender assembly from the fuel tank. Refer to Fuel Sender Assembly Replacement.
19. Remove the fuel tank vent hose.

Installation Procedure

1. Install the fuel tank vent hose.
2. Install the fuel sender assembly to the fuel tank. Refer to Fuel Sender Assembly Replacement.
3. If the fuel filler pipe was replaced, install the fuel filler pipe, the ground strap (Wagon only), and the fuel filler pipe attaching screws.

Tighten

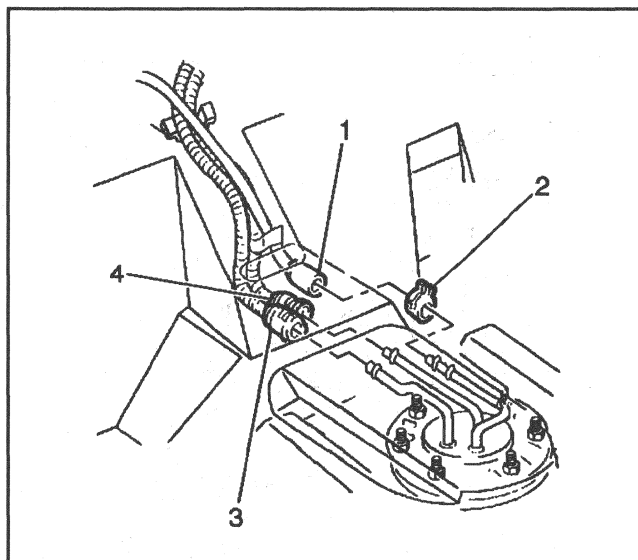
- Tighten the fuel filler pipe attaching screws to 6 N·m (53 lb in) (Except Wagon) and 1.9 N·m (17 lb in).
- Tighten the fuel filler pipe ground strap screw (Wagon only) to 4 N·m (35 lb in).

4. With the aid of an assistant, position and support the fuel tank.
5. Install the front fuel tank strap attaching bolts.

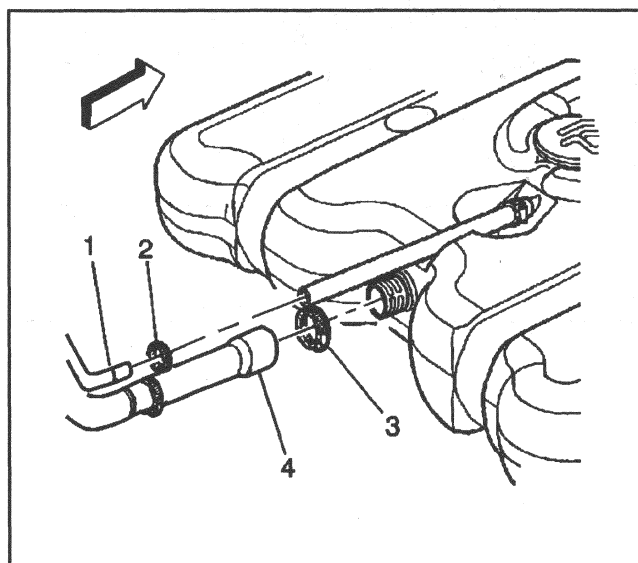
Tighten

Tighten the front fuel tank strap attaching bolts to 32 N·m (24 lb ft).

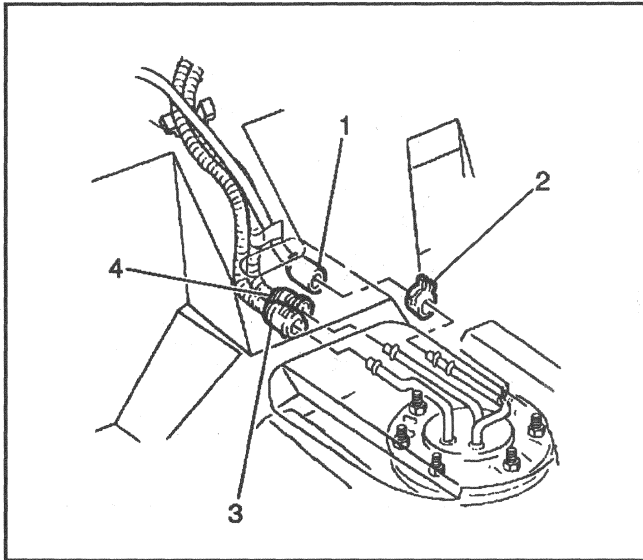
6. Connect the fuel filler pipe (4) and the clamp (3).
7. Connect the fuel tank vent hose (1) and the clamp (2).



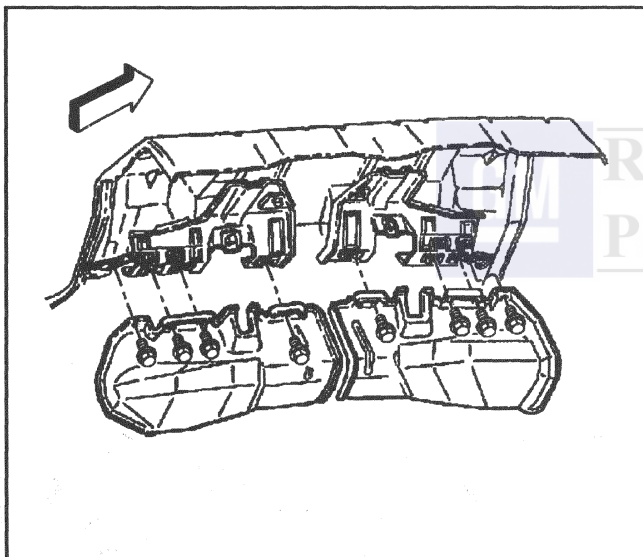
12666



12661



12666



12664

8. Connect the fuel sender electrical connector.
9. Connect the fuel feed (3) and the fuel return (4) quick-connect fittings to the fuel sender assembly. Refer to Servicing Quick-Connect Fittings.
10. Connect the EVAP hose (1) and the clamp (2).

11. Install the lower fuel tank shields on the upper fuel tank shield with the attaching screws.

Tighten

Tighten the lower fuel tank shield attaching screws to 1 N.m (9 lb in).

12. Lower the vehicle.
13. Refill the fuel tank.
14. Install the fuel filler cap.
15. Connect the negative battery cable.
16. Inspect for leaks.
 - 16.1. Turn the ignition switch ON for two seconds.
 - 16.2. Turn the ignition switch OFF for ten seconds.
 - 16.3. Turn the ignition switch ON.
 - 16.4. Check for fuel leaks.

Fuel System Cleaning

Fuel Tank Cleaning

Important:

- Only use oil free compressed air to blow out the fuel pipes.
- Inspect the fuel tank internally and clean the fuel tank if you find a plugged fuel filter.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Drain the fuel tank. Refer to Draining Fuel Tank.
4. Remove the fuel tank. Refer to Fuel Tank Replacement.

5. Remove the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
6. Inspect the fuel pump strainer. Replace a contaminated strainer and inspect the fuel pump.
7. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet.
Important: When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water mixture in accordance with all applicable local, state, and federal laws and regulations.
8. Flush the fuel tank with hot water.
9. Pour the water out of the fuel sender assembly opening. Rock the tank to be sure that removal of the water from the tank is complete.
10. Install the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
11. Install the fuel tank. Refer to Fuel Tank Replacement.
12. Refill the fuel tank.
13. Install the fuel filler cap.
14. Connect the negative battery cable.
15. Inspect for leaks.
 - 15.1. Turn the ignition switch ON for 2 seconds.
 - 15.2. Turn the ignition switch OFF for 10 seconds.
 - 15.3. Turn the ignition switch ON.
 - 15.4. Check for fuel leaks.

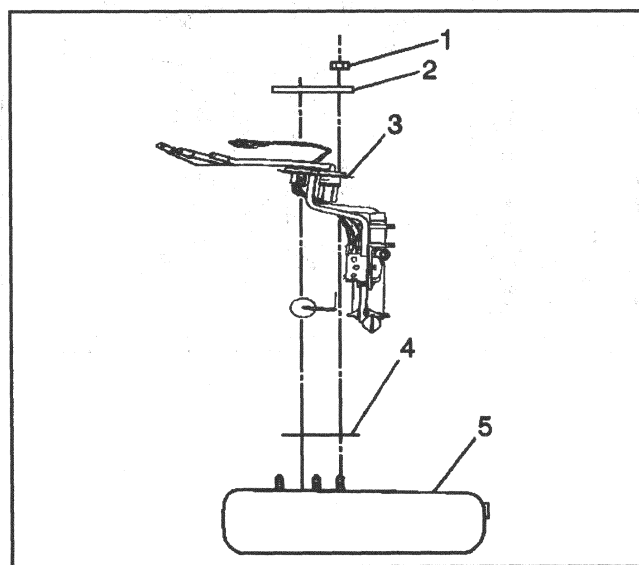
Fuel Sender Assembly

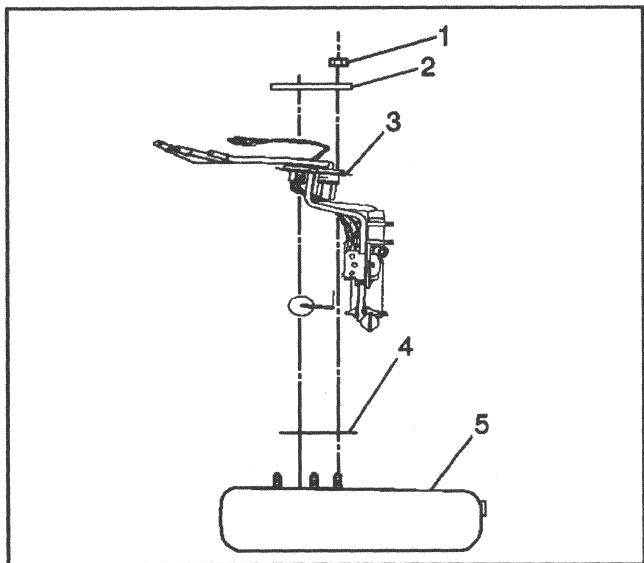
Removal Procedure

Caution: To reduce the risk of fire and personal injury that may result from a fuel leak, always replace the fuel sender gasket when reinstalling the fuel sender assembly.

Notice: Do Not handle the fuel sender assembly by the fuel pipes. Due to the length of the fuel pipes, the amount of leverage generated by handling the fuel pipes could damage the joints.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Drain the fuel tank. Refer to Draining Fuel Tank.
4. Remove the fuel tank. Refer to Fuel Tank and Fuel Filler Pipe Replacement.
5. Remove the fuel sender assembly retaining nuts (1), the retaining ring (2), the fuel sender assembly (3), and the gasket (4). Discard the gasket.
6. Clean the gasket sealing surfaces.





21301

Installation Procedure

1. Position the new gasket (4) on the fuel tank (5).

Important: Do Not fold over or twist the fuel pump strainer when installing the fuel sender assembly as this will restrict fuel flow. Also, assure that the fuel pump strainer does not block full travel of the float arm.

2. Install the fuel sender assembly (3), the retaining ring (2), and the fuel sender retaining nuts (1).

Tighten

Tighten the fuel sender assembly retaining nuts alternately and evenly to 3 N.m (27 lb in).

3. Install the fuel tank. Refer to Fuel Tank and Fuel Filler Pipe Replacement.
4. Add fuel.
5. Install the fuel filler cap.
6. Connect the negative battery cable.
7. Inspect for leaks.

7.1. Turn the ignition switch ON for 2 seconds.

7.2. Turn the ignition switch OFF for 10 seconds.

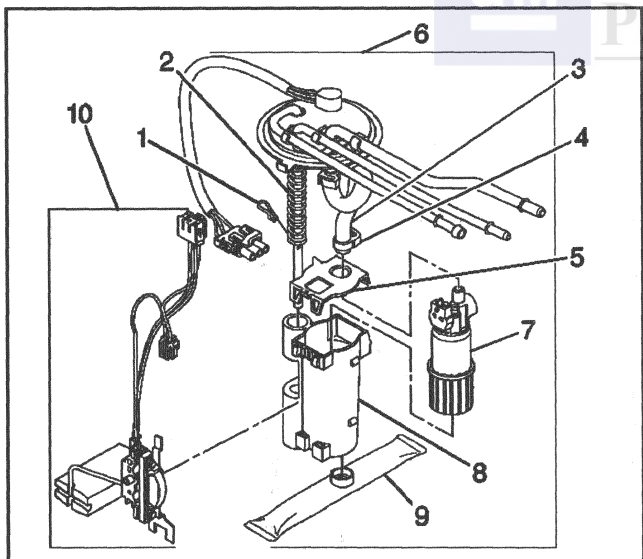
7.3. Turn the ignition switch ON.

7.4. Check for fuel leaks.

Fuel Sender Assembly Service

Removal Procedure

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Drain the fuel tank. Refer to Draining Fuel Tank.
4. Remove the fuel tank. Refer to Fuel Tank and Fuel Filler Pipe Replacement.
5. Remove the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
6. Note the position of the fuel strainer (9) on the fuel pump (7).
7. Support the fuel sender assembly (6) with one hand and grasp the strainer (9) with the other hand.
8. Rotate the strainer in one direction and pull the strainer off the pump. Discard the strainer after inspection.
9. Inspect the strainer. Replace a contaminated strainer and clean the fuel tank.
10. Inspect the fuel pump inlet for dirt and debris. If found, replace the fuel pump.
11. If the fuel pump is being replaced, proceed to Step 12.
12. Loosen the clamp (4) and remove the fuel feed hose (3) from the fuel pump outlet.
13. Remove the terminal retainer.



21304

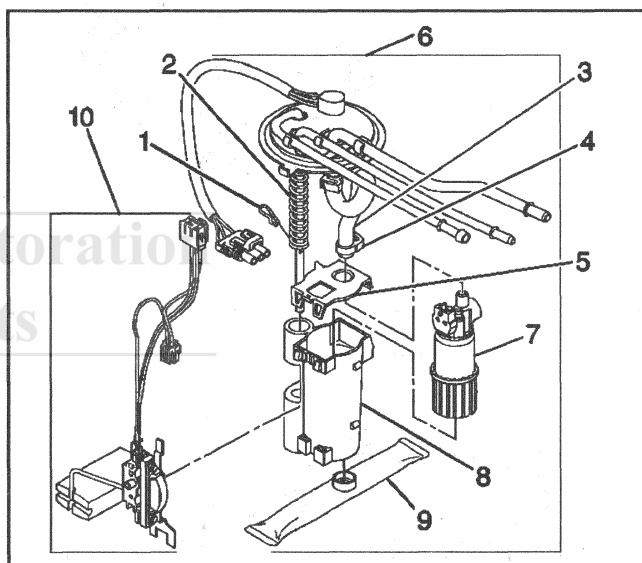
14. Disconnect the fuel pump electrical connector and the electrical connector from the bottom of the sender cover.
 15. Remove the retainer clip (1) from the fuel return pipe.
 16. Remove the fuel pump and fuel level sensor assembly and the spring (2) from the fuel sender.
 17. Remove the housing cover (5) from the fuel pump housing (8).
 18. Remove the fuel pump (7) from the fuel pump housing (8).
- Notice:** Do Not run the fuel pump unless the fuel pump is submerged in fuel.
19. If the fuel level sensor is being replaced, proceed to Step 20.
 20. Slide the fuel level sensor (10) from the retainers on the fuel pump housing (8).

Installation Procedure

1. Install the fuel level sensor (10) to the fuel pump housing (8).
 2. Install the fuel pump (7) and the isolator into the fuel pump housing (8).
- Important:** The small hole in the housing cover (5) aligns over the fuel level sensor (10).
3. Install the housing cover (5) to the fuel pump housing (8).
- Important:** The fuel pump and fuel level sensor assembly must be aligned directly under the fuel sender cover.
4. Slide the fuel pump and fuel level sensor assembly and spring (2) onto the fuel return pipe.
 5. Compress the spring (2) and install the retainer clip (1) through the fuel return pipe.
 6. Connect the fuel feed hose (3) to the fuel pump outlet. Tighten the clamp (4) so that 5 to 8 teeth are engaged.
 7. Connect the fuel pump electrical connector and the electrical connector to the bottom of the sender cover.
 8. Install the terminal retainer.

Important: Always install a new pump strainer when replacing the fuel pump.

9. Install a new fuel pump strainer in the same position as noted during disassembly. Push on the outer edge of the strainer ferrule until the strainer is fully seated.
10. Install the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
11. Install the fuel tank. Refer to Fuel Tank and Fuel Filler Pipe Replacement.
12. Add fuel.

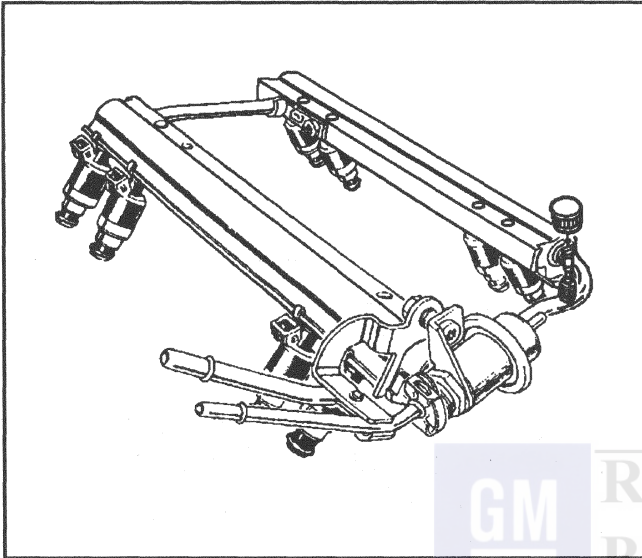


13. Install the fuel filler cap.
14. Connect the negative battery cable.
15. Inspect for leaks.
 - 15.1. Turn the ignition switch ON for 2 seconds.
 - 15.2. Turn the ignition switch OFF for 10 seconds.
 - 15.3. Turn the ignition switch ON.
 - 15.4. Check for fuel leaks.

Fuel Pressure Connection Valve

Removal Procedure

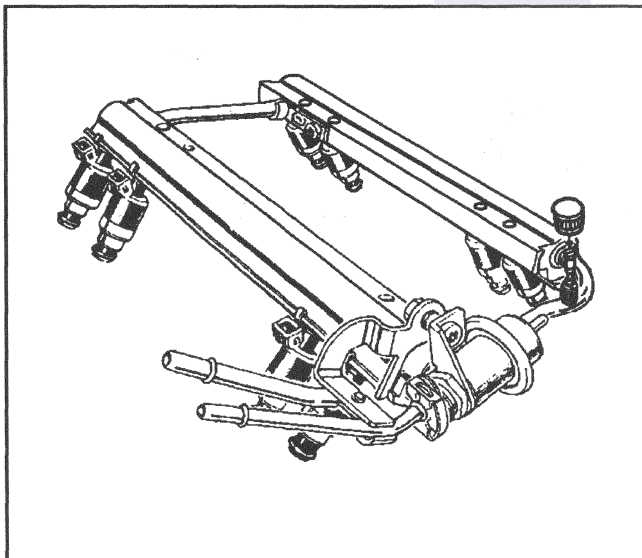
1. Clean the area around the fuel pressure connection with GM X-30A or equivalent.
2. Disconnect the negative battery cable.
3. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
4. Remove the fuel pressure connection valve assembly.



12763

Installation Procedure

1. Install the fuel pressure connection valve assembly.
2. Tighten the fuel filler cap.
3. Connect the negative battery cable.
4. Inspect for leaks.
 - 4.1. Turn the ignition switch ON for 2 seconds.
 - 4.2. Turn the ignition switch OFF for 10 seconds.
 - 4.3. Turn the ignition switch ON.
 - 4.4. Check for fuel leaks.

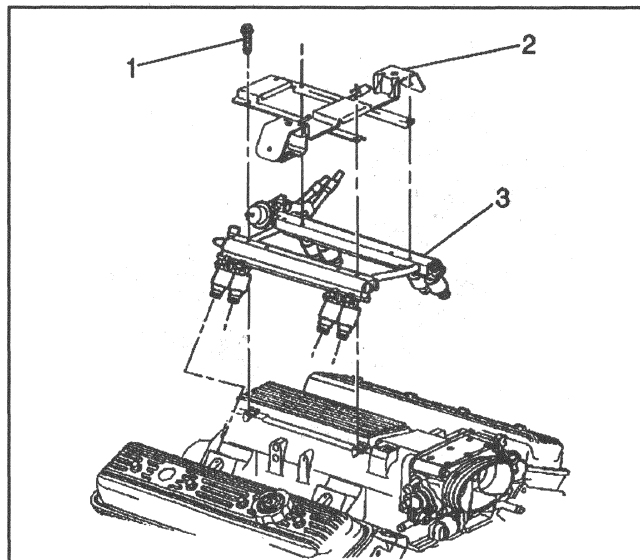


12763

Fuel Outlet Tube

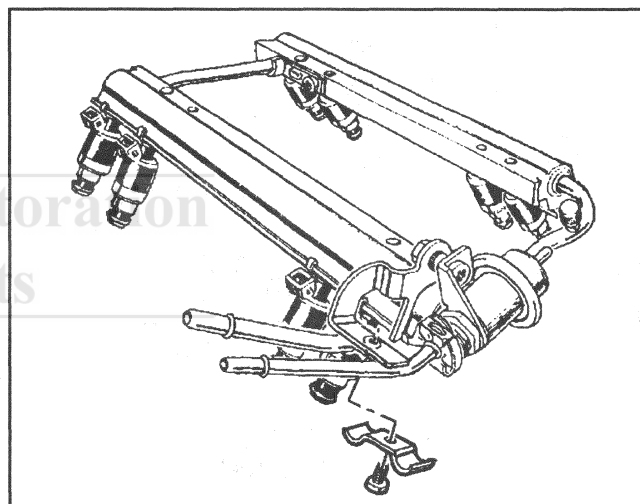
Removal Procedure

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Remove the fuel rail assembly. Refer to Fuel Rail Assembly.



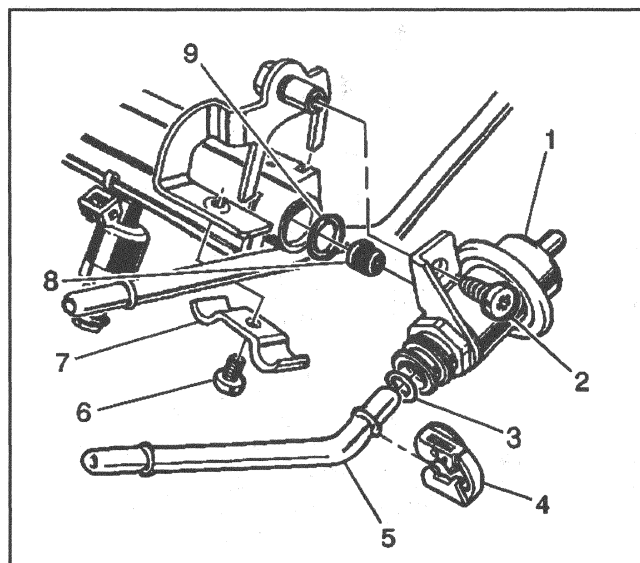
21302

4. Remove the fuel tube bracket attaching screw and the fuel tube bracket.

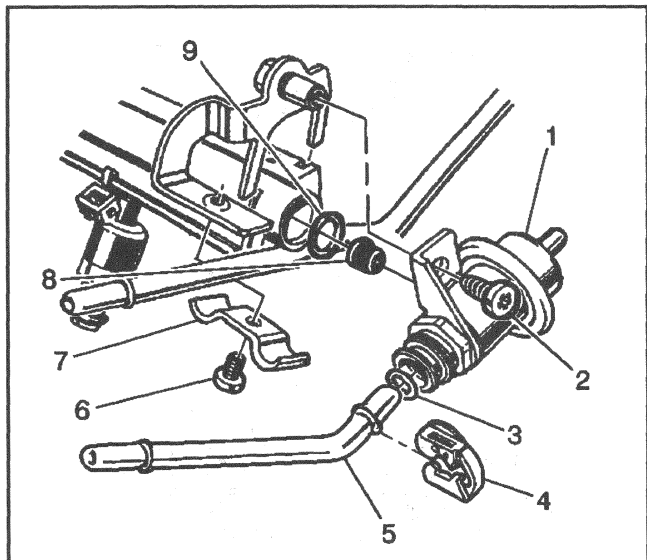


12764

5. Remove the fuel outlet tube retainer clip (4).
6. Remove the fuel outlet tube (5) from the pressure regulator (1).
7. Remove the O-ring (3) from the fuel outlet tube (5). Discard the O-ring.



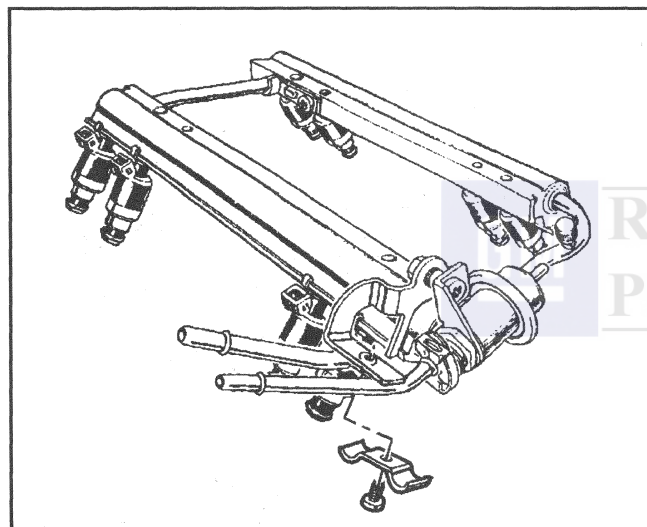
13652



13652

Installation Procedure

1. Lubricate the new O-ring (3) with clean engine oil.
2. Install the O-ring (3) on the fuel outlet tube (5).
3. Push the fuel outlet tube (5) into the pressure regulator (1).
4. Install the fuel outlet tube retainer clip (4).

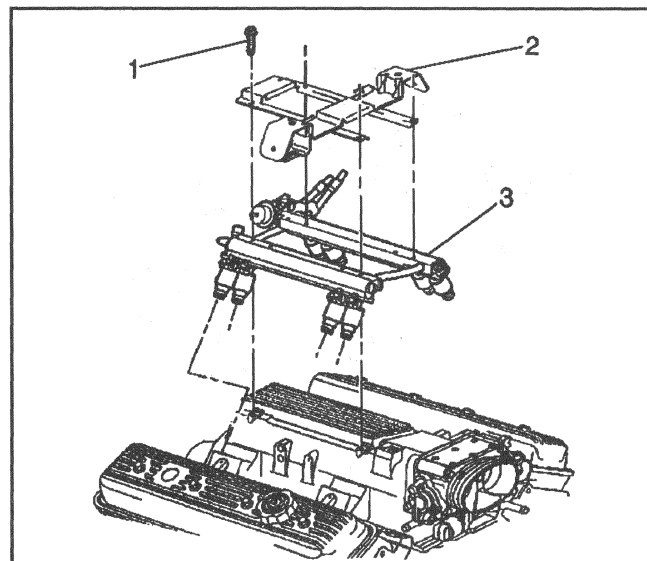


12764

5. Install the fuel tube bracket and the attaching screw.

Tighten

Tighten the fuel tube bracket attaching screw to 5 N·m (44 lb in).



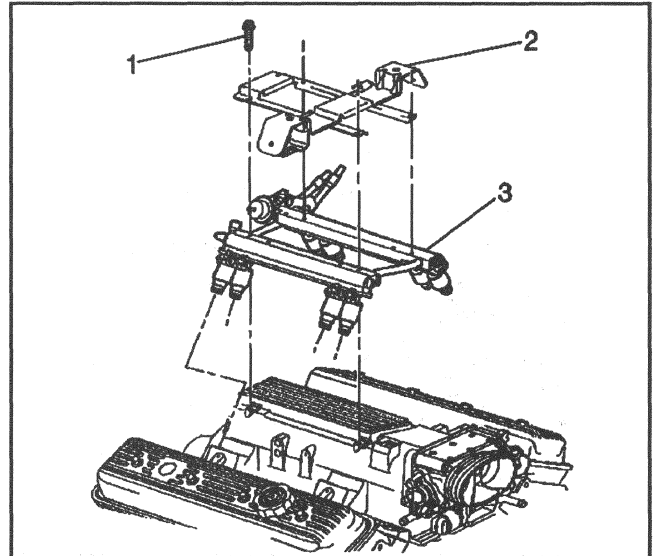
21302

6. Install the fuel rail assembly. Refer to Fuel Rail Assembly.
7. Tighten the fuel filler cap.
8. Connect the negative battery cable.
9. Inspect for leaks.
 - 9.1. Turn the ignition switch ON for 2 seconds.
 - 9.2. Turn the ignition switch OFF for 10 seconds.
 - 9.3. Turn the ignition switch ON.
 - 9.4. Check for fuel leaks.

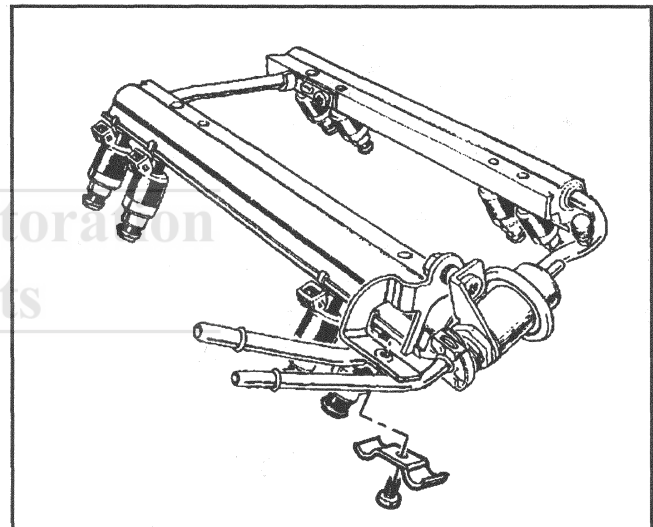
Fuel Crossover Tube

Removal Procedure

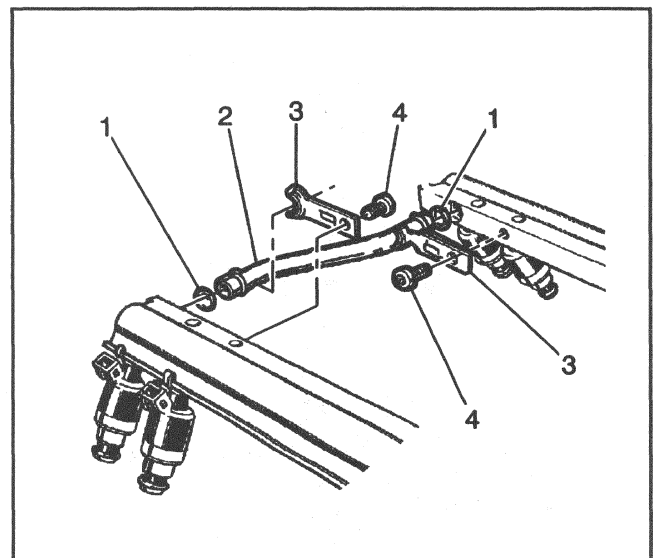
1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Remove the fuel rail assembly. Refer to Fuel Rail Assembly.
4. Remove the fuel tube bracket attaching screw and the fuel tube bracket.
5. Remove the crossover tube retainer attaching screws (4) and the crossover tube retainers (3).
6. Remove the crossover tube (2) from the fuel rails.
7. Remove the O-rings (1) from the crossover tube (2). Discard the O-rings.



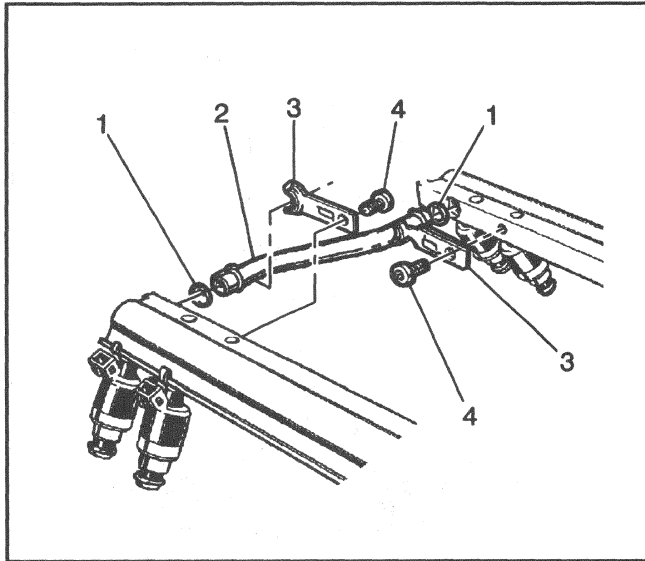
21302



12764



12581



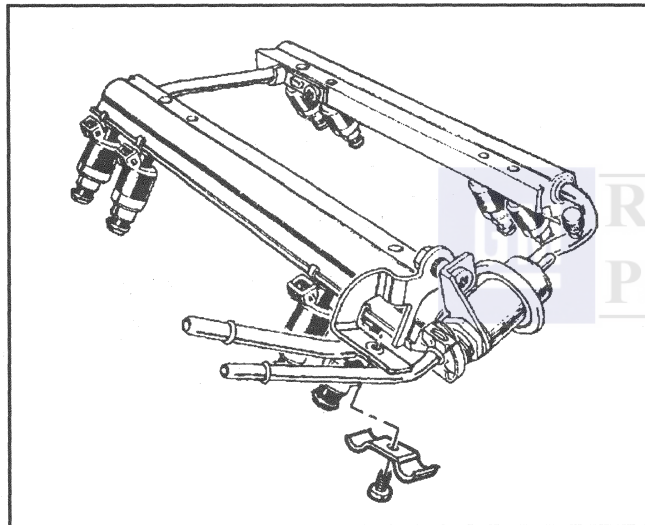
12581

Installation Procedure

1. Lubricate the new crossover tube O-rings (1) with clean engine oil.
2. Install the O-rings (1) on the crossover tube (2).
3. Install the crossover tube (2) into the fuel rail sections.
4. Install the crossover tube retainers (3) and the attaching screws (4).

Tighten

Tighten the crossover tube retainer attaching screws to 5 N·m (44 lb in).

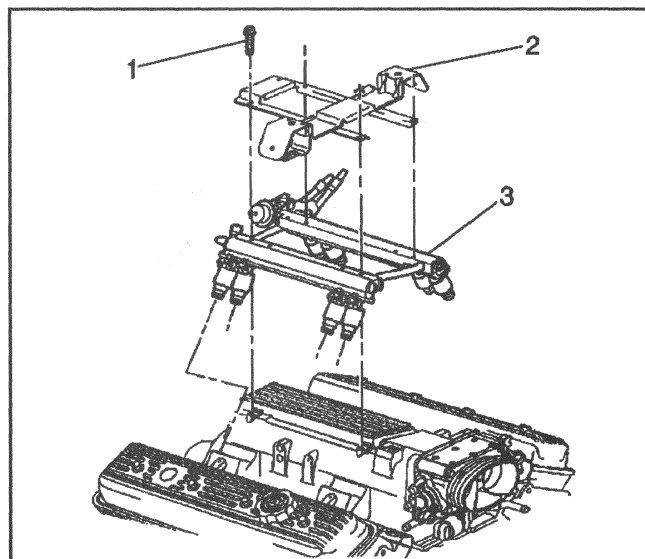


12764

5. Install the fuel tube bracket and the attaching screw.

Tighten

Tighten the fuel tube bracket attaching screw to 5 N·m (44 lb in).



21302

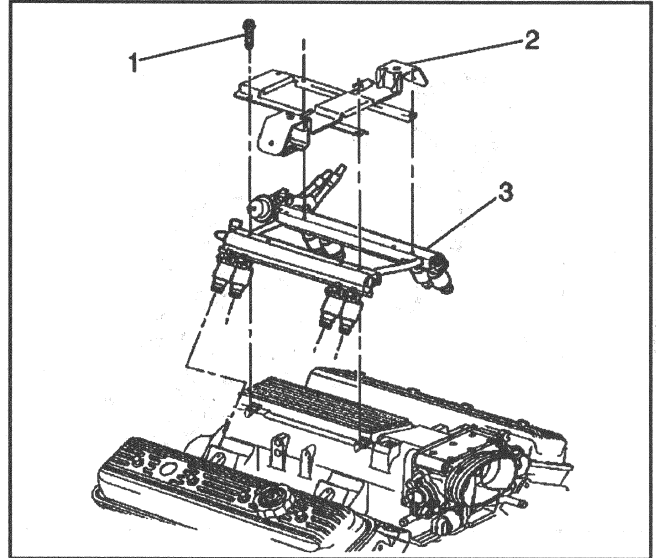
6. Install the fuel rail assembly. Refer to Fuel Rail Assembly.
7. Tighten the fuel filler cap.
8. Connect the negative battery cable.
9. Inspect for leaks.
 - 9.1. Turn the ignition switch ON for 2 seconds.
 - 9.2. Turn the ignition switch OFF for 10 seconds.
 - 9.3. Turn the ignition switch ON.
 - 9.4. Check for fuel leaks.

Fuel Injector

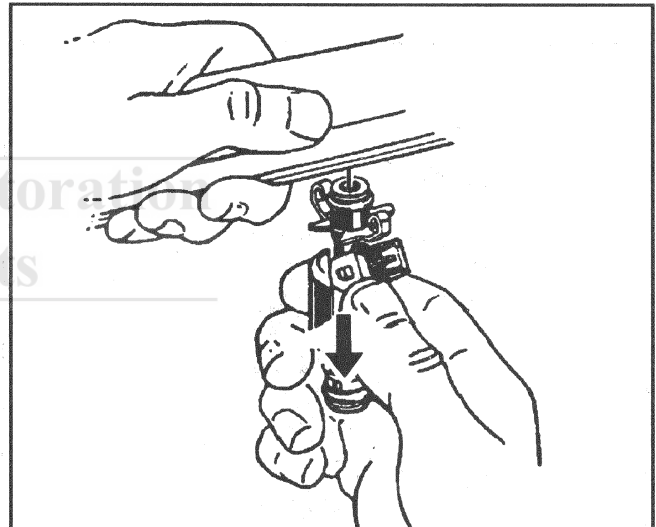
Removal Procedure

Important:

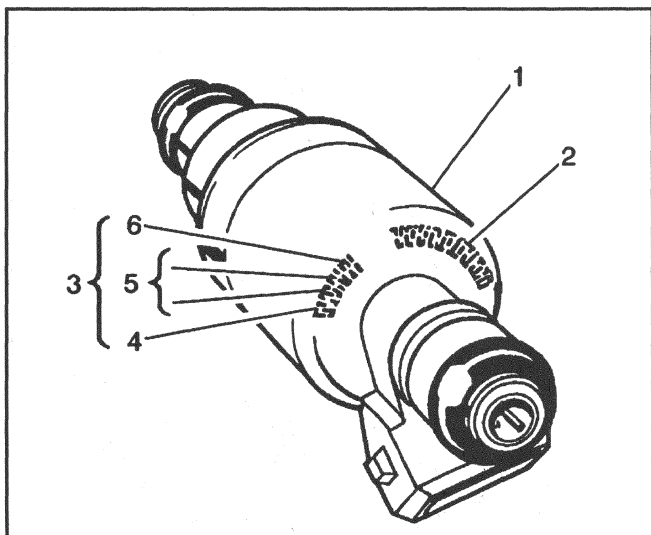
- Use care in removing the fuel injectors to prevent damage to the electrical connector pins on the injector and to prevent damage to the nozzle. Service the fuel injector as a complete assembly only. The fuel injector is an electrical component. Do Not immerse the fuel injector in any type of cleaner.
 - The engine oil may be contaminated with fuel if the fuel injectors are leaking.
1. Disconnect the negative battery cable.
 2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
 3. Remove the fuel rail assembly. Refer to Fuel Rail Assembly.
 4. Spread the injector retainer clip to release the injector from the fuel rail.
 5. Remove the fuel injector.
 6. Discard the injector retainer clip.
 7. Remove the injector O-ring seals from both ends of the injector. Discard the O-ring seals. Save the O-ring backup for use in reinstallation.



21302



12772



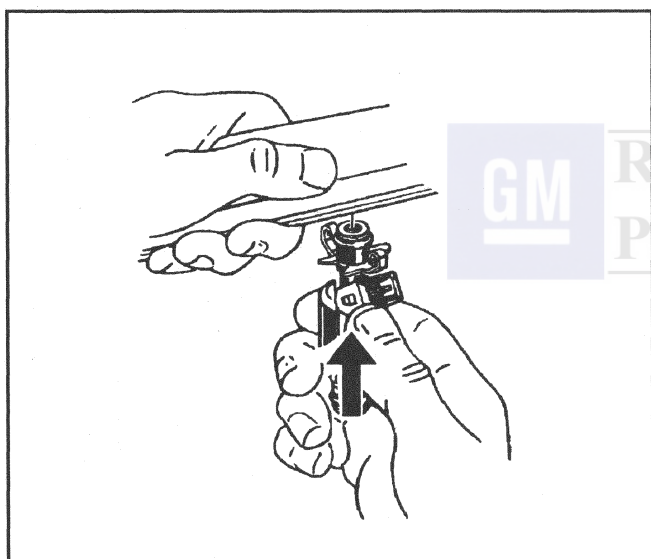
12639

Installation Procedure

Important:

- When ordering new fuel injectors, be sure to order the correct injector for the application being serviced.
- The upper and lower fuel injector O-rings use different part numbers. To identify the correct O-ring, the upper O-ring is black and the lower O-ring is brown. Both O-rings are the same size but consist of different material.
- The fuel injector lower O-ring uses a nylon collar, called the O-ring backup, to properly position the O-ring on the injector. Always reinstall the O-ring backup, or the sealing O-ring may move on the injector when installing the fuel rail and result in a possible vacuum leak.

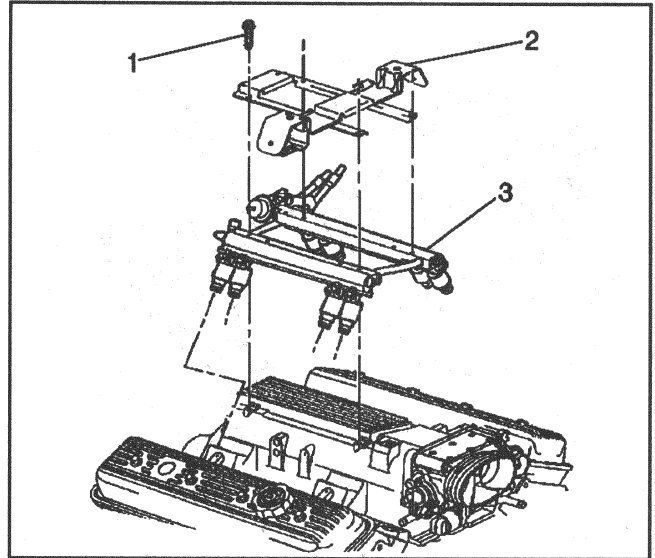
The fuel injector assembly (1) is stamped with a part number identification (2) and a build date code (3). The build date code consists of the month (4) 1-9 (Jan-Sept) O, N, D, (Oct, Nov, Dec); day (5); and year (6).



12642

1. Lubricate the new injector O-ring seals with clean engine oil.
2. Install the new injector O-ring seals on the injector.
3. Install a retainer clip on the injector. Position the clip on the right side of the injector electrical connector.
4. Push the fuel injector into the fuel rail injector socket with the electrical connector facing outward. The retainer clip locks on to a flange on the fuel rail.

5. Install the fuel rail assembly. Refer to Fuel Rail Assembly.
6. Tighten the fuel filler cap.
7. Connect the negative battery cable.
8. Inspect for leaks.
 - 8.1. Turn the ignition switch ON for 2 seconds.
 - 8.2. Turn the ignition switch OFF for 10 seconds.
 - 8.3. Turn the ignition switch ON.
 - 8.4. Check for fuel leaks.

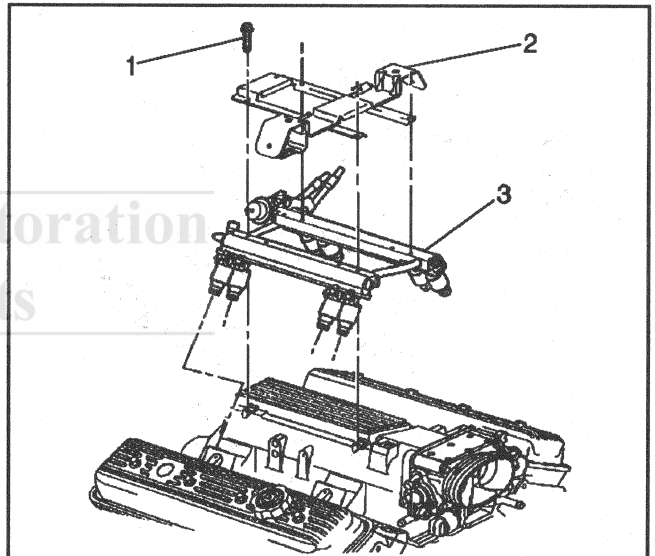


21302

Fuel Pressure Regulator

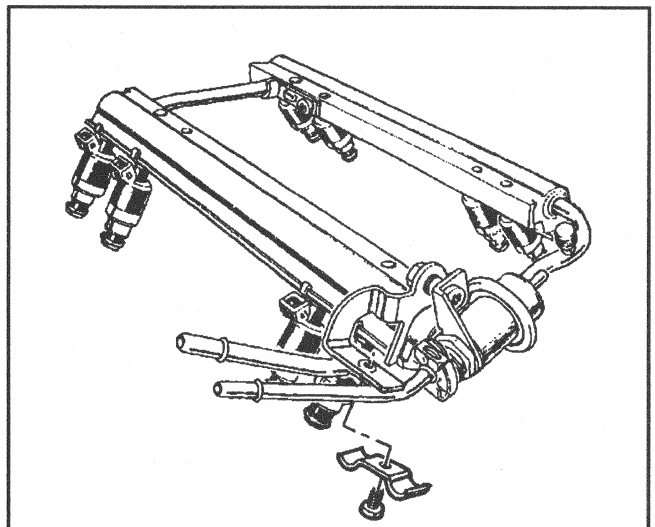
Removal Procedure

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Remove the fuel rail assembly. Refer to Fuel Rail Assembly.

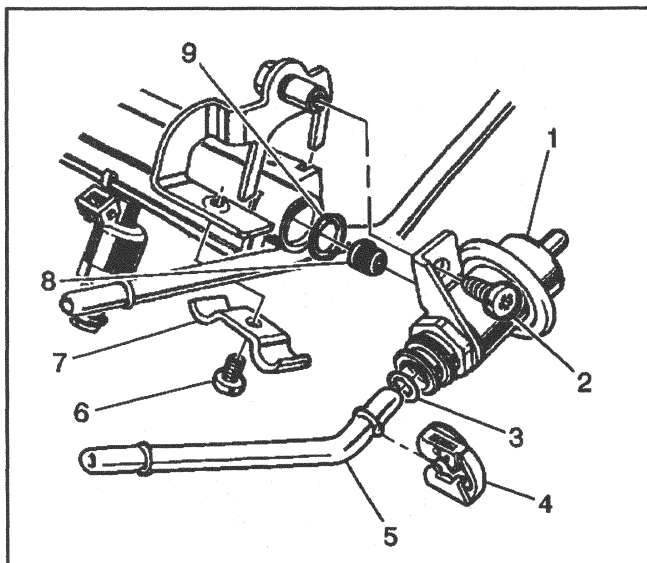


21302

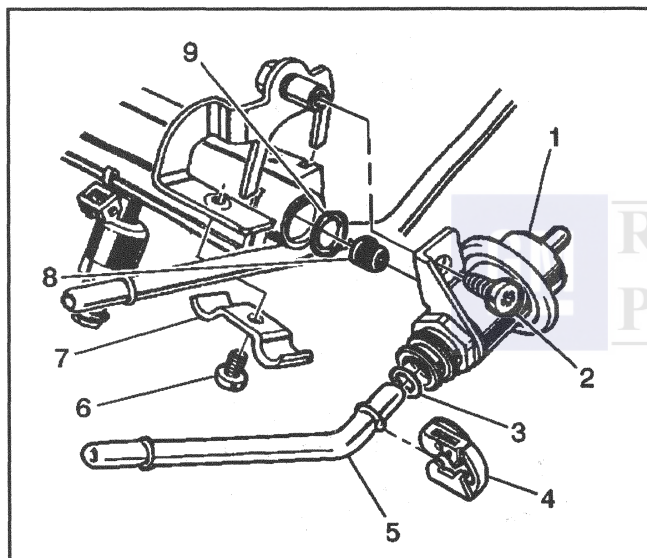
4. Remove the fuel tube bracket attaching screw and the fuel tube bracket.



12764



13652



13652

5. Remove the pressure regulator attaching screw (2) and the pressure regulator (1).
6. Remove the fuel outlet tube retainer clip (4).
7. Remove the fuel outlet tube (5) from the pressure regulator (1).
8. Remove the pressure regulator inlet O-ring (9). Discard the pressure regulator inlet O-ring.
9. Remove the fuel outlet tube O-ring (3). Discard the fuel outlet tube O-ring.
10. Inspect the filter screen (8) for contamination. Remove the filter screen with a small pick and discard the filter screen if it is dirty.

Installation Procedure

1. Lubricate the new pressure regulator inlet O-ring (9) with clean engine oil.
2. Install the pressure regulator inlet O-ring (9) on the pressure regulator (1).
3. Lubricate the new fuel outlet tube O-ring (3) with clean engine oil.
4. Install the fuel outlet tube O-ring (4) on the fuel outlet tube (5).
5. Install the fuel outlet tube (5) into the pressure regulator (1).
6. Install the fuel outlet tube retainer clip (4).
7. Push the pressure regulator (1) into the fuel rail.
8. Apply Loctite 262 to the pressure regulator attaching screw (6) if necessary.
9. Install the pressure regulator attaching screw (2).

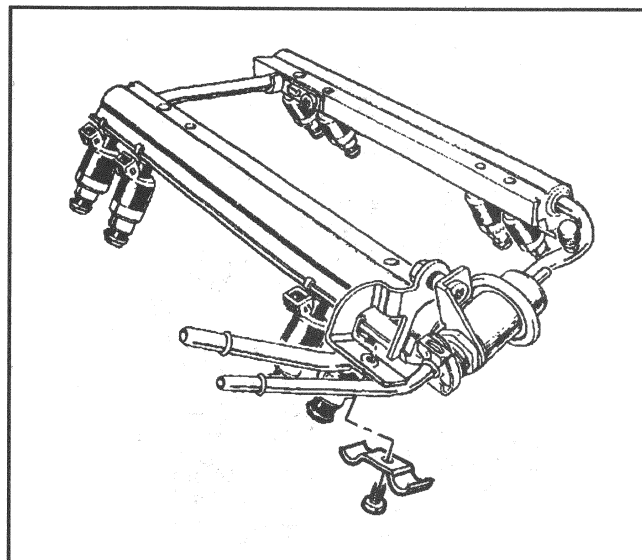
Tighten

Tighten the pressure regulator attaching screw to 10 N·m (89 lb in).

10. Install the fuel tube bracket and the attaching screw.

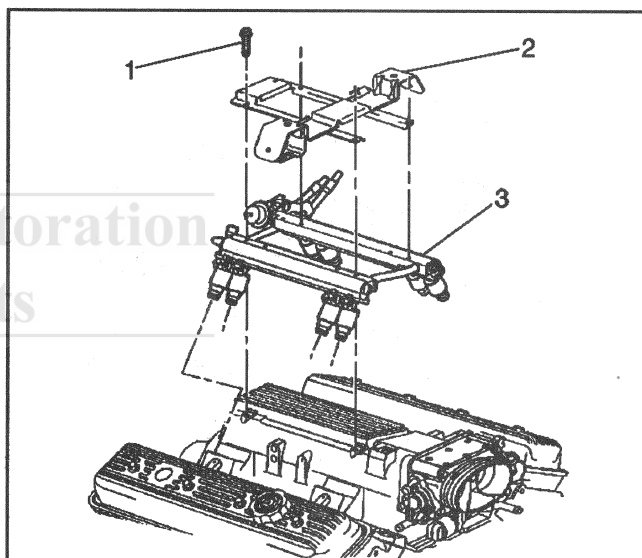
Tighten

Tighten the fuel tube bracket attaching screw to 5 N·m (44 lb in).



12764

11. Install the fuel rail assembly. Refer to Fuel Rail Assembly.
12. Tighten the fuel filler cap.
13. Connect the negative battery cable.
14. Inspect for leaks.
 - Turn the ignition switch ON for 2 seconds.
 - Turn the ignition switch OFF for 10 seconds.
 - Turn the ignition switch ON.
 - Check for fuel leaks.



21302

Fuel Rail Assembly

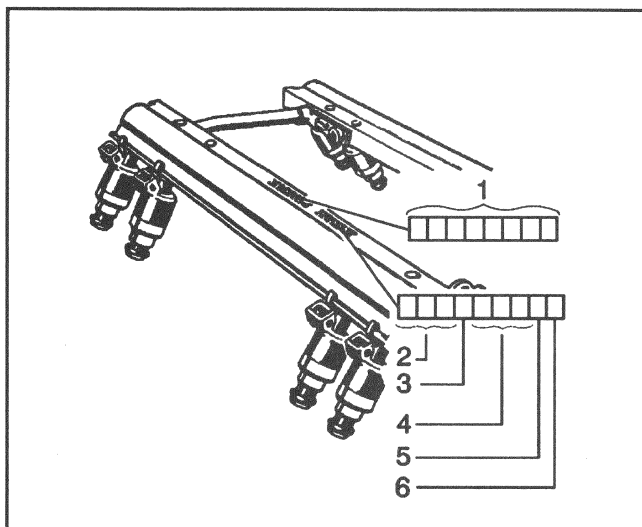
Removal Procedure

Tools Required

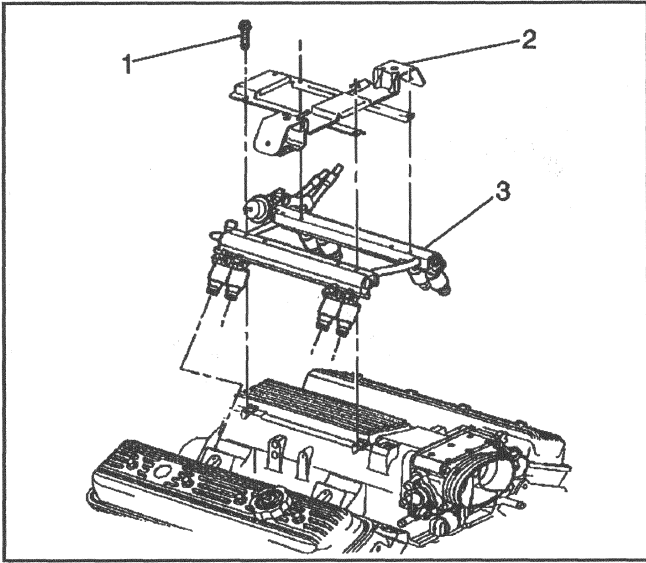
J 37088-A, tool set, Fuel Line Quick-Connect Separator

An eight digit identification number (1) is stamped on the fuel rail assembly. Refer to this model identification number if servicing or part replacement is required.

The nine digit number stamped on the fuel rail assembly indicates the day (2) and year (3) that the fuel rail was built, the plant code (4), the shift ID (5), and the source code (6).



12762



21302

Notice:

- Use care in removing the fuel rail assembly to prevent damage to the injector electrical connector terminals and the injector spray tips. When the fuel rail is removed, support the fuel rail in order to avoid damaging the fuel rail components.
 - Prevent dirt and other contaminants from entering open pipes and passages. Cap the fittings and plug the holes when servicing.
 - The upper and lower O-rings are different colors (black and brown). Install the black O-ring in the upper position on the injector. Install the brown O-ring in the lower position on the injector. The O-rings are the same size but are made of different materials.
1. Disconnect the negative battery cable.
 2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
 3. Remove the resonator.
 4. Before removal, clean the fuel rail assembly with a spray type engine cleaner, GM X-30A or equivalent, if necessary. Follow the package instructions. Do Not soak fuel rails in liquid cleaning solvent.
 5. Disconnect the quick-connect fittings from the fuel rail. Refer to Servicing Quick-Connect Fittings.
 6. Disconnect the vacuum lines from the fuel pressure regulator and the EVAP canister purge solenoid.
 7. Disconnect the electrical harness and cables from the routing clips on the resonator bracket (2).
 8. Remove the resonator bracket (2).
 9. Disconnect the electrical connectors from the fuel injectors. Identify the connectors to their corresponding injectors to ensure correct sequential injector firing order after reassembly.
 10. Remove the fuel rail assembly (3).
 11. Remove the injector lower O-ring seal (brown) from the spray tip end of each injector.
 12. Discard the O-ring seals. Save the O-ring backups.



Installation Procedure

Important: The fuel injector lower O-ring uses a nylon collar, called the O-ring backup, to properly position the O-ring on the injector. Always reinstall the O-ring backup, or the sealing O-ring may move on the injector when installing the fuel rail and result in a possible vacuum leak.

1. Lubricate the new lower injector O-ring seals (brown).
2. Install the new O-ring seals on the spray tip end of each injector.
3. Install the fuel rail assembly (3) to the intake manifold.
4. Install the resonator bracket (2).
5. Install the fuel rail and resonator bracket attaching bolts (1).

Tighten

Tighten the fuel rail and resonator bracket attaching bolts to 10 N·m (89 lb in).

6. Install the injector electrical connectors.
 - Install each connector on the proper injector to ensure correct sequential injector firing order.
 - Rotate the injectors as required in order to avoid stretching the wire harness.
7. Install the electrical harness and cables into the routing clips on the resonator bracket (2).
8. Connect the vacuum lines to the fuel pressure regulator and the EVAP canister purge solenoid.
9. Connect the quick-connect fittings to the fuel rail fuel pipes. Refer to Servicing Quick-Connect Fittings.
10. Tighten the fuel filler cap.
11. Connect the negative battery cable.
12. Inspect for leaks.
 - 12.1. Turn the ignition switch ON for 2 seconds.
 - 12.2. Turn the ignition switch OFF for 10 seconds.
 - 12.3. Turn the ignition switch ON.
 - 12.4. Check for fuel leaks.

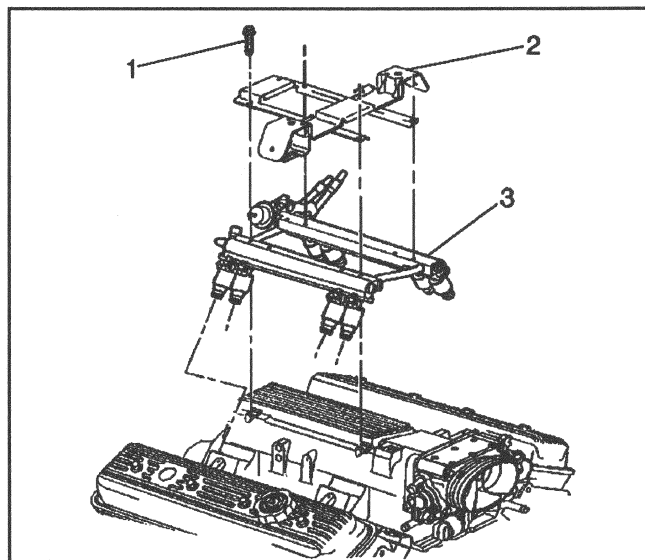
Fuel Pressure Relief Procedure

Tool Required

J 34730-1A Fuel Pressure Gauge

Caution:

- ***In order to reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.***
- ***After relieving system pressure, a small amount of fuel may be released when servicing fuel pipes or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting the fuel pipes in order***



21302

- *After relieving system pressure, a small amount of fuel may be released when servicing fuel pipes or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting the fuel pipes in order to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.*

1. Turn the ignition OFF.
2. Disconnect the negative battery cable in order to avoid possible fuel discharge if an accidental attempt is made to start the engine.
3. Loosen the fuel filler cap in order to relieve the fuel tank vapor pressure.
4. Connect the J 34730-1A fuel pressure gauge to the fuel pressure valve. Wrap a shop towel around the fitting while connecting the gauge in order to avoid spillage.
5. Install the bleed hose of the gauge into an approved container.
6. Open the valve on the gauge to bleed the system pressure. Fuel connections are now safe for servicing.
7. Drain any fuel remaining in the gauge into an approved container.

Fuel Hose and Pipes (Fuel Feed and Return Pipes)

Removal Procedure

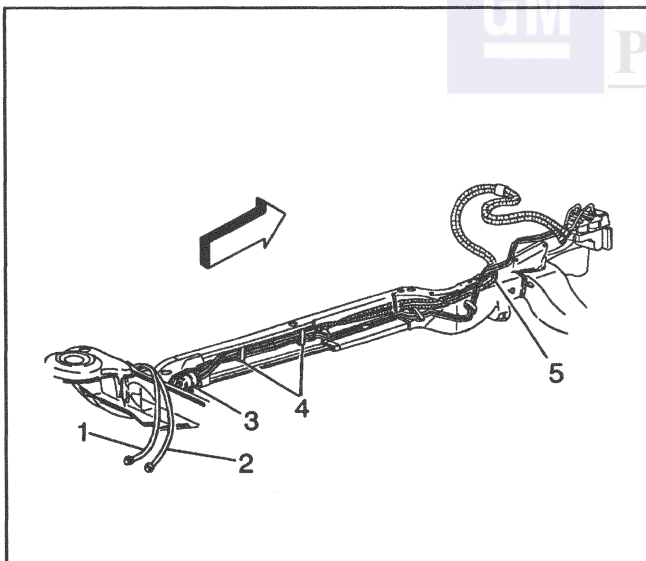
Tools Required

J 37088-A, Tool Set, Fuel Line Quick-Connect Separator

Notice:

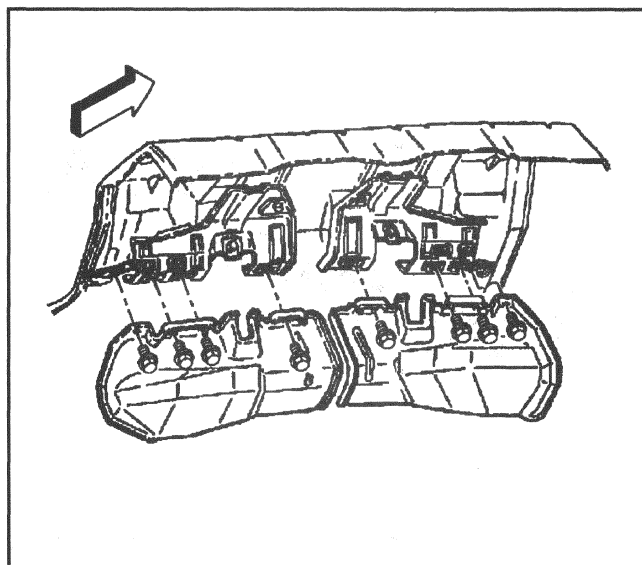
- Replace nylon fuel feed or return pipes if the pipe becomes kinked and cannot be straightened.
- Do Not attempt to repair sections of nylon fuel pipes. Replace the pipes if they are damaged.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to the Fuel Pressure Relief Procedure.
3. Disconnect the quick-connect fittings at the fuel rail. Refer to Servicing Quick-Connect Fittings.
4. Remove the fuel feed and return pipes from the retaining clip at the brake booster.
5. Raise the vehicle.
6. Disconnect the quick-connect fittings at the fuel filter (3). Refer to Servicing Quick-Connect Fittings.



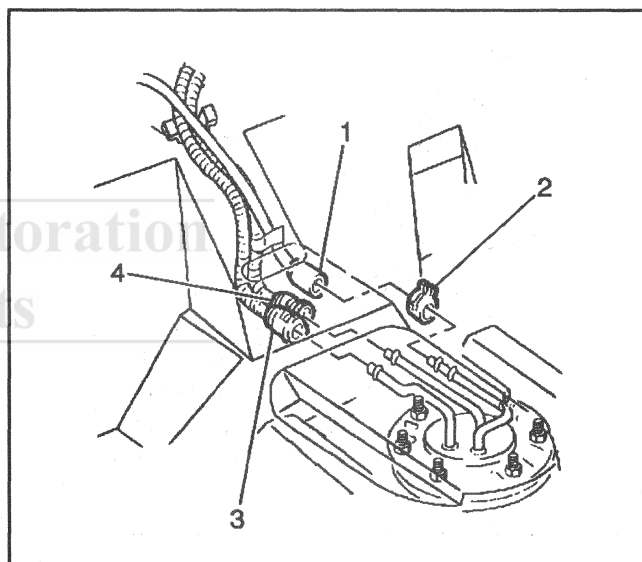
21305

7. Remove the lower fuel tank shield attaching screws and the lower fuel tank shields.



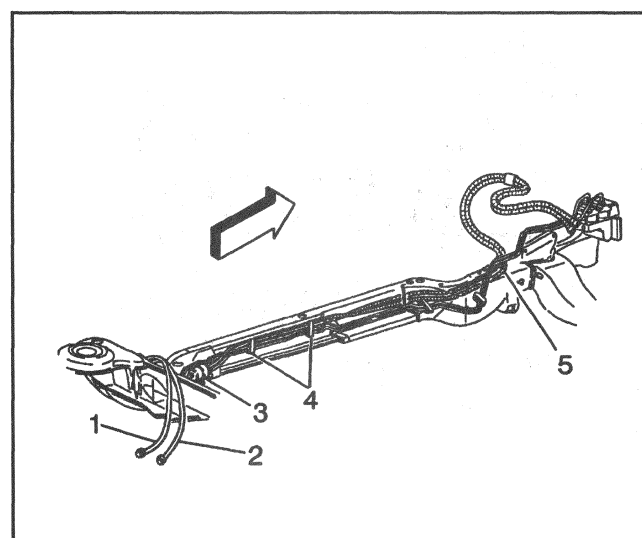
12664

8. Remove the fuel feed, return, and EVAP pipe underbody retainer.
9. Disconnect the quick-connect fittings (3 and 4) at the fuel sender. Refer to Servicing Quick-Connect Fittings.

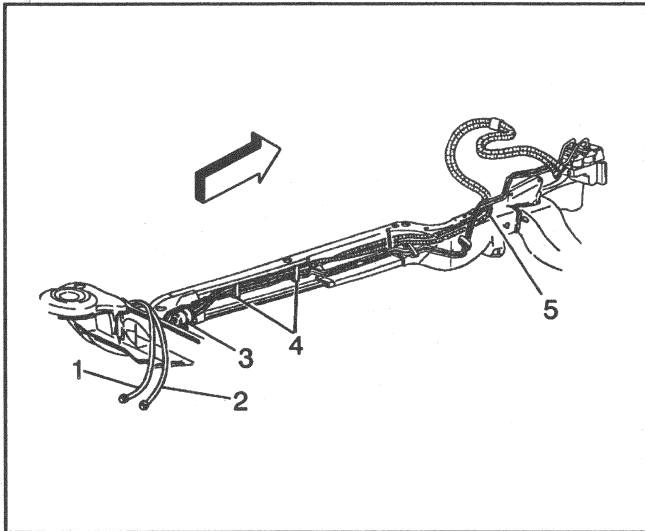


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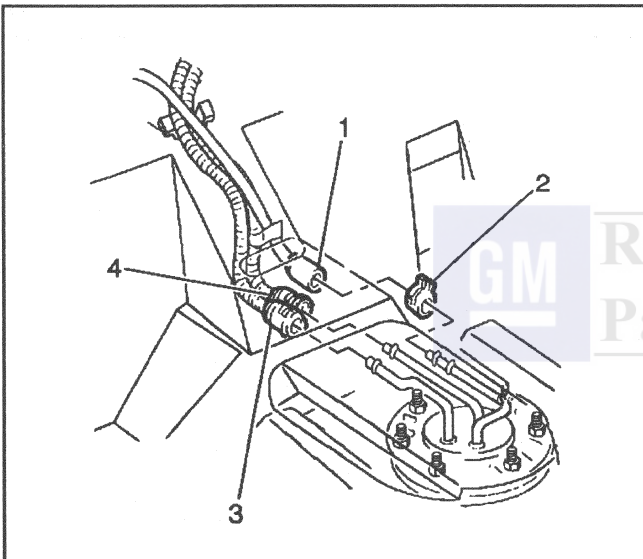
10. Disconnect the fuel feed and return pipes from the retaining clips (4).
11. Remove the fuel feed and return pipes. Note the position of the pipes for installation.



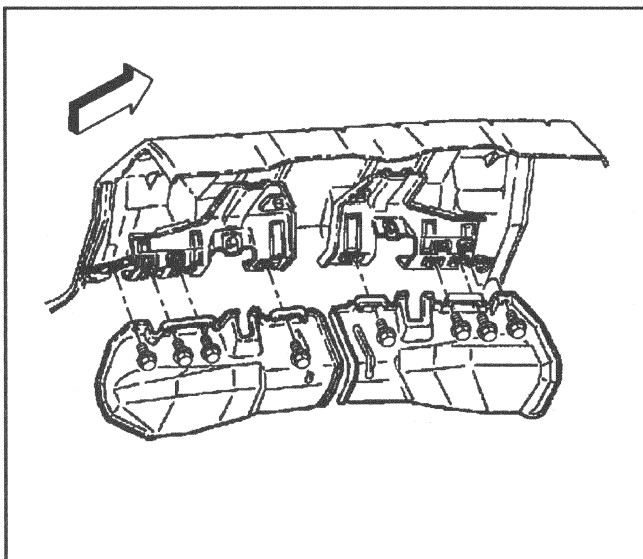
21305



21305



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Installation Procedure

Caution: To Reduce the Risk of Fire and Personal Injury:

- If nylon fuel pipes are nicked, scratched or damaged during installation, they must be replaced.
- When installing new fuel pipes, Do Not hammer directly on the fuel harness body clips as this may damage the nylon pipes resulting in a possible fuel leak.

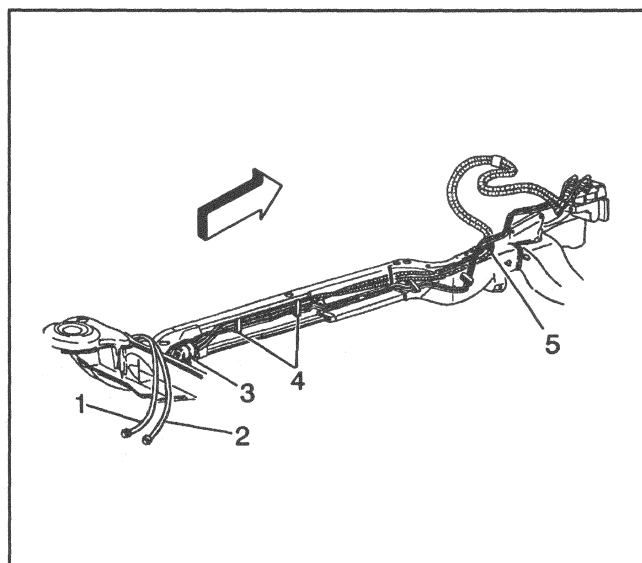
1. Lower the vehicle.
2. Insert the rear ends of the fuel feed pipe (1) and fuel return pipe (2) into the top forward frame hole (5).
3. Raise the vehicle.
4. Route the pipes in the same position as noted during disassembly.
5. Connect the quick-connect fittings (3 and 4) at the fuel sender.
6. Install the fuel feed, return, and EVAP pipe underbody retainer.

7. Install the lower fuel tank shields and the tank shield attaching screws.

Tighten

Tighten the lower fuel tank shield attaching screws to 1 N.m (9 lb in).

8. Connect the quick-connect fittings at the fuel filter (3).
9. Close all the retaining clips (4).
10. Lower the vehicle.
11. Install the fuel feed and return pipes into the retaining clip at the brake booster.
12. Connect the quick-connect fittings to the fuel rail. Refer to Servicing Quick-Connect Fittings.
13. Connect the negative battery cable.
14. Inspect for leaks.
 - 14.1. Turn the ignition switch ON for 2 seconds.
 - 14.2. Turn the ignition switch OFF for 10 seconds.
 - 14.3. Turn the ignition switch ON.
 - 14.4. Check for fuel leaks.



21305

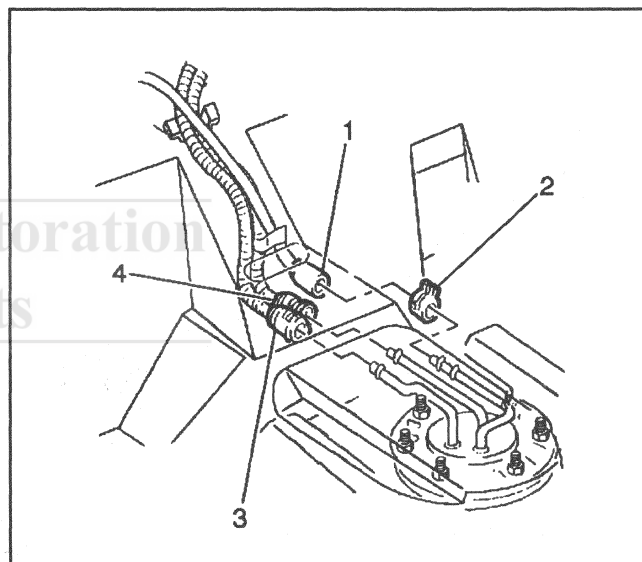
Fuel Hose and Pipes (EVAP Pipes)

Removal Procedure

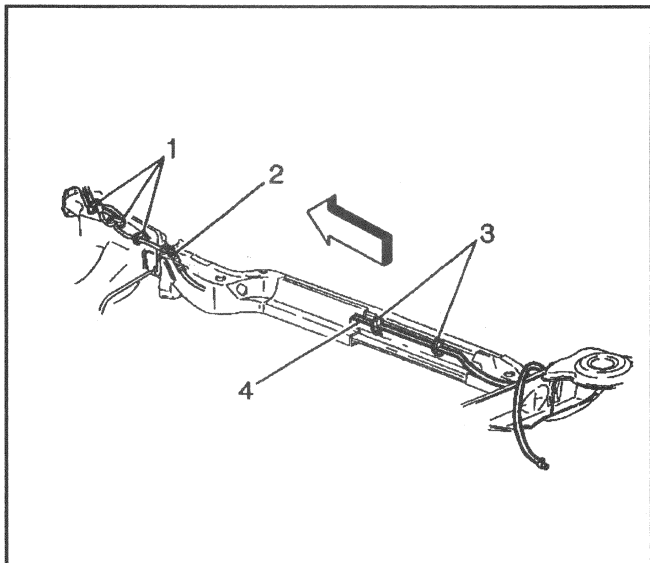
Notice:

- Replace nylon pipes if the pipes become kinked and cannot be straightened.
- Do Not attempt to repair sections of nylon pipes. Replace the pipes if they are damaged.
- When replacing EVAP pipes, always replace the pipes with original equipment or parts that meet the GM specifications for those parts.
- When replacing EVAP hoses, always replace the hoses with original equipment or parts that meet the GM specifications for those parts. Use only reinforced fuel resistant hose which is identified with the word "Fluoroelastomer" or "GM 6163-M" on the hose.

1. Raise the vehicle.
2. Remove the fuel feed, return, and EVAP pipe underbody retainer.
3. Disconnect the EVAP pipe and the clamp (2) from the fuel sender.

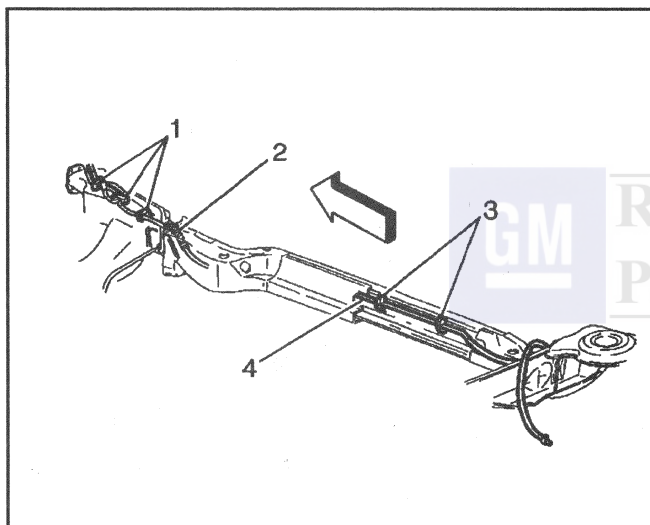


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35841

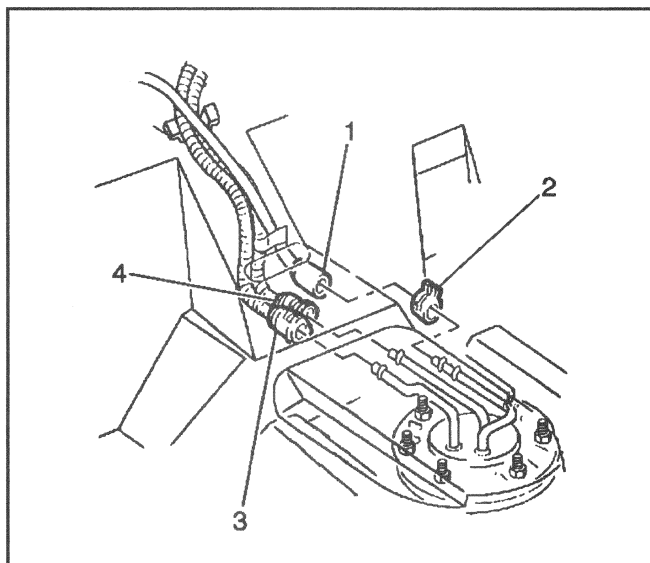
4. Disconnect the EVAP pipe (4) from the retaining clips (3). Note the position of the EVAP pipe for installation.
5. Lower the vehicle.
6. Disconnect the EVAP pipe hose end clamp at the EVAP canister.
7. Disconnect the EVAP pipe from the forward pipe retaining clips (1).
8. Remove the EVAP pipe (4).



35841

Installation Procedure

1. Insert the rear end of the EVAP pipe (4) into the top forward frame hole (2). Load the pipe until the formed pipe/conduit reaches into the hole.
2. Install the EVAP pipe into the forward pipe retaining clips (1).
3. Connect the EVAP pipe hose end and clamp to the EVAP canister.
4. Raise the vehicle.
5. Install the new EVAP pipe (4) into the retaining clips (3) in the same position as noted during disassembly.



12666

6. Connect the EVAP pipe and clamp (2) at the fuel sender.
7. Install the fuel feed, return, and EVAP pipe underbody retainer.
8. Lower the vehicle.

Fuel Pump Relay

Removal Procedure

1. Remove the underhood electrical center cover.
2. Remove the fuel pump relay.

Installation Procedure

1. Install the fuel pump relay.
2. Install the underhood electrical center cover.

Servicing Quick Connect Fittings

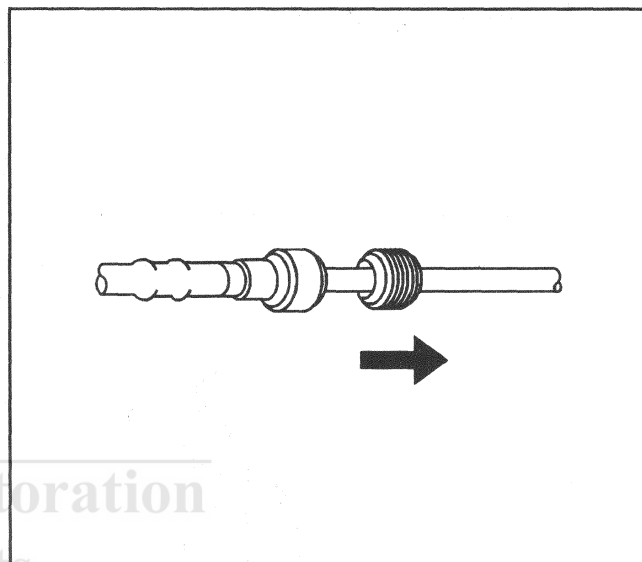
Removal Procedure

Tools Required

J37088 Tool Set, Fuel Line Quick-Connect Separator

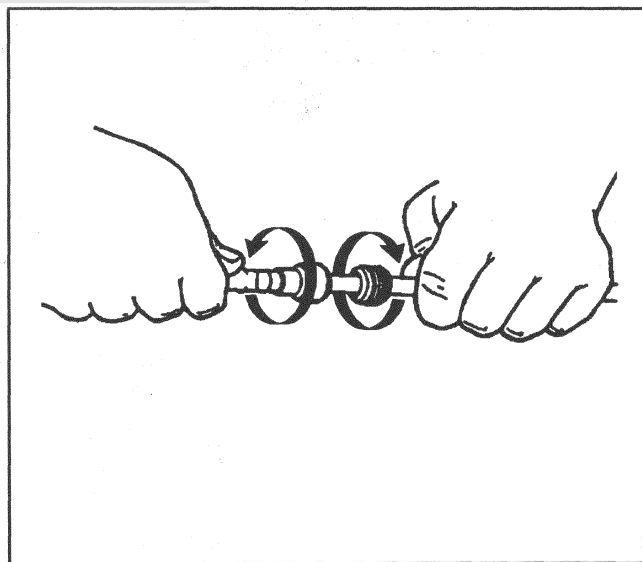
Important: Relieve the fuel system pressure before servicing any fuel system connection. Refer to the Fuel Pressure Relief Procedure.

1. Slide the dust cover from the quick-connect fitting.

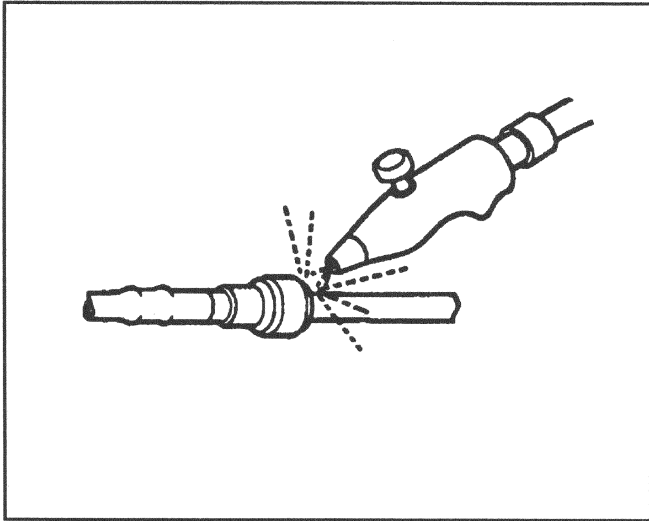


12773

2. Grasp both sides of the fitting. Twist the female connector 1/4 turn in each direction to loosen any dirt within the fitting.



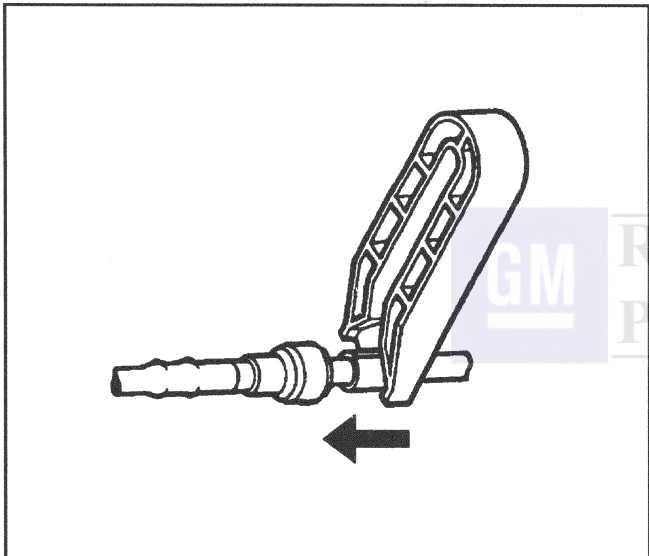
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12776

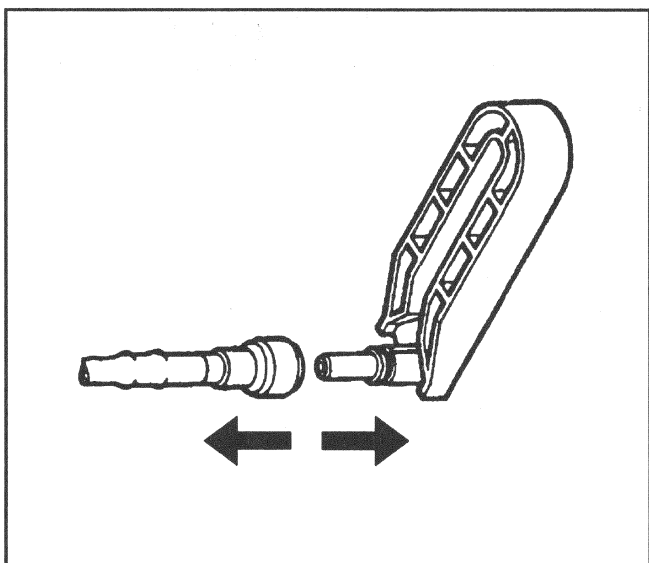
Caution: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Blow dirt out of the fitting using compressed air.



12780

4. Choose the correct tool from J37088 Tool Set for the size of the fitting. Insert the tool into the female connector, then push inward to release the locking tabs.



12782

Notice: If it is necessary to remove rust or burrs from a fuel pipe, use emery cloth in a radial motion with the pipe end in order to prevent damage to the O-ring sealing surface.

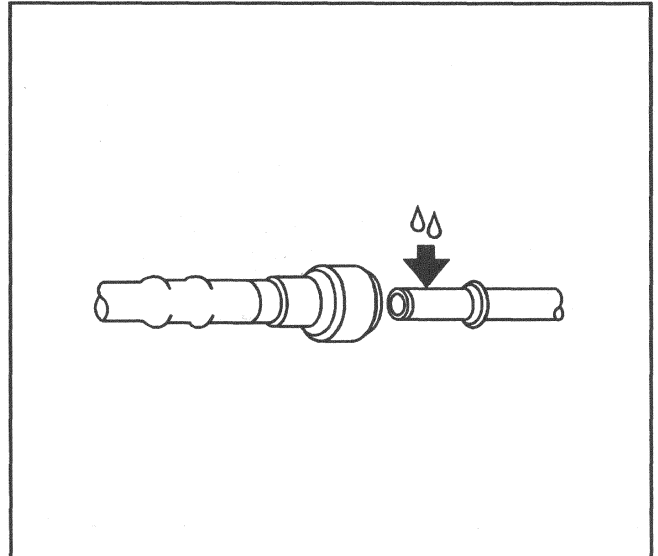
- Using a clean shop towel, wipe off the male pipe end.
 - Inspect both ends of the fitting for dirt and burrs. Clean or replace components as required.
5. Pull the connection apart.

Installation Procedure

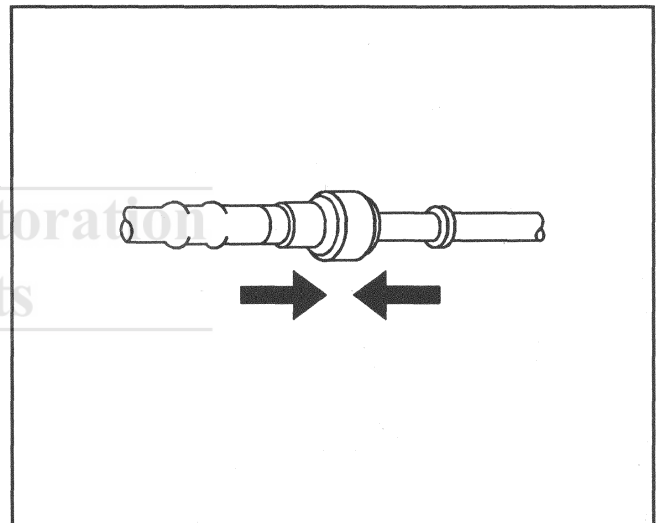
Caution: To Reduce the Risk of Fire and Personal Injury:

Before connecting the fitting, always apply a few drops of clean engine oil to the male pipe end. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

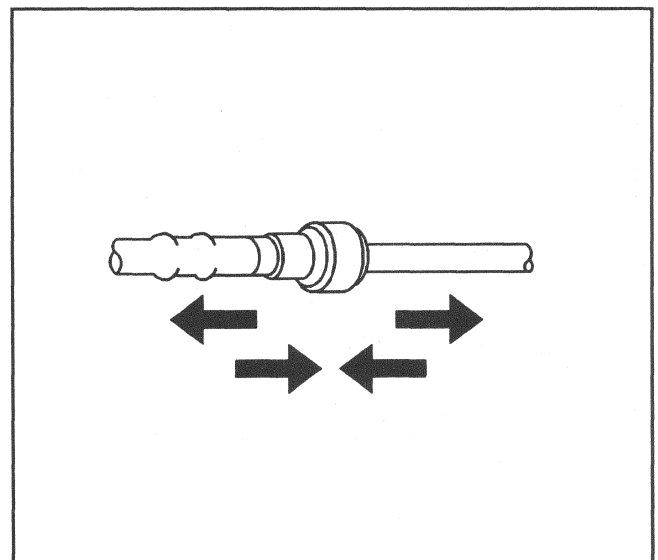
1. Apply a few drops of clean engine oil to the male pipe end.
2. Push both sides of the fitting together to cause the retaining tabs to snap into place.
3. Once installed, pull on both sides of the fitting to make sure the connection is secure.



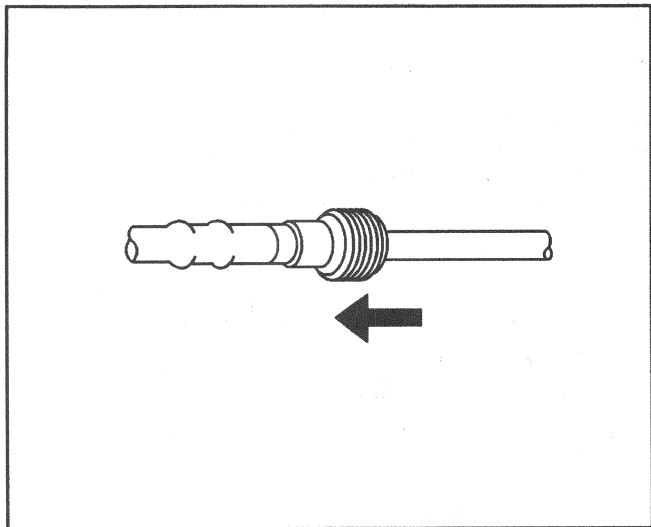
12784



12786

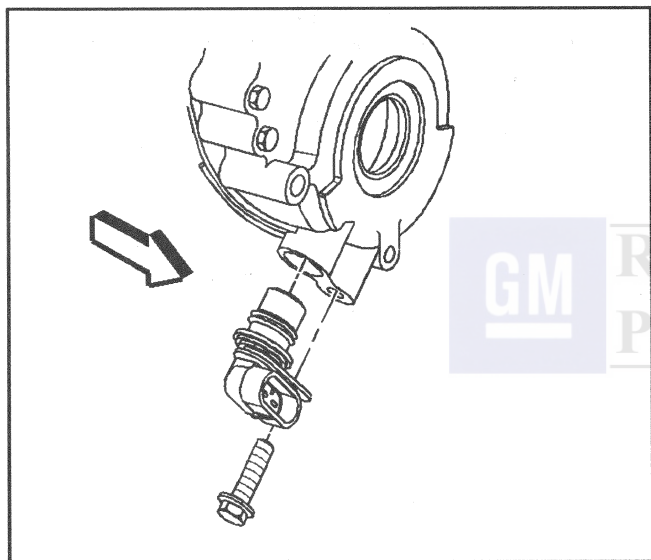


12787



12789

4. Reposition the dust cover over the quick-connect fitting.

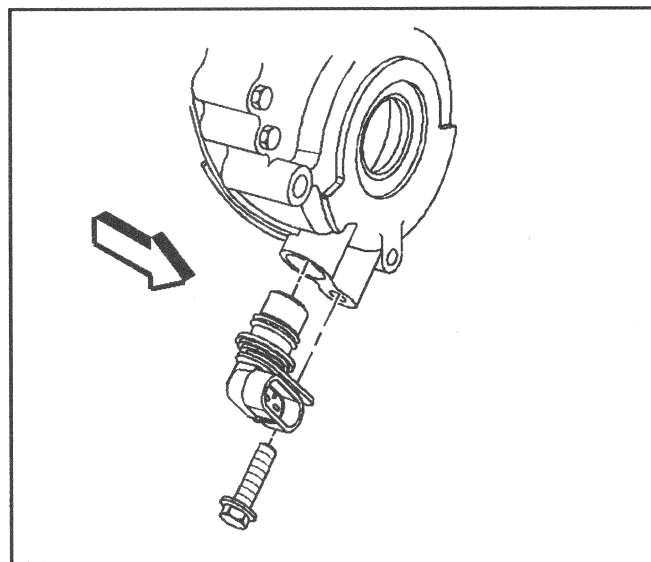


11485

Crankshaft Position Sensor

Removal Procedure

1. Raise the vehicle.
2. Disconnect the Crankshaft Position (CKP) sensor electrical connector.
3. Remove the CKP sensor retaining screw.
4. Remove the CKP sensor.



11485

Installation Procedure

1. Install the crankshaft position sensor.
2. Install the crankshaft position sensor retaining screw.

Tighten

Tighten the CKP sensor to 4–6 N·m (35–53 lb in).

3. Connect the electrical connector.

Knock Sensor (Bank 1)**Removal Procedure**

Caution: Engine coolant may be hot. The knock sensor is mounted in the engine block cooling passage. Engine coolant in the block will drain when the knock sensor is removed.

1. Drain the engine coolant. Refer to Engine Cooling (6B).
2. Raise the vehicle.
3. Disconnect the knock sensor wiring harness connector from the knock sensor.
4. Remove the knock sensor from the engine block.

Installation Procedure

1. Install the knock sensor (6) into the engine block. Be sure the threads are clean. Do not apply thread sealant to the sensor threads.

Tighten

Torque the KS to 19 N.m (14 lb ft).

2. Connect the KS wiring harness connector to the knock sensor.
3. Lower the vehicle.
4. Refill the Engine coolant. Refer to Engine Cooling (6B).

Knock Sensor (Bank 2)**Removal Procedure**

Caution: Engine coolant may be hot. The knock sensor is mounted in the engine block cooling passage. Engine coolant in the block will drain when the knock sensor is removed.

1. Drain the engine coolant. Refer to Engine Cooling (6B).
2. Raise the vehicle.
3. Disconnect the knock sensor wiring harness connector from the knock sensor.
4. Remove the knock sensor from the engine block.

Installation Procedure

1. Install the knock sensor into the engine block. Be sure the threads are clean. Do not apply thread sealant to the sensor threads.

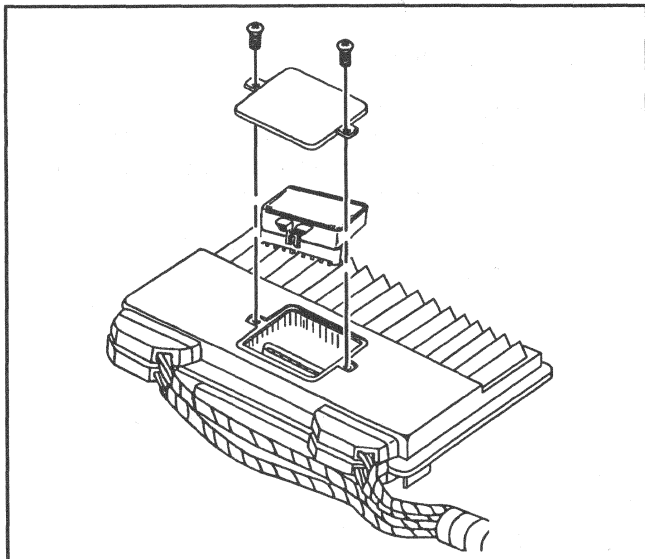
Tighten

Torque the KS to 19 N.m (14 lb. ft.).

2. Connect the KS wiring harness connector to the knock sensor.
3. Lower the vehicle.
4. Refill the Engine coolant. Refer to Engine Cooling (6B).



Restoration
Parts



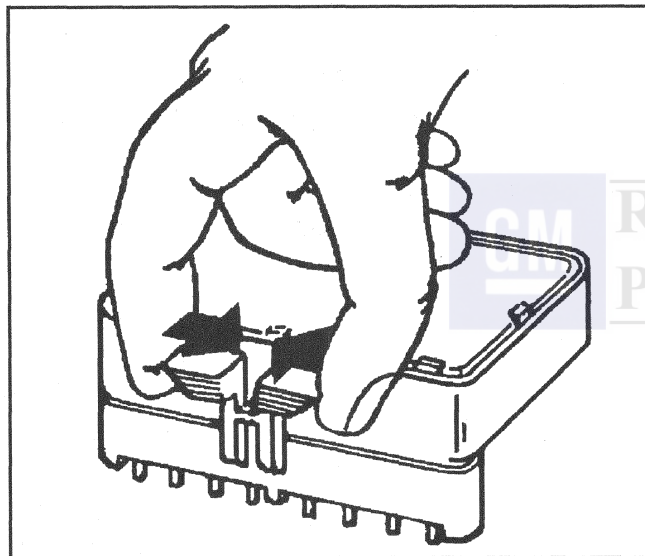
13490

Knock Sensor Module

Removal Procedure

Notice: To prevent possible electrostatic discharge damage to the PCM and KS module, Do Not touch the connector pins or soldered components on the circuit board.

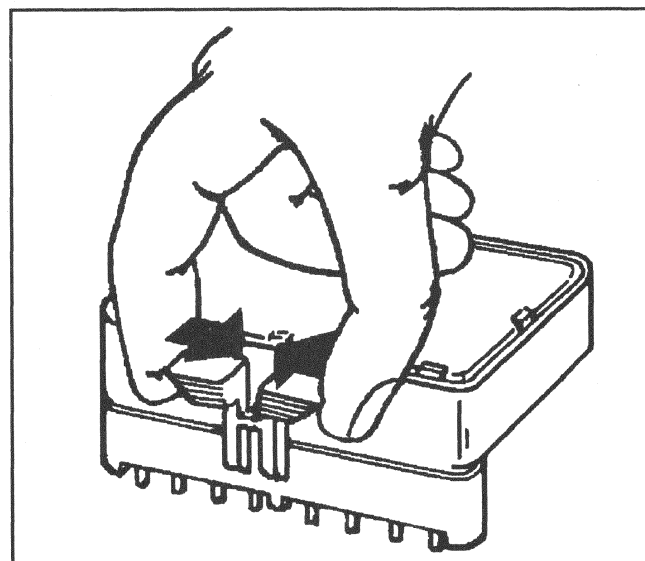
1. Remove the PCM from the mounting bracket, refer to *PCM Replacement/Programming*
2. Remove the knock sensor module access cover.



13517

Notice: To prevent possible electrostatic discharge damage to the PCM, do not touch the connector pins or soldered components on the circuit board.

3. Remove the knock sensor module.



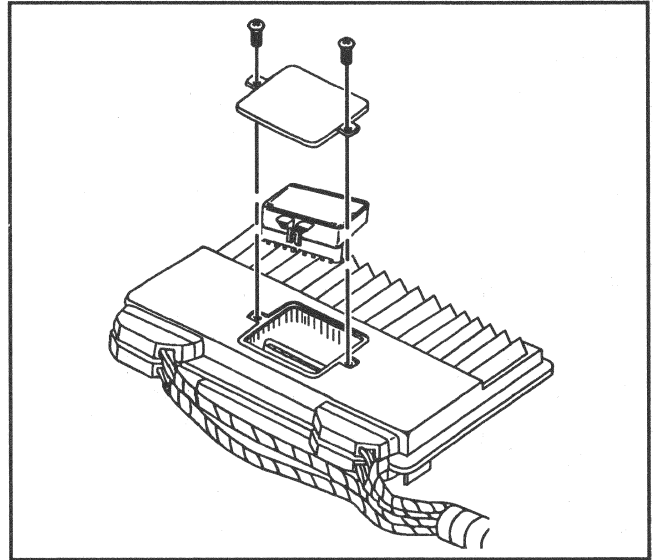
13517

Installation Procedure

Notice: To prevent possible electrostatic discharge damage to the PCM, do not touch the connector pins or soldered components on the circuit board.

1. Install the knock sensor module.

2. Install the access cover.
3. Install the PCM to the mounting bracket, refer to *PCM Replacement/Programming*



13490

EGR Valve

Removal Procedure

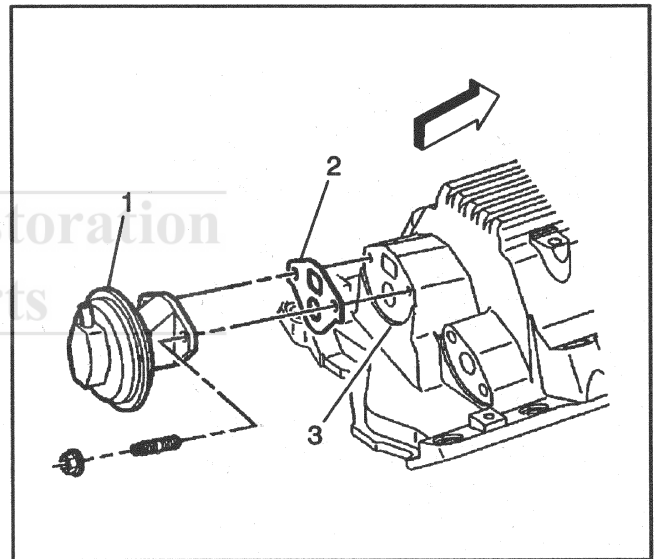
1. Remove the vacuum line from the EGR Valve (1).
2. Remove the EGR Valve retaining nuts from the intake manifold (3).

Notice: If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

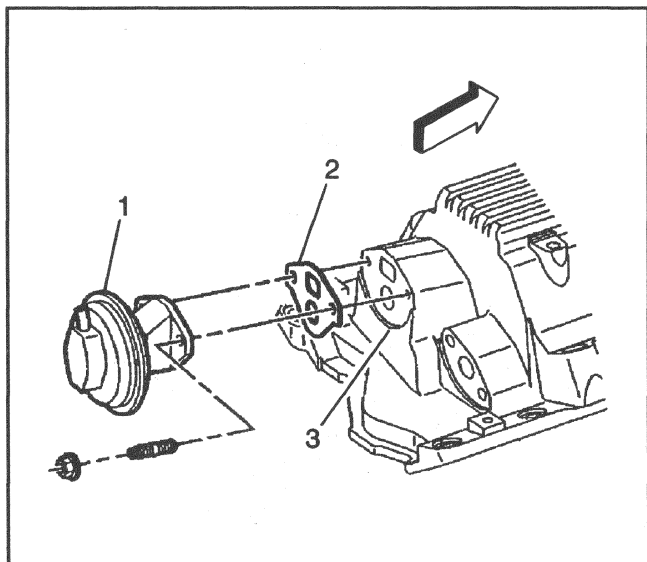
Clean using the following procedure:

- With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
- Look for exhaust deposits in the valve outlet. Remove deposit buildup with a screwdriver.
- Clean mounting surfaces of intake manifold and valve assembly.

3. Remove the EGR valve (1).



13641



13641

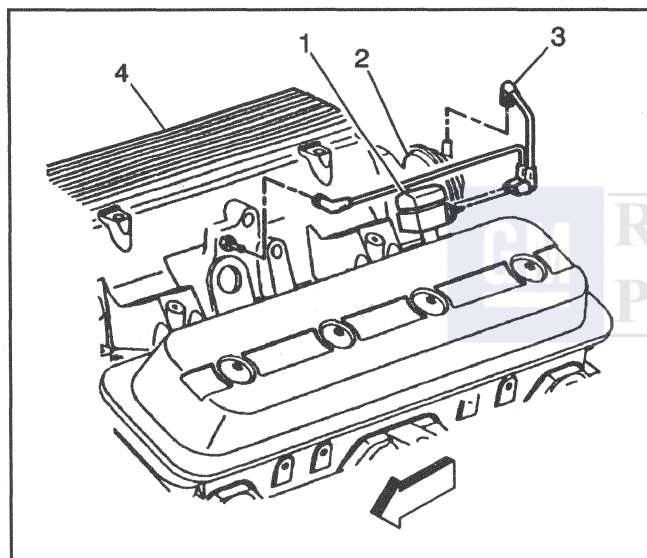
Installation Procedure

1. Install the EGR Valve (1) on the intake manifold (3) using a new gasket (2).

Tighten

Tighten the EGR Valve Bolts to 22 N.m (16 lb ft).

2. Connect the vacuum hose to the EGR Valve (1).

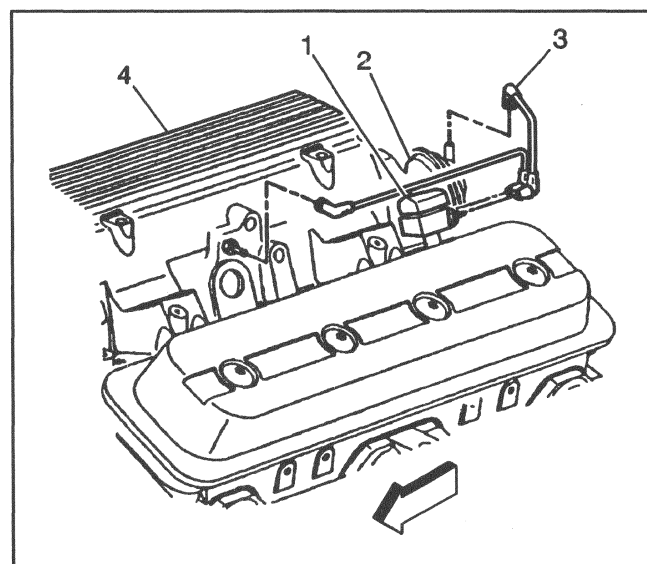


13486

EGR Vacuum Control Signal Solenoid Valve

Removal Procedure

1. Disconnect the electrical connector at the solenoid valve (1).
2. Disconnect the vacuum hose harness (3).
3. Remove the Nut and solenoid valve (1) from the intake manifold (4).



13486

Installation Procedure

1. Install the solenoid valve (1) and bracket to the intake manifold (4).

Tighten

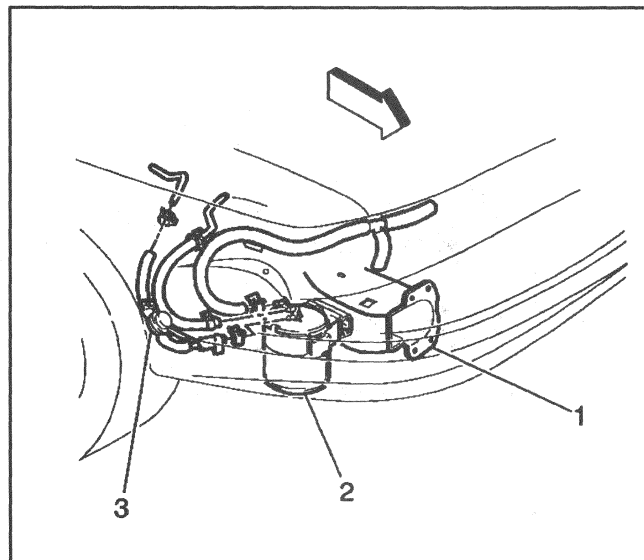
Tighten the Nut to 34 N.m (25 lb ft).

2. Connect the vacuum hose harness (3).
3. Connect the electrical connector to the solenoid valve (1).

EVAP Canister

Removal Procedure

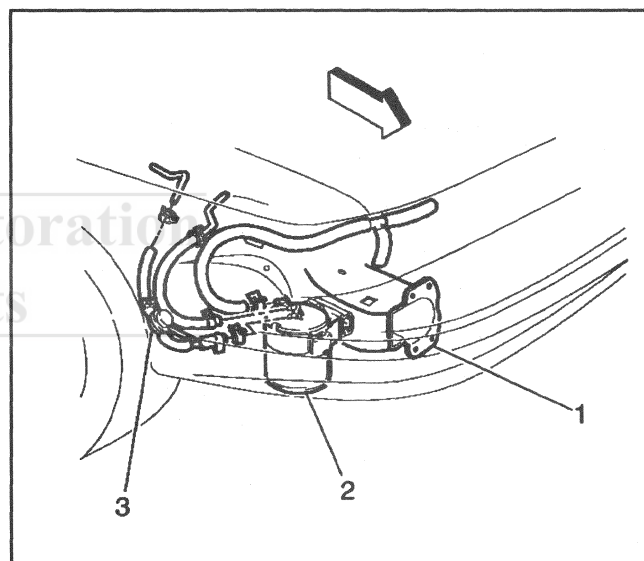
1. Raise the vehicle.
2. Remove the access panel.
3. Disconnect the hoses from the canister.
4. Remove the canister (2) from the canister bracket.
5. Remove the canister (2) from the vehicle.



30013

Installation Procedure

1. Install the canister (2) to the bracket.
2. Connect the hoses to the canister (2).
3. Install the access panel.
4. Lower the vehicle.

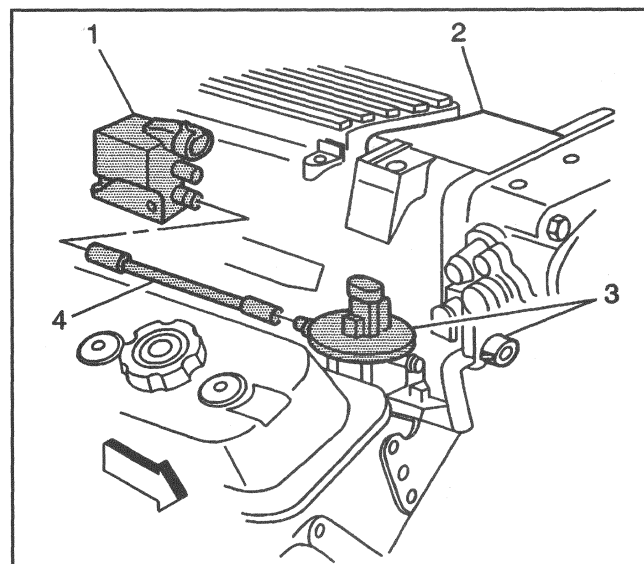


30013

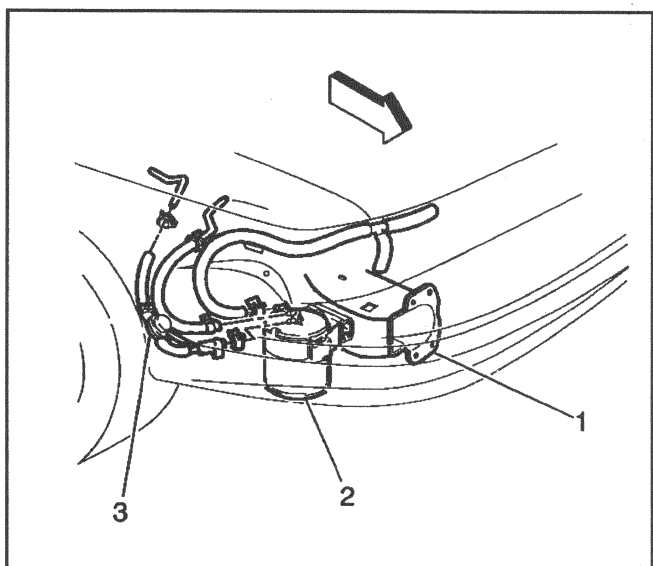
EVAP System Cleaning

Cleaning Procedure

1. Turn the ignition off.
2. Remove the purge solenoid and the vacuum switch from the vehicle.
3. Lightly tap the purge solenoid and the vacuum switch on a clean work area looking for carbon particles or carbon dust exiting either of the vacuum ports.
4. If no carbon release is evident, reinstall the components and continue with published service manual DTC procedures.
5. If carbon is being released from either component, continue with this service procedure.



13571



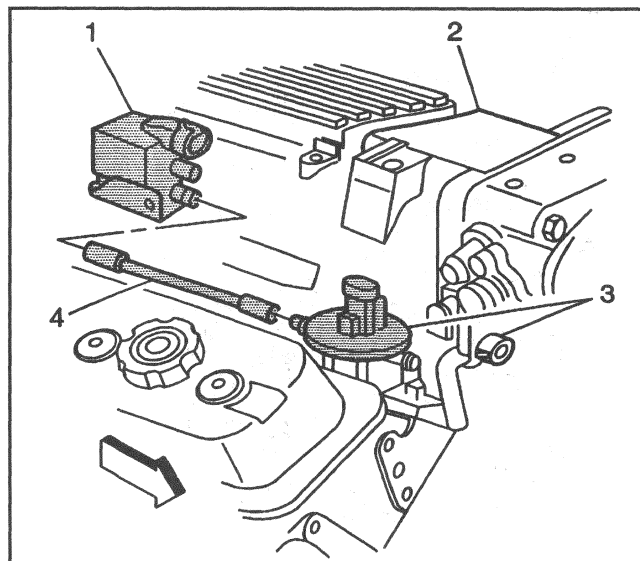
30013

6. Remove the charcoal canister from the vehicle.
7. Ensure the main cylinder valve is turned off on the EVAP purge/pressure diagnostic station J 41413.
8. Disconnect the black hose that connects the nitrogen cylinder to the cart J 41413 at the pressure regulator by unscrewing the knurled nut on the regulator.
9. Using a section of vacuum line, connect one end over the open fitting of the J 41413 pressure regulator.
10. Turn on the main nitrogen cylinder valve and connect the remaining end to the purge solenoid end of the EVAP purge line at the vehicle. Continue to blow any debris from the purge line for 15 seconds.
11. Return the EVAP Pressure/Purge Diagnostic Station J 41413 to its original condition by re-installing the black hose disconnected in step 8.
12. Manifold vacuum vehicles proceed with published service manual diagnostics.
13. Connect a scan tool and display data parameter EVAP vacuum switch.
14. Start the engine and allow to reach operating temperature.
15. Open throttle until engine speed reaches 2000 RPM.
16. If the EVAP vacuum switch changes state Go to Step 19.
17. If vacuum switch does not change state repair low source vacuum condition by performing a complete throttle body service including cleaning of the purge port(s) and Go to Step 14.
18. If EVAP vacuum switch does change state, proceed with published service manual diagnostics.
19. Connect the EVAP diagnostic cart J 41413 to the vehicle EVAP service port and turn the four position switch to Purge.
20. Start the engine and allow to reach operating temperature.
21. Open throttle until engine speed reaches 2000 RPM.
22. Note the H2O vacuum gauge on the EVAP cart. Vacuum should read greater than 15in. H2O.
23. If vacuum is less than 15in. H2O, perform a complete throttle body service including cleaning of the purge port(s) as outlined in the service manual and Go to Step 20.
24. If vacuum is greater than 15in. H2O, continue with published service diagnostics.

EVAP Purge Vacuum Switch

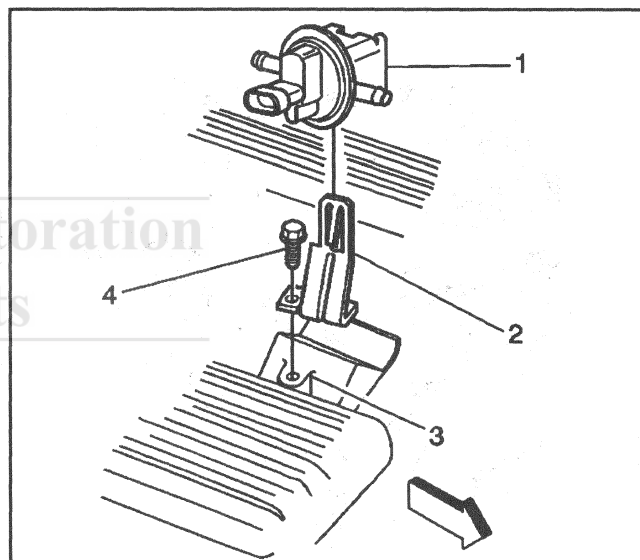
Removal Procedure

1. Disconnect the electrical connector.
2. Remove the vacuum lines (4) from the EVAP vacuum switch (3).



13571

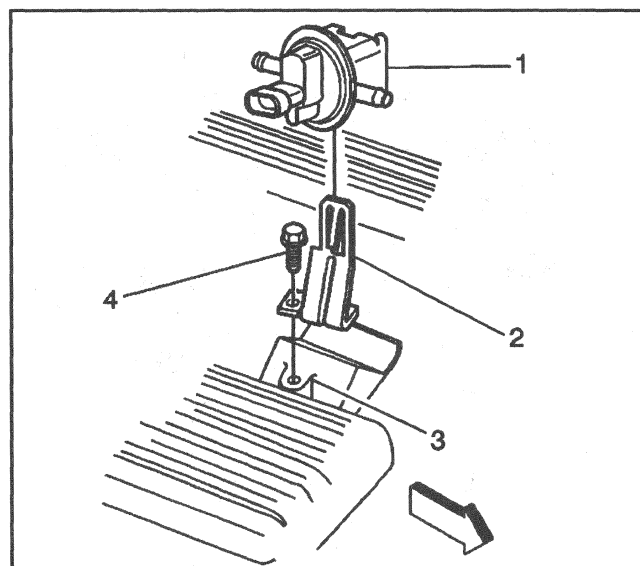
3. Remove the EVAP vacuum switch (1) from the bracket (2).



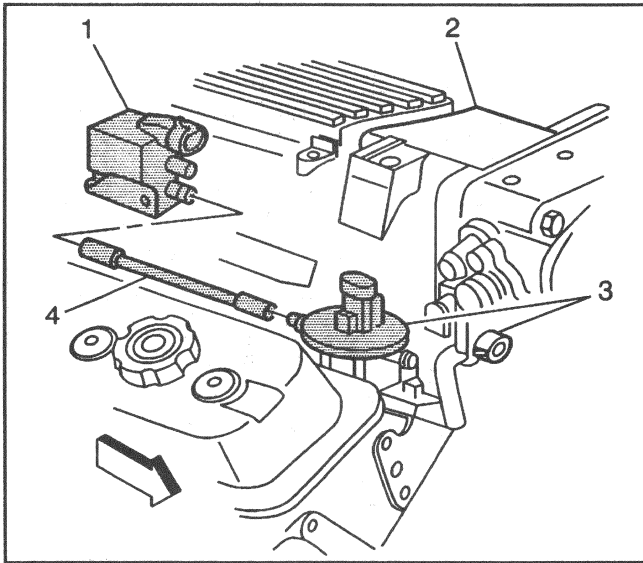
21173

Installation Procedure

1. Install the New EVAP vacuum switch (1) to the bracket (2).

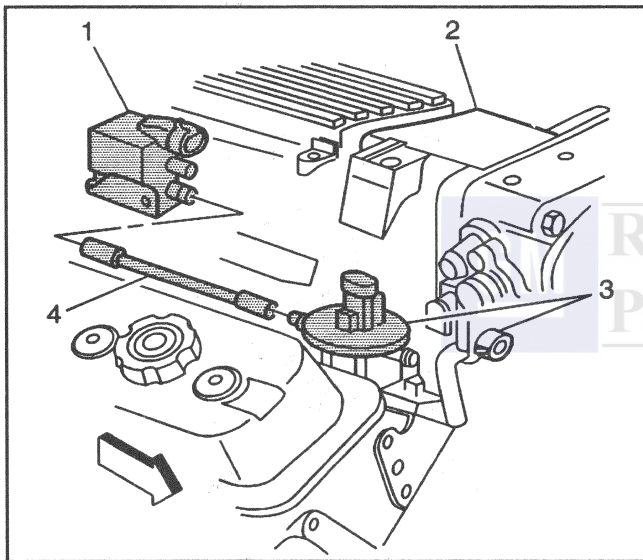


21173



13571

2. Connect the vacuum lines (4) to the EVAP vacuum switch (3).
3. Connect the electrical connector.

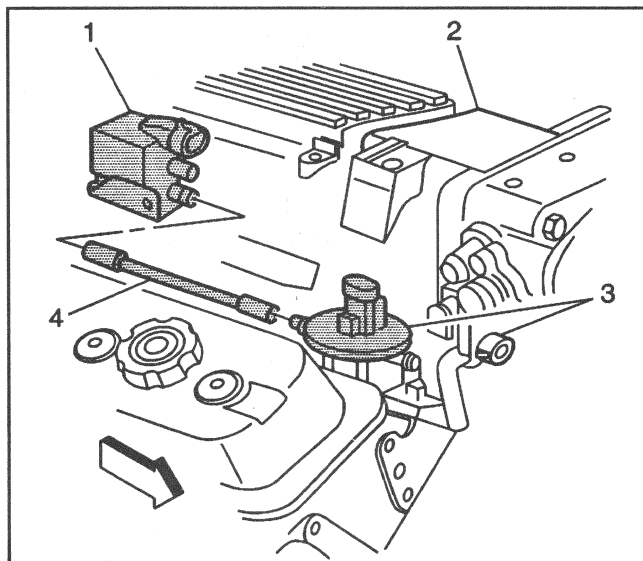


13571

EVAP Canister Purge Solenoid Valve

Removal Procedure

1. Disconnect the electrical connector
2. Disconnect the hoses (4) from the solenoid valve (1).
3. Remove the bracket and solenoid (1) from the intake manifold (2).



13571

Installation Procedure

1. Install the solenoid valve (1) to the intake manifold (2).

Tighten

Tighten the Fastener to 5.8 N.m (52 lb in).

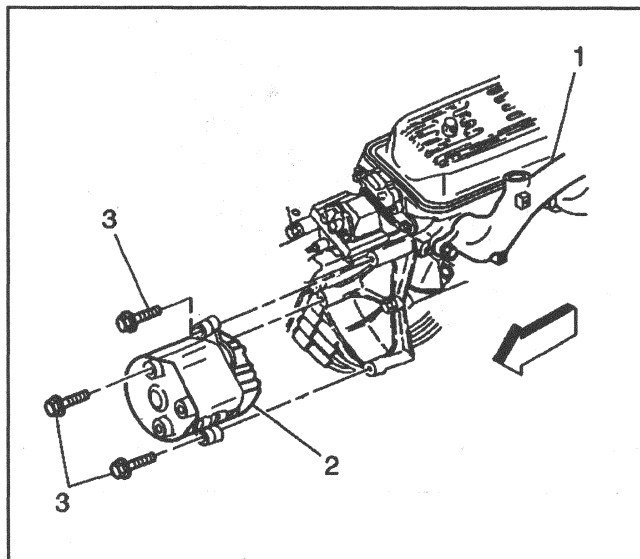
2. Connect the electrical connector to the solenoid valve (1).
3. Connect the hoses to the solenoid valve (1).

EVAP Canister Hoses

Refer to Vehicle Emission Control Information label for routing of EVAP canister hoses.

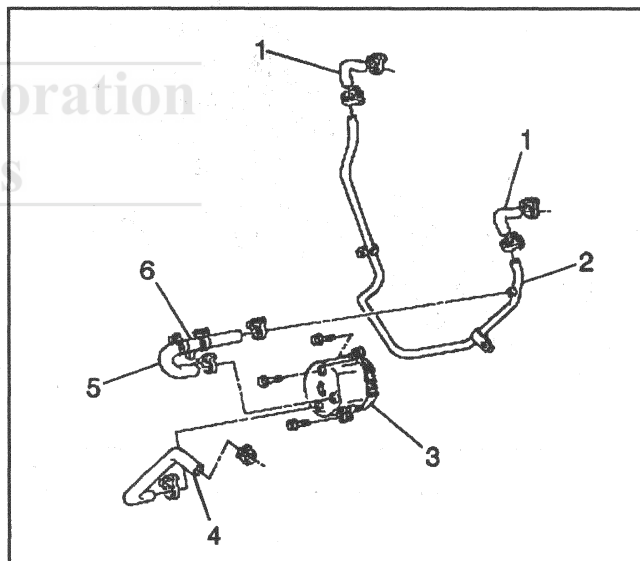
Air Pump**Removal Procedure**

1. Disconnect the electrical connector from the AIR pump (2).

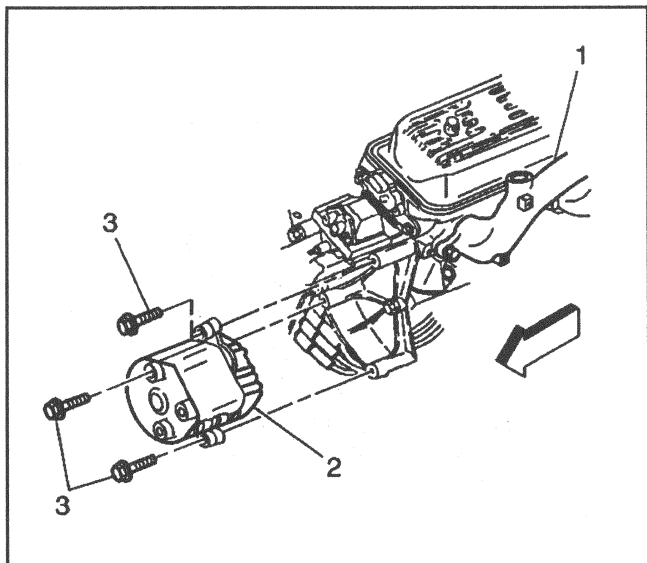


21176

2. Remove the outlet (5) and inlet (4) hoses from the AIR pump (3).

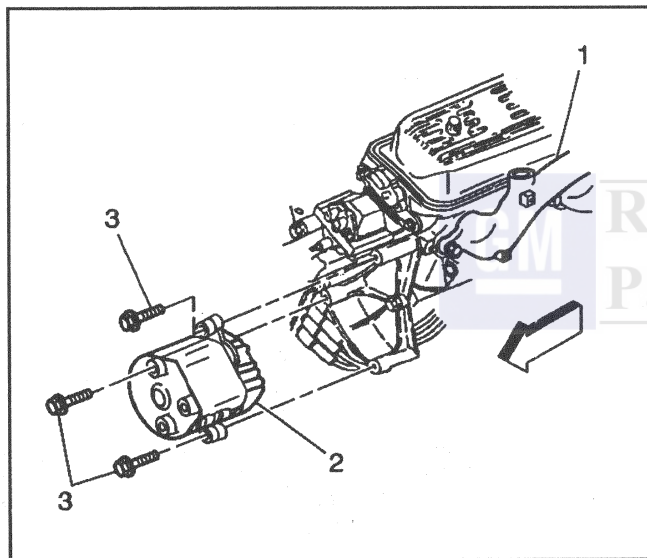


21174



21176

3. Remove the Air pump mounting bolts (3) from the bracket.
4. Remove the Air pump (2).



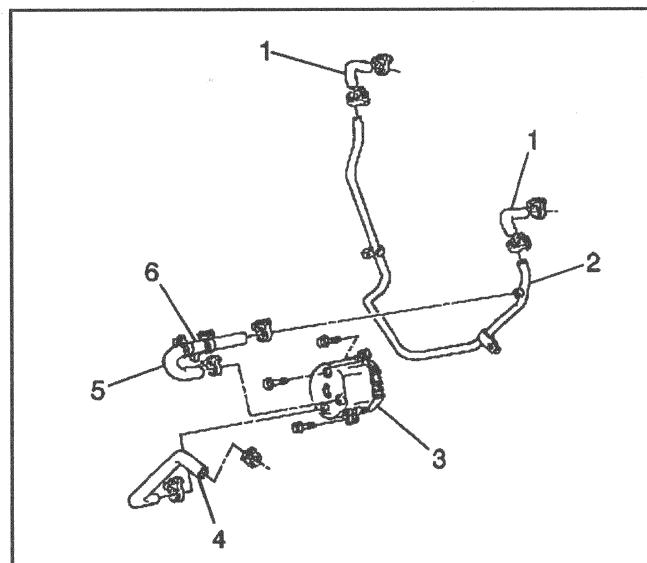
21176

Installation Procedure

1. Install the AIR pump (2) to bracket.
2. Install the mounting bolts (3).

Tighten

Tighten the AIR Pump Bolts to 5.6 N.m (50 lb in).



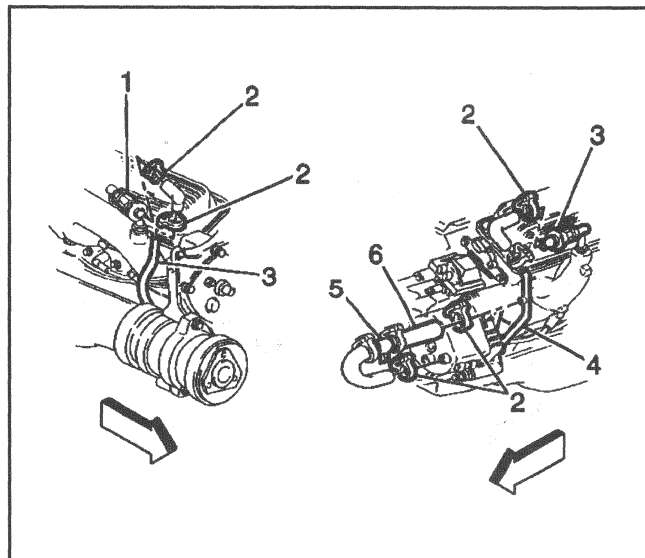
21174

3. Connect the outlet (5) and inlet (4) hoses to the AIR pump (3).
4. Connect the electric connector to AIR pump (3).
5. Check the AIR system for proper operation.

Air Check Valve and Pipes (Bank 1)

Removal Procedure

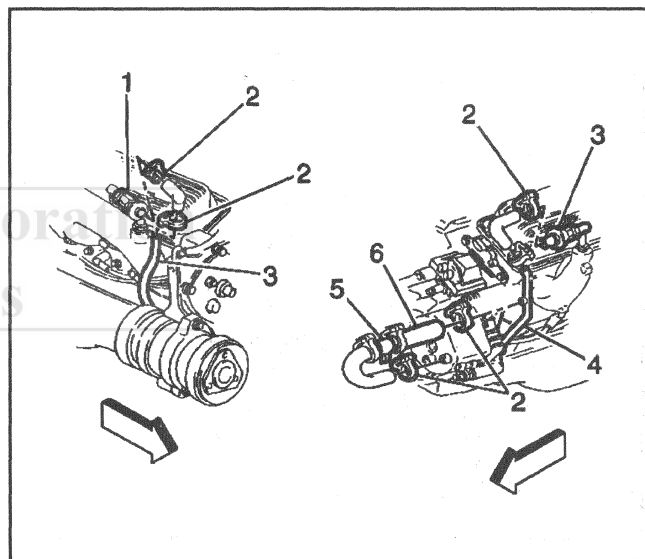
1. Loosen the check valve clamp (3).
2. Disconnect the AIR hose from the check valve (3).
3. Disconnect the left check valve pipe.
4. Unscrew the check valve from the AIR pipe (3).
5. Before replacing a check valve, test the valve for proper operation.
 - 5.1. Install a vacuum pump to the nipple side of the check valve, AIR pump side.
 - 5.2. Pump the vacuum pump to 10 inches Hg. and observe the gauge.
 - 5.3. If the vacuum bleeds down to zero within 5 seconds, replace the check valve.



21189

Installation Procedure

1. Screw the check valve (3) onto the AIR pipe.
- Tighten**
Tighten the Check valve to the AIR pipe 23 N.m (17 lb ft).
2. AIR pipe to the exhaust manifold.
3. Install the air hose to the check valve (3).
4. Install the check valve clamp (2).

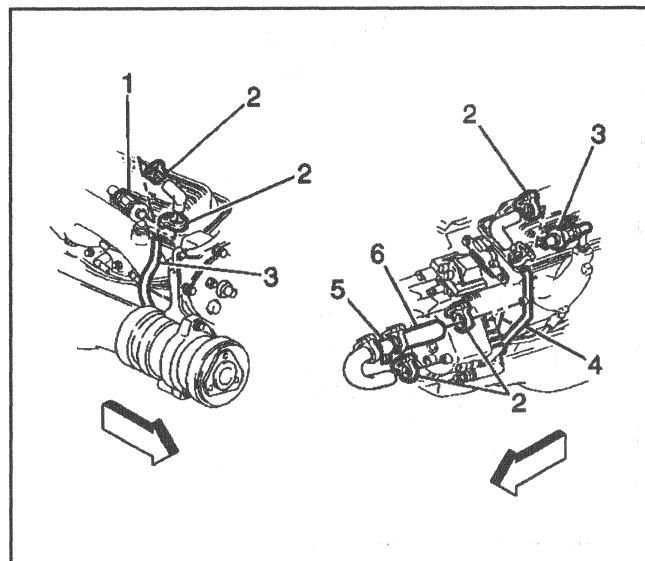


21189

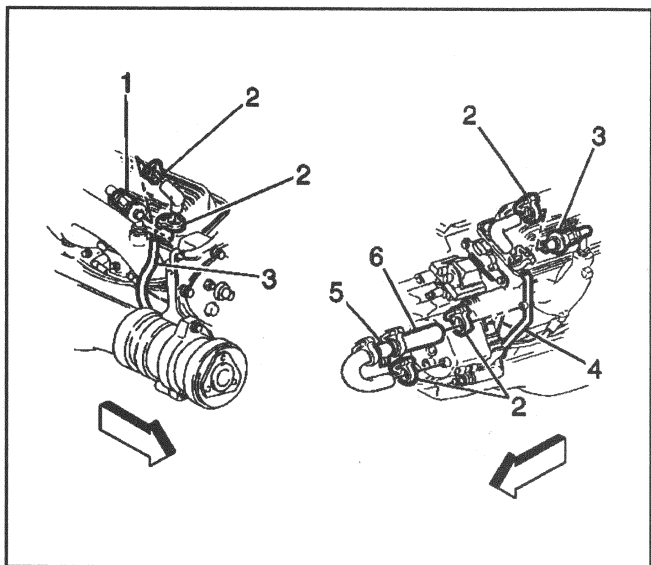
Air Check Valve and Pipes (Bank 2)

Removal Procedure

1. Remove the clamps (2) and AIR hoses from the AIR system right pipe (3).
2. Remove the right check valve pipe.
3. Unscrew the check valve (1) from the AIR pipe.
4. Before replacing a check valve, test the valve for proper operation.
 - 4.1. Install a vacuum pump to the nipple side of the check valve, AIR pump side.
 - 4.2. Pump the vacuum pump to 10 inches Hg. and observe the gauge.
 - 4.3. If the vacuum bleeds down to zero within 5 seconds, replace the check valve.



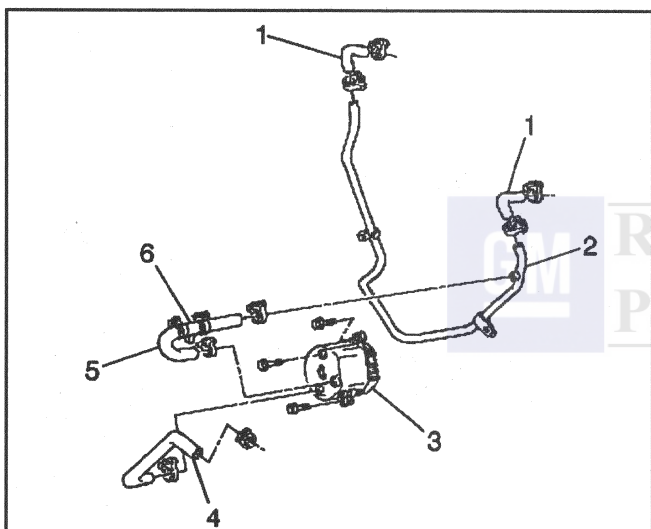
21189



21189

Installation Procedure

1. Screw the check valve (1) onto the AIR pipe.
Tighten
Tighten the Check valve to 23 N.m (17 lb ft).
2. Connect the right AIR pipe to the exhaust manifold.
3. Install the Hose and clamp to the check valve (1).
4. Check the AIR system for proper operation.

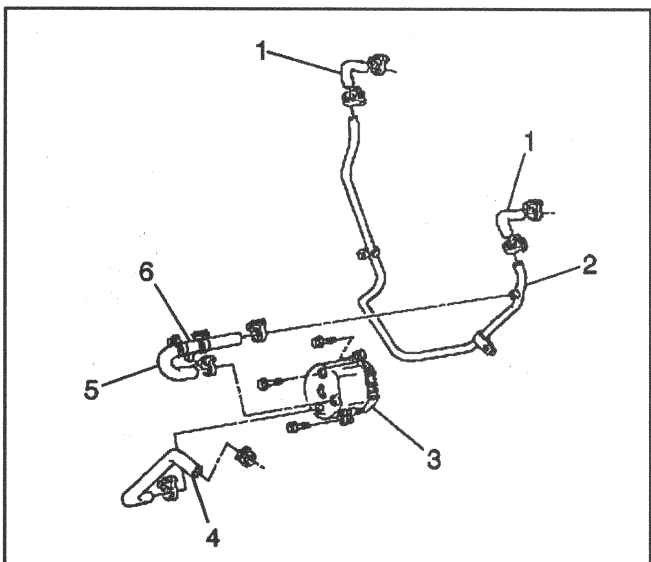


21174

Air Check Valve and Pipes (Cross Under Pipe)

Removal Procedure

1. Loosen the AIR clamps.
2. Remove the AIR hoses (1) to the check valves (both sides)
3. Loosen the AIR clamp at the AIR pump outlet (5).
4. Remove the outlet hose (5) at the AIR pump (3).
5. Raise the vehicle.
6. Remove the fasteners to the AIR cross under pipe (2) bracket, both sides.
7. Cut the cross under pipe near center of the oil pan to aid in removal.
8. Remove the cross under pipe.



21174

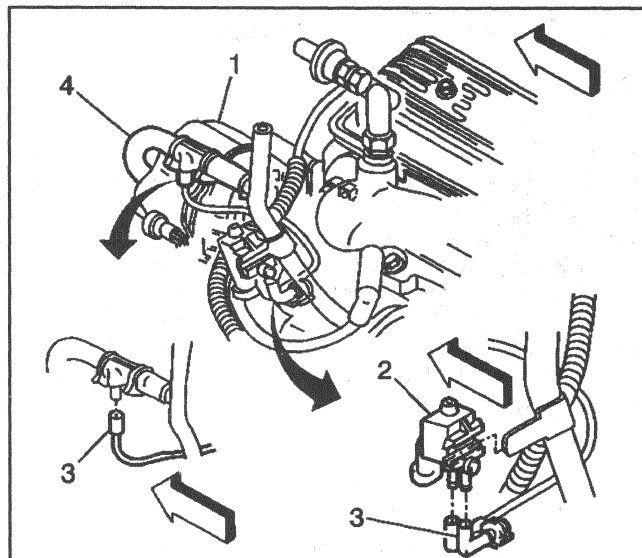
Installation Procedure

Important: The new cross under pipe must be cut similarly to the old pipe before installation.

1. Install the cross under pipe.
2. Use the appropriate length of 5/8 inch heater hose to join both halves of the cross under pipe. Clamp both ends of the hose securely with stainless steel clamps.
3. Install the fasteners to the AIR cross under pipe (2) bracket, both sides.
4. Lower the vehicle.
5. Install the outlet hose (5) at the AIR pump (3).
6. Tighten the AIR clamp at the AIR pump outlet hose (5).
7. Install the AIR hoses (1) to the check valves (both sides)
8. Tighten the AIR clamp at the check valves and AIR pipes.
9. Check the AIR system for proper operation and for leaks.

Air Vacuum Bleed Valve**Removal Procedure**

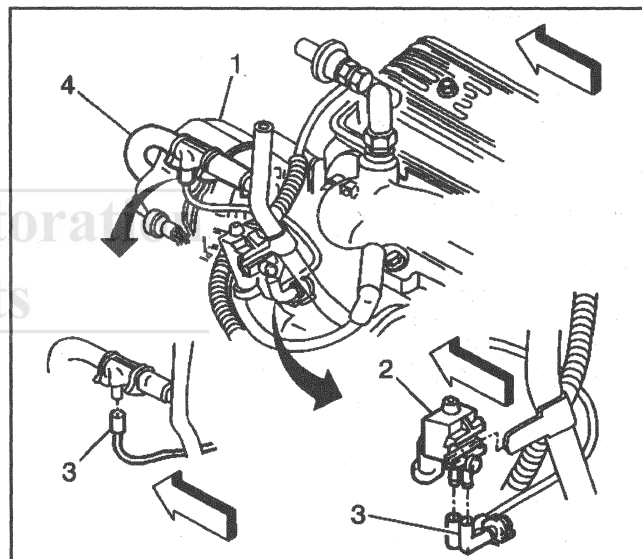
1. Disconnect the electrical connector from the solenoid (2).
2. Disconnect the vacuum harness (3) from the solenoid (2).
3. Remove the Solenoid (2).



21172

Installation Procedure

1. Install the solenoid (2).
2. Connect the vacuum harness (3) to the solenoid (2).
3. Connect the electrical connector to the solenoid (2).



21172

Description and Operation

Powertrain Control Module

The Control Module refers to the Powertrain Control Module (PCM) or the Vehicle Control Module (VCM). The control module is designed to maintain exhaust emission levels to Federal or California standards while providing excellent driveability and fuel efficiency. Review the components and wiring diagrams in order to determine which systems are controlled by each specific control module. The control module monitors numerous engine and vehicle functions. The control module controls the following operations:

- Fuel control
- Ignition Control (IC)
- Knock Sensor (KS) system
- Automatic transmission shift functions
- Cruise Control Enable (if so equipped)
- Generator (if so equipped)
- Evaporative Emission (EVAP) Purge
- A/C Clutch Control
- Cooling Fan Control

Control Module Function

The Control Module supplies a buffered voltage to various sensors and switches. The input and output devices in the control module include an analog to digital converters, signal buffers, counters, and special drivers. The Control Module controls most components with electronic switches which complete a ground circuit when turned ON. These switches are arranged in groups of 4 and 7 called one of the following:

- Quad Driver Module
- Output Driver Modules

The surface mounted Quad Driver Module can independently control up to 4 outputs (Control Module) terminals. The Output Driver Modules can independently control up to 7 outputs. Not all outputs are always used.

Use of Circuit Testing Tools

Do not use a test lamp in order to diagnose the Powertrain electrical systems unless specifically instructed by the diagnostic procedures. Use the Connector Test Adapter Kit, J 35616 whenever diagnostic procedures call for probing any connectors.

Control Module Service Precautions

The control module is designed to withstand normal current draws associated with vehicle operations. Avoid overloading any circuit. When testing for opens or shorts, do not ground any of the control module circuits unless instructed. When testing for opens or shorts, do not apply voltage to any of the control module circuits unless instructed. Only test these circuits with a digital voltmeter J 39200, while the control module connectors remain connected to the control module.

Aftermarket (Add-On) Electrical And Vacuum Equipment

Aftermarket (Add-On) Electrical and Vacuum Equipment is defined as any equipment installed on a vehicle after leaving the factory that connects to the vehicle's electrical or vacuum systems. No allowances have been made in the vehicle design for this type of equipment.

Notice: Do not add on any Add-On vacuum operated equipment to this vehicle.

Notice: Connect the Add-On electrical operated equipment to the vehicle's electrical system at the battery (power and ground).

Add-On electrical equipment, even when installed to these strict guidelines, may still cause the Powertrain system to malfunction. This may also include equipment not connected to the vehicle's electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any Powertrain problem is to eliminate all Aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, diagnose the problem in the normal manner.

Electrostatic Discharge Damage

Notice: In order to prevent possible Electrostatic Discharge damage to the PCM, Do Not touch the connector pins or the soldered components on the circuit board.

Electronic components used in the control systems are often designed in order to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage; therefore, it is important to use care when handling and testing electronic components.

Engine Controls Information

The driveability and emissions information describes the function and operation of the control module. The emphasis is placed on the diagnosis and repair of problems related to the system.

Engine Components, Wiring Diagrams, and Diagnostic Tables (DTCs):

- Component Locations
- Wiring Diagrams
- Control Module Terminal End View and Terminal Definitions

- OnBoard Diagnostic (OBD) System Check
- Diagnostic Trouble Code Tables (DTCs)

The Component System includes the following items:

- Component and circuit description
- On-vehicle service for each sub-system
- Functional checks and Diagnostic Tables
- How To Use Electrical Systems Diagnostic Information

The DTCs also contain diagnostic support information containing circuit diagrams, circuit or system information, and helpful diagnostic information.

Maintenance Schedule

Refer to the General Motors Maintenance Schedule in Section 0B of the appropriate service manual for the maintenance that the owner or technician should perform in order to retain emission control performance.

Visual and Physical Underhood Inspection

Perform a careful visual and physical underhood inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual and physical inspection:

- Inspect all vacuum hoses for the following conditions:
 - Correct routing
 - Pinches
 - Cuts
 - Disconnects
- Inspect hoses that are difficult to see beneath the air cleaner, A/C compressor, generator, etc.
- Inspect all wires in the engine compartment for the following items:
 - Proper connections
 - Burned or chafed spots
 - Pinched wires
 - Contact with sharp edges
 - Contact with hot exhaust manifolds

This visual and physical inspection is very important. Perform the inspection carefully and thoroughly.

Basic Knowledge Of Tools Required

Notice: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in incorrect diagnostic performance or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary in order to effectively use this information.

System Status and Drive Cycle For Inspection/Maintenance

The System Status selection is included in the scan tool System Info menu.

Several states require that the I/M 240 (OBD II system) pass on-board tests for the major diagnostics prior to having a vehicle emission inspection. This is also a requirement to renew license plates in some areas.

Using a scan tool, the technician can observe the System Status (complete or not complete) in order to verify that the vehicle meets the criteria to comply with local area requirements. Using the System Status display, any of the following systems or combination of systems may be monitored for I/M Readiness:

- The Catalyst
- The HO2S
- The HO2S Heater
- The EGR System
- The AIR system

Following a DTC info clear, System Status will clear only for the systems affected by any DTCs stored. Following a battery disconnect or a Control Module replacement, all System Status information will clear.

Important: The System Status display indicates only whether or not the test has been completed. The System Status display does not necessarily mean that the test has passed. If a Failed Last Test indication is present for a DTC associated with one of the above systems, that test is failed; diagnosis and repair is necessary in order to meet the I/M 240 requirement. Verify that the vehicle passes all of the diagnostic tests associated with the displayed System Status' prior to returning the vehicle to the customer. Refer to the Typical OBD II Drive Cycle table (more than one drive cycle may be needed) to use as a guide to complete the I/M 240 System Status tests.

Typical OBD II Drive Cycle

Diagnostic Time Schedule for I/M Readiness	
Vehicle Drive Status	What is Monitored?
Cold Start, coolant temperature less than 50°C (122°F)	—
Idle 2.5 minutes in Drive (Auto) Neutral (Man), A/C and rear defogger ON	HO2S Heater, Misfire, Secondary Air, Fuel Trim, EVAP Purge
A/C off, accelerate to 90 km/h (55 mph), 1/2 throttle.	Misfire, Fuel Trim, Purge
3 minutes of Steady State - Cruise at 90 km/h (55 mph)	Misfire, EGR, Secondary Air, Fuel Trim, HO2S, EVAP Purge
Clutch engaged (Man), no braking, decelerate to 32 km/h (20 mph)	EGR, Fuel Trim, EVAP Purge
Accelerate to 90–97 km/h (55–60 mph), 3/4 throttle	Misfire, Fuel Trim, EVAP Purge
5 minutes of Steady State Cruise at 90–97 km/h (55–60 mph)	Catalyst Monitor, Misfire, EGR, Fuel Trim, HO2S, EVAP Purge
Decelerate, no breaking. End of Drive Cycle	EGR, EVAP Purge
Total time of OBD II Drive Cycle 12 minutes	—

Primary System Based Diagnostics

There are primary system based diagnostics which evaluate the system operation and their effect on vehicle emissions. The primary system based diagnostics are listed below with a brief description of the diagnostic functionality.

Oxygen Sensor Diagnosis

Diagnose the Fuel Control Heated Oxygen Sensors are for the following conditions:

- Heater Performance (time to activity on cold start)
- Slow Response
- Response Time (time to switch R/L or L/R)
- Inactive Signal (output steady at bias voltage - approximately 450 mV)
- Signal Fixed High
- Signal Fixed Low

Diagnose the Catalyst Monitor Heated Oxygen Sensors for the following functions:

- Heater Performance (time to activity on cold start)
- Signal fixed low during steady state conditions.
- Inactive Sensor.

Fuel Control Heated Oxygen Sensors

The main function of the fuel control heated oxygen sensor is to provide the control module with exhaust stream information in order to allow proper fueling and maintain emissions within the mandated levels. After the sensor reaches the operating temperature, the sensor generates a voltage inversely proportional to the amount of oxygen present in the exhaust gases.

The control module uses the signal voltage from the fuel control heated oxygen sensors in a closed loop in order to adjust the fuel injector pulse width. While in a closed loop, the Control Module can adjust fuel delivery in order to maintain an air to fuel ratio which allows the best combination of emission control and driveability.

If the oxygen sensor pigtail wiring, connector or terminal are damaged, replace the entire oxygen sensor assembly. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, the sensor must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference. Any attempt to repair the wires, connectors or terminals could degrade oxygen sensor performance.

Catalyst Monitor Heated Oxygen Sensors

In order to control emissions of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), the system uses a three-way catalytic converter. The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas, converting them into harmless water vapor and carbon dioxide. The catalyst also reduces NOx, converting it to nitrogen.

The Control Module has the ability to monitor this process using the post heated oxygen sensors. The pre-sensors produce an output signal which indicates the amount of oxygen present in the exhaust gas entering the three-way catalytic converter. The post sensor produces an output signal which indicates the oxygen storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust gases efficiently. If the catalyst is operating efficiently, the pre HO2S signal will be far more active than that produced by the post HO2S.

In addition to catalyst monitoring, the post heated oxygen sensor has a limited role in controlling fuel delivery. If the post HO2S signal indicates a high or low oxygen content for an extended period of time while in a closed loop, the Control Module adjusts the fuel delivery slightly in order to compensate.

Catalyst Monitor Diagnostic Operation

The OBD II catalyst monitor diagnostic measures oxygen storage capacity. In order to do this, the heated sensors are installed before and after the Three-Way Catalyst (TWC). Voltage variations between the sensors allow the control module to determine the catalyst emission performance.

As a catalyst becomes less effective in promoting chemical reactions, the catalyst's capacity to store and release oxygen generally degrades. The OBD II catalyst monitor diagnostic is based on an correlation between conversion efficiency and oxygen storage capacity.

A good catalyst (e.g. 95% hydrocarbon conversion efficiency) shows a relatively flat output voltage on the post-catalyst Heated Oxygen Sensor (HO2S). A degraded catalyst (65 % hydrocarbon conversion) shows a greatly increased activity in output voltage from the post catalyst HO2S.

The post-catalyst HO2S is used to measure the oxygen storage and release capacity of the catalyst. A high oxygen storage capacity indicates a good catalyst; low oxygen storage capacity indicates a failing catalyst. The TWC and the HO2S must be at operating temperature in order to achieve correct oxygen sensor voltages like those shown in the Post-Catalyst HO2S Outputs graphic.

The catalyst monitor diagnostic is sensitive to the following conditions:

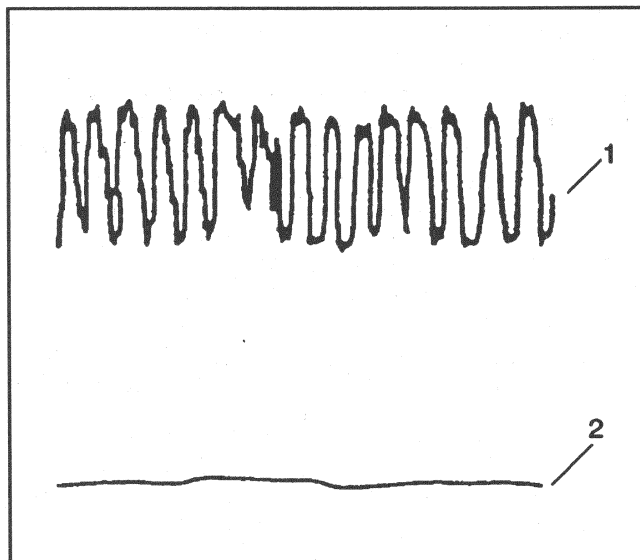
- Exhaust leaks
- HO2S Contamination
- Alternate fuels

Exhaust system leaks may cause the following results:

- Prevent a degraded catalyst from failing the diagnostic
- Cause a false failure for a normally functioning catalyst
- Prevent the diagnostic from running

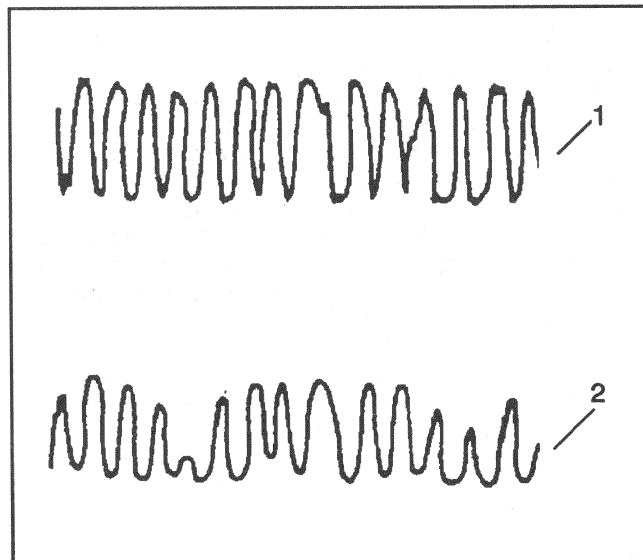
Some of the contaminants that may be encountered are phosphorus, lead, silica, and sulfur. The presence of these contaminants prevents the TWC diagnostic from functioning properly.

Three-Way Catalyst Oxygen Storage Capacity



14442

The control module must monitor the Three-Way catalyst system (TWC) for efficiency. In order to accomplish this, the control module monitors the pre-catalyst and post-catalyst oxygen sensors. When the TWC is operating properly, the post-catalyst (2) oxygen sensor will have significantly less activity than the pre-catalyst (1) oxygen sensor. The TWC stores oxygen as needed during its normal reduction and oxidation process. The TWC releases oxygen as needed during its normal reduction and oxidation process. The control module calculates the oxygen storage capacity using the difference between the pre-catalyst and post-catalyst oxygen sensor's voltage levels.



14446

Whenever the voltage levels of the post-catalyst (2) oxygen sensor nears the voltage levels that of the pre-catalyst (1) oxygen sensor, the catalysts efficiency is degraded.

Stepped or staged testing levels allow the control module to statistically filter test information. This prevents falsely passing or falsely failing the oxygen storage capacity test. The calculations performed by the on-board diagnostic system are very complex. For this reason, do not use post catalyst oxygen sensor activity in order to determine the oxygen storage capacity unless directed by the electronic service information

Three stages are used in order to monitor catalyst efficiency. Failure of the first stage indicates that the catalyst requires further testing in order to determine catalyst efficiency. Failure of the second stage indicates that the catalyst may be degraded. The third stage then looks at the inputs from the pre and post O₂ sensors more closely before determining if the catalyst is indeed degraded. This further statistical processing is done to increase the accuracy of oxygen storage capacity type monitoring. Failing the first (stage 0) or second (stage 1) test Does Not indicate a failed catalyst. The catalyst may be marginal or the fuel sulfur content could be very high.

Aftermarket HO₂S characteristics may be different from the original equipment manufacturer sensor. This may lead to a false pass or a false fail of the catalyst monitor diagnostic. Similarly, if an Aftermarket catalyst does not contain the same amount of cerium as the original part, the correlation between oxygen storage and conversion efficiency may be altered enough to set a false DTC.

Evaporative Emission (EVAP) Purge System Vacuum Switch

The EVAP system uses a switch located in the purge line between the canister and the EVAP canister purge solenoid valve in order to detect when the purge is occurring. This switch senses the flow from the engine through the purge valve. When no purge is present, the switch is closed, applying a 12 volt signal to the control module as a NO PURGE signal. When canister purging occurs, the switch opens, interrupting off the 12 volt signal to the control module. A scan tool display will indicate that purge is occurring.

Clogging of the canister fresh air vent could allow the purge hose between the switch and canister to trap vacuum with the purge valve closed. This would result in a diagnostic indication of a purge valve stuck open or a vacuum switch failure. Similarly, leaks or blockages in the purge hoses may result in misdiagnosis of the purge valve or vacuum switch.

When an EVAP canister purge solenoid valve diagnostic trouble code sets, check the canister fresh air vent, vacuum switch and the integrity of all purge hoses prior to servicing the valve.

Misfire Monitor Diagnostic Operation

The misfire monitor diagnostic is based on crankshaft rotational velocity (reference period) variations. The control module determines crankshaft rotational velocity using the crankshaft position sensor and camshaft position sensor. When a cylinder misfires the crankshaft slows down momentarily. By monitoring the crankshaft and camshaft position sensor signals, the control module can calculate when a misfire occurs.

For a non-catalyst damaging misfire, the diagnostic is required to monitor a misfire present for between 1000–3200 engine revolutions.

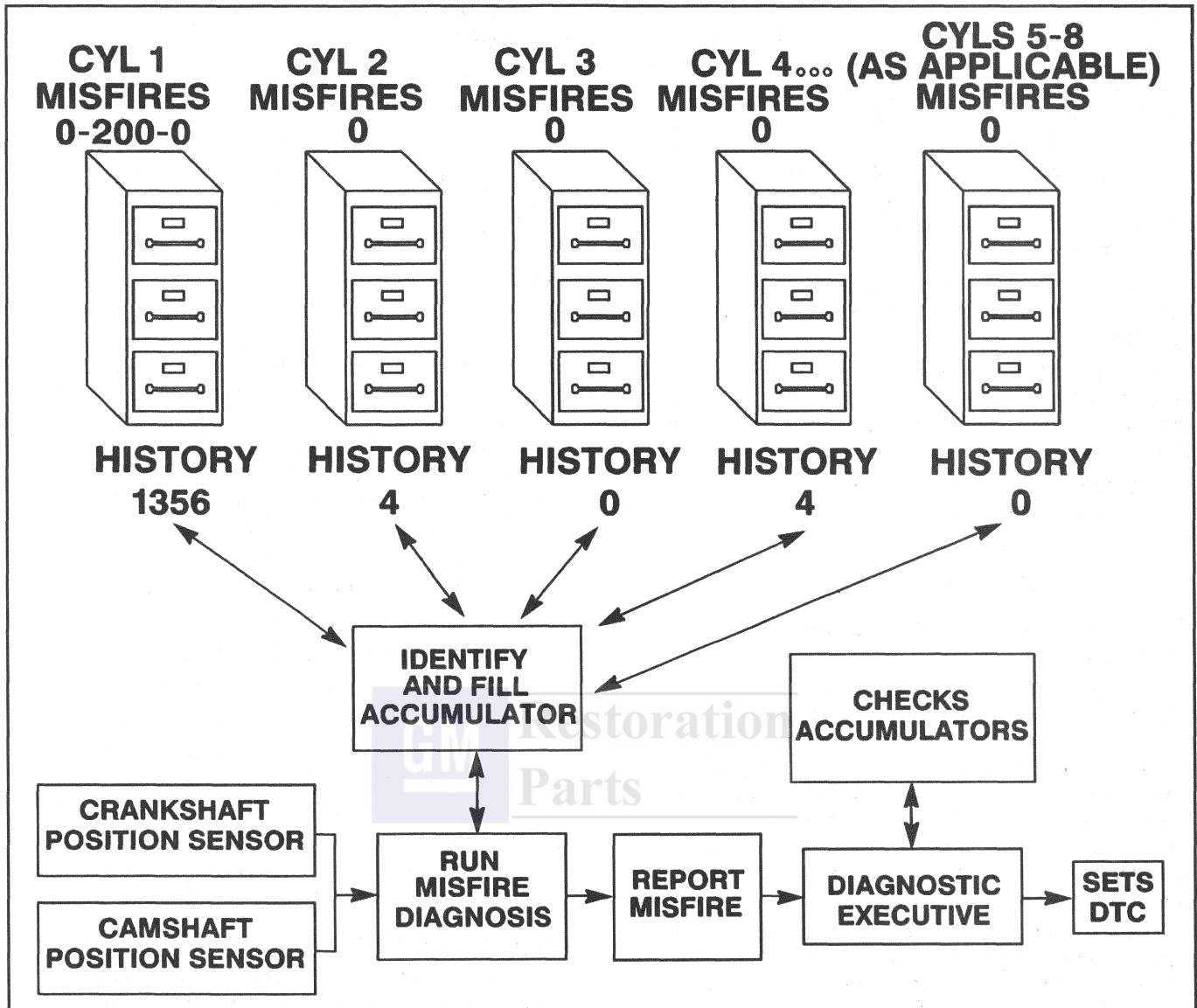
For catalyst damage misfire, the diagnostic responds to the misfire within 200 engine revolutions.

Rough roads may cause false misfire detection. A rough road applies torque to the drive wheels and drive train. This torque can intermittently decrease the crankshaft rotational velocity. The Control module detects this as a false misfire.

On automatic transmission equipped vehicles, the Torque Converter Clutch (TCC) will disable whenever a misfire is detected. Disabling the TCC isolates the engine from the rest of the drive line and minimizes the effect of the drive wheel inputs on crankshaft rotation.

When the TCC has disabled as a result of misfire detection, the TCC will re-enabled after approximately 3200 engine revolutions if no misfire is detected. The TCC remains disabled whenever the misfire is detected, with or without a DTC set. This allows the misfire diagnostic to reevaluate the system.

During a transmission high temperature condition, the misfire diagnostic will disable, and the TCC will operate normally. This avoids further increasing the temperature of the transmission.



17379

Whenever a cylinder misfires, the misfire diagnostic counts the misfire and notes the crankshaft position at the time it the misfire occurred. These misfire counters are basically a file on each engine cylinder.

A current and a history misfire counter is maintained for each cylinder. The misfire current counters (Misfire Cur #1 -8) indicate the number of firing events out of the last 200 cylinder firing events which were misfires. The misfire current counters displays real time data without a misfire DTC stored. The misfire history counters (Misfire Hist #1 - 8) indicate the total number of cylinder firing events which were misfires. The misfire history counters displays 0 until the misfire diagnostic has failed and a DTC P0300 is set. Once the misfire DTC sets, the misfire history counters will be updated every 200 cylinder firing events.

The Misfire counters graphic illustrates how these misfire counters are maintained. If the misfire diagnostic reports a failure, the Diagnostic Executive reviews all of the misfire counters before reporting a DTC. This way, the Diagnostic Executive reports the most current information.

When crankshaft rotation is erratic, the control module detects a misfire condition. Because of this erratic condition, the data that is collected by the diagnostic can sometimes incorrectly identify which cylinder is misfiring. The Misfire Counters graphic shows there are misfires counted from more than one cylinder. Cylinder #1 has the majority of counted misfires. In this case, the Misfire Counters would identify cylinder #1 as the misfiring cylinder. The misfires in the other counters were just background noise caused by the erratic rotation of the crankshaft. If the number of accumulated is sufficient for the diagnostic to identify a true misfire, the diagnostic will set DTC P0300 - Misfire Detected.

Use Techline equipment to monitor misfire counter data on OBD II compliant vehicles. Knowing which specific cylinders misfired can lead to the root cause, even when dealing with a multiple cylinder misfire. Using the information in the misfire counters, identify which cylinders are misfiring. If the counters indicate cylinders number 1 and 4 misfired, look for a circuit or component common to both cylinders number 1 and 4 such as an open ignition coil in an electronic ignition system.

Misfire counter information is located in the Specific Eng. menu, Misfire Data sub-menu of the of the data list.

The misfire diagnostic may indicate a fault due to a temporary fault not necessarily caused by a vehicle emission system malfunction. Examples include the following items:

- Contaminated fuel
- Running out of fuel
- Fuel fouled spark plugs
- Basic engine fault

Fuel Trim System Monitor Diagnostic Operation

This system monitors the averages of short-term and long-term fuel trim values. If these fuel trim values stay at their limits for a calibrated period of time, a malfunction is indicated. The fuel trim diagnostic compares the averages of short-term fuel trim values and long-term fuel trim values to rich and lean thresholds. If either value is within the thresholds, a pass is recorded. If either value is outside their thresholds, a rich or lean DTC will set.

In order to meet OBD II requirements, the control module uses weighted fuel trim cells in order to determine the need to set a fuel trim DTC. A fuel trim DTC can only be set if fuel trim counts in the weighted fuel trim cells exceed specifications. This means that the vehicle could have a fuel trim problem which is causing a concern under certain conditions (i.e. engine idle high due to a small vacuum leak or rough due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S DTC may set). Remember, use a scan tool in order to observe fuel trim counts while the problem is occurring.

Remember, a fuel trim DTC may be triggered by a list of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

Comprehensive Component Monitor Diagnostic

Comprehensive component monitoring diagnostics are required to monitor emissions-related input and output Powertrain components. The CARB OBD II Comprehensive Component Monitoring List of Components Intended To Illuminate The MIL is a list of components, features or functions that could fall under this requirement.

Input Components

The Control Module monitors the input components for circuit continuity and out-of-range values. This includes performance checking. Performance checking refers to indicating a fault when the signal from a sensor does not seem reasonable (i.e. a Throttle Position (TP) sensor that indicates high throttle position at low engine loads or MAP voltage). The input components may include but are not limited to the following sensors:

- The Vehicle Speed Sensor (VSS)
- The Crankshaft Position (CKP) sensor
- The Knock Sensor (KS)
- The Throttle Position (TP) sensor
- The Engine Coolant Temperature (ECT) sensor
- The Camshaft Position (CMP) sensor
- The Manifold Absolute Pressure (MAP) sensor
- The Mass Air Flow (MAF) sensor

In addition to the circuit continuity and rationality check, the ECT sensor is monitored for its ability to achieve a steady state temperature to enable closed loop fuel control.

Output Components

Diagnose the output components for the proper response to control module commands. Components where functional monitoring is not feasible will be monitored for circuit continuity and out-of-range values if applicable.

Output components to be monitored include, but are not limited to the following circuits:

- The Idle Air Control (IAC) Motor
- The Control module controlled EVAP Canister Purge Valve
- The Electronic transmission controls
- The A/C relay
- The Cooling fan relay
- The VSS output
- The MIL control
- The Cruise control inhibit

California Air Resources Board (CARB) OBD II Comprehensive Component Monitoring List of Components Intended to Illuminate MIL

Important: Not all vehicles have these components.

Components Intended to Illuminate MIL
Transmission Range (TR) Mode Pressure Switch
Transmission Turbine Speed Sensor (HI/LO)
Transmission Vehicle Speed Sensor (HI/LO)
Transmission Vehicle Speed Sensor (HI/LO)
Ignition Sensor (Cam Sync, Diag)
Ignition Sensor Hi Res (7x)
Knock Sensor (KS)
Engine Coolant Temperature (ECT) Sensor
Intake Air Temperature (IAT) Sensor
Throttle Position (TP) Sensor A, B
Manifold Absolute Pressure (MAP) Sensor
Mass Air Flow (MAF) Sensor
Automatic Transmission Temperature Sensor
Transmission Torque Converter Clutch (TCC) Control Solenoid
Transmission TCC Enable Solenoid
Transmission Shift Solenoid A
Transmission Shift Solenoid B
Transmission 3/2 Shift Solenoid
Ignition Control (IC) System
Idle Air Control (IAC) Coil
Evaporative Emission Purge Vacuum Switch
Evaporative Emission Canister Purge (EVAP Canister Purge)

Wiring Harness Service

The control module harness electrically connects the control module to the various solenoids, switches, and sensors in the vehicle engine room and passenger compartment.

Replace the wire harnesses with the proper part number replacement. When splicing signal wires into a harness, use the wiring that has high temperature insulation.

Consider the low amperage and voltage levels utilized in the Powertrain control systems. Make the best possible bond at all splices. Use rosin-core solder in these areas.

Molded-on connectors require complete replacement of the connector. Splice a new connector into the harness. Replacement connectors and terminals are listed in Group 8.965 in the Standard Parts Catalog.

For wiring repair, refer to *Wiring Repairs*.

Connectors and Terminals

In order to prevent shorting between opposite terminals, use care when probing a connector and when replacing terminals. Damage to the components could result.

Always use jumper wires between connectors for circuit checking.

Never probe through Weather-Pack seals.

Use the tachometer adapter J 35812, or the equivalent, which provides a convenient connection to the tachometer lead. The connector test adapter kit J 35616, or the equivalent, contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and test tool BT-8616, or the equivalent, is used for removing a fuse and to adapt the fuse holder to a meter for diagnosis.

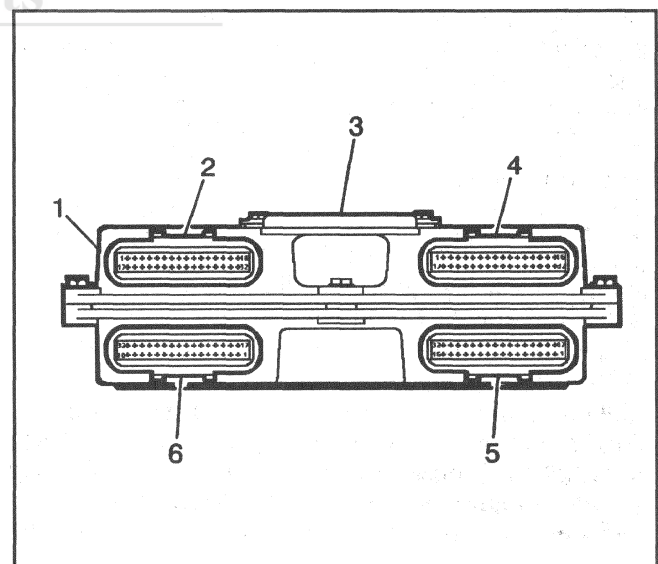
Open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness may temporarily correct the open circuit. Oxidized or loose connections may cause intermittent problems.

Be certain the type of connector and terminal before making any connector or terminal repair.

Weather-Pack and Com-Pack III terminals look similar, but are serviced differently.

PCM Function

Powertrain Control Module



13489

Legend

- (1) Powertrain Control Module (PCM)
- (2) PCM Connector C3 (Gray/Clear)
- (3) Knock Sensor Module Access Cover
- (4) PCM Connector C4 (Blue)
- (5) PCM Connector C2 (Black)
- (6) PCM Connector C1 (Red)

The Powertrain Control Module (PCM) is located in the engine compartment. The PCM is the control center of the vehicle. It controls the following:

- Fuel metering system.
- Transmission shifting.
- Ignition timing.
- On-board diagnostics for powertrain functions.

The PCM constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The PCM also performs the diagnostic function of the system. It can recognize operational problems. The PCM also alerts the driver through the MIL (Malfunction Indicator Lamp). When the PCM detects a malfunction, it stores a diagnostic trouble code (DTC). A DTC stored, will identify the problem areas. This will aid the technician in making repairs.

The PCM consists of two parts: a controller (the PCM without the Knock Sensor module) and the Knock Sensor module.

The PCM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the PCM. The resistance is so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter (J 39200) with at least 10 megohms input impedance is required to ensure accurate voltage readings.

The PCM controls output circuits such as the injectors, IAC, cooling fan relays, etc. by controlling the ground or power feed circuit through transistors or a device called an Output Driver Module.

EEPROM

The Electronically Erasable Programmable Read Only Memory (EEPROM) is a permanent memory that is physically soldered within the PCM. The EEPROM contains program and calibration information that the PCM needs to control powertrain operation.

Unlike the PROM used in past applications, the EEPROM is not replaceable. If the PCM is replaced, the new PCM will need to be programmed. Techline equipment containing the correct program and calibration for the vehicle, is required to program the PCM.

Short Term Fuel Trim

The short term fuel trim is a PCM erasable memory register. The neutral value for the short term fuel trim is 0%. Any deviation from 0% indicates the short term fuel trim is changing the injector pulse width. The amount of pulse width change depends on how far the short term fuel trim value is from 0%. The short term fuel trim is rich when the scan tool indicates -99%. The short fuel trim is lean when the

scan tool indicates 99%. The short term fuel trim changes the pulse width by varying the Closed Loop factor of the base pulse width equation. As the PCM monitors the oxygen sensors input, it is constantly varying the short term fuel trim value. The value is updated very quickly, therefore, the short term fuel trim only corrects for short term mixture trends. The correction of long term mixture trends is the function of long term fuel trim.

When the PCM determines that the Short Term Fuel Trim is out of the operating range, the following DTCs will set:

- DTC P0171 Bank 1 Too Lean.
- DTC P0172 Bank 1 Too Rich.
- DTC P0174 Bank 2 Too Lean.
- DTC P0175 Bank 2 Too Rich.

Long Term Fuel Trim

The long term fuel trim is a matrix of cells arranged by RPM and MAP. Each cell of the long term fuel trim is a register like the short term fuel trim. As the engine operating conditions change, the PCM will switch from cell to cell to determine what long term fuel trim factor to use in the base pulse width equation.

While in any given cell, the PCM also monitors the short term fuel trim. If the short term fuel trim is far enough from 0%, the PCM will change the long term fuel trim value. Once the long term fuel trim value is changed, it should force the short term fuel trim back toward 0%. If the mixture is still not correct (as judged by the HO2S), the short term fuel trim will continue to have a large deviation from the ideal 0%. In this case, the long term fuel trim value will continue to change until the short term fuel trim becomes balanced. Both the short term fuel trim and long term fuel trim have limits which vary by calibration. If the mixture is off enough so that long term fuel trim reaches the limit of its control and still cannot correct the condition, the short term fuel trim would also go to its limit of control in the same direction. If the mixture is still not corrected by both short term fuel trim and long term fuel trim at their extreme values, a Fuel Trim Diagnostic Trouble Code (DTC) will likely result. When the PCM determines that the Long Term Fuel Trim is out of the operating range, the following DTCs will set:

- DTC P0171 Bank 1 Too Lean.
- DTC P0172 Bank 1 Too Rich.
- DTC P0174 Bank 2 Too Lean.
- DTC P0175 Bank 2 Too Rich.

Under the conditions of power enrichment, the PCM sets the short term fuel trim to 0% and freezes it there until power enrichment is no longer in effect. This is done so the Closed Loop factor and the long term fuel trim will not try to correct for the commanded richness of power enrichment.

Speed Density System

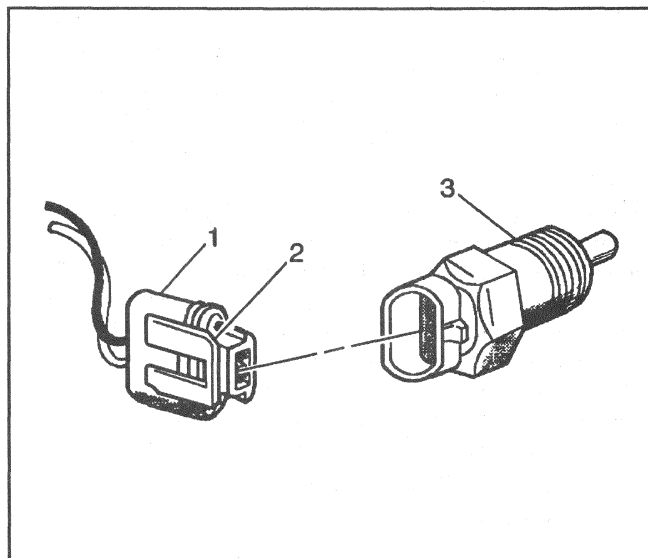
Three specific data sensors provide the PCM with the basic information for fuel management portion of its operation. That is three specific signals to the PCM establish the engine speed and air density factors. The engine speed signal comes from the distributor high resolution circuit. The PCM uses this information to determine engine speed (RPM). Air density is derived from IAT and MAP sensor inputs. The IAT sensor measures the air temperature that is entering the engine. The IAT signal works in conjunction with the MAP sensor to determine air density. As the intake manifold pressure increases, the air density in the intake manifold also increases and additional fuel is required. This information from the IAT and MAP sensors is used by the PCM to control injector pulse width.

The speed density system is only needed when there is a Mass Air Flow (MAF) sensor malfunction. If the PCM detects a malfunction with the MAF sensor circuit, the PCM will default to speed density fuel management.

Information Sensors

All of the sensors and input switches can be diagnosed using a scan tool. The following is a short description of how the sensors and switches can be diagnosed by using a scan tool. The scan tool can also be used to compare the values for a normal running engine with the engine being diagnosed.

Engine Coolant Temperature (ECT) Sensor



13578

Legend

- (1) ECT Electrical Connector
- (2) Connector Tab
- (3) Engine Coolant Temperature (ECT) Sensor

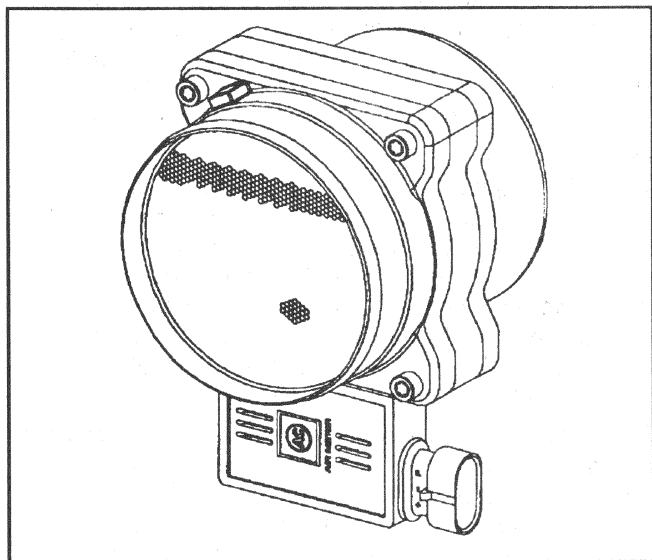
The engine coolant temperature sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant pump. Low coolant temperature produces a high resistance (100,000 ohms at $-40^{\circ}\text{C}/-40^{\circ}\text{F}$) while high temperature causes low resistance (70 ohms at $130^{\circ}\text{C}/266^{\circ}\text{F}$).

The PCM supplies a 5 volt signal to the engine coolant temperature sensor through a resistor in the PCM and measures the voltage. The voltage will be high when the engine is cold. The voltage will be low when the engine is hot. By measuring the voltage, the PCM calculates the engine coolant temperature. Engine coolant temperature affects most systems the PCM controls.

The scan tool displays engine coolant temperature in degrees. After engine startup, the temperature should rise steadily to about 90°C (194°F) then stabilize when thermostat opens. If the engine has not been run for several hours (overnight), the engine coolant temperature and intake air temperature displays should be close to each other. When the PCM detects a malfunction in the ECT sensor circuit, the following DTCs will set:

- DTC P0117 circuit low.
- DTC P0118 circuit high.
- DTC P0125 excessive time to Closed Loop.
- DTC P1114 circuit intermittent low.
- DTC P1115 circuit intermittent high.

Service Category Specifications contains a table to check for sensor resistance values relative to temperature.

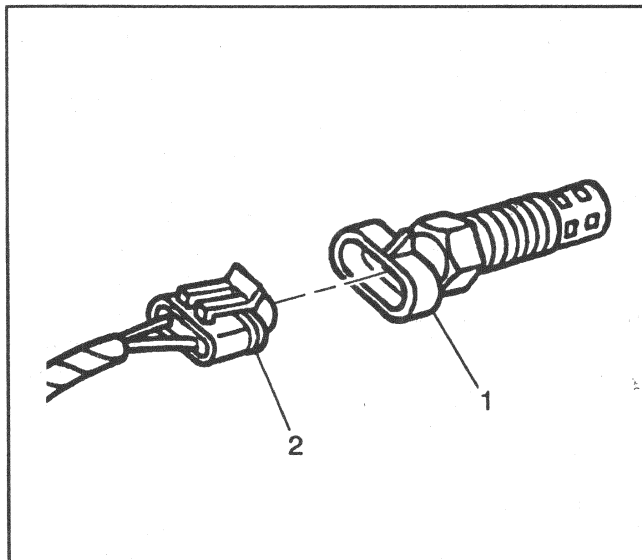
Mass Air Flow (MAF) Sensor

13487

The Mass Air Flow (MAF) sensor measures the amount of air which passes through it. The PCM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration. A small quantity of air indicates deceleration or idle.

The scan tool reads the MAF value and displays it in grams per second (gm/Sec). At idle, it should read between 6 gm/Sec – 9 gm/Sec on a fully warmed up engine. Values should change rather quickly on acceleration, but values should remain fairly stable at any given RPM. When the PCM detects a malfunction in the MAF sensor circuit, the following DTCs will set:

- DTC P0100 circuit malfunction.
- DTC P0101 system performance.
- DTC P0102 frequency low.
- DTC P0103 frequency high.

Intake Air Temperature (IAT) Sensor

13643

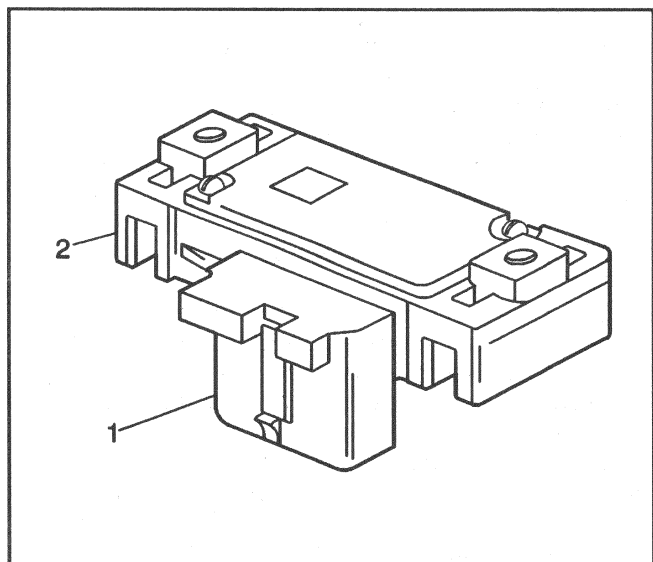
Legend

- (1) Intake Air Temperature (IAT) Sensor
- (2) Electrical Harness Connector

The Intake Air Temperature (IAT) sensor is a thermistor which changes value based on the temperature of air entering the engine. Low temperature produces a high resistance (100,000 ohms at $-40^{\circ}\text{C}/-40^{\circ}\text{F}$). A high temperature causes low resistance (70 ohms at $130^{\circ}\text{C}/266^{\circ}\text{F}$). The PCM supplies a 5.0 volt signal to the sensor through a resistor in the PCM and measures the voltage. The voltage will be high when the incoming air is cold, and low when the air is hot. By measuring the voltage, the PCM calculates the incoming air temperature. The IAT sensor signal is used to adjust spark timing according to incoming air density.

The scan tool displays temperature of the air entering the engine, which should read close to ambient air temperature when engine is cold. The temperature should rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the IAT sensor temperature and engine coolant temperature should read close to each other. If the PCM detects a malfunction in the IAT sensor circuit, the following DTCs will set:

- DTC P0112 circuit low.
- DTC P0113 circuit high.
- DTC P1111 circuit intermittent high.
- DTC P1112 circuit intermittent low.

Manifold Absolute Pressure (MAP) Sensor

13693

Legend

- (1) Electrical Connector
- (2) Manifold Absolute Pressure (MAP) Sensor

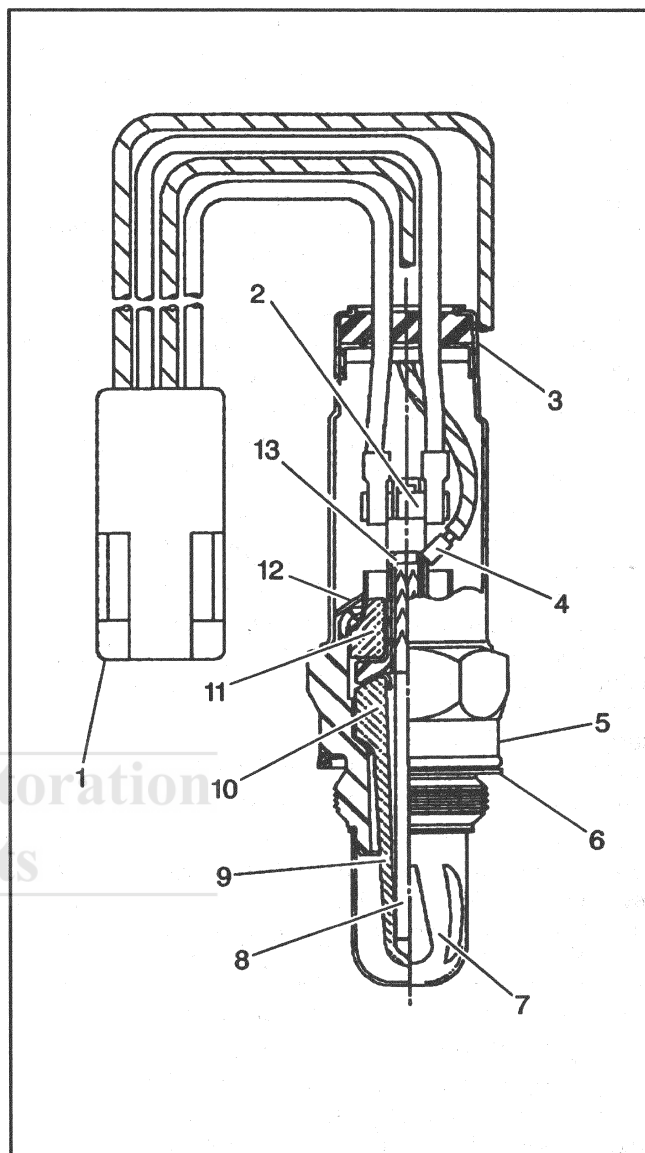
The Manifold Absolute Pressure (MAP) sensor responds to changes in the intake manifold pressure. The pressure changes as a result of engine load and speed. The map sensor converts this to a voltage output.

A closed throttle on engine coast down would produce a relatively low map output voltage. A wide open throttle would produce a high map output voltage. This high output voltage is produced because the pressure inside the manifold is the same as outside the manifold. The MAP is inversely proportional to what is measured on a vacuum gage. The MAP sensor is used for the following:

- Altitude determination.
- Ignition timing control.
- EGR diagnostic.
- Speed density fuel management default.

When the PCM detects a malfunction in the MAP sensor circuit, the following DTCs will set:

- DTC P0106 circuit performance malfunction.
- DTC P0107 circuit low.
- DTC P0108 circuit high.
- DTC P1107 intermittent circuit low.

Heated Oxygen Sensors (HO2S) Cutaway

13576

Legend

- (1) Four Wire In-Line Connector
- (2) Heater Termination
- (3) Water Shield Assembly
- (4) Sensor Lead
- (5) Flat Seat Shell
- (6) Seat Gasket
- (7) Outer Electrode and Protective Coating
- (8) Rod Heater
- (9) Inner Electrode
- (10) Zirconia Element
- (11) Insulator
- (12) Clip Ring
- (13) Gripper

Front Heated Oxygen Sensors (HO2S)

The Heated Oxygen Sensors are mounted in the exhaust system where they can monitor the oxygen content of the exhaust gas stream. The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100 mV (high oxygen content – lean mixture) to 900 mV (low oxygen content – rich mixture). The heated oxygen sensor voltage can be monitored with a scan tool. By monitoring the voltage output of the oxygen sensor, the PCM calculates what fuel mixture command to give to the injectors (lean mixture – low HO2S voltage = rich command, rich mixture – high HO2S voltage = lean command).

When the PCM detects an HO2S signal circuit that is low, the PCM will set the following DTCs:

- DTC P0131 Bank 1 left front HO2S.
- DTC P0151 Bank 2 right front HO2S.
- DTC P0137 Bank 1 left rear HO2S.
- DTC P0157 Bank 2 right rear HO2S.

When the PCM detects an HO2S signal circuit that is high, the PCM will set the following DTCs:

- DTC P0132 Bank 1 left front HO2S.
- DTC P0152 Bank 2 right front HO2S.
- DTC P0138 Bank 1 left rear HO2S.
- DTC P0158 Bank 2 right rear HO2S.

When the PCM detects no HO2S activity, the PCM will set the following DTCs:

- DTC P0134 Bank 1 left front HO2S.
- DTC P0154 Bank 2 right front HO2S.
- DTC P0140 Bank 1 left rear HO2S.
- DTC P0160 Bank 2 right rear HO2S.

A fault in the heated oxygen sensor heater element or its ignition feed or ground will result in an increase in time to Closed Loop fuel control. This may cause increased emissions, especially at start-up. When the PCM detects a malfunction in the HO2S heater circuits, the following DTCs will set:

- DTC P0135 Bank 1 left front HO2S heater.
- DTC P0155 Bank 2 right front HO2S heater.
- DTC P0141 Bank 1 left rear HO2S heater.
- DTC P0161 Bank 2 right rear HO2S heater.

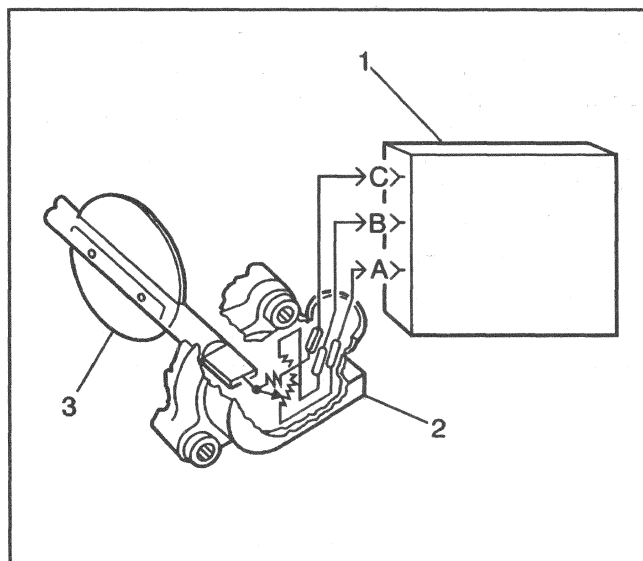
The PCM also has the ability to detect HO2S response, switching, transition time, and incorrect ratio voltage problems. If a HO2S response switching, transition time, or ratio problem is detected, the PCM will store a DTC that indicates degraded HO2S performance.

Rear Heated Oxygen Sensors (HO2S)

To control emissions of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), a three-way catalytic converter is used. The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas, converting them into harmless water vapor and carbon dioxide. The catalyst also reduces NOx, converting it to nitrogen. The PCM has the ability to monitor this process using the Bank 1 HO2S 2 and the Bank 2 HO2S 2 heated oxygen sensors. The front HO2S sensors produces an output signal which indicates the amount of oxygen present in the exhaust gas entering the three-way catalytic converter. The rear HO2S sensors produces an output signal which indicates the oxygen storage capacity of the catalyst; this in turn indicates the catalysts ability to convert exhaust gases efficiently. If the catalyst is operating efficiently, the front sensors will produce a far more active signal than that produced by the rear sensors.

The catalyst monitor sensors operate the same as the fuel control sensors. Although the Bank 1 HO2S 2 and Bank 2 HO2S 2 sensors main function is catalyst monitoring, they also play a limited role in fuel control. If a sensor output indicates a voltage either above or below the 450 millivolt bias voltage for an extended period of time, the PCM will make a slight adjustment to fuel trim to ensure that fuel delivery is correct for catalyst monitoring

Throttle Position (TP) Sensor



13572

Legend

- (1) Powertrain Control Module (PCM)
- (2) Throttle Position (TP) Sensor
- (3) Throttle Valve

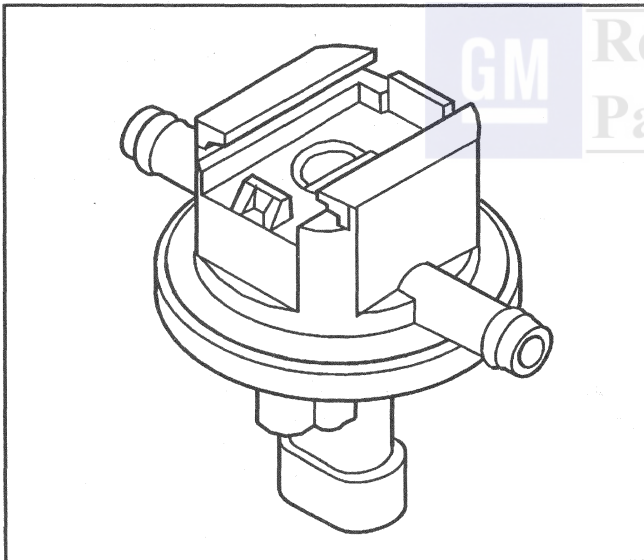
The Throttle Position (TP) sensor is a potentiometer. The TP sensor is connected to the throttle shaft on the throttle body. By monitoring the voltage on the signal line, the PCM calculates throttle position. As the throttle valve angle is changed (accelerator pedal moved), the TP sensor signal also changes. At a closed throttle position, the output of the TP sensor is low. As the throttle valve opens, the output increases so that at Wide Open Throttle (WOT), the output voltage should be above 4.0 volts.

The PCM calculates fuel delivery based on throttle valve angle (driver demand). A broken or loose TP sensor may cause intermittent bursts of fuel from an injector. This may cause an unstable idle because the PCM detects the throttle is moving.

When the PCM detects a malfunction with the TP sensor circuits, the following DTCs will set:

- DTC P0121 circuit performance malfunction.
- DTC P0122 circuit low.
- DTC P0123 circuit high.
- DTC P1121 intermittent circuit high.
- DTC P1122 intermittent circuit low.

EVAP Purge Vacuum Switch

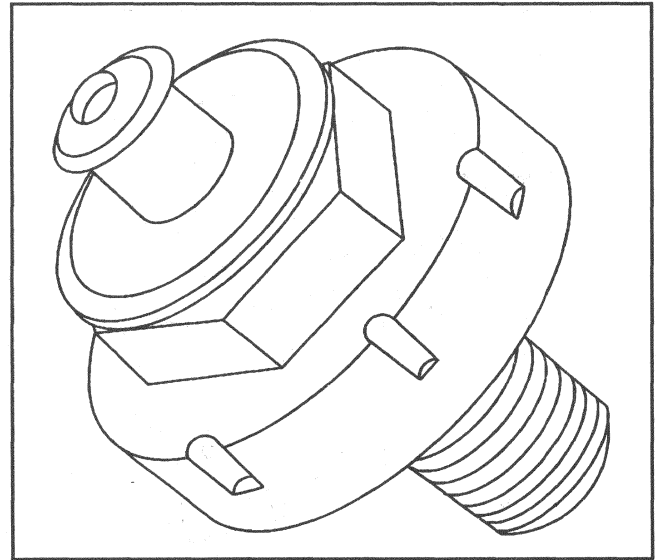


13498

The EVAP Purge Vacuum Switch is used by the PCM to monitor EVAP canister purge solenoid operation and purge system integrity. The EVAP Purge Vacuum Switch should be closed to ground with no vacuum present (0% EVAP Purge PWM). With EVAP Purge PWM at 25% or greater, the EVAP Purge Vacuum Switch should open.

An incorrect EVAP Purge system flow should set a DTC P0441. A continuous purge condition with no purge commanded by the PCM should set a DTC P1441. Refer to Evaporative Emission (EVAP) Control System for a complete description of the EVAP system.

Knock Sensors (KS)



13635

The Knock Sensor (KS) system is used to detect engine detonation. The PCM will retard the spark timing based on the signals from the KS module. The Knock Sensor(s) produce an AC voltage that is sent to the KS module. The amount of AC voltage produced is proportional to the amount of knock.

An operating engine produces a normal amount of engine mechanical vibration (Noise). The knock sensor(s) will produce an AC voltage signal from this Noise. When an engine is operating, the PCM will learn the minimum and maximum frequency of the noise the engine produces. When the PCM determines that this frequency is less than or greater than the expected amount, a knock sensor DTC will set.

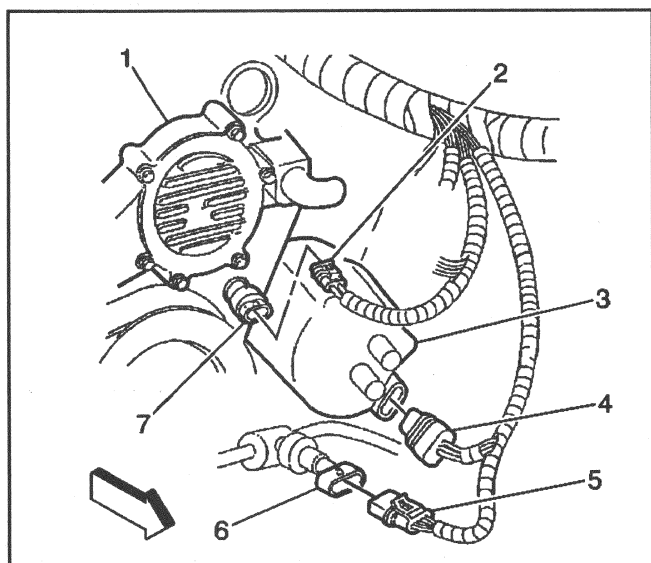
A/C Request Signal

The A/C request circuit signals the PCM when an A/C mode is selected at the A/C control head. The PCM uses this information enable the A/C compressor clutch and to adjust the idle speed before turning ON the A/C clutch. If this signal is not available to the PCM, the A/C compressor will be inoperative.

Refer to A/C Clutch Circuit Diagnosis for A/C wiring diagrams and diagnosis of A/C electrical system.

A/C Refrigerant Pressure Sensor

This signal is used by the PCM to enable the cooling fans when head pressure reaches a predetermined amount. If a fault is present in the A/C refrigerant pressure sensor circuit, DTC P0530 or P0531 will set. When the PCM sets a DTC, the A/C compressor clutch will be disabled.

Power Steering Pressure (PSP) Switch

29971

Legend

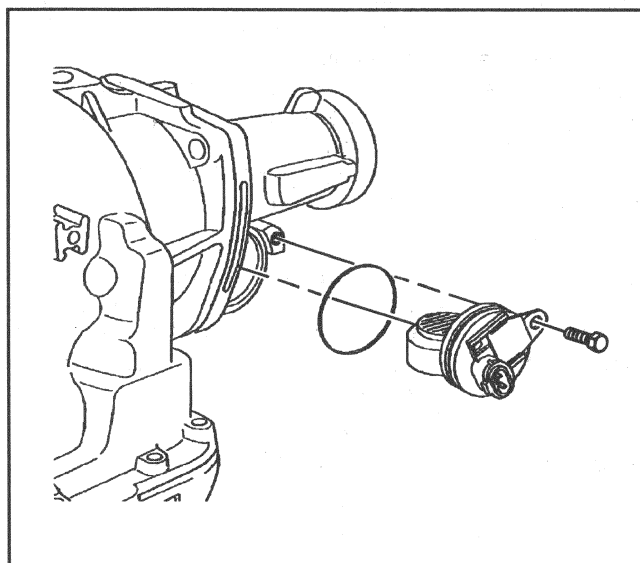
- (1) Engine Coolant Pump
- (2) Engine Coolant Temperature Sensor Electrical Connector
- (3) AIR Pump
- (4) AIR Pump Electrical Connector
- (5) Power Steering Pressure Switch Electrical Connector
- (6) Power Steering Pressure Switch
- (7) Engine Coolant Temperature Sensor

This signal is used by the PCM to increase the idle speed when the vehicle is in a parking maneuver. The PSP switch is a normally open switch. When the power steering pressure is high, the switch will close. When the switch closes, the PCM will increase idle speed to compensate for the additional load.

Park/Neutral Position (PNP) Switch (Automatic Transmission)

Important: Vehicle should not be driven with the PNP switch disconnected, as idle quality will be affected. Having the switch disconnected may also cause a VSS DTC to set.

The PNP switch indicates to the PCM when the transmission is in park, neutral, or drive. This information is used for the EGR and IAC valve operation. Refer to Electrical Diagnosis for more information on the PNP switch. The PNP switch is part of the neutral/start and backup light switch assembly. Refer to Park/Neutral Position Switch diagnosis.

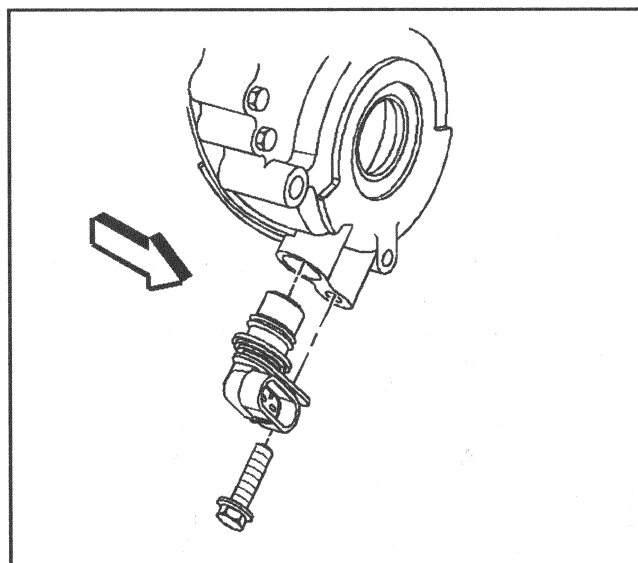
Vehicle Speed Sensor (VSS)

13640

The Vehicle Speed Sensor (VSS) is a pulse counter type input that informs the PCM how fast the vehicle is being driven. The VSS system uses an inductive sensor mounted in the tail housing of the transmission and a toothed reluctor wheel on the tail shaft. As the reluctor rotates, the teeth alternately interfere with the magnetic field of the sensor creating an induced voltage pulse.

The VSS produces an AC voltage signal that increases with vehicle speed. The PCM processes this signal and sends it to the following components:

- Instrument Panel.
- Radio control head.
- Chime Module.
- Cruise Control Module.

Crankshaft Position Sensor (CKP)

11485

The crankshaft position sensor provides the PCM with crankshaft speed and crankshaft position. The PCM utilizes this information to determine if an engine Misfire is present. The PCM monitors the CKP sensor for momentarily drop in crankshaft speed to determine if a misfire is occurring. When the PCM detects a misfire, a DTC P0300 will set.

The PCM also monitors the CKP sensor signal circuit for malfunctions. The PCM monitors CKP signal and the High and Low resolution signals. The PCM calculates these signals to determine a ratio. When the PCM detects that the ratio is out of normal operating range, the PCM will set a DTC P0335 or a DTC P0336.

A/C Clutch Circuit

In order to improve engine operation, and protect the A/C compressor and A/C clutch during Wide Open Throttle (WOT) performance, the A/C compressor operation is controlled by the PCM.

This A/C system consists of the following components:

- The heater and A/C control
- The A/C pressure cycling switch
- The A/C refrigerant pressure sensor
- The A/C clutch relay
- The A/C compressor clutch
- The PCM.

The A/C refrigerant pressure cycling switch is closed when there is sufficient system pressure (depending on refrigerant charge and ambient temperature). When the heater and A/C control is placed in the A/C mode, a request signal is sent to the PCM. The PCM will then energize the A/C clutch relay, unless abnormally high or low A/C pressure is detected by the A/C refrigerant pressure sensor. The PCM will also turn the cooling fans ON when A/C is requested. The A/C clutch relay is controlled by the PCM so that the PCM can increase idle speed before turning ON the clutch or disable the clutch during WOT, or high coolant temperature.

The PCM will energize the A/C clutch whenever the engine is running less than 4100 RPM and A/C has been requested, unless any of the following conditions are met:

- Wide Open Throttle (WOT).
- A/C head pressure greater than 431 psi or less than 0 psi (as determined by the A/C refrigerant pressure sensor).
- Ignition voltage less than 10 volts.
- Engine speed greater than 5550 RPM for 180 seconds.
- ECT greater than 124°C (256°F).

The A/C Request Table should be used for diagnosing the A/C request circuit only. Refer to Section 1B or 1C of the appropriate service manual should be used for diagnosing the refrigerant portion of the system.

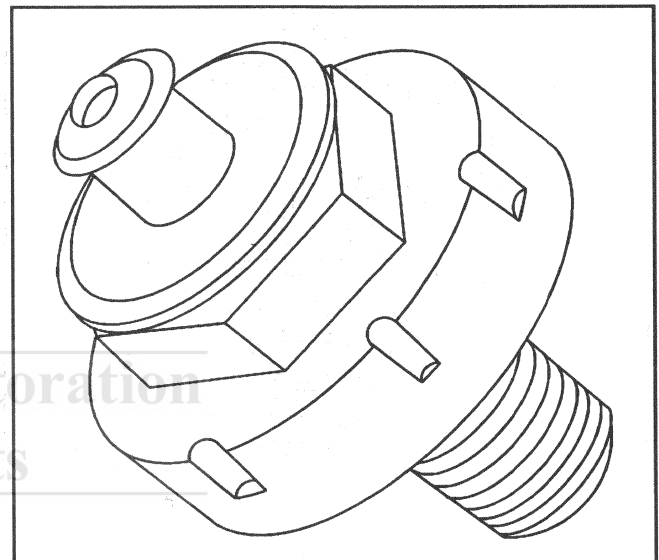
The scan tool will be used in diagnosing the system. The PCM has the ability to display the following parameters:

- A/C request input to the PCM
- A/C compressor status
- A/C system pressure
- A/C clutch ON or OFF status

Refer to Heater Ventilation and Air Conditioning (HVAC) for service procedures.

Knock Sensor System

Knock Sensor



13635

Varying octane levels in today's gasoline can cause detonation in some engines. Detonation is sometimes called spark knock. Detonation is caused by an uncontrolled explosion (burn) in the combustion chamber. This uncontrolled explosion could produce a flame front opposite that of the normal flame front produced by the spark plug. The rattling sound normally associated with detonation is the result of two or more opposing pressures (flame fronts) colliding within the combustion chamber. Though light detonation is sometimes considered normal, heavy detonation could result in engine damage.

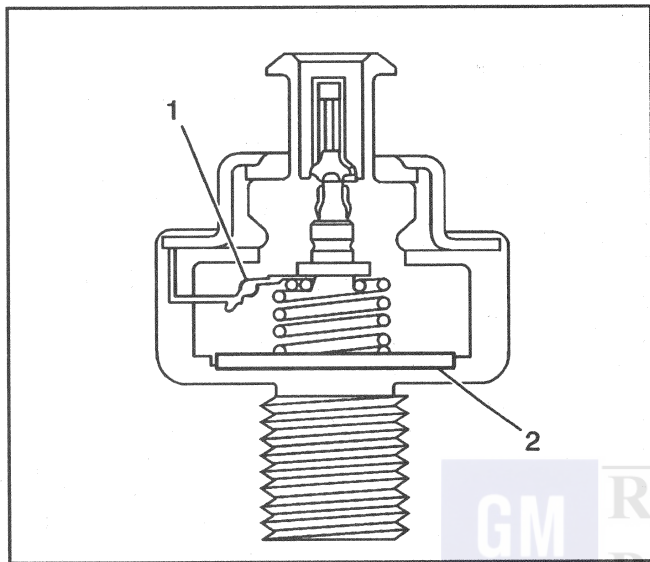
To control spark knock, a Knock Sensor (KS) system is used. This system is designed to retard spark timing up to 20° to reduce spark knock in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

The Knock system has the following components:

- KS module.
- Knock sensor(s)

The knock sensor system is used to detect engine detonation. The PCM will retard the spark timing based on signals from the KS module. The knock sensor(s) produce an AC voltage which is sent to the KS module. The amount of AC voltage produced by the sensors is determined by the amount of knock. This signal voltage is input to the PCM. The PCM then adjusts the Ignition Control (IC) to reduce spark knocking.

Knock Sensor Cutaway



Legend

- (1) Shunt Resistor
- (2) Piezo Crystal

The scan tool has several positions for diagnosing the KS circuit.

- KS activity indicates whether or not a knock signal is being detected by the knock sensors. The scan tool will display YES when a knock is detected.
- Knock retard indicates the amount of spark the PCM is removing from the IC spark advance in response to the signal from the knock sensors.
- Spark Indicates the amount of spark advance being commanded by the PCM on the IC circuit.

DTC P0325 indicates that the KS module is malfunctioning or is missing. DTCs P0327 and P0332 indicates that a Knock sensor or Knock sensor circuit is malfunctioning. If these DTCs are set, Refer to applicable DTC table.

Electric Cooling Fan

General Description

The electric cooling fan(s) are used to cool engine coolant flowing through the radiator. They are also used to cool the refrigerant flowing through the A/C condenser.

Operation

The electric cooling fan(s) are controlled by the PCM. The PCM controls the ground path for the cooling fan relay(s). The relay(s) are used to control the high current flow to power the cooling fan motors. The PCM determines operation of the independent fans based on various sensor inputs.

Primary Cooling Fan (Fan 1)

The primary cooling fan is controlled by the PCM based on the following inputs:

- The A/C system
- The Engine Coolant Temperature (ECT) sensor
- The Vehicle Speed Sensor (VSS).

The PCM will turn the primary cooling fan ON when any of the following conditions exist at idle:

- Certain PCM Diagnostic Trouble Codes (DTCs) are set.
- ECT above 107°C (225°F).
- A/C head pressure above 225 psi.

Once the primary fan has been turned ON by the Engine Coolant Temperature (ECT) sensor, the PCM will turn the fan OFF when that temperature has dropped about 4°C (7°F). If the primary cooling fan has been turned ON by high A/C head pressure, the PCM will turn the fan OFF when the pressure has dropped to 180 psi. The minimum ON time for the primary cooling fan is 50 seconds.

Secondary Cooling Fan (Fan 2)

The secondary cooling fan is controlled by the PCM based on the following inputs:

- The A/C system
- The Engine Coolant Temperature (ECT) sensor
- The Vehicle Speed Sensor (VSS).

The PCM will turn the secondary cooling fan ON when any of the following conditions exist at idle:

- Certain PCM Diagnostic Trouble Codes (DTCs) set.
- ECT above 111°C (232°F).
- A/C head pressure above 248 psi.

Once the secondary fan has been turned ON by the ECT, the PCM will turn the fan OFF when that temperature has dropped about 4°C (7°F). If the secondary cooling fan has been turned ON by high A/C head pressure, the PCM will turn the fan OFF when the pressure has dropped to 203 psi. The minimum ON time for the secondary cooling fan is 26 seconds.

Important: Vehicles equipped with option VO8 (Heavy Duty Cooling), will have one mechanical fan (primary) and one electric fan (secondary).

Diagnosis

The following diagnostic table will diagnose the contact side of the cooling fan relays. The driver side of the cooling fan relays (Coil side of relay) will be diagnosed using DTCs P1641 and P1642.

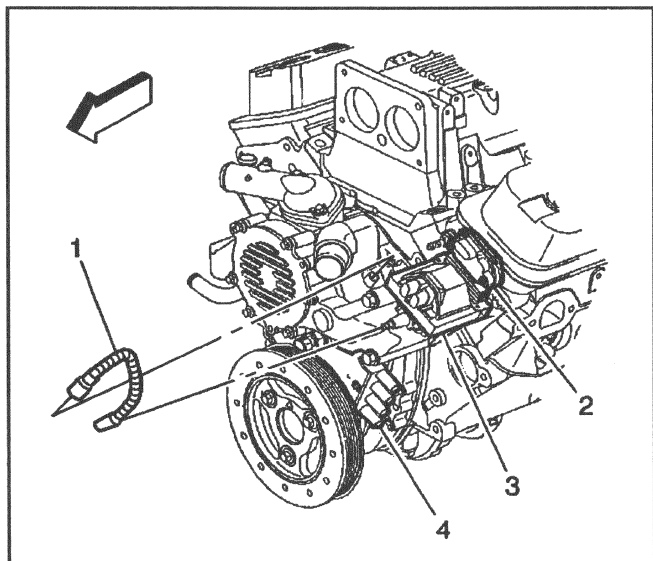
Distributor Ignition System

The distributor ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the PCM controls distributor spark advance (timing) with an Ignition Control (IC) system. Only the IC system will be described here. Additional information on the system is found in Ignition System (6D).

To properly control ignition/combustion timing the PCM needs to know:

- Camshaft position.
- Engine speed (RPM).
- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine coolant temperature.
- The amount of detonation.

Distributor Ignition System



21190

Legend

- (1) Ignition Coil Wire
- (2) Ignition Coil Module
- (3) Ignition Coil
- (4) Distributor

The distributor ignition system is a net build distributor (no timing adjustment) that provides angle based timing information to the PCM for individual cylinder spark timing. The ignition module is capable of providing both 4X and 180X timing pulses each crankshaft revolution. Using these timing pulses, the PCM processes ignition spark timing and sends an IC signal to the ignition coil module to activate the secondary ignition system.

The PCM provides the distributor with the following:

- Ignition voltage circuit.
- Ground circuit.
- Two 5 volt reference voltages to the ignition control module.

As the camshaft turns (during crank or run), a slotted two-track timing disk is rotated inside the ignition control module. Each time a slot in either track of the disk is properly aligned, the ignition control module will pulse one of the 5 volt reference voltages to ground. A reference signal is generated each time the PCM detects that the reference voltages have been grounded by the ignition control module. When the PCM detects reference signals, ignition timing can be processed.

The PCM will also compare the 4X and the 180X signals to each other to determine the location of the number one cylinder and top dead center. In addition, if only one signal is being received by the PCM a Diagnostic Trouble Code (DTC) will be set. DTC P1371 will be set if the 4X signal is missing and DTC P0372 will be set if the 180X signal is missing. The vehicle will not run if the 4X (Reference) signal is not available at the PCM for processing.

The Ignition Control (IC) system consists of the following:

- Camshaft Position Sensor
- Ignition Coil
- Ignition Coil Module
- Powertrain Control Module.

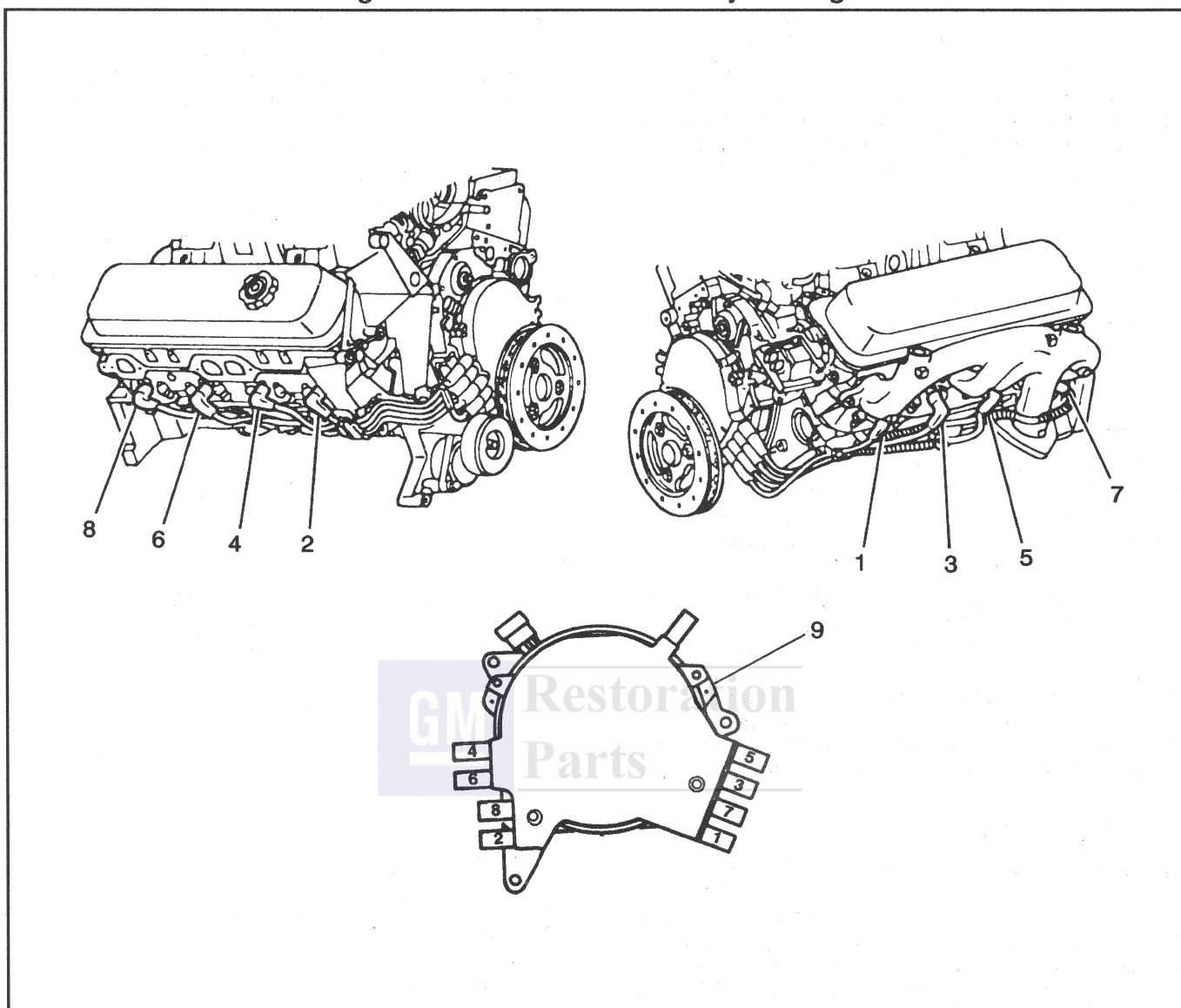
These circuits perform the following functions:

- Low resolution signal reference.
 - This provides the PCM with reference signals, firing order, and camshaft position information. If the low resolution signal circuit becomes open or grounded, the engine will not run because the PCM will not operate the ignition coil module, fuel pump, or the fuel injectors.
 - A DTC P1371 will set if the PCM receives high resolution signal references without the low resolution signals. If the engine cranks but will not start, refer to *Engine Cranks but Does Not Run*.

- High resolution signal reference.
 - This provides the PCM with detailed reference signals and crankshaft position information.
 - If this circuit becomes opens or grounded a DTC P0372 will set and the engine will still run.
 - When there is a malfunction with the high resolution circuit, excessive crank times will be experienced.
- System ground.
 - This circuit is grounded at the PCM and provides ground for the distributor to generate low and high resolution signal reference signals.
- If this circuit becomes open, the engine will not run since there will be no reference information.
- Ignition Control (IC).
 - This circuit controls the ignition coil ON and OFF time. It signals the ignition coil module to begin primary coil dwell current when the IC is high. The ignition coil module shuts OFF ignition coil current when the signal goes low.
 - If this circuit becomes open, shorted to voltage, or grounded, the engine will not start and a DTC P1351 or P1361 will set.



Ignition Wire Harness Assembly Routing



13492

Legend

- | | |
|-----------------|--------------------------|
| (1) Cylinder #1 | (5) Cylinder #5 |
| (2) Cylinder #2 | (6) Cylinder #6 |
| (3) Cylinder #3 | (7) Cylinder #7 |
| (4) Cylinder #4 | (8) Cylinder #8 |
| | (9) Distributor Assembly |

Results of Incorrect Operation

An open IC circuit will set a DTC P1351. A grounded IC circuit will set a DTC P1361. An open or grounded IC circuit will result in an engine cranks but will not run. An open or ground in the low resolution signal circuit will set a DTC P1371 and the engine will not start. If the high resolution signal circuit becomes open or grounded a DTC P0372 would set. This will cause reduced performance and poor fuel economy.

An inoperative distributor vent system may cause premature distributor failure. To check system operation perform *Distributor Vent System Check*.

The PCM uses information from the MAP and engine coolant temperature sensor in addition to RPM to calculate spark advance as follows:

- Cold engine = More spark advance.
- Engine under minimum load based on RPM and low amount of air flow – More spark advance.
- Hot engine = Less spark advance.

- Engine under heavy load based on RPM and high amount of air flow – Less spark advance.

For removal and replacement of ignition system components, refer to Section 6D4, Ignition System.

The description, operation and repair procedures of the distributor ignition system components are found in Service Category Ignition Systems. For misfire or ignition control check, refer to the following DTCs:

- P0300
- P0323
- P0372
- P1351
- P1361
- P1371

Air Intake System

Air Intake System

Important: If the Mass Air Flow (MAF) sensor is installed backwards, the system will go rich. An arrow cast into the plastic portion of the sensor indicates proper air flow direction. The arrow must point toward the engine.

The Air intake system draws outside air through the filter element. The air cleaner assembly is remotely mounted. The air is then ducted to the MAF sensor, a resonator (for quieter engine operation) and the intake duct to the throttle body. An additional resonator is attached to the top of the intake duct to further eliminate intake noise. The air then flows into the intake manifold, through the cylinder heads and into the cylinders.

Fuel Supply Components

The fuel tank stores the fuel supply. An electric fuel pump, located in the fuel tank with the fuel level sensor assembly, pumps fuel through an in-line fuel filter to the fuel rail assembly. The pump provides fuel at a pressure greater than is needed by the injectors. The fuel pressure regulator, part of the fuel rail assembly, keeps fuel available to the injectors at a regulated pressure. A separate pipe returns unused fuel to the fuel tank.

Fuel Tank

The fuel tank stores fuel for the vehicle. The fuel tank is located behind the rear wheels and is held in place by two metal straps and a cross strap attached to the underbody. The tank shape includes a reservoir to maintain a constant supply of fuel around the fuel pump strainer during low fuel conditions and aggressive vehicle maneuvers. The fuel tank is molded from high density polyethylene. When working on or near the fuel tank, be sure to observe important information molded on the bottom of the tank.

Fuel Tank Filler Pipe

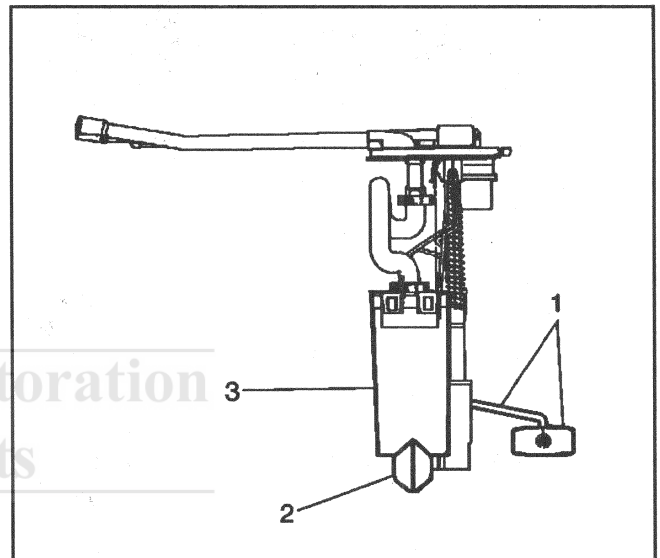
The fuel tank filler pipe outlet is positioned at the rear of the vehicle. The fuel filler pipe has a built-in restrictor and deflector in order to prevent refueling with leaded fuel.

Fuel Filler Cap

The filler pipe has a threaded-type cap. The threaded part of the cap requires several turns counterclockwise to remove. A torque-limiting device prevents the cap from being over tightened. To install the cap, turn the cap clockwise until you hear a clicking noise. This indicates that the cap is correctly torqued and fully seated.

Notice: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serious malfunction of the system.

Fuel Sender Assembly



21312

The fuel sender assembly is inside the fuel tank attached to the top of the fuel tank. The fuel sender assembly consists of the following major components:

- The fuel sender (1).
- The fuel pump (3).
- The fuel pump strainer (2).

Fuel Sender

The fuel sender consists of a float, a wire float arm, a rheostat, and a roll-over valve. Fuel level is sensed by the position of the float and float arm which operate the 90 ohm rheostat. As the float position changes, the amount of current passing through the rheostat varies, thus changing the gauge reading on the instrument panel. The EVAP pipe of the fuel sender has a pressed in roll-over valve. The roll-over valve prevents fuel from entering the evaporative emission canister if the vehicle rolls over by shutting OFF the EVAP pipe to the canister.

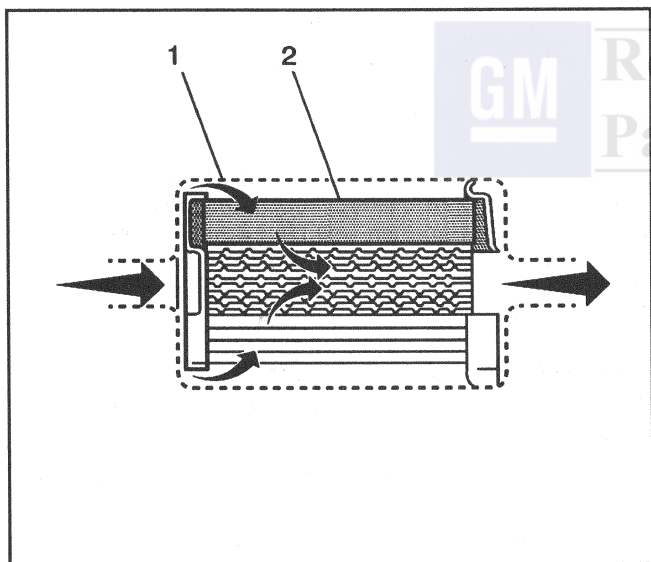
Fuel Pump

The fuel pump attaches to the fuel sender assembly inside the fuel tank. The fuel pump is an electric medium pressure twin turbine pump. The fuel pump pumps fuel to the fuel rail assembly at a specified flow and pressure. Excess fuel returns to the fuel tank by the return pipe. The fuel pump delivers a constant flow of fuel to the engine even during low fuel conditions and aggressive vehicle maneuvers. The PCM controls the electric fuel pump operation through a fuel pump relay.

Fuel Pump Strainer

The fuel pump strainer attaches to the lower end of the fuel pump. The fuel pump strainer is made of woven plastic. The functions of the fuel pump strainer are to filter contaminants and to wick fuel. The fuel pump strainer is self-cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water. Clean the fuel tank and replace a plugged fuel pump strainer with a new one.

In-Line Fuel Filter



12628

The fuel feed pipe has a steel fuel filter installed ahead of the fuel injection system. The paper filter element (2) traps particles in the fuel that may damage the injection system. The filter housing (1) is made to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. Quick-connect type fittings are used at both ends of the filter. There is no service interval for fuel filter replacement. Replace a restricted fuel filter.

Nylon Fuel Pipes

Nylon fuel pipes are designed to perform the same job as the steel or flexible fuel pipes or hoses that they replace. Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There are two sizes of nylon fuel pipes used: 3/8" ID for the fuel feed, and 5/16" ID for the fuel return.

The fuel feed and return pipes are assembled as a harness. Retaining clips hold the pipes together and provide a means for attaching the pipes to the vehicle. Heat resistant rubber hose and/or corrugated plastic conduit protect the sections of the pipes that are exposed to chafing, high temperature or vibration.

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if nylon fuel pipes are forced into sharp bends, the pipes will kink and restrict the fuel flow. Also, once exposed to fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Take special care when working on a vehicle with nylon fuel pipes.

Caution: In Order To Reduce the Risk of Fire and Personal Injury: Always cover nylon fuel pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period. Take care not to nick or scratch the nylon fuel pipes. If damaged, they must be replaced.

Quick-Connect Fittings

Quick-connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consist of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs or fingers hold the fittings together.

EVAP Pipes and Hoses

The EVAP pipe extends from the fuel sender assembly to the evaporative emission canister. The EVAP pipe is made of nylon pipe. The EVAP pipe connects to the fuel sender assembly and the evaporative emission canister with fuel resistant rubber hoses.

Caution: To Reduce the Risk of Fire and Personal Injury:

- **Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.**
- **Take care not to nick or scratch the nylon vapor pipes. If damaged, replace the nylon vapor pipes.**

Fuel Metering Modes of Operation

Modes of Operation

The PCM looks at voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions called modes. The PCM controls all modes.

Starting Mode

With the ignition switch in the ON position (before engaging the starter), the PCM energizes the fuel pump relay for two seconds allowing the fuel pump to build up pressure. The PCM first checks speed density, then switches to the Mass Air Flow (MAF) sensor. The PCM also uses the Engine Coolant Temperature (ECT), Throttle Position (TP), and Manifold Absolute Pressure (MAP) sensors to determine the proper air/fuel ratio for starting. This ranges from 1.5:1 at -36°C (-33°F) to 14.7:1 at 94°C (201°F) running temperature. The PCM controls the amount of fuel delivered in the starting mode by changing the pulse width of the injectors. This is done by pulsing the injectors for very short times.

Clear Flood Mode

If the engine floods, clear the engine by pushing the accelerator pedal down all the way. The PCM then pulses the injectors at an air/fuel ratio of 20:1. The PCM holds this injector rate as long as the throttle stays wide open and the engine speed is below 300 RPM. If the throttle position becomes less than 80 percent, the PCM returns to the starting mode.

Run Mode

The run mode has two conditions called Open Loop and Closed Loop. When the engine is first started, and engine speed is above a predetermined RPM, the system begins Open Loop operation. The PCM ignores the signal from the HO₂S and calculates the air/fuel ratio based on inputs from the ECT, MAF, MAP, and TP sensors. The system stays in Open Loop until meeting the following conditions:

- Both HO₂S have varying voltage output, showing that they are hot enough to operate properly. (This depends on temperature.)
- The ECT sensor is above a specified temperature.
- A specific amount of time has elapsed after starting the engine.

Specific values for the above conditions exist for each different engine, and are stored in the Electrically Erasable Programmable Read Only Memory (EEPROM). The system begins Closed Loop operation after reaching these values. In Closed Loop, the PCM calculates the air/fuel ratio (injector on-time) based on the signal from various sensors, but mainly the HO₂S. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

When the driver pushes on the accelerator pedal, air flow into the cylinders increases rapidly, while fuel flow tends to lag behind. To prevent possible hesitation, the PCM increases the pulse width to the injectors to provide extra fuel during acceleration. The PCM determines the amount of fuel required based on throttle position, coolant temperature, manifold air pressure, mass air flow and engine speed.

Deceleration Mode

When the driver releases the accelerator pedal, air flow into the engine is reduced. The PCM looks at the corresponding changes in throttle position, manifold air pressure and mass air flow. The PCM shuts OFF fuel completely if the deceleration is very rapid, or for long periods (such as long closed throttle coast-down). The fuel shuts OFF in order to protect the warm-up three-way catalytic converters.

Battery Voltage Correction Mode

When battery voltage is low, the PCM compensates for the weak spark delivered by the distributor in the following ways:

- Increasing the amount of fuel delivered.
- Increasing the idle RPM.
- Increasing ignition dwell time.

Fuel Cutoff Mode

To prevent possible engine damage from over-speed, the PCM cuts off fuel from the injectors when the engine speed is above approximately 5500 RPM. To prevent tire damage on vehicles equipped with base tires, the PCM also cuts off fuel from the injectors at vehicle speeds above 108 mph. Also, see Rapid Deceleration in Deceleration Mode.

Fuel Metering System Components

The fuel metering system consists of the following parts:

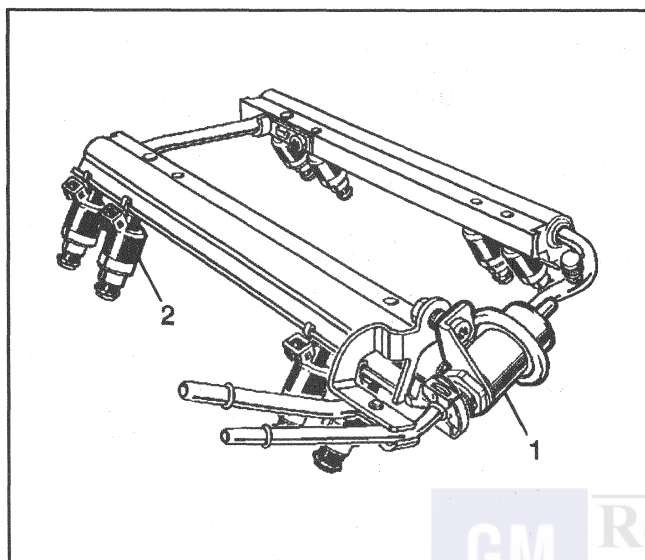
- The fuel supply components (fuel tank, pump, pipes).
- The fuel pump electrical circuit.
- The fuel rail.
- The fuel injectors.
- The fuel pressure regulator.
- The throttle body.
- The Idle Air Control (IAC) valve.
- The Throttle Position (TP) sensor.

The fuel tank stores the fuel supply. An electric fuel pump, located in the fuel tank with the fuel level sensor assembly, pumps fuel through an in-line fuel filter to the fuel rail assembly. The pump provides fuel at a pressure greater than is needed by the injectors. The fuel pressure regulator, part of the fuel rail assembly, keeps fuel available to the injectors at a regulated pressure. A separate pipe returns unused fuel to the fuel tank.

Fuel Pump Electrical Circuit

When the ignition switch is in the ON position (before engaging the starter), the PCM energizes the fuel pump relay for two seconds, causing the fuel pump to pressurize the fuel system. If the PCM does not receive ignition reference pulses (engine cranking or running) within two seconds, it shuts OFF the fuel pump relay, causing the fuel pump to stop.

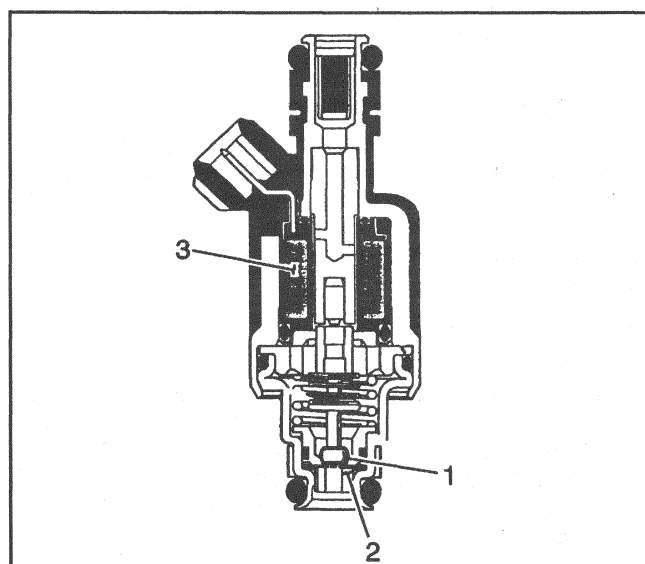
Fuel Rail Assembly



The fuel rail assembly attaches to the engine intake manifold. The fuel rail assembly performs the following functions:

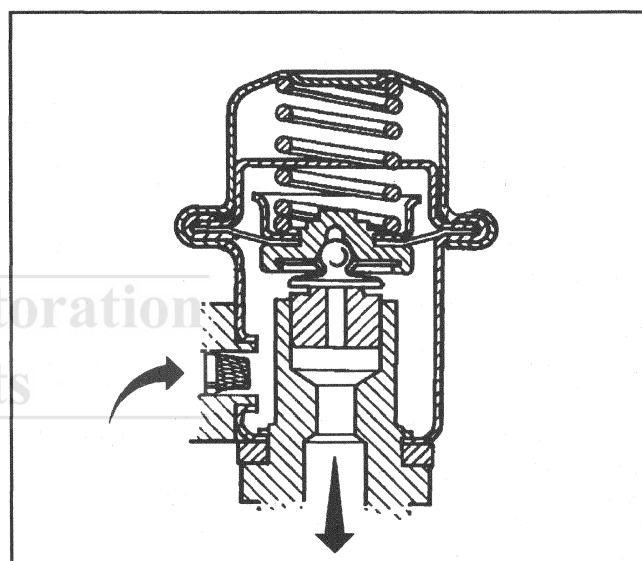
- It positions the injectors (2) in the intake manifold.
- It distributes fuel evenly to the injectors.
- It integrates the fuel pressure regulator (1) into the fuel metering system.

Fuel Injectors



The top-feed fuel injector assembly is a solenoid operated device, controlled by the PCM, that meters pressurized fuel to a single engine cylinder. The PCM energizes the injector solenoid (3), which opens a ball valve (1), allowing fuel to flow past the ball valve, and through a recessed flow director plate (2). The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber. An injector stuck partly open can cause a loss of pressure after engine shutdown. Consequently, long cranking times would be noticed on some engines.

Fuel Pressure Regulator Assembly

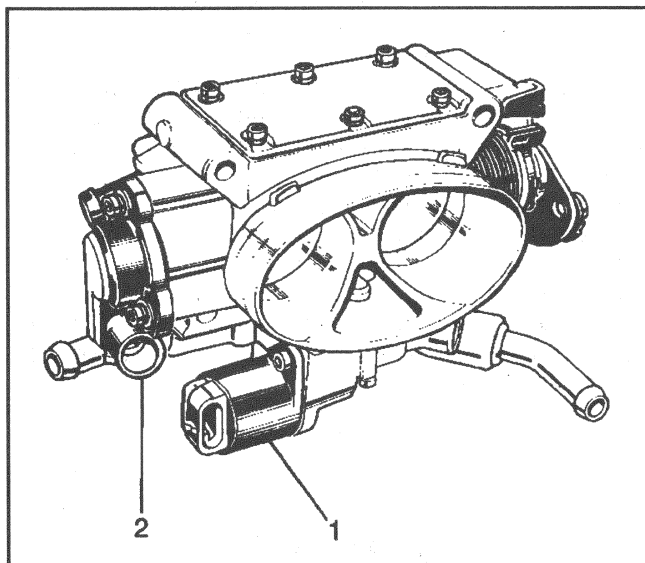


The fuel pressure regulator is a diaphragm operated relief valve with fuel pump pressure on one side, and regulator spring pressure and intake manifold vacuum on the other side. The fuel pressure regulator maintains a constant pressure differential across the injectors at all times. The pressure regulator compensates for engine load by increasing fuel pressure as engine vacuum drops. With the ignition ON and the engine OFF (zero vacuum), system fuel pressure at the pressure test connection should be 284–325 kPa (41–47 psi). If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Diagnostic Trouble Code (DTC) P0132, P0152, P0172 or P0175 may result. Table A-7 has information on diagnosing fuel pressure conditions.

Accelerator Controls

The accelerator control system is cable operated. There are no linkage adjustments, therefore use the specific cable for each application.

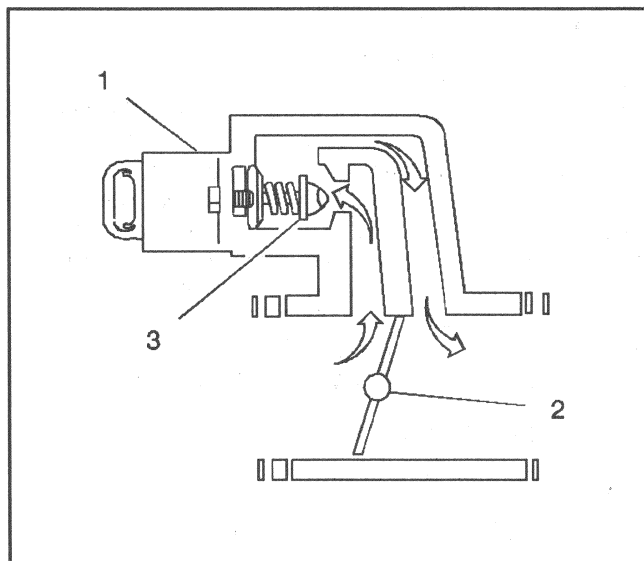
Throttle Body Assembly



21314

The throttle body assembly attaches to the intake manifold. The throttle body controls air flow into the engine, thereby controlling engine output. The vehicle operator opens the throttle valves within the throttle body through the accelerator controls. During engine idle, the throttle valves are almost closed. A fixed air bypass orifice and the Idle Air Control (IAC) valve (1) handle the air flow control. Engine coolant flows through the coolant cavity on the bottom of the throttle body in order to prevent throttle valve icing during cool weather operation. The throttle body also provides the location for mounting the Throttle Position (TP) sensor (2) and for sensing changes in engine vacuum due to throttle valve position. Vacuum ports are located at, above, or below the throttle valve to generate vacuum signals needed by various components.

Idle Air Control (IAC) Valve



10172

The purpose of the IAC valve is to control engine idle speed, while preventing stalls due to changes in engine load. The IAC valve, mounted in the throttle body, controls a portion of the bypass air. An orifice located between the throttle valves also supplies a constant amount of bypass air. By moving a conical valve known as a pintle, in, towards the seat (to decrease air flow); or out, away from the seat (to increase air flow), a controlled amount of air can be bypassed. If engine speed is too low, more air is bypassed to increase RPM. If engine speed is too high, less air is bypassed to decrease RPM. The PCM moves the IAC valve in small steps, called counts. These can be measured and displayed by a scan tool, which plugs into the Data Link Connector (DLC). The PCM calculates the proper position of the IAC valve during idle based on battery voltage, coolant temperature, engine load, and engine RPM. If the RPM drops below specification and the throttle valve is closed, the PCM senses a near stall condition and calculates a new valve position in order to prevent stalling.

- Engine idle speed is a function of total air flow into the engine. Idle speed is based on IAC valve pintle position + crankcase ventilation valve flow + throttle valve opening + bypass orifice air flow + calibrated vacuum loss through accessories.
- Controlled idle speed is programmed into the PCM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum idle air rate is set at the factory with a stop screw. This setting allows enough air flow by the throttle valves to cause the IAC valve pintle to be positioned a calibrated number of steps (counts), from the seat, during controlled idle operation.
- If the IAC valve is disconnected and reconnected with the engine running, the idle speed may be wrong. If this occurs, reset the IAC valve by depressing the accelerator pedal slightly, start and run the engine for five seconds, then turn the ignition OFF for ten seconds.

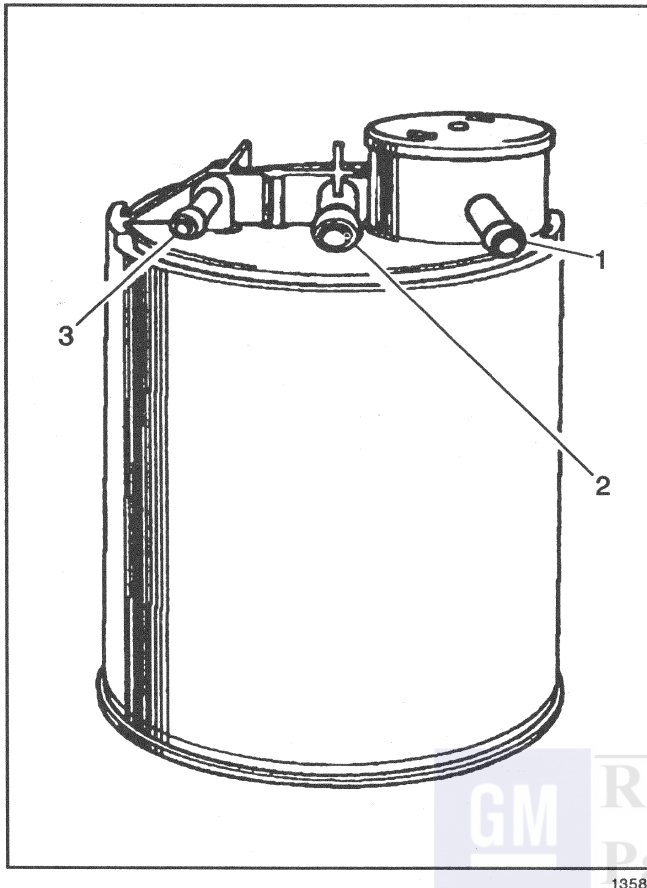
Throttle Position (TP) Sensor

The TP sensor attaches to the side of the throttle body opposite the throttle lever. It senses the throttle valve angle and relays that information to the PCM. The PCM requires knowledge of throttle angle to generate the required injector control signals (pulses).

EVAP Control System

The Evaporative Emission (EVAP) control system used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

Fuel Vapor Canister



Legend

- (1) Tank Tube
- (2) Air Tube (Fresh Air Inlet)
- (3) Purge Tube

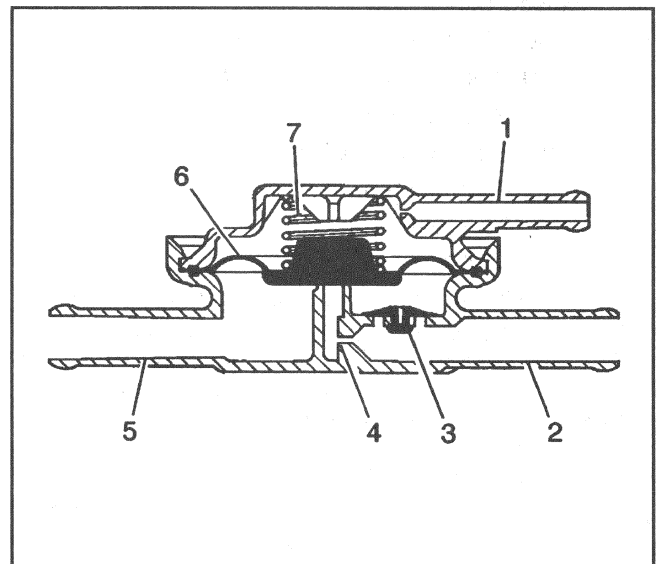
The Evaporative Emission (EVAP) control system uses a 1500 cc charcoal canister to absorb fuel vapors from the gas tank.

When gasoline vapor builds enough to overcome the spring tension of the EVAP pressure control valve, the vapor will flow to the canister where it is absorbed and stored by the charcoal. Under certain operating conditions the PCM will command the purge solenoid valve to open. This allows the vapor to flow into the intake manifold for combustion.

This system has a remote mounted canister purge control solenoid valve. The PCM operates this solenoid valve to control vacuum to the canister. Under cold engine or idle conditions, the solenoid valve is closed, which prevents vacuum from being applied to the canister. The PCM activates (or opens) the solenoid valve and allows purge under the following conditions:

- Engine is warm.
- After the engine has been running a specified period of time.
- Above a specified road speed.
- Above a specified throttle opening.

EVAP Pressure Control Valve



13645

Legend

- (1) Control Tube
- (2) Tube to Canister
- (3) Umbrella Valve
- (4) Restriction
- (5) Tube to Fuel Tank
- (6) Diaphragm
- (7) Diaphragm Spring

Evaporative Emission (EVAP) Pressure Control Valve

This system uses an in-line EVAP pressure control valve as a pressure relief valve. When vapor pressure in the tank exceeds approximately 5 kPa (.7 psi) the diaphragm valve opens, allowing vapors to vent to the canister. A 1.14 mm (0.045 inch) orifice in the passage leading to the canister tube causes pressure to drop slowly, preventing the valve from oscillating (buzzing). When the tank pressure drops below 5 kPa (.7 psi), the valve closes causing vapors to be held in the fuel tank.

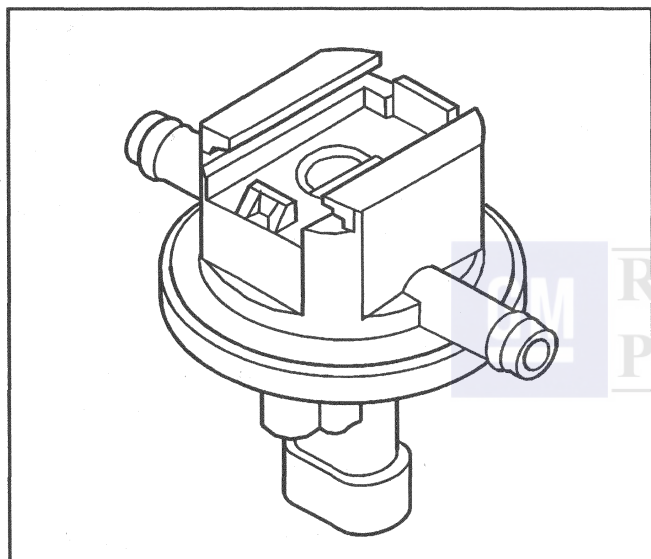
Results of Incorrect Operation

- Poor idle, stalling and poor driveability can be caused by the following:
 - Inoperative purge solenoid valve.
 - Damaged canister.
 - Hoses split, cracked and, or not connected to the proper tubes.

- Evidence of fuel loss or fuel vapor odor can be caused by:
 - Liquid fuel leaking from fuel lines.
 - Cracked or damaged canister.
 - Inoperative canister control valve.
 - Vacuum hoses that are:
 - Disconnected.
 - Mis-routed–routed.
 - Kinked.
 - Deteriorated or damaged vapor hoses.

If the solenoid valve is open, or is not receiving power, the canister can purge to the intake manifold at the incorrect time. This can allow extra fuel during warm-up, which can cause rough or unstable idle.

EVAP Vacuum Switch



EVAP Purge Vacuum Switch

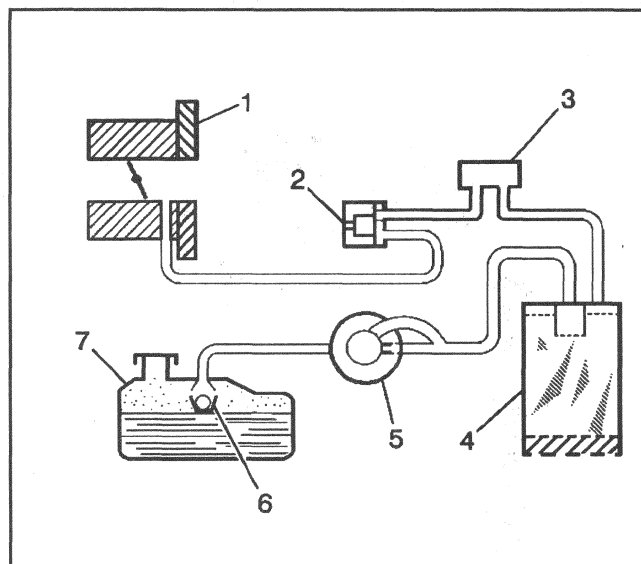
The EVAP Purge Vacuum Switch is used by the PCM to monitor EVAP canister purge solenoid operation and purge system integrity. The EVAP Purge Vacuum Switch should be closed to ground with no vacuum present (0% EVAP Purge PWM). With EVAP Purge PWM at 25% or greater, the EVAP Purge Vacuum Switch should open.

An incorrect EVAP Purge system flow should set a DTC P0441. A continuous purge condition with no purge commanded by the PCM should set a DTC P1441. Refer to Evaporative Emission (EVAP) Control System for a complete description of the EVAP system.

The Evaporative Emission (EVAP) canister purge solenoid valve and the EVAP Vacuum switch diagnosis is covered in the following DTCs:

- P0441
- P0443
- P1441

EVAP Control System Schematic



Legend

- (1) Throttle Body
- (2) EVAP Solenoid Valve
- (3) EVAP Vacuum Switch
- (4) EVAP Canister
- (5) EVAP Pressure Control Valve
- (6) Floating Roll-Over Valve
- (7) Fuel Tank

Visual Check of EVAP Canister

If cracked or damaged, replace EVAP canister.

Evaporative Emission (EVAP) Pressure Control Valve

With a hand vacuum pump, apply approximately 51 kPa (15 in. Hg) to the control vacuum tube. After ten seconds, there should be at least 17 kPa (5 in. Hg) vacuum remaining. Be sure the hand vacuum pump being used does not have an internal leak and the hose connections to control vacuum tube and pump are secure. If after 10 seconds there is less than 17 kPa (5 in. Hg) vacuum, the valve must be replaced.

With 51 kPa (15 in. Hg) vacuum still applied to the control vacuum tube, attach a short piece of hose to the valve's tank tube side. Blow into the tube. You should feel the air pass through the valve. If air does not pass through, the valve must be replaced.

Secondary Air Injection System

The Secondary Air Injection (AIR) system helps reduce Hydrocarbon (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx) exhaust emissions. It also heats up the warm up 3-way catalytic converters quickly on engine start-up so conversion of exhaust gases can occur sooner.

The system includes the following:

- **AIR pump** – The AIR pump is mounted to the lower left front of the engine Compartment and supplies the air to the AIR system. The electric air pump pressurizes air from the engine and pumps it to the check valves near the exhaust manifolds. The AIR pump is controlled by the PCM. Battery voltage to the AIR pump is controlled by the AIR pump relay. An integral stop valve prevents air flow through the pump during OFF periods. When the PCM provides a ground circuit for the secondary AIR pump relay, battery voltage is allowed to power up the AIR pump and integral stop valve.
- **Vacuum Bleed Valve** – This valve helps prevent vacuum buildup within the AIR system, which could prevent the integral stop valve from opening. The bleed valve is controlled by the air pump relay and will be energized when the AIR pump is commanded ON. If the vacuum relief system is not functioning, the vacuum will cause the AIR pump integral valve not to open. This may result in no AIR flow to the exhaust manifolds or delay the delivery of air which may not allow the diagnostic to pass.
- **Check valves** – The check valves prevent back flow of exhaust gases into the AIR pump in the event of an exhaust backfire.
- **Necessary plumbing.**
 - Hoses
 - Pipes
 - Clamps

- (5) Check Valve
- (6) AIR Injection Pipe
- (7) Intake Manifold
- (8) AIR Injection Pipe
- (9) AIR Bleed Valve Solenoid Valve
- (10) Air to Exhaust Ports
- (11) Fresh Air Intake Pipe

The AIR pump with integral stop valve is controlled by the PCM. The PCM will turn ON the AIR pump by providing the ground to complete the circuit which energizes the AIR pump relay. When air to the exhaust ports is desired, the PCM turns ON both the integral stop valve and AIR pump.

The PCM turns ON the AIR pump during startup any time engine coolant temperature is above 15°C (59°F). The AIR pump will operate for a maximum of 240 seconds, or until the system enters Closed Loop operation. At the same time the PCM turns the AIR pump OFF, it also de-energizes the integral stop valve solenoid so no air is directed to the exhaust ports.

The air system will be disabled under the following conditions:

- When the PCM recognizes a problem and sets a diagnostic trouble code.
- When the fuel system is operating in Closed Loop.
- The AIR pump has been ON for 240 seconds.
- Engine Speed is greater than 2825 RPM.
- MAP is greater than 96 kPa with VSS over 60 mph.
- MAP is less than 20 kPa.
- ECT less than -8.5°C (17°F).
- Warm up 3-way catalytic converters over temperature detected.
- Short and long term fuel trim are not in their normal ranges.
- Power enrichment is detected.

Results of Incorrect Operation

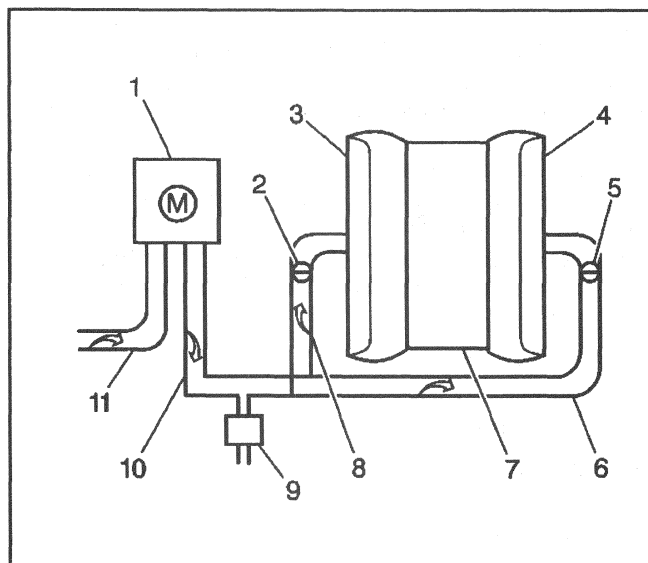
If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels will be too high.

Air flowing to the exhaust ports at all times could increase temperature of the warm up 3-way catalytic converter.

Diagnostic Trouble Codes P0410, P0412, P1415, and P1416 will set if there is a malfunction in the following components:

- The AIR pump.
- The AIR pump relay.
- Hoses or pipes that are leaking.
- The Check valves that are leaking.
- Circuits going to the AIR pump and the AIR pump relay.
- The vacuum bleed valve.

AIR System (Typical)



29965

Legend

- (1) AIR Pump
- (2) AIR Check Valve
- (3) Exhaust Manifold
- (4) Exhaust Manifold

AIR Pump

The AIR pump is a regenerative turbine type which is permanently lubricated and requires no periodic maintenance.

The engine should be at normal operating temperature in neutral at idle. Using the scan tool enable the AIR pump. Select HO2S voltages for both Bank 1 and Bank 2 HO2S. The HO2S voltages for both sensors should remain under 350 mV because air is being directed to the exhaust ports. If the HO2S voltages remain low during the Output Test, the AIR pump and integral stop valve are operating satisfactorily. If the HO2S voltage does not remain low when the AIR pump is enabled, inspect for the following:

- For a seized AIR pump.
- Hoses, pipes and all connections for leaks and proper routing.
- For air flow going to the exhaust ports.
- AIR pump for proper mounting.
- Hoses and Pipes for deterioration or holes.

Hoses and Pipes

If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the AIR pump running, bubbles will form if a leak exists.

Check Valve

Caution: Before proceeding with the next check, make sure the check valve is cooled off. Also, tap on the check valve to remove any debris that may be inside the valve.

A check valve should be inspected whenever the hose is disconnected or whenever check valve failure is suspected. (An AIR pump that had become inoperative and had shown indications of having exhaust gases in the outlet port would indicate check valve failure.)

Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not operate properly.

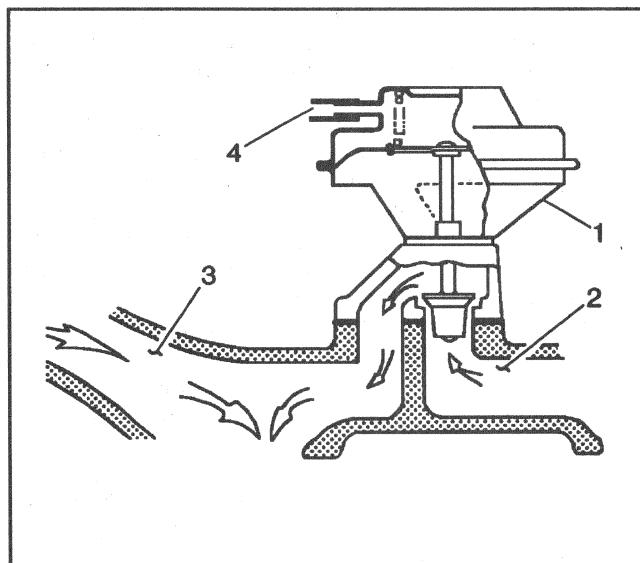
EGR System

The exhaust gas recirculation (EGR) system is used to lower Nox (Oxides of Nitrogen) emission levels that are caused by high combustion temperatures and excessive oxygen. The valve does this by decreasing combustion temperature and displacing oxygen.

The main element of the system is the EGR. The valve is mounted on the intake manifold. The is operated by engine vacuum.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber.

EGR Flow



13637

Legend

- (1) EGR Valve
- (2) Exhaust Gas
- (3) Intake Air
- (4) Ported Vacuum

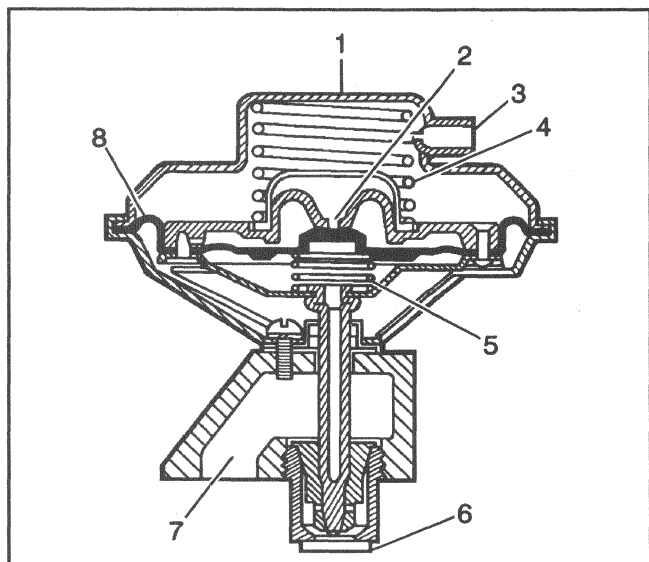
The EGR valve is opened by vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If a large amount of exhaust gas enters the combustion chamber, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the EGR valve. The EGR valve is usually open during warm engine operation when the vehicle is above idle speed.

The EGR vacuum control has a vacuum solenoid valve that is controlled by pulse width modulation. This means the PCM turns the solenoid valve ON and OFF many times a second and varies the amount of ON time to vary the amount of vacuum applied to the EGR valve.

The PCM uses information from the following sensors/inputs to regulate the EGR solenoid valve:

- ECT sensor
- MAP sensor
- RPM
- TP sensor
- IAT sensor
- VSS
- Negative backpressure EGR valves will have a N stamped on the top side of the valve after the part number.
- Positive backpressure EGR valves will have a P stamped on the top side of the valve after the part number.
- Port EGR valves have no identification stamped after the part number.

Negative Backpressure EGR Valve



13573

Legend

- (1) EGR Valve
- (2) Air Bleed Hole
- (3) Vacuum Port
- (4) Large Spring
- (5) Small Spring
- (6) Exhaust Gas
- (7) Intake Air
- (8) Diaphragm

The EGR valve used on this engine is a negative backpressure valve. It varies the amount of exhaust gas flow into the manifold depending on the manifold vacuum and variations in the exhaust backpressure.

The diaphragm on this EGR valve has an internal vacuum bleed hole which is held closed by a small spring when there is no exhaust backpressure. The amount of vacuum to the valve is controlled by an PCM controlled solenoid valve.

Engine vacuum opens the EGR valve against the pressure of a large spring. When vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.

The following DTCs will diagnose the EGR system:

- DTC P0400—EGR System
- DTC P0403—EGR Solenoid Control Circuit

Too much EGR flow dilutes the fresh intake air/fuel mixture causing the engine to operate roughly or stall. With too much flow (at idle, cruise, or cold operation) tends to weaken combustion and may result in any of the following conditions:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Vehicle surges during cruise.
- Rough idle.

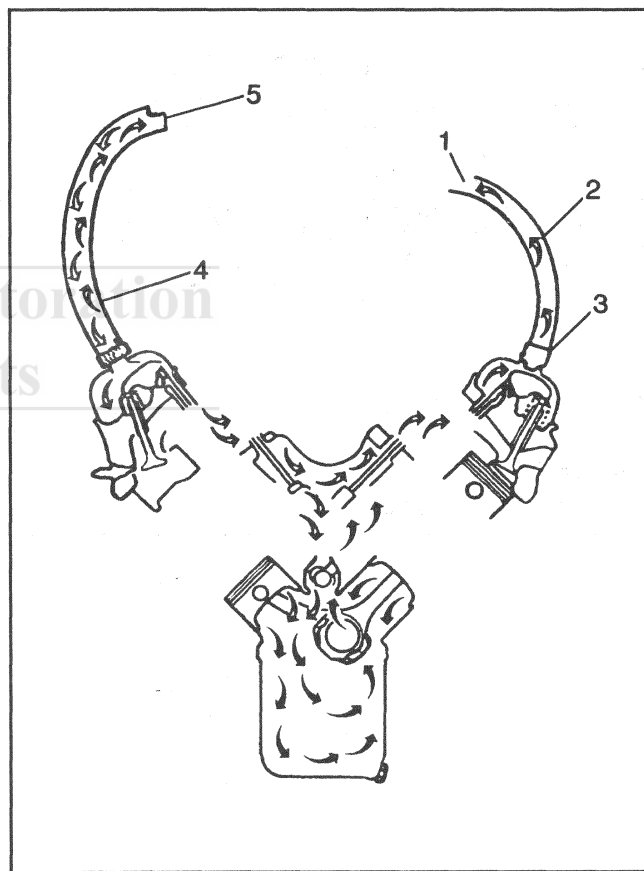
Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause the following:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

Crankcase Ventilation System

A closed crankcase ventilation system is used to provide a more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a crankcase ventilation valve into the intake manifold.

Typical Crankcase Ventilation Valve Flow



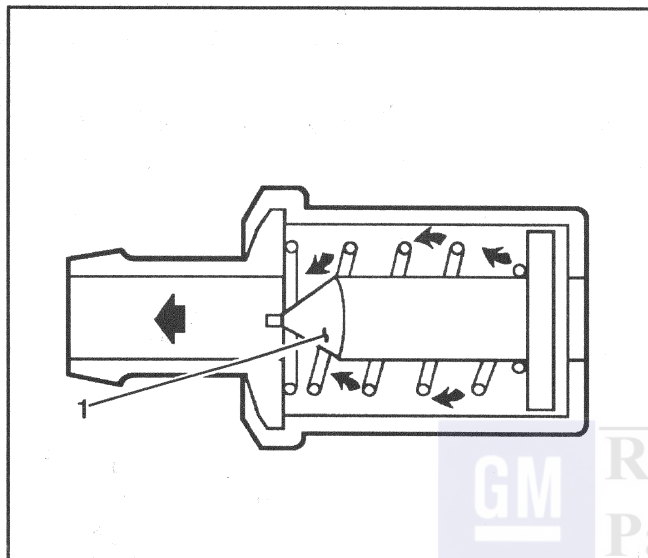
13575

Legend

- (1) To Intake Manifold
- (2) Crankcase Ventilation Valve Hose
- (3) Positive Crankcase Ventilation Valve (PCV)
- (4) Crankcase Vent Hose
- (5) To Throttle Body

The primary control is through the crankcase ventilation valve which meters the flow at a rate depending on manifold vacuum. To maintain idle quality, the crankcase ventilation valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

PCV Cutaway



13636

Legend

(1) Check Valve

Results of Incorrect Operation

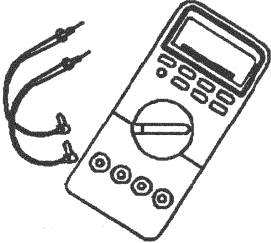
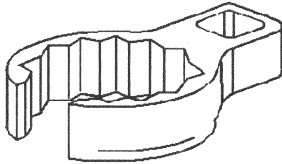
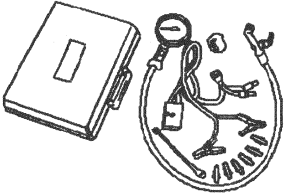
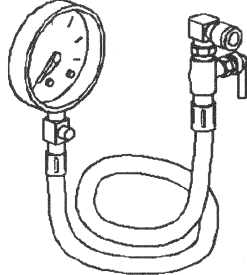
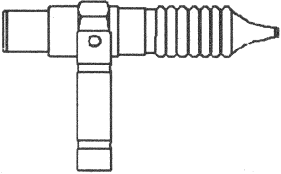
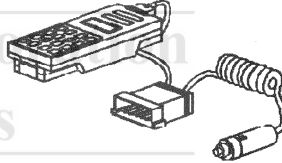
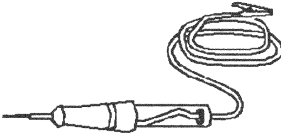
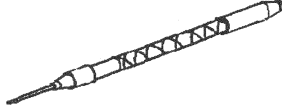
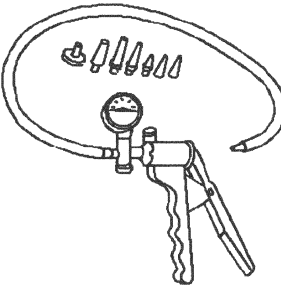
A plugged PCV valve or hose may cause:

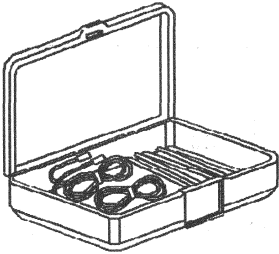
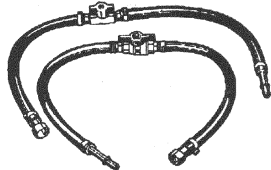
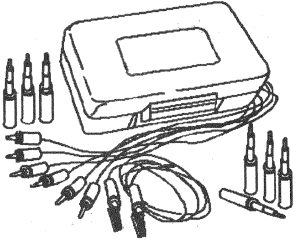
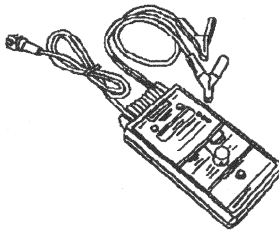
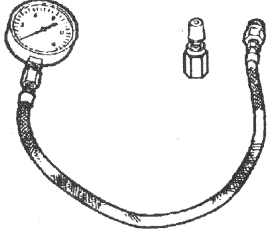
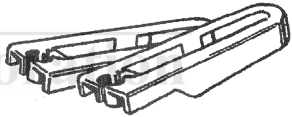
- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in engine.

A leaking valve or hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

Special Tools and Equipment

	J 39200 Digital Multi-meter		J 39194-B Oxygen Sensor Wrench
	J 34730-E Fuel Pressure Gauge Kit		J 34730-1A Fuel Pressure Gauge
	J 26792 Spark Tester		TKO-A Tech 1A 7000001 Cartridge Kit
	J 34142-B Test Light		J 35689-A Metri-Pack Terminal Kit
	J 23738-A Vacuum Pump		J 28742-A Weather Pack Terminal Remover

	J 37027-A IAC Motor Analyzer		J 37287 Inlet and Return Fuel Line Shut-off Adapters
	J 35616-A Connector Test Adapter Kit		J 39021 Fuel Injector Coil/Balance Tester
	J 35314-A Exhaust Back Pressure Tester		J 37088-A Fuel Line Quick Connect Seperator
	J 33431-B Signal Generator and Instrument Panel Tester		

7A

Transmission/Transaxle Diagnosis

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No 2-3 Shift or 2-3 Shift Slips,		Circuit Electrical	7A-84
Rough or Hunting	7A-45	DTC P0751 1-2 (A) Shift	
3-2 Flare or Tie-Up	7A-45	Solenoid Performance	7A-87
No 3-4 Shift, Slips or Rough 3-4 Shift	7A-46	DTC P0753 1-2 (A) Shift	
No Reverse or Slips in Reverse	7A-46	Solenoid Electrical	7A-90
No Part Throttle or Delayed Downshifts	7A-47	DTC P0756 2-3 (B) Shift	
		Solenoid Performance	7A-94

DTC P0758 2-3 (B) Shift Solenoid Electrical.....	7A-97
DTC P1810 TFP Valve Position Sw CKT Malfunction.....	7A-101
DTC P1812 Transmission Fluid Overtemp.....	7A-105
DTC P1860 TCC PWM Solenoid Electrical.....	7A-108
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DTC P1873 Torque Conv Stator Temp Switch Ckt Low.....	7A-117
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Automatic Transmission - 4L60-E

Specifications

Fastener Tightening Specifications

Application	N-m	Lb Ft	Lb In
Accumulator Cover Bolt	11	—	97
Case Extension to Case Bolt	35	26	—
Converter Cover Bolt	10	—	89
Fill Tube Bolt	47	35	—
Floorshift Control Bolt	10	—	89
Flywheel to Torque Converter Bolt	63	46	—
Inflatable Bracket Nut/Bolt	10	—	89
Infatable Restraint Arming Sensor Bracket Screw	10	—	89
Knee Bolster Inner Bracket Bolt	10	—	89
Knee Bolster Outer Bracket Bolt	10	—	89
Lower Trim Panel Screw	3.3	—	29
Negative Battery Cable Bolt	15	11	—
Oil Cooler Pipe Fitting at Radiator	26	19	—
Oil Cooler Pipe Fitting at Transmission	22	16	—
Oil Cooler Pipe Retaining Clip Bolt	12	—	106
Oil Pan to Transmission Case Bolt	11	—	97
Park/Neutral Position Switch Screw	3	—	27
Pressure Control Solenoid Bolt	11	—	97
Shift Cable Grommet Screw	1.7	—	15
Shift Control Cable Attachment	20	15	—
Spacer Plate Support Bolt	11	—	97
TCC Solenoid Bolt	11	—	97
Transmission to Engine Bolt	47	35	—
Valve Body-to-Case Bolt	11	—	97
Vehicle Speed Sensor	11	—	97

On-Car Lubrication Specifications

Application	Liters	Gallons	Quarts
Pan Removal	4.7	—	5
Overhaul	10.6	—	11

Range Reference

Range	Park	Reverse	Neutral	OD				D			2		1	
Gear				1st	2nd	3rd	4th	1st	2nd	3rd	1st**	2nd	1st	2nd** *
1-2 Shift Solenoid	ON*	ON*	ON*	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	ON	OFF
2-3 Shift Solenoid	ON*	ON*	ON*	ON	ON	OFF	OFF	ON	ON	OFF	ON	ON	ON	ON
2-4 Band	—	—	—	—	A	—	A	—	A	—	—	A	—	A
Reverse Input Clutch	—	A	—	—	—	—	—	—	—	—	—	—	—	—
Overrun Clutch	—	—	—	—	—	—	—	—	—	A	A	A	A	A
Forward Clutch	—	—	—	A	A	A	A	A	A	A	A	A	A	A
Forward Sprag Clutch Assembly	—	—	—	H	H	H	—	H	H	H	H	H	H	H
3-4 Clutch	—	—	—	—	—	A	A	—	—	A	—	—	—	—
Lo/Roller Clutch	—	—	—	H	—	—	—	H	—	—	H	—	H	—
Lo/Rev Clutch	A	A	—	—	—	—	—	—	—	—	—	—	A	—

A = Applied

H = Holding

ON = The solenoid is energized.

OFF = The solenoid is de-energized

*Shift Solenoid state is a function of vehicle speed and may change if the vehicle speed increases sufficiently in Park, Reverse or Neutral. However, this does not affect the operation of the transmission.

**Manual Second-First gear is electronically prevented under normal operating conditions.

***Manual First-Second gear is only available above approximately 48-56 km/h (30-35 mph).

Shift Speed

4.3L (L99)

		1-2 Shift @ +/- 250 RPM Output Shaft Speed			2-3 Shift @ +/- 200 RPM Output Shaft Speed			3-4 Shift @ +/- 150 RPM Output Shaft Speed			3-1 @ +/- 100 RPM Output Shaft Speed	3-2 @ +/- 100 RPM Output Shaft Speed	3-1 Wide Open Throttle Shift	2-3 Wide Open Throttle Shift
% of TPS		12	25	50	12	25	50	12	25	50				
Trans Cal	Axle													
A	2.93	431	574	1005	754	969	1615	1041	1328	N/A	N/A	646	1292	N/A
B	3.23	491	736	1186	859	1186	1963	1186	1840	N/A	N/A	777	1268	N/A

5.7L (LT1)

		1-2 Shift @ +/- 250 RPM Output Shaft Speed			2-3 Shift @ +/- 200 RPM Output Shaft Speed			3-4 Shift @ +/- 150 RPM Output Shaft Speed			3-1 @ +/- 100 RPM Output Shaft Speed	3-2 @ +/- 100 RPM Output Shaft Speed	3-1 Wide Open Throttle Shift	2-3 Wide Open Throttle Shift
% of TPS		12	25	50	12	25	50	12	25	50				
Trans Cal	Axle													
A	2.56	412	602	1046	697	1078	1902	919	1426	N/A	476	N/A	951	N/A
B	2.93	412	602	1046	697	1078	1902	919	1426	N/A	444	N/A	951	N/A
C	3.08	496	724	1220	801	1220	2135	1106	1716	4576	N/A	763	1296	N/A

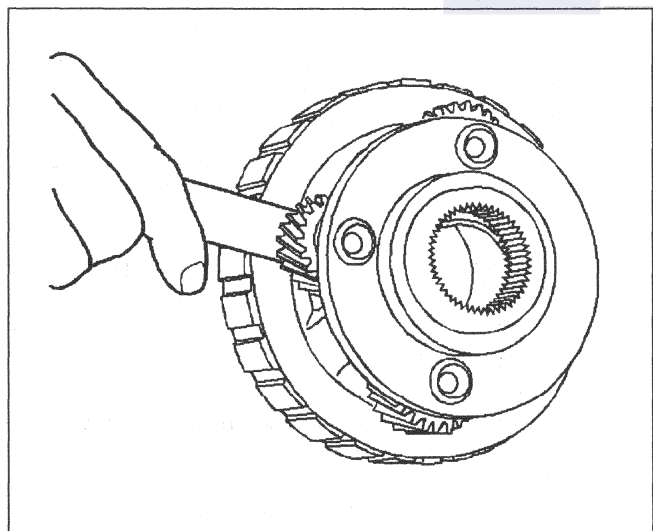
Transmission End Play Check

Identification	Washer Thickness (mm)	Washer Thickness (in)
67	1.87-1.97	0.074-0.078
68	2.04-2.14	0.080-0.084
69	2.21-2.31	0.087-0.091
70	2.38-2.48	0.094-0.098
71	2.55-2.65	0.100-0.104
72	2.72-2.82	0.107-0.111
73	2.89-2.99	0.113-0.117
74	3.06-3.16	0.120-0.124

Low and Reverse Clutch Spacer Plate Selection

Gauge Dimension D	Selective Plate	
	Identification	Thickness
28.065-27.545 mm (1.105-1.084")	None	1.684-1.829 mm (0.066-0.072")
28.586-28.066 mm (1.125-1.105")	0	1.314-1.168 mm (0.052-0.046")
27.544-27.026 mm (1.084-1.064")	1	2.198-2.344 mm (0.087-0.092")

Reaction Carrier Pinion Gear End Play



5504

1. Check the pinion end play. The end play must not exceed 0.61 mm (0.024 in).

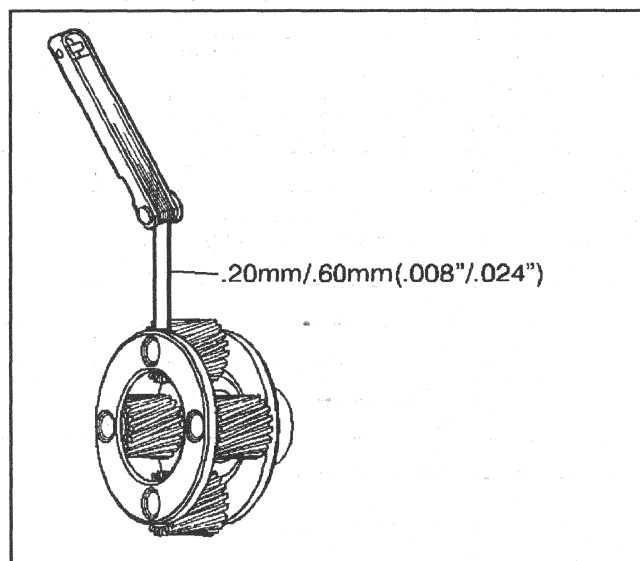
Inspect the reaction carrier for the following conditions:

- Pinion gear damage
- Proper pinion staking
- Excessive pinion washer wear
- Keystoned pinion gears

2. Ensure that the pinions turn freely.

Input Carrier Pinion End Play

Inspection Procedure



5469

1. Check the pinion end play. The end play must not exceed 0.61 mm (0.024 in).
2. Inspect the input carrier for pinion gear damage, proper pin stake and keystone pinion gears. Pinions must rotate freely.

Forward Clutch Piston Travel Check

Backing Plate Travel: 0.75–1.60 mm (0.030"–0.063")	
Plate Thickness	Identification
6.97–7.07 mm (0.274–0.278")	A
6.38–6.48 mm (0.250–0.255")	B
5.79–5.89 mm (0.227–0.232")	C
5.20–5.30 mm (0.205–0.208")	D
4.61–4.71 mm (0.180–0.185")	E

Reverse Input and Input Clutches

Backing Plate Travel: 1.02–1.94 mm (0.40"–0.76")	
Plate Thickness	Identification
7.249–7.409 mm (0.285"–0.292")	2
6.678–6.519 mm (0.263"–0.257")	3
5.947–5.787 mm (0.234"–0.228")	4

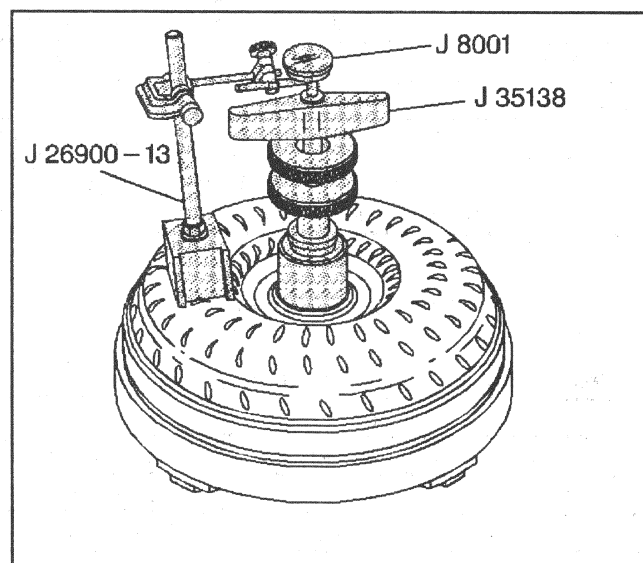
Oil Pump Rotor and Slide Measurement

Oil Pump Rotor Thickness (mm)	Oil Pump Rotor Thickness (in.)
17.948–17.961	0.7066–0.7071
17.961–17.974	0.7071–0.7076
17.974–17.987	0.7076–0.7081
17.987–18.000	0.7081–0.7086
18.000–18.013	0.7086–0.7091

Oil Pump Slide Thickness (mm)	Oil Pump Slide Thickness (in.)
17.948–17.961	0.7066–0.7071
17.961–17.974	0.7071–0.7076
17.974–17.987	0.7076–0.7081
17.987–18.000	0.7081–0.7086
18.000–18.013	0.7086–0.7091

Torque Converter End Play Check**Tools Required**

- J 8001 Dial Indicator
- J 26900-13 Dial Indicator Post
- J 35138 End Play Checking Tool



7775

1. Inspect the torque converter and replace if any of the following conditions exist:

- Evidence of damage to the pump assembly.
- Metal particles are found after flushing the cooler and cooler lines.
- External leaks in the hub area.
- Converter pilot is broken, damaged or poor fit into the crankshaft.
- Converter hub is scored or damaged.
- Internal damage to the stator.
- Contamination from engine coolant.
- Excessive end play.

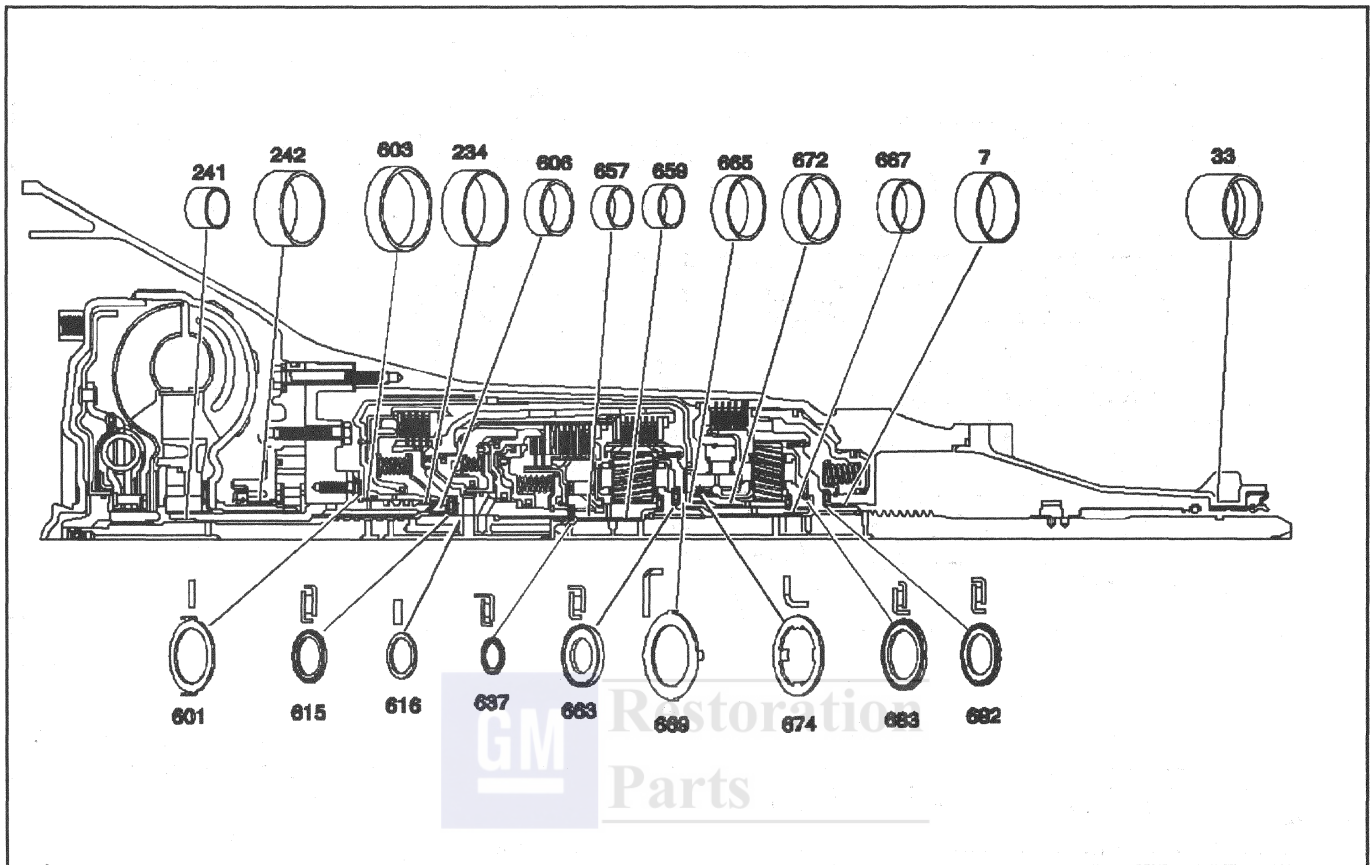
Important: The torque converter should not be replaced if the fluid has an odor, discoloration or no evidence of metal or clutch plate material. Flushing the torque converter is not recommended.

2. Install the torque converter end play checking tool and the dial indicator.
 - The end play for a 245 mm torque converter should be 0–0.5 mm (0–0.020 in).
 - The end play for a 298 mm torque converter should be 0–0.6 mm (0–0.024 in).

Component Locator

Transmission Component Location

Bearings and Bushings

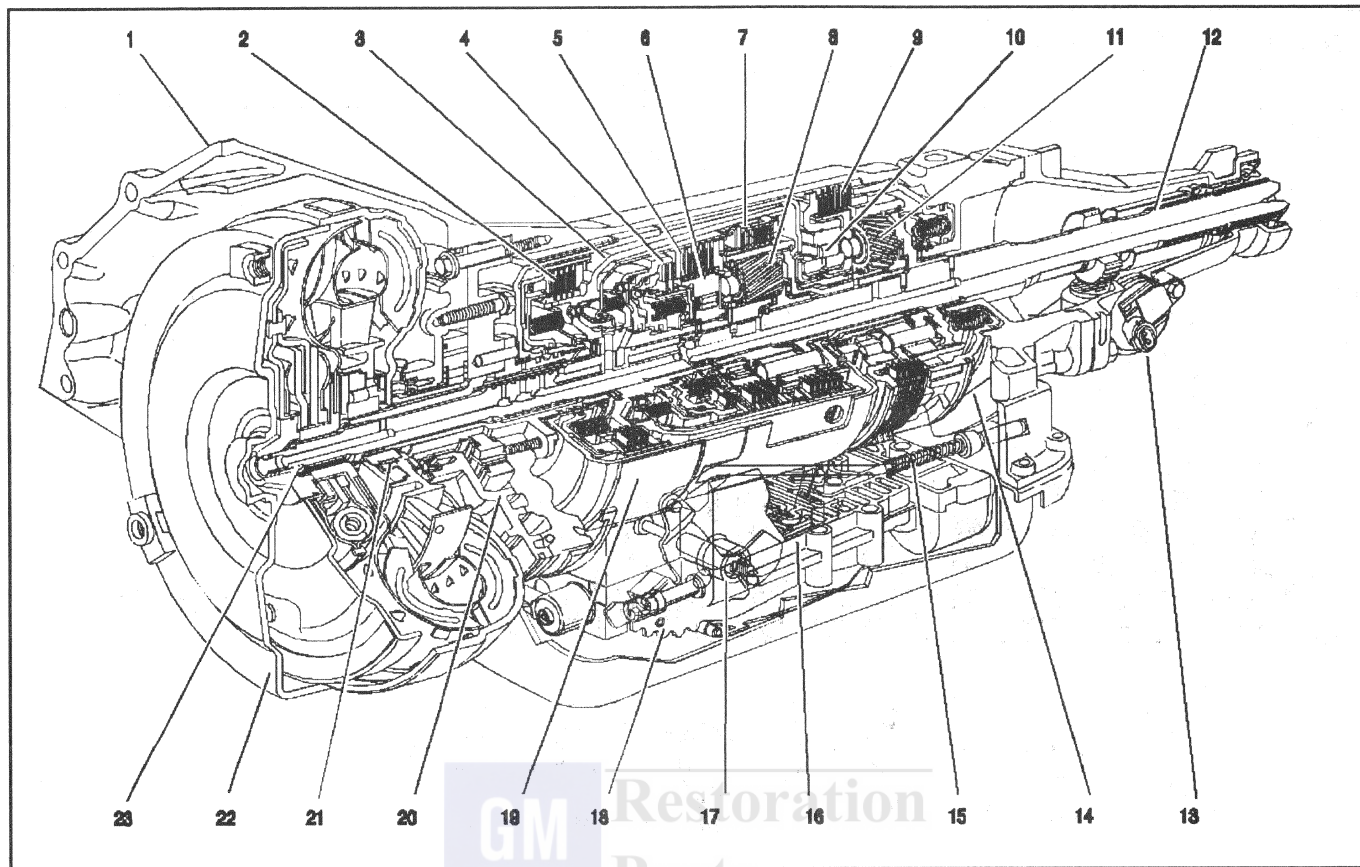


9258

Legend

- | | |
|---|--|
| (241) Bushing, Stator Shaft (Rear) | (601) Washer, Thrust (Pump to Drum) |
| (242) Bushing, Oil Pump Body | (615) Bearing Assembly, Stator Shaft/Selective Washer |
| (603) Bushing, Reverse Input Cl. (Front) | (616) Washer, Thrust (Selective) |
| (234) Bushing, Stator Shaft (Front) | (637) Bearing Assembly, Input Sun Gear |
| (606) Bushing, Reverse Input Clutch (Rear) | (663) Bearing Assembly, Thrust (Input Carrier to Reaction Shaft) |
| (657) Bushing, Input Sun Gear (Front) | (669) Washer, Thrust (Reaction Shaft/Shell) |
| (659) Bushing, Input Sun Gear (Rear) | (674) Washer, Thrust (Race/Reaction Shell) |
| (665) Bushing, Reaction Carrier Shaft (Front) | (683) Bearing Assembly, Thrust (Reaction Carrier/Support) |
| (672) Bushing, Reaction Gear | (692) Bearing, Reaction Gear Support to Case |
| (667) Bushing, Reaction Carrier Shaft (Rear) | |
| (7) Bushing, Case | |
| (33) Bushing, Case Extension | |

Case and Associated Parts

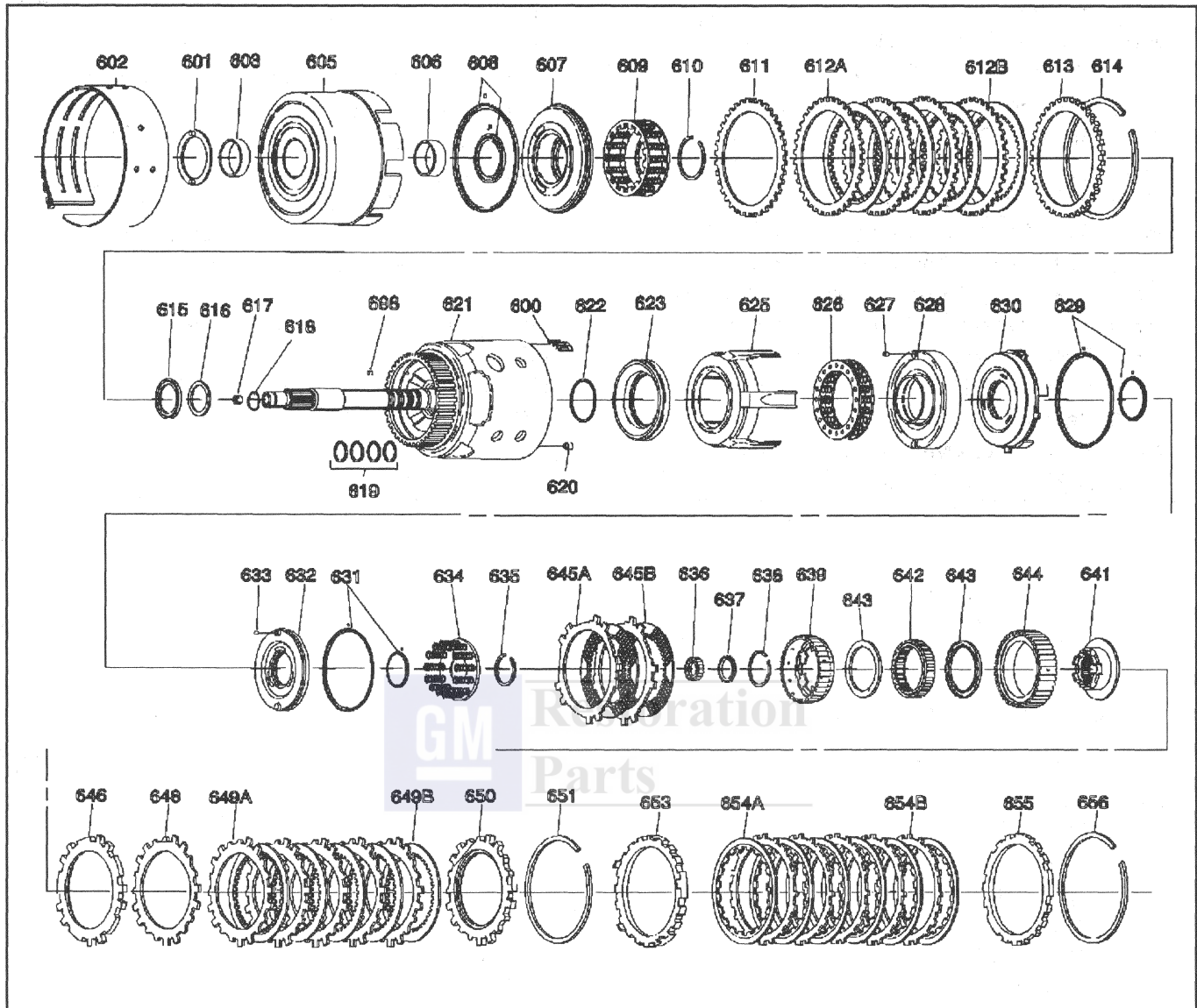


8879

Legend

- | | |
|-----------------------------------|-------------------------------------|
| (1) Case Assembly | (13) Speed Sensor |
| (2) Reverse Input Clutch | (14) Parking Pawl |
| (3) Input Clutch Housing | (15) Parking Lock Actuator Assembly |
| (4) Overrun Clutch | (16) Control Valve Assembly |
| (5) Forward Clutch | (17) Manual Shaft |
| (6) Forward Sprag Clutch Assembly | (18) Inside Detent Lever |
| (7) 3-4 Clutch | (19) 2-4 Band Assembly |
| (8) Input Planetary Gear Set | (20) Pump Assembly |
| (9) Lo and Reverse Clutch | (21) Stator Roller Clutch |
| (10) Lo Roller Clutch Assembly | (22) Torque Converter Assembly |
| (11) Reaction Planetary Gear Set | (23) Turbine Shaft |
| (12) Output Shaft | |

Internal Parts 1



9259

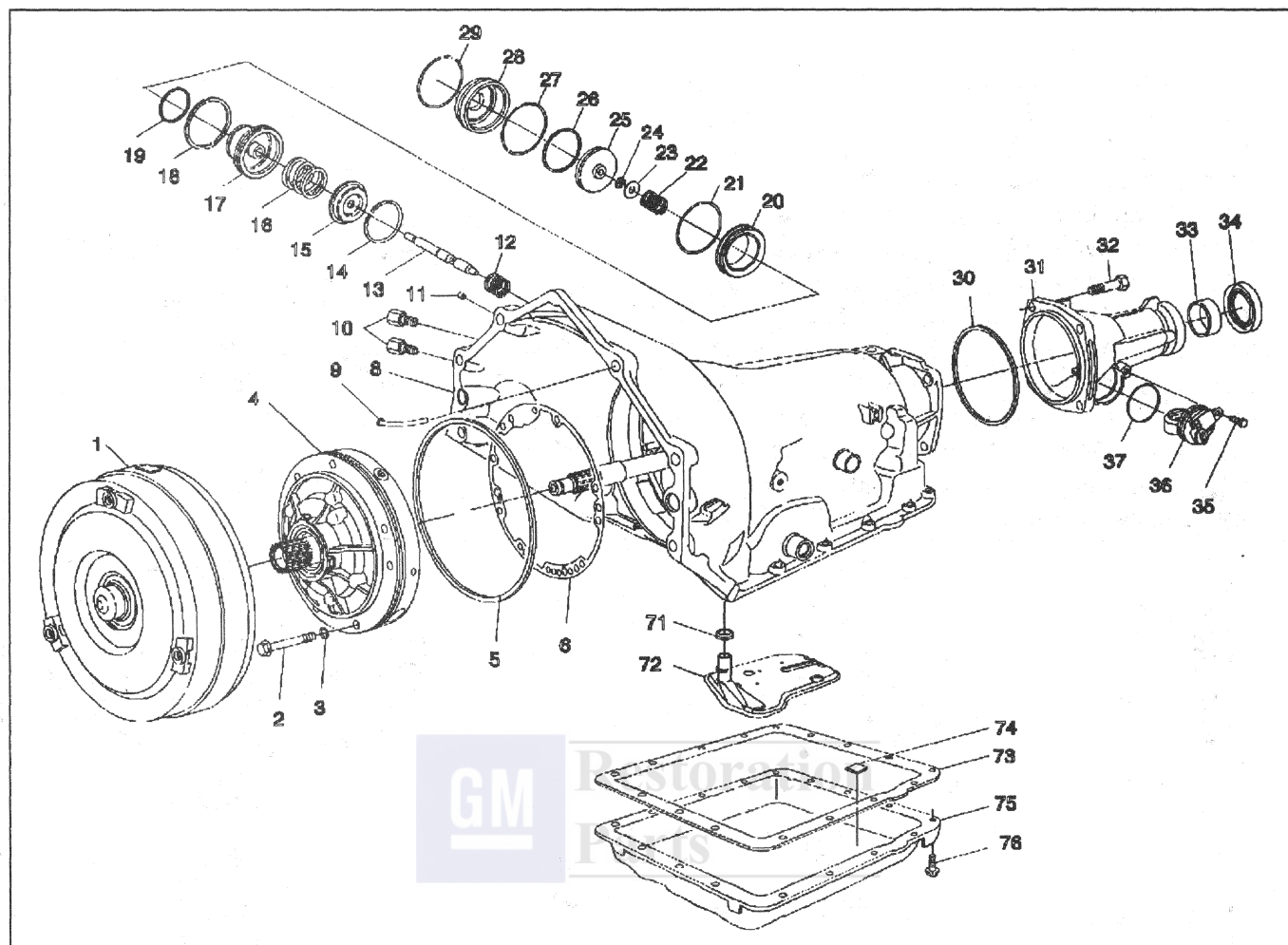
Legend

- | | |
|---|---|
| (602) Band Assembly, 2-4 | (614) Ring, Reverse Input Cl. Retaining |
| (601) Washer, Thrust (Pump to Drum) | (615) Bearing Assembly, Stator Shaft/Selective Washer |
| (603) Bushing, Reverse Input Cl. (Front) | (616) Washer, Thrust (Selective) |
| (605) Housing and Drum Assembly, Reverse Input Clutch | (617) Retainer and Ball ASM., Check Valve |
| (606) Bushing, Reverse Input Clutch (Rear) | (618) Seal, O-Ring (Turbine Shaft/Selective Washer) |
| (608) Seals, Reverse Input Clutch (Inner and Outer) | (698) Plug, Orificed Cup |
| (607) Piston ASM., Reverse Input Clutch | (621) Housing and Shaft Assembly, Input |
| (609) Spring ASM., Reverse Input Clutch | (600) Spring ASM., 3-4 Clutch Boost (5) |
| (610) Ring, Reverse Input Clutch Spring Retainer | (622) Seal, O-Ring Input to Forward Hsg. |
| (611) Plate, Reverse Input Clutch (Belleville) | (620) Retainer and Checkball Assembly |
| (612a) Plate ASM., Reverse Input Clutch (Steel) | (623) Piston, 3rd and 4th Clutch |
| (612b) Plate, Reverse Input Clutch (Fiber) | (625) Ring, 3rd and 4th Clutch (Apply) |
| (613) Plate, Reverse Input Clutch Backing (Selective) | (626) Spring Assembly, 3rd and 4th Clutch |

(627) Retainer and Ball Assembly, Forward Clutch Housing	(643) Retainer Rings, Sprag Assembly
(628) Housing, Forward Clutch	(642) Forward Sprag Assembly
(630) Piston, Forward Clutch	(644) Race, Forward Clutch (Outer)
(629) Seal, Forward Clutch (Inner and Outer)	(641) Retainer and Race Assembly, Sprag
(619) Ring, Oil Seal (Solid)	(646) Plate, Forward Clutch (Apply)
(633) Ball, Overrun Clutch	(648) Plate, Forward Clutch (Waved)
(632) Piston, Overrun Clutch	(649a) Plate Assembly, Forward Clutch (Steel)
(631) Seal, Overrun Clutch (Inner and Outer)	(649b) Plate, Forward Clutch (Fiber)
(634) Spring Assembly, Overrun Clutch	(650) Plate, Forward Clutch Backing (Sel.)
(635) Snap Ring, Overrun Clutch Spring Retainer	(651) Ring, Forward Clutch Backing Plate Retainer
(645a) Plate Assembly, Overrun Clutch (Steel)	(653) Plate, 3rd and 4th Clutch Apply (Stepped)
(645b) Plate, Overrun Clutch (Fiber)	(654a) Plate Assembly, 3rd and 4th Clutch (Fiber)
(636) Seal, Input Housing to Output Shaft	(654b) Plate, 3rd and 4th Clutch (Steel)
(637) Bearing Assembly, Input Sun Gear	(655) Plate, 3rd and 4th Clutch Backing (Sel.)
(638) Snap Ring, Overrun Cl. Hub Retaining	(656) Ring, 3rd and 4th Clutch Backing Plate Retainer
(639) Hub, Overrun Clutch	



Internal Parts 2

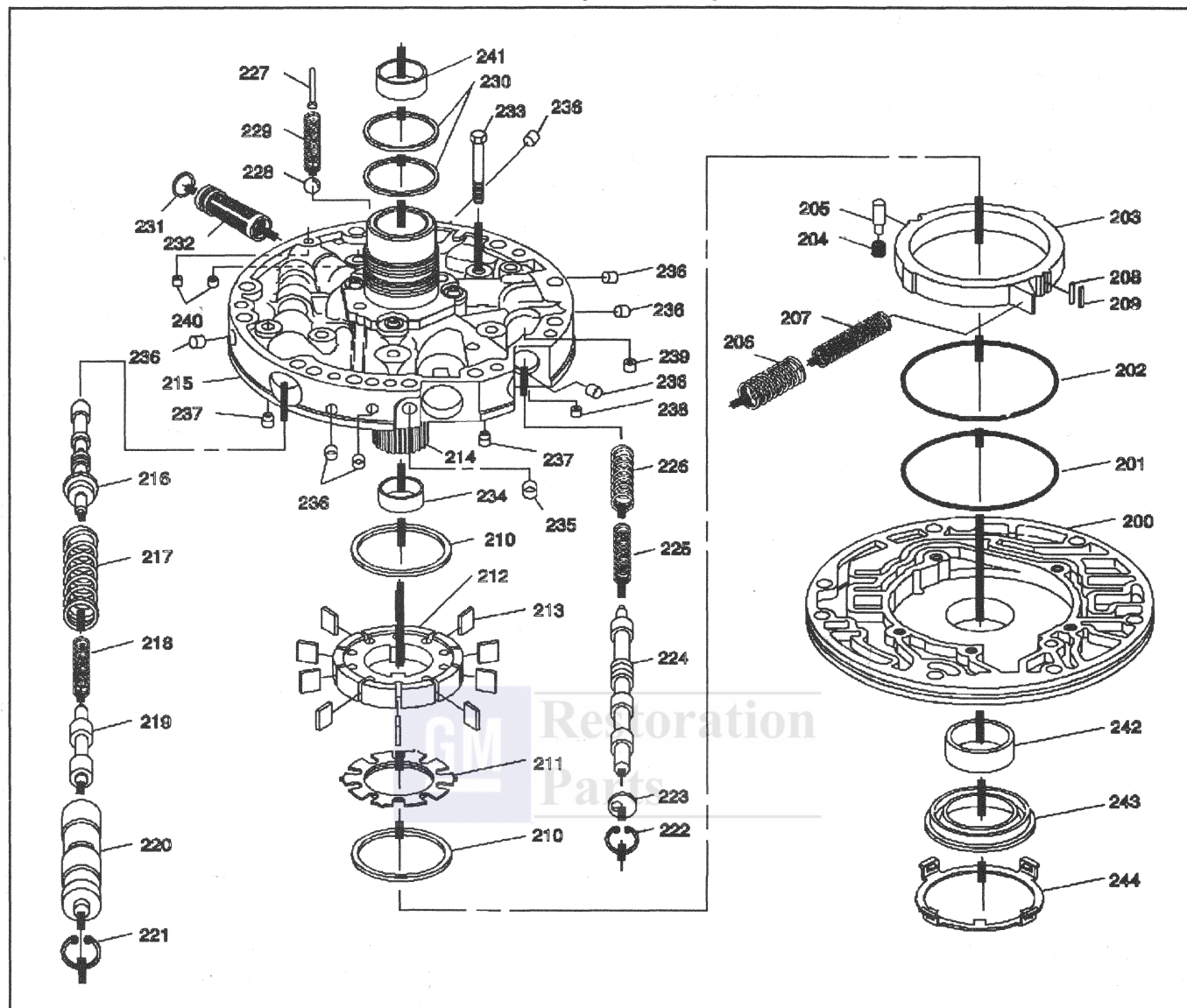


9264

Legend

- | | |
|--|--|
| (1) Torque Converter Assembly | (23) Washer, Servo Apply Pin |
| (2) Bolt, Pump to Case | (24) Ring, Retainer (Apply Pin) |
| (3) O-Ring, Pump to Case Bolt | (25) Piston, 4th Apply |
| (4) Pump Assembly, Oil | (26) Ring, Oil Seal (4th Apply Piston-Outer) |
| (5) Seal, Oil (Pump to Case) | (27) Seal, O-Ring (2-4 Servo Cover) |
| (6) Gasket, Pump Cover to Case | (28) Cover, 2-4 Servo |
| (8) Case, Transmission | (29) Ring, Servo Cover Retaining |
| (9) Vent Assembly, Transmission | (30) Seal, Case Extension to Case |
| (10) Connector, Oil Cooler Pipe | (31) Extension, Case |
| (11) Plug, Case Servo | (32) Bolt, Case Extension to Case |
| (12) Spring, Servo Return | (33) Bushing, Case Extension |
| (13) Pin, 2nd Apply Piston | (34) Seal Assembly, Case Extension Oil |
| (14) Ring, Retainer (2nd Apply Piston) | (35) Bolt, Speed Sensor Retaining |
| (15) Retainer, Servo Cushion Spring | (36) Speed Sensor, Internal Transmission |
| (16) Spring, Servo Cushion | (37) Seal, O-Ring (ITSS to Case Extension) |
| (17) Piston, 2nd Apply | (71) Seal, Filter |
| (18) Ring, Oil Seal (2nd Apply Piston-Outer) | (72) Filter Assembly, Transmission Oil |
| (19) Ring, Oil Seal (2nd Apply Piston-Inner) | (73) Gasket, Transmission Oil Pan |
| (20) Housing, Servo Piston (Inner) | (74) Magnet, Chip Collector |
| (21) Seal, O-Ring | (75) Pan, Transmission Oil |
| (22) Spring, Servo Apply Pin | (76) Screw, Transmission Oil Pan |

Oil Pump Assembly



9262

Legend

- | | |
|--|---|
| (201) Ring, Oil Seal (Slide to Wear Plate) | (233) Bolt, M8 X 1.25 X 40 (Cover to Body) |
| (200) Body, Pump | (236) Plug, Oil Pump Cover |
| (202) Seal, O-Ring (Slide Seal Back-Up) | (235) Plug, Oil Pump Cover (FWD Clutch Feed) |
| (203) Slide, Pump | (239) Orifice, Oil Cooler (Cup Plug) |
| (204) Spring, Pivot Pin | (238) Orifice, Converter Clutch Signal (Cup Plug) |
| (205) Pin, Pivot Slide | (226) Spring, Converter Clutch Valve (Outer) |
| (206) Spring, Pump Slide (Outer) | (225) Spring, Converter Clutch Valve (Inner) |
| (207) Spring, Pump Slide (Inner) | (224) Valve, Converter Clutch |
| (208) Support, Pump Slide Seal | (223) Valve, Stop |
| (209) Seal, Pump Slide | (222) Ring, Oil Pump Converter Clutch Valve Retaining |
| (210) Ring, Pump Vane | (237) Retainer and Ball Assembly, Check Valve |
| (242) Bushing, Pump Body | (213) Vane, Pump |
| (243) Seal Assembly, Oil | (211) Guide, Rotor |
| (244) Retainer, Front Helix | (214) Shaft, Stator |
| (241) Bushing, Stator Shaft (Rear) | (234) Bushing, Stator Shaft (Front) |
| (230) Ring, Oil Seal (Stator Shaft) | |

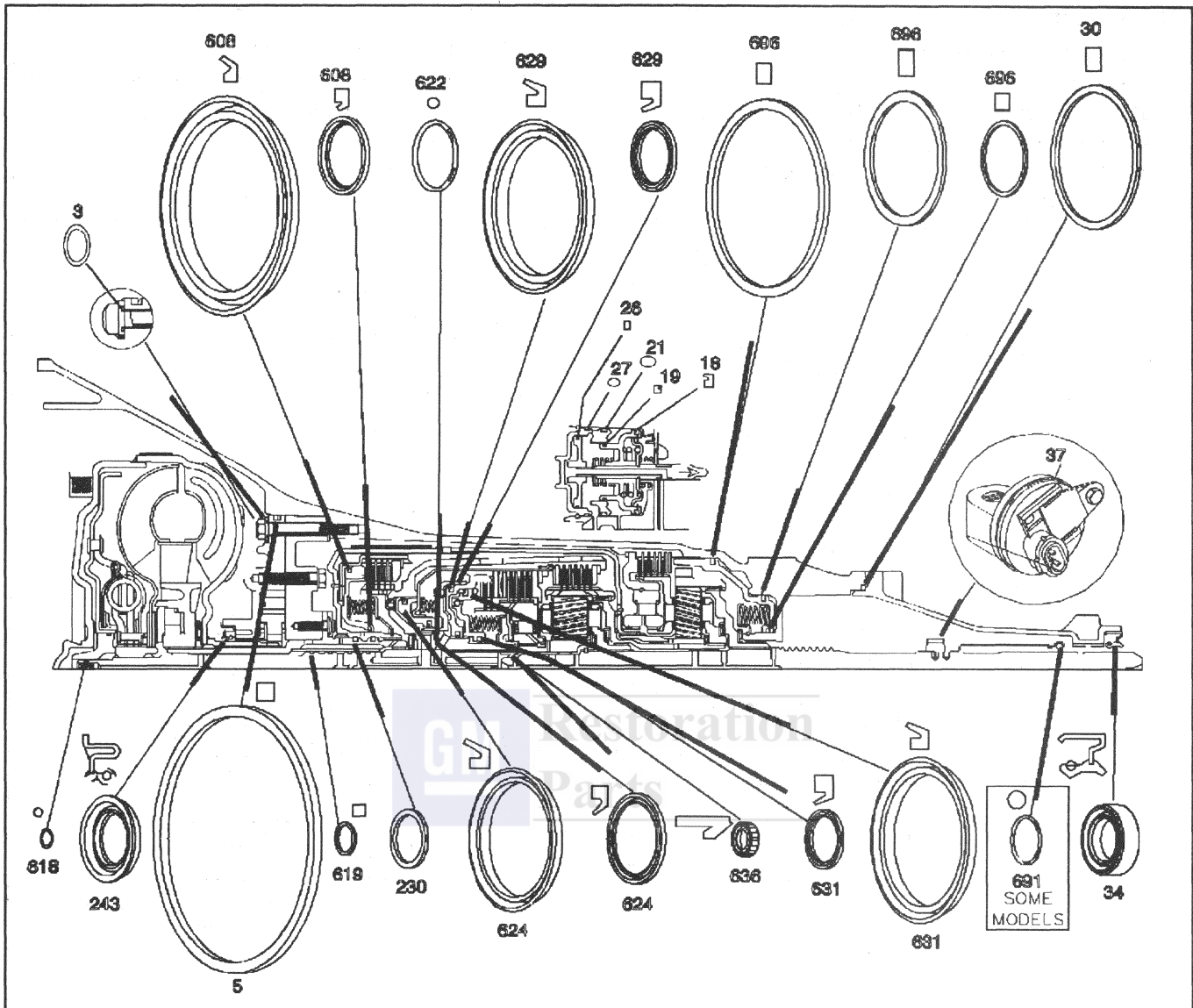
Transmission/Transaxle**Automatic Transmission - 4L60-E 7A-13**

- (212) Rotor, Oil Pump
- (227) Rivet, Pressure Relief Bolt
- (229) Spring Pressure Relief
- (228) Ball, Pressure Relief
- (231) Seal, Oil Pump Cover Screen
- (232) Screen, Oil Pump Cover
- (221) Ring, Oil Pump Reverse Boost Valve Retaining

- (240) Plug, Cup Orifice
- (215) Cover, Pump
- (216) Valve, Pressure Regulator
- (217) Spring, Pressure Regulator Valve
- (218) Spring, Pressure Regulator Isolator
- (219) Valve, Reverse Boost
- (220) Sleeve, Reverse Boost Valve



Seal Locations



9261

Legend

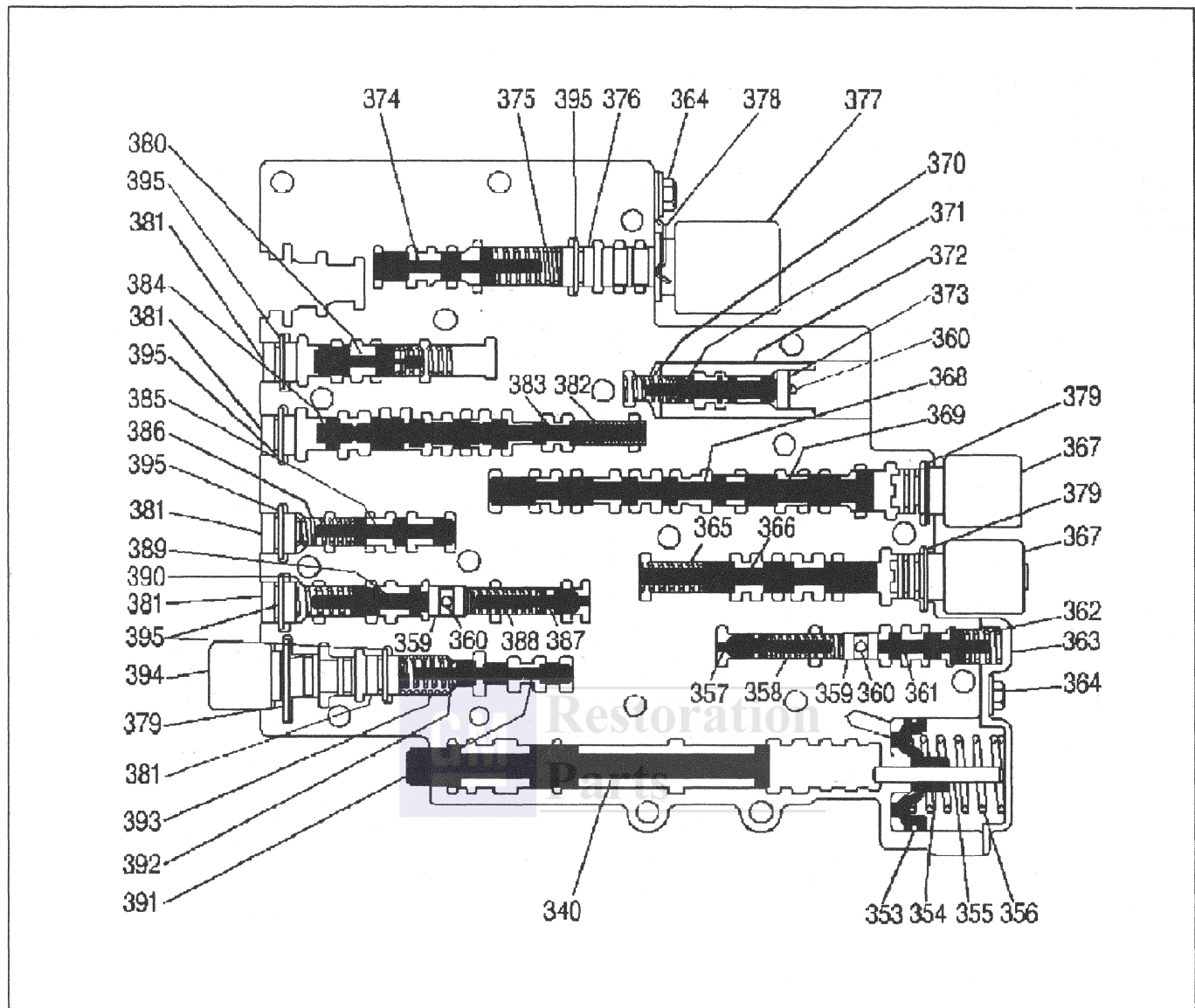
- | | |
|---|---|
| (608) Seals, Reverse Input Clutch (inner and outer) | (18) Ring, Oil Seal (2nd Apply Piston-Outer) |
| (622) Seal, O-Ring Input to Forward HSG | (37) Seal, O-Ring (ITSS to Case Extension) |
| (629) Seal, Forward Clutch (Inner and Outer) | (618) Seal, O-Ring (Turbine Shaft/Selective Washer) |
| (696) Seal, Transmission (Lo and Reverse Clutch-Outer, Center, Inner) | (243) Seal Assembly, Oil |
| (30) Seal, Case Extension to Case | (619) Ring, Oil Seal (Solid) |
| (3) O-Ring, Pump to Case Bolt | (230) Ring, Oil Seal (Stator Shaft) |
| (26) Ring, Oil Seal (4th Apply Piston-Outer) | (624) 3rd and 4th Clutch Seals |
| (27) Seal, O-Ring (2-4 Servo Cover) | (636) Seal, Input Housing to Output Shaft |
| (21) Seal, O-Ring | (631) Seal, Overrun Clutch (Inner and Outer) |
| (19) Ring, Oil Seal (2nd Apply Piston-Inner) | (691) Seal, Output Shaft |
| | (34) Seal Assembly, Case Extension Oil |

10124

- (2) Decrease
- (3) Line
- (4) Converter Feed
- (5) Release
- (6) Apply
- (8) Lube from Cooler
- (9) Actuator Feed Limit
- (10) Filtered Actuator Feed
- (11) Torque Signal
- (12) PR
- (15) Reverse
- (16) Reverse Input (Rev. Cl.)

- (17) D4
- (18) Forward Clutch Feed
- (20) Accumulator
- (22) Signal A
- (23) Signal B
- (24) 2nd
- (25) 2nd Clutch
- (26) C.C. Signal
- (42) Lo/1st
- (43) Exhaust
- (47) Void

Valve Trains



10125

Legend

- | | |
|--------------------------------------|---|
| (391) Valve, 3-2 Control | (375) Spring, Actuator Feed Limit Valve |
| (392) Spring, 3-2 Control Valve | (376) Plug, Bore |
| (393) Spring, Bore Plug | (364) Bolt, Forward Accumulator Cover |
| (381) Plug, Bore | (378) Retainer, Pressure Control Solenoid |
| (379) Retainer, Solenoid | (377) Pressure Control Solenoid |
| (394) 3-2 Control Solenoid | (370) Spring, 1-2 Accumulator Valve |
| (395) Retainer, Bore Plug | (371) Valve, 1-2 Accumulator |
| (390) Spring, 3-2 Downshift Valve | (372) Sleeve, 1-2 Accumulator Valve |
| (389) Valve, 3-2 Downshift | (373) Plug, Bore |
| (386) Spring, 3-4 Shift Valve | (360) Pin, Coiled Spring |
| (385) Valve, 3-4 Shift | (368) Valve, 2-3 Shift |
| (384) Valve, 3-4 Relay | (369) Valve, 2-3 Shuttle |
| (380) Valve, Converter Clutch Signal | (367) 2-3 Shift Solenoid |
| (374) Valve, Actuator Feed Limit | (362) Spring, Low Overrun Valve |

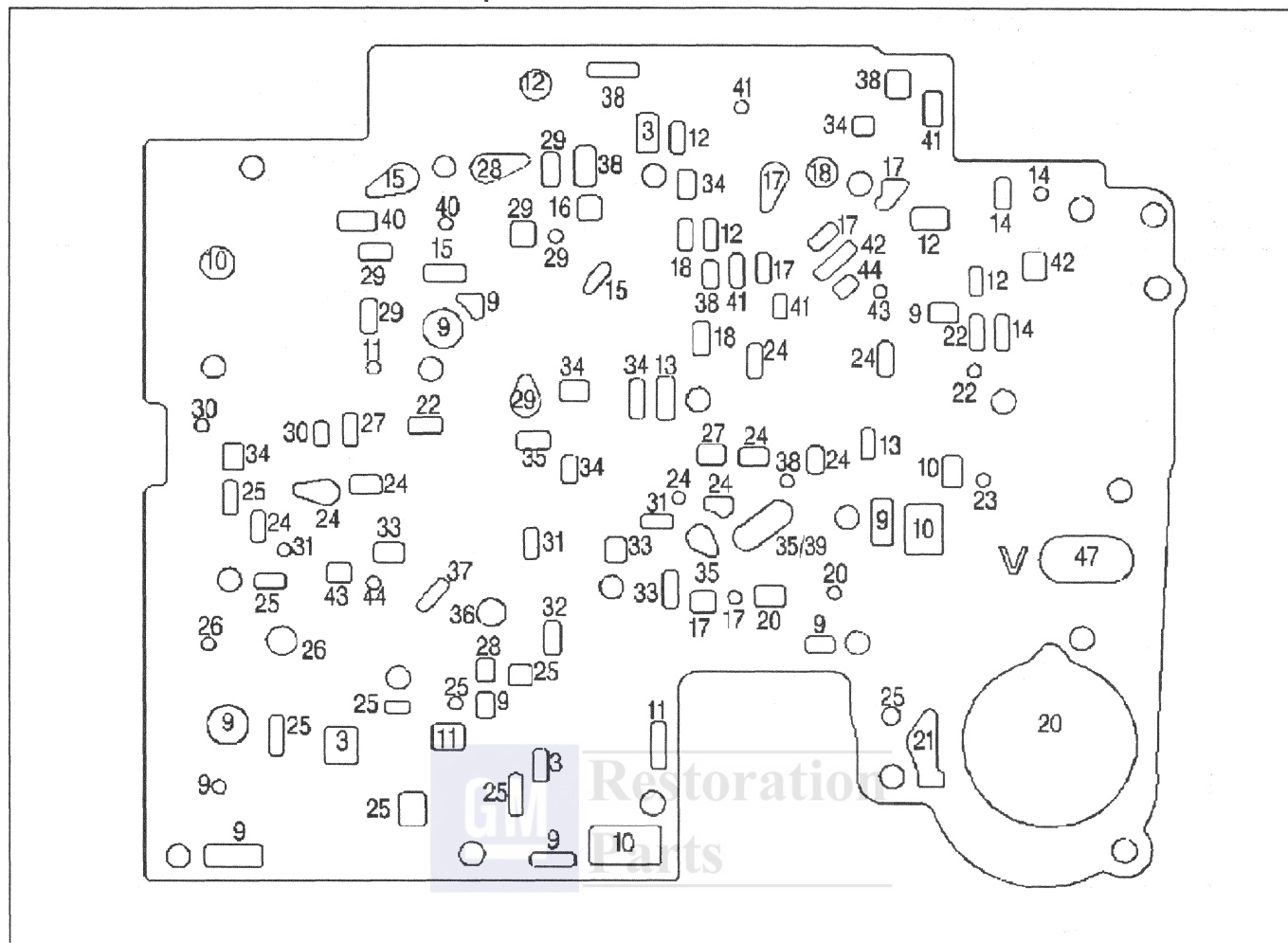
Transmission/Transaxle**Automatic Transmission - 4L60-E 7A-17**

(363) Cover, Forward Accumulator
(355) Pin, Forward Accumulator
(356) Spring, Forward Accumulator
(354) Piston, Forward Accumulator
(353) Seal, Forward Accumulator Oil
(340) Valve, Manual
(361) Valve, Low Overrun
(359) Plug, Bore

(358) Spring, Forward Abuse Valve
(357) Valve, Forward Abuse
(366) Valve, 1-2 Shift
(365) Spring, 1-2 Shift Valve
(382) Spring, 4-3 Sequence Valve
(383) Valve, 4-3 Sequence
(388) Spring, Reverse Abuse Valve
(387) Valve, Reverse Abuse



Spacer Plate to Valve Gasket

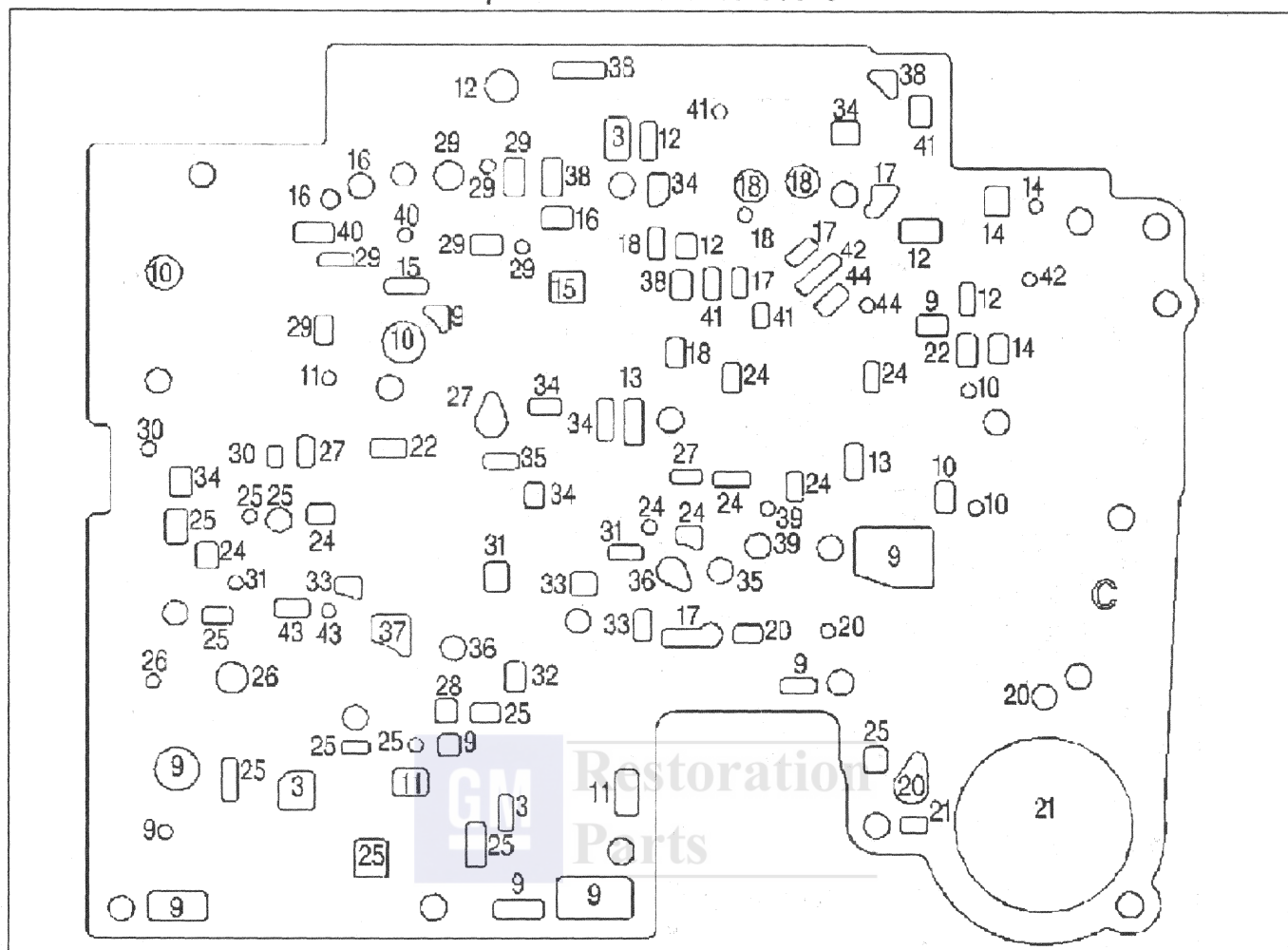


10127

Legend

- | | |
|-------------------------------|--------------------------|
| (3) Line | (28) 3rd Accum |
| (9) Actuator Feed Limit | (29) 3-4 Clutch |
| (10) Filtered Actuator Feed | (30) 4th Signal |
| (11) Torque Signal | (31) Servo Feed |
| (12) PR | (32) 4th |
| (13) D4 3-2 | (33) 3-4 Accum |
| (14) Lo/Reverse | (34) D3 |
| (15) Reverse | (35) Overrun |
| (16) Reverse Input (Rev. Cl.) | (35/39) Overrun |
| (17) D4 | (36) Overrun Clutch Feed |
| (18) Forward Clutch Feed | (37) Overrun Clutch |
| (20) Accumulator | (38) D2 |
| (21) Orificed Accumulator | (40) 3-2 Signal |
| (22) Signal A | (41) Lo |
| (23) Signal B | (42) Lo/1st |
| (24) 2nd | (43) Exhaust |
| (25) 2nd Clutch | (44) Orificed Exhaust |
| (26) C.C. Signal | (47) Void |
| (27) 3-4 Signal | |

Spacer Plate to Case Gasket

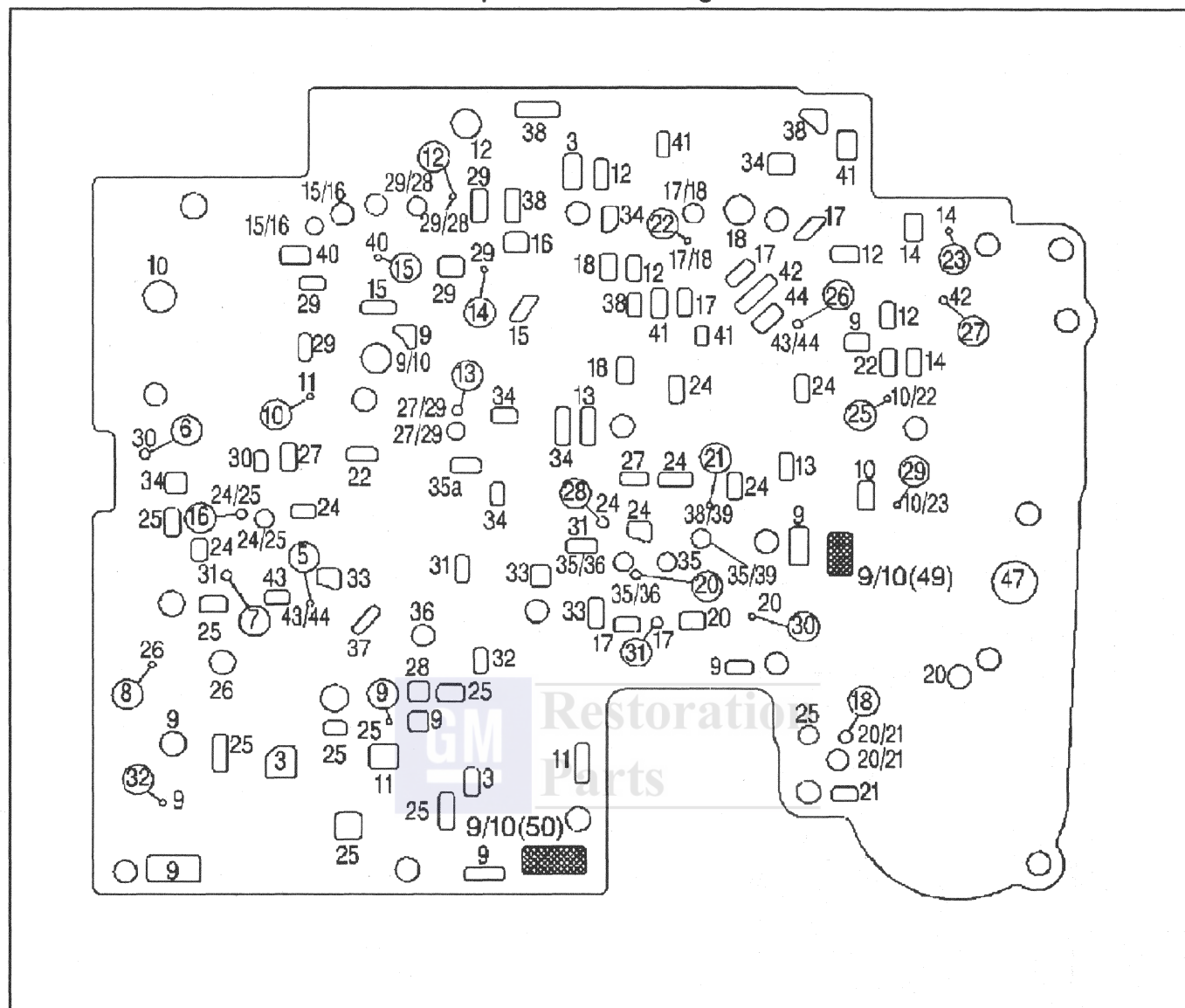


10128

Legend

- | | |
|-------------------------------|--------------------------|
| (3) Line | (27) 3-4 Signal |
| (9) Actuator Feed Limit | (28) 3rd Accum |
| (10) Filtered Actuator Feed | (29) 3-4 Clutch |
| (11) Torque Signal | (30) 4th Signal |
| (12) PR | (31) Servo Feed |
| (13) D4 3-2 | (32) 4th |
| (14) Lo/Reverse | (33) 3-4 Accum |
| (15) Reverse | (34) D3 |
| (16) Reverse Input (Rev. Cl.) | (35) Overrun |
| (17) D4 | (36) Overrun Clutch Feed |
| (18) Forward Clutch Feed | (38) D2 |
| (20) Accumulator | (39) Orificed D2 |
| (21) Orificed Accumulator | (40) 3-2 Signal |
| (22) Signal A | (41) Lo |
| (24) 2nd | (42) Lo/1st |
| (25) 2nd Clutch | (43) Exhaust |
| (26) C.C. Signal | (44) Orificed Exhaust |

Spacer Plate Passages



10126

Legend

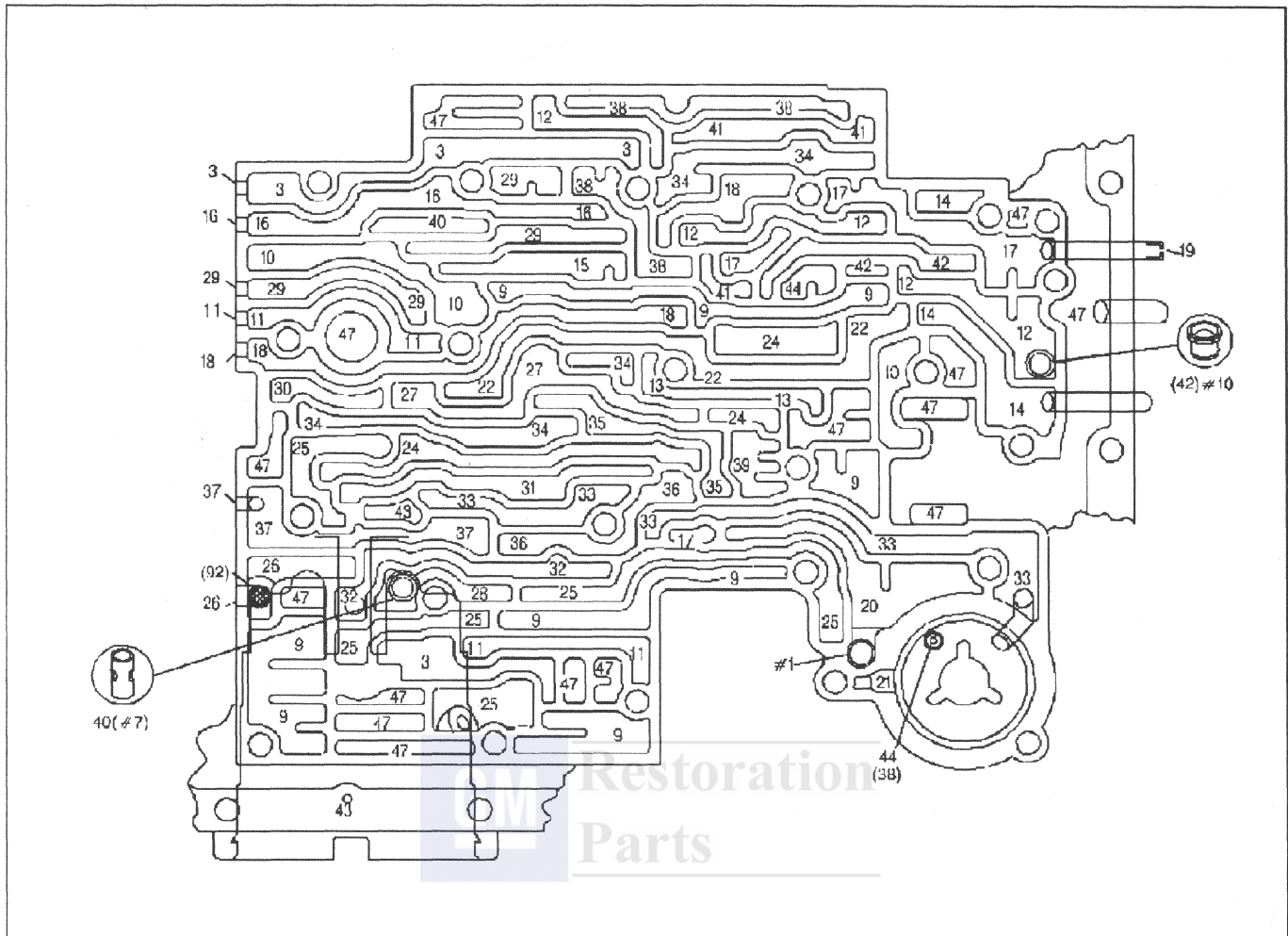
- | | |
|-------------------------------|---------------------------|
| (3) Line | (22) Signal A |
| (5) Release | (21) Orificed Accumulator |
| (6) Apply (Reg Apply) | (23) Signal B |
| (7) To Cooler | (24) 2nd |
| (8) Lube from cooler | (25) 2nd Clutch |
| (9) Actuator Feed Limit | (26) C.C. Signal |
| (10) Filtered Actuator Feed | (27) 3-4 Signal |
| (11) Torque Signal | (27/29) 3-4 Signal |
| (12) PR | (28) 3rd Accum |
| (13) D4 3-2 | (29) 3-4 Clutch |
| (14) Lo/Reverse | (30) 4th Signal |
| (15) Reverse | (31) Servo Feed |
| (16) Reverse Input (Rev. Cl.) | (32) 4th |
| (17) D4 | (33) 3-4 Accum |
| (18) Forward Clutch Feed | (34) D3 |

Transmission/Transaxle**Automatic Transmission - 4L60-E 7A-21**

(35a) D3	(38/39) D2
(35) Overrun	(41) Lo
(35/36) Overrun	(40) 3-2 Signal
(35/39) Overrun	(47) Void
(36) Overrun	(43) Exhaust
(37) Overrun Clutch Feed	(43/44) Exhaust
(38) D2	(44) Orificed Exhaust



Case Passages

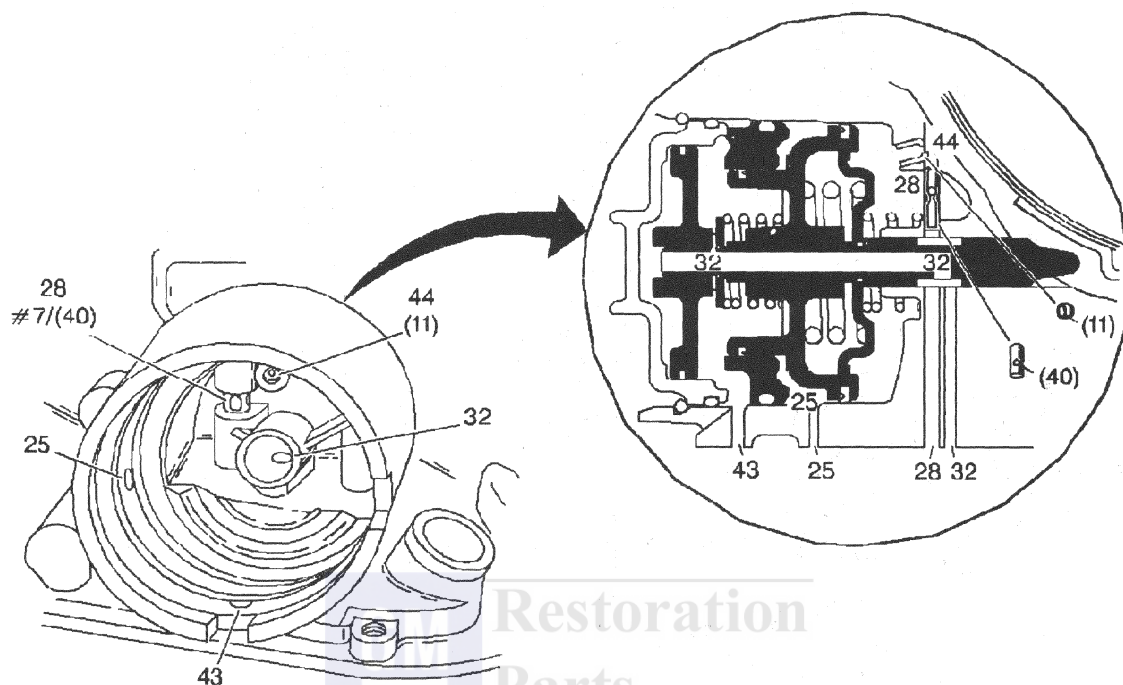


10129

Legend

- | | |
|-------------------------------|--------------------------|
| (1) Suction (Intake) | (27) 3-4 Signal |
| (3) Line | (28) 3rd Accum |
| (9) Actuator Feed Limit | (29) 3-4 Clutch |
| (10) Filtered Actuator Feed | (30) 4th Signal |
| (11) Torque Signal | (31) Servo Feed |
| (12) PR | (32) 4th |
| (13) D4 3-2 | (33) 3-4 Accum |
| (14) Lo/Reverse | (34) D3 |
| (15) Reverse | (35) Overrun |
| (16) Reverse Input (Rev. Cl.) | (36) Overrun Clutch Feed |
| (17) D4 | (37) Overrun Clutch |
| (18) Forward Clutch Feed | (38) D2 |
| (19) Rear Lube | (39) Orificed D2 |
| (20) Accumulator | (40) 3-2 Signal |
| (21) Orificed Accumulator | (41) Lo |
| (22) Signal A | (42) Lo/1st |
| (24) 2nd | (44) Orificed Exhaust |
| (25) 2nd Clutch | (47) Void |
| (26) C.C. Signal | |

2-4 Servo Passages



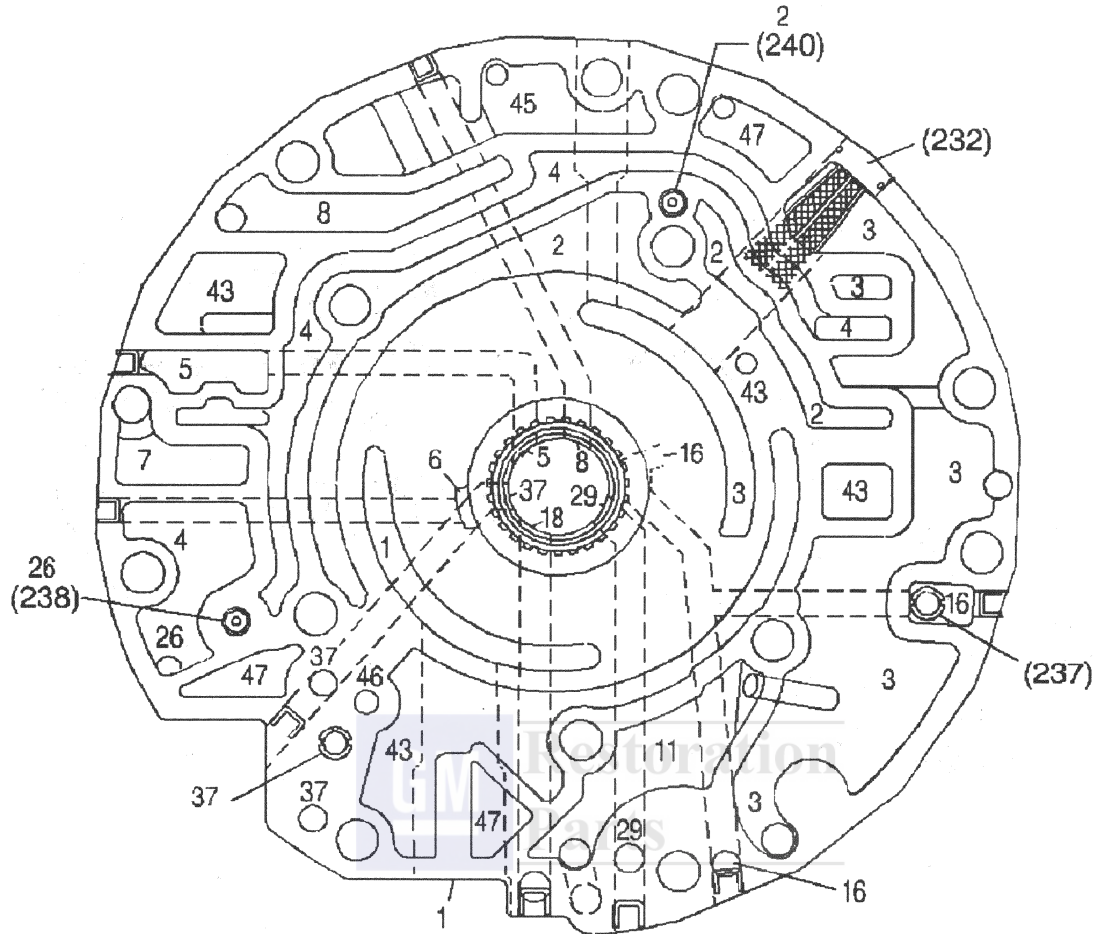
10130

Legend

- (11) Case Servo Orificed Plug
- (25) 2nd Clutch
- (28) 3rd Accumulator
- (32) 4th

- (43) Exhaust
- (44) Orificed Exhaust
- (40) 3rd Accumulator

Pump Cover Passages

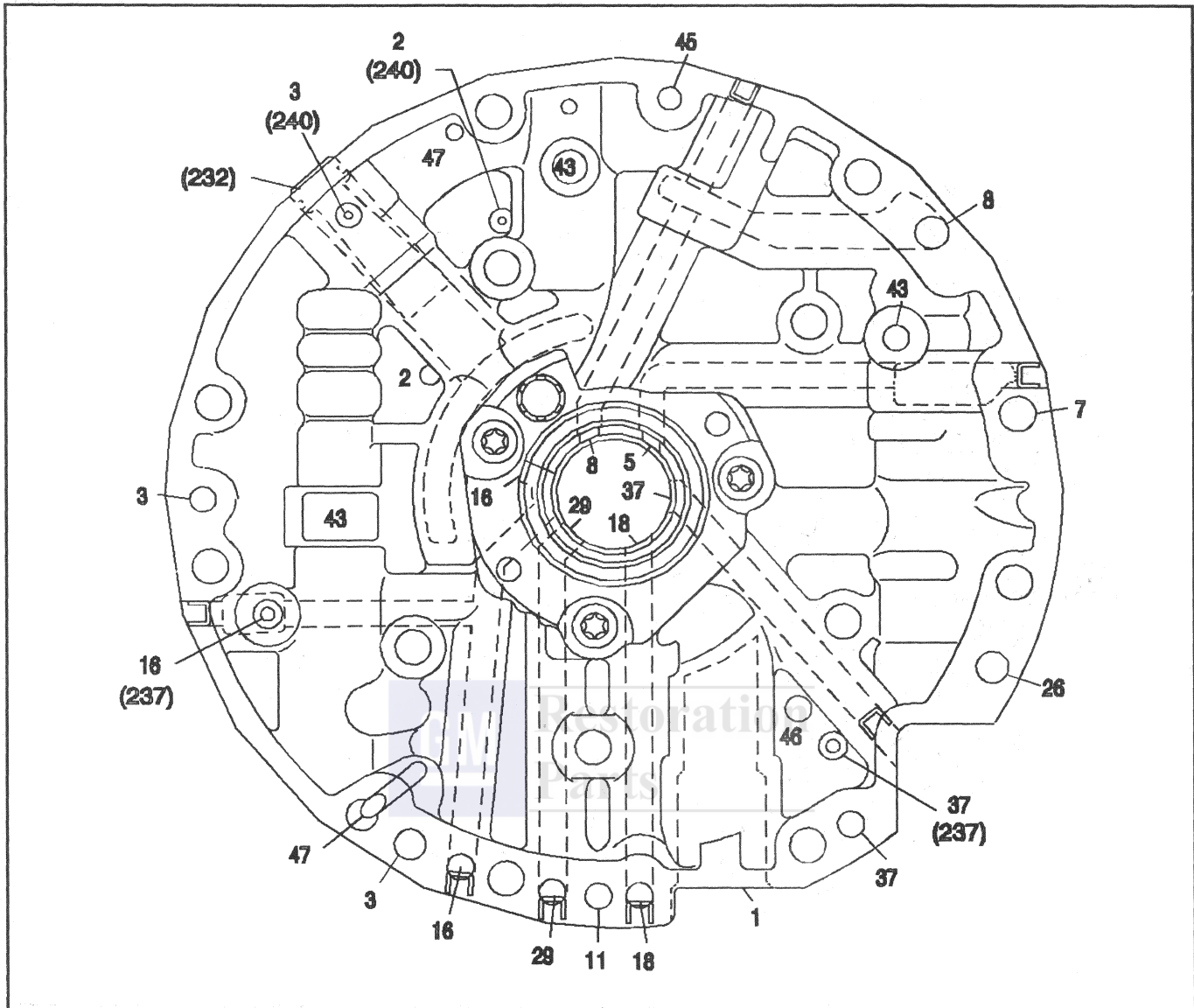


10122

Legend

- | | |
|----------------------|--------------------------|
| (1) Suction (intake) | (18) Forward Clutch Feed |
| (2) Decrease | (26) C.C. Signal |
| (3) Line | (29) 3-4 Clutch |
| (4) Converter Feed | (37) Overrun Clutch |
| (5) Release | (43) Exhaust |
| (7) To Cooler | (45) Vent |
| (8) Lube from Cooler | (46) Seal Drain |
| (11) Torque Signal | (47) Void |
| (16) Reverse Input | |

Pump Cover Passages: Case Side

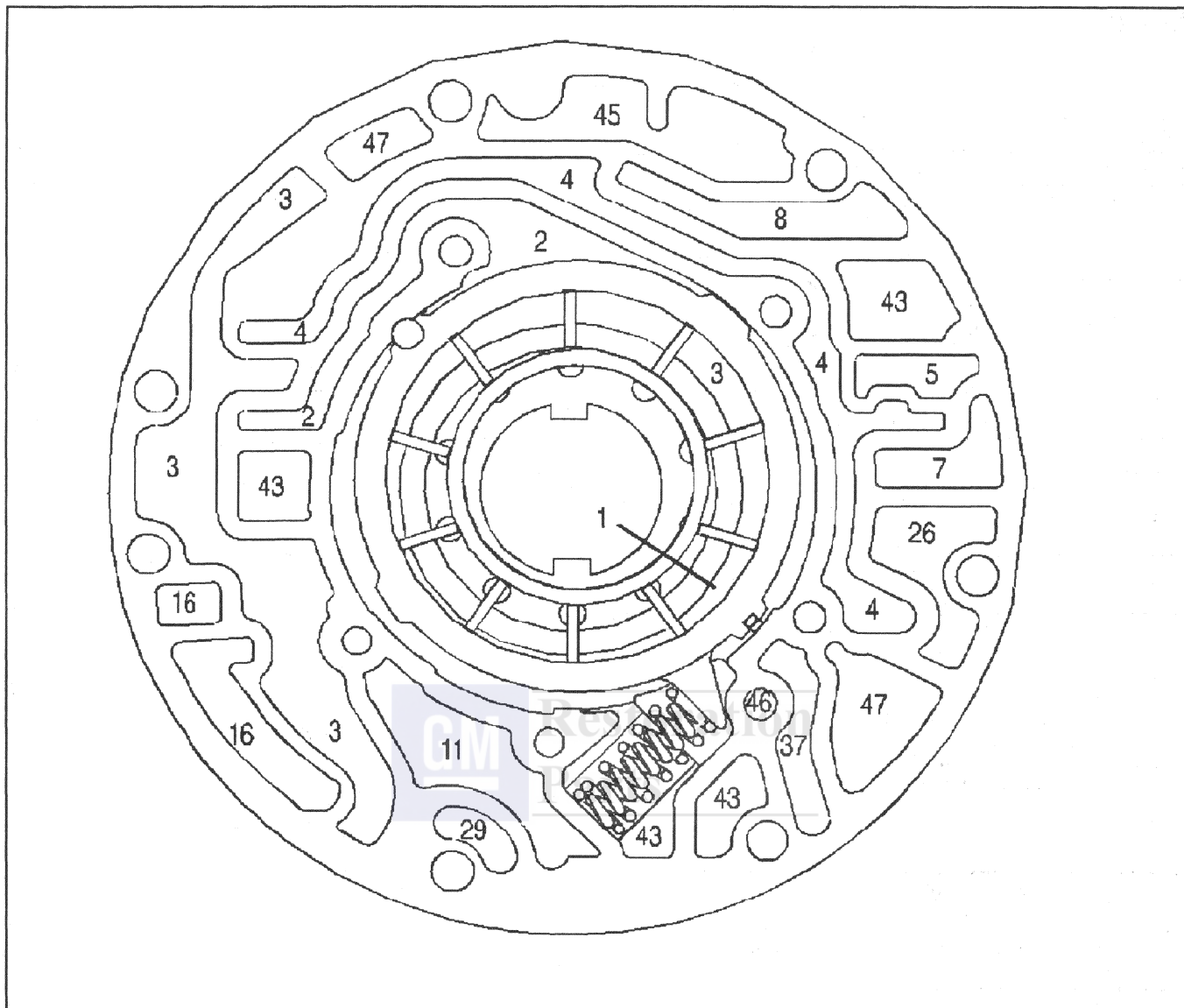


10131

Legend

- | | |
|----------------------|--------------------------|
| (1) Suction (intake) | (18) Forward Clutch Feed |
| (2) Decrease | (26) C.C. Signal |
| (3) Line | (29) 3-4 Clutch |
| (5) Release | (37) Overrun Clutch |
| (7) To Cooler | (43) Exhaust |
| (8) Lube from Cooler | (45) Vent |
| (11) Torque Signal | (46) Seal Drain |
| (16) Reverse Input | (47) Void |

Pump Body Passages



10123

Legend

- | | |
|----------------------|---------------------|
| (1) Suction (intake) | (16) Reverse Input |
| (2) Decrease | (26) C.C. Signal |
| (3) Line | (29) 3-4 Clutch |
| (4) Converter Feed | (37) Overrun Clutch |
| (5) Release | (43) Exhaust |
| (7) To Cooler | (45) Vent |
| (8) Lube from Cooler | (46) Seal Drain |
| (11) Torque Signal | (47) Void |

Diagnostic Information and Procedures

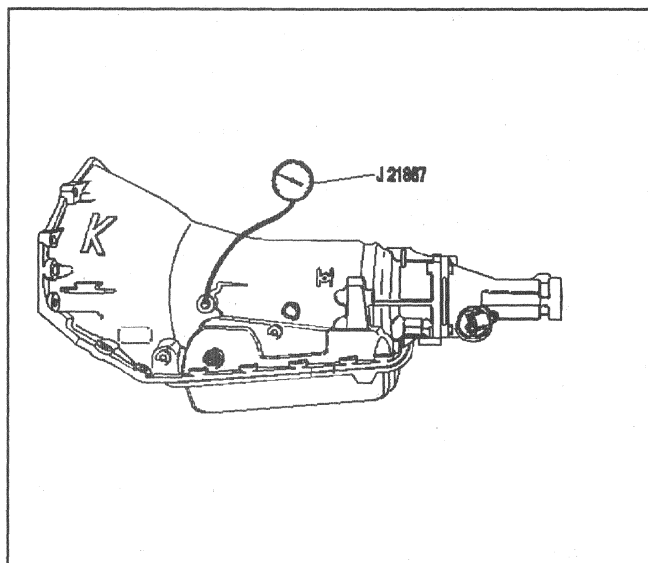
Functional Test Procedure

Step	Action	Value(s)	Yes	No
DEFINITION: Diagnose and verify the customer's complaint				
1	1. Perform <i>Transmission Fluid Checking Procedure</i> . 2. Fill the reservoir to the suggested level. Is the fluid level correct?	—	Go to Step 2	—
2	Check for PCM trouble codes, both current and history. Are PCM trouble codes present?	—	Go to Malfunction Trouble Code	Go to Step 3
3	1. Perform <i>Electrical/Garage Shift Procedure</i> . 2. Perform <i>Road Test Procedure</i> . Was the condition duplicated?	—	Go to Step 4	Go to Step 12
4	Is a harsh or soft shift condition present?	—	Go to Step 7	Go to Step 5
5	Is the vehicle's performance poor?	—	Go to Torque Converter Evaluation	Go to Step 6
6	Is the engagement into Drive or Reverse delayed or missing?	—	Go to Step 7	Go to Step 9
7	Perform <i>Line Pressure Check Procedure</i> . Is the line pressure correct?	—	Go to Step 8	Refer to Symptom Diagnosis Charts
8	Inspect the transmission wire harness connectors and the transmission range switch. Was the problem found and corrected?	—	System OK	Refer to Symptom Diagnosis Charts
9	Is vibration or noise a problem?	—	Refer to Flywheel/Torque Converter Vibration Test	Go to Step 10
10	Is the fluid leaking?	—	Refer to Fluid Leak Diagnosis	Go to Step 11
11	Are other transmission conditions present?	—	Refer to Symptom Diagnosis Charts	Go to Step 12
12	The condition is intermittent. Re-examine the complaint.	—	Exit Table	—

Transmission Fluid Checking Procedure

Step	Action	Value(s)	Yes	No
DEFINITION: Diagnose transmission fluid conditions by color				
1	Check the fluid color. Is the fluid color red?	—	Go to Step 2	Go to Step 11
2	Is the fluid level satisfactory?	—	Go to Step 20	Go to Step 3
3	Check the fluid. Is the fluid foamy?	—	Go to Step 8	Go to Step 4
4	Check the fluid level. The proper fluid level should be in the middle of the X-hatch. Is the level high?	—	Go to Step 9	Go to Step 5
5	Fluid will be low. Add fluid to the proper fluid level. Is the fluid level satisfactory?	—	Go to Step 6	—
6	Check for external leaks. Refer to <i>Fluid Leak Diagnosis</i> . Did you find any leaks?	—	Go to Step 7	Go to Step 20
7	Correct the leak condition. Did you correct the leak condition?	—	Go to Step 20	—
8	Is the fluid level too high?	—	Go to Step 9	Go to Step 10
9	Remove excess fluid to the proper fluid level. Is the fluid level satisfactory?	—	Go to Step 20	—
10	Check for contaminants in the fluid. Drain the fluid to determine the source of the contamination. Did you drain the fluid?	—	Go to Step 15	—
11	Is the fluid color non-transparent pink?	—	Go to Step 12	Go to Step 13
12	Replace the cooler. Is the replacement complete?	—	Go to Step 15	—
13	The fluid color should be light brown. Transmission fluid may turn dark with normal use. This does not always indicate oxidation or contamination. Is the fluid color light brown?	—	Go to Step 14	—
14	Drain the fluid to determine if the fluid is contaminated. A very small amount of material in the bottom pan is a normal condition, but large pieces of metal or other material in the bottom pan require a transmission overhaul. Was the fluid contaminated?	—	Go to Step 15	Go to Step 18
15	Overhaul the transmission. Refer to the Unit Repair Section. Is the overhaul complete?	—	Go to Step 16	—
16	Flush the cooler. Has the cooler been flushed?	—	Go to Step 17	—
17	Add new fluid. Is the procedure complete?	—	Go to Step 19	—
18	Change the fluid and the filter. Is this procedure complete?	—	Go to Step 19	—
19	Is the fluid level satisfactory? If not, correct as necessary.	—	Go to Step 20	—
20	Perform the Functional Test. Is the Functional Test completed?	—	System OK	—

Line Pressure Check Procedure



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Line pressures are calibrated for two sets of gear ranges – Drive-Park-Neutral, and Reverse. This allows the transmission line pressure to be appropriate for different pressure needs in different gear ranges:

Gear Range	Line Pressure Range
Drive, Park or Neutral	55–189 psi
Reverse	64–324 psi

Before performing a line pressure check, verify that the pressure control solenoid for the transmission is receiving the correct electrical signal from the PCM:

1. Install a scan tool.
2. Start the engine and set the parking brake.
3. Check for diagnostic trouble codes, including the diagnostic code for a stored pressure control solenoid.
4. Repair the vehicle if necessary. Include the following areas:
 - Inspect the fluid level.
 - Inspect the manual linkage at the transmission.
 - Install or connect the TECH 1 scan tool.
 - Install or connect the oil pressure gage at the line pressure tap.
5. Put the gear selector in Park and set the parking brake.
6. Start the engine and allow the engine to warm up at idle.
7. Access the PCS Control test on the TECH 1 scan tool.
8. Increase DESIRED PCS in 0.1-amp increments. Read the corresponding line pressure on the pressure gage. Allow the pressure to stabilize for 5 seconds after each current change.
9. Compare your data to the Drive-Park-Neutral line pressure chart below.

Notice: The transmission may experience harsh, soft or mushy shifts for up to two days later.

Caution: *Keep the brakes applied at all times in order to prevent unexpected vehicle motion.*

If your pressure readings differ greatly from the line pressure chart, refer to the Diagnosis Charts.

The TECH 1 scan tool is only able to control the pressure control solenoid in Park and Neutral with the vehicle stopped. This protects the clutches from extremely high or low pressures in Drive or Reverse ranges.

Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (PSI)
0.02	170–190
0.10	165–185
0.20	160–180
0.30	155–175
0.40	148–168
0.50	140–160
0.60	130–145
0.70	110–130
0.80	90–115
0.90	65–90
0.98	55–65

The pressures in the table assume an engine speed of 1500 RPM and a temperature of 66°C (150°F). The pressure will vary with a change in temperature.

Electrical/Garage Shift Procedure

Perform this preliminary test before a hoist test or a road test in order to make sure that the electronic control inputs are connected and operating. If you do not check the inputs before operating the transmission, you could misdiagnose a simple electrical condition as a major transmission condition.

A scan tool provides valuable information and must be used on the HYDRA-MATIC 4L60-E transmission for accurate diagnosis.

1. Move the gear selector to PARK, (P) and set the parking brake.
2. Connect the scan tool to the DLC terminal.
3. Start the engine.
4. Connect the power to the scan tool.
5. Verify that the following signals are present:
 - Engine speed
 - Trans Output Speed
 - Vehicle Speed
 - A/B/C RNG
 - PRNDL Select
 - Desired PCS
 - Actual PCS
 - PCS Duty Cycle

- Brake Switch
 - 4WD Low Switch (4WD Only)
 - Engine Coolant Temp
 - Trans Fluid Temp
 - Throttle Angle
 - System Volts
6. Monitor the BRAKE SWITCH signal while tapping the brake pedal with your foot. The BRAKE SWITCH should be on when the pedal is depressed. The brake switch should come off when the brake pedal is released.
 7. Monitor the PRNDL SELECT signal and move the gear selector through all of the ranges.
 8. Verify that the PRNDL SELECT value matches the gear range indicated on the instrument panel or console. Gear selections should be immediate and not harsh.
 9. Move the gear selector to neutral and monitor the THROTTLE ANGLE signal while increasing and decreasing the engine RPM with the accelerator pedal. The THROTTLE ANGLE should increase with the engine RPM.

Road Test Procedure

- Perform the road test using a scan tool.
- Perform this test when the traffic and the road conditions permit. Observe all safety regulations.

1. Start the engine.
2. Depress the brake pedal.

Important: Gear selections should be immediate and not harsh.

3. Move the gear selector as follows:
 - 3.1. Park to Reverse.
 - 3.2. Reverse to Neutral.
 - 3.3. Neutral to D4.
4. Perform the same procedure as instructed previously in the road test:
 - Upshifts and TCC apply.
 - The part throttle detent downshift
 - The full throttle detent downshift
 - Manual downshifts
 - Coasting downshifts
 - Manual gear range selection

Use the scan tool in order to see if any transmission malfunction codes have been set. If so, perform the transmission test. After repairing the vehicle, perform the road test and verify that no codes have been set again. If no codes have been set and the condition remains, refer to the Diagnosis Charts contained in this section. If the condition is suspected to originate in the torque converter, refer to *Torque Converter Clutch Diagnosis* Torque Converter Clutch Diagnosis.

Upshift Control and TCC Apply

The PCM calculates the upshift points based primarily on two inputs: THROTTLE ANGLE and VEHICLE SPEED. When the PCM says a shift should occur, an electrical signal goes to the shift solenoids which in turn move the valves to perform the upshift.

The shift speed charts reference the THROTTLE ANGLE instead of MIN THROTTLE or WOT in order to make the shift speed measurement more uniform and accurate. Use a scan tool in order to monitor the THROTTLE ANGLE. Some scan tools are programmed in order to record shift point information. Check the instruction manual in order to see if this test is available.

With the gear selection in D4, do the following:

1. Look at the shift speed chart contained in this section and choose a percent throttle angle of 15 or 20.
2. Set up the scan tool in order to monitor the THROTTLE ANGLE and the VEHICLE SPEED.
3. Accelerate to the chosen throttle angle and hold the throttle steady.

Important: Shift speeds may vary due to the slight hydraulic delays responding to electronic controls. A change from the original equipment tire size also affects the shift speeds.

Note when the TCC applies. This should occur in third or fourth gear. If the apply is not noticed by an ROM drop, refer to the Preliminary Torque Converter Clutch diagnosis.

The TCC should not apply unless the transmission has reached a minimum operating temperature of 18° C TRAN TEMP and an engine coolant temp of 60° C.

4. As the transmission upshifts, note the shift speed and the commanded gear changes for the following:
 - 2nd gear
 - 3rd gear
 - 4th gear
5. Repeat steps 1-4, using several different throttle angles.

Full Throttle Detent Downshift

At vehicle speeds of 64–88 km/h (40–55 mph) in fourth gear, quickly increase the throttle angle to the maximum position.

Verify that the following conditions are met:

- The TCC releases.
- The transmission downshifts to 2nd gear immediately.
- The 1-2 shift solenoid turns off. The 2-3 shift solenoid is on.

Part Throttle Detent Downshift

At vehicle speeds of 64–88 km/h (40–55 mph) in fourth gear, quickly increase the throttle angle.

Verify that the following conditions are met:

- The TCC releases.
- The transmission downshifts to 3rd gear immediately.
- The 1-2 shift solenoid turns off.

Coasting Downshifts

1. With the gear selector in D4, accelerate to the 4th gear with the TCC applied.
2. Release the accelerator pedal. Lightly apply the brakes. Observe that the following occurs:
 - The TCC releases
 - The downshifts occur at speeds shown on the shift speed chart.

Manual Downshifts

The shift solenoids do not control the initial downshift during the 4-3 and the 3-2 manual downshifts. All manual downshifts are hydraulic except the 2-1. The solenoid states will change during or shortly after a manual downshift is selected.

1. At vehicle speeds of 64–88 km/h (40–55 mph) in fourth gear, release the accelerator pedal while moving the gear selector to D3. Observe the following:
 - The TCC releases.
 - The transmission downshifts to 3rd gear immediately.
 - The engine slows down the vehicle.
2. Move the gear selector back to D4 and accelerate to 64–72 km/h (40–45 mph). Release the accelerator while moving the gear selector to D2 and observe that:
 - The TCC releases.
 - The transmission downshifts to the 2nd gear immediately.
 - The engine slows down the vehicle.
3. Move the gear selector back to D4 and accelerate to 48 km/h (30 mph). Release the accelerator pedal while moving the gear selector to D1 and observe the following conditions:
 - The TCC releases.
 - The transmission downshifts to 1st gear immediately.
 - The engine slows down the vehicle.

Manual Gear Range Selection

Upshifts in the manual gear ranges are controlled by the shift solenoids.

Perform the following tests by accelerating at 10°–15° TP Sensor.

Manual Third (D3)

With the vehicle stopped, move the gear selector to D3 and accelerate in order to observe:

- 1-2 shift
- 2-3 shift

Manual Second (D2)

1. With the vehicle stopped, move the gear selector to the D2 position and accelerate in order to observe if the transmission starts and remains in second gear.
2. Accelerate to 40 km/h (35 mph) and observe the following:
 - The 2-3 shift does not occur.
 - The TCC does not apply.

Manual First (D1)

1. With the vehicle stopped, move the gear selector to D1.
2. Accelerate to 32 km/h (20 mph).
3. Observe the following conditions:
 - No upshifts occur.
 - The TCC does not apply.
 - You can upshift out of first at the fuel cut-off.

Reverse

With the engine stopped, move the gear selector to R and slowly accelerate in order to observe if the 1-2 and the 2-3 shift solenoids are on.

Use a scan tool in order to see if any transmission trouble codes have been set. Refer to Trouble Codes diagnosis in this section and repair the vehicle as directed. After repairing the vehicle, perform the hoist test and verify that the code has not set again.

If the transmission is not performing well and no trouble codes have been set, there may be an intermittent condition. Check all electrical connections for damage or a loose fit. Some scan tools have a snapshot test which can help catch an intermittent condition that doesn't occur long enough to set a code.

You may want to read Electronic Component Diagnosis in this section in order to become familiar with the transmission conditions caused by transmission electrical malfunctions.

If no trouble codes have been set and the condition is suspected to be hydraulic, take the vehicle on a road test.

Noise and Vibration Analysis

A noise or vibration that is noticeable when the vehicle is in motion may not be caused by the transmission.

A noise or vibration that is noticeable while the vehicle is in the P (Park) or the N (Neutral) position with the engine at idle, but is less noticeable as the RPM increases, may be the result of poor engine performance.

Inspect the following components for the conditions stated:

- Tires and wheels — Uneven wear; imbalance; mixed sizes.

- Suspension components — alignment and wear; loose fasteners. Refer to Section 3C.
- Engine mounts — damage; loose bolts.
- Transmission case mounting holes — Missing bolts, nuts, and studs; stripped threads; cracks.
- Flywheel — Missing or loose bolts; cracks; imbalance. For flywheel balancing, refer to *Engine Flywheel Replacement* in Engine Mechanical.
- Torque converter — Missing or loose bolts or lugs; missing or loose balance weights; imbalance.

Flywheel/Torque Converter Vibration Test

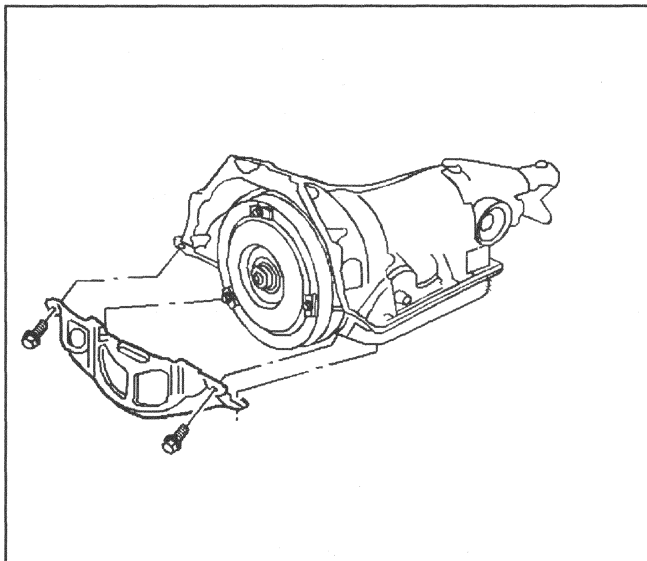
Inspection Procedure

Notice: Some Engine/Transmission combinations cannot be balance in this manner, due to the limited clearances between the transmission torque converter bolts and the engine. Be sure that the bolts do not bottom out in the lug nuts, or the transmission converter cover could be dented, and cause internal damage.

1. Start the engine.
2. Place the transmission in P (Park) or N (Neutral).
3. Run the engine at idle speed.
4. Observe the vibration.
5. Shut OFF the engine.

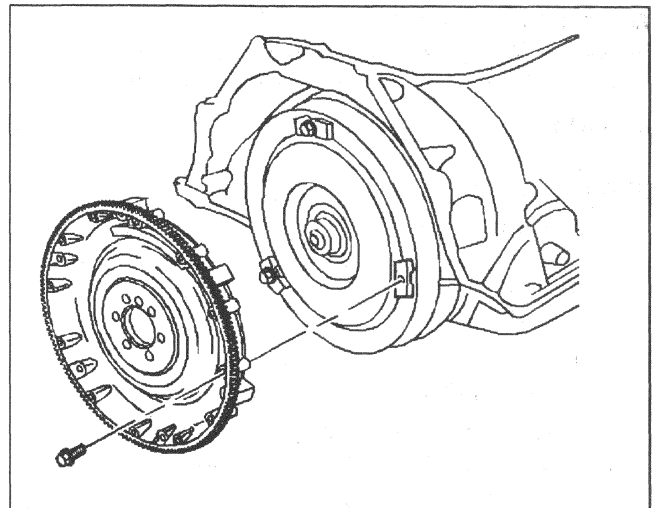
Removal Procedure

1. Disconnect the negative battery cable. Refer to the *Battery Disconnect Caution* in General Information.
2. Raise the vehicle. Refer to Section 0A.
3. Support the vehicle with safety stands.
4. Remove the starter motor. Refer to *Starter Motor Replacement* in Engine Electrical.



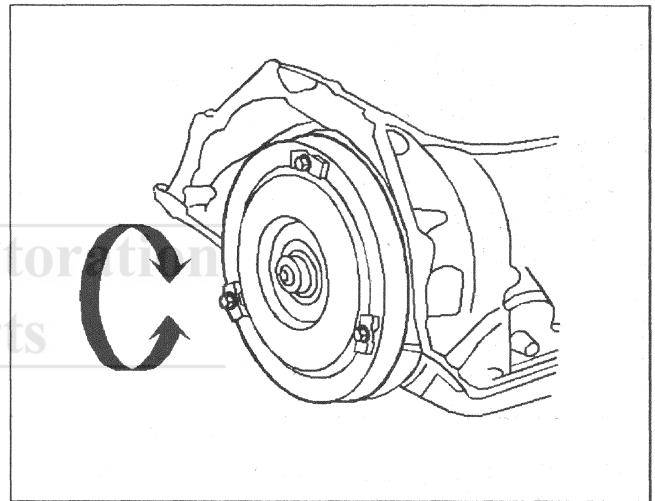
13902

5. Remove the converter cover bolts.
6. Remove the converter cover.



13908

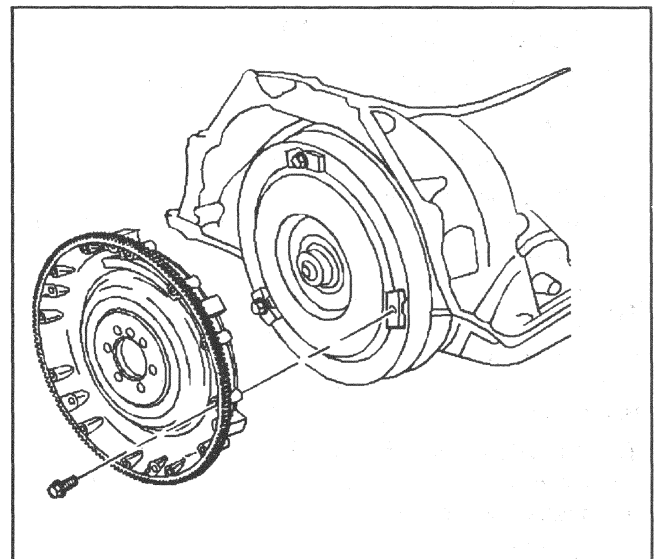
7. Remove the torque converter to flywheel bolts. Discard the flywheel bolts.



13910

8. Rotate the torque converter 120° (1/3 turn).

Installation Procedure



13908

Notice: Be sure that the bolts do not bottom out in the lug nuts, or the transmission converter cover could be dented, and cause internal damage.

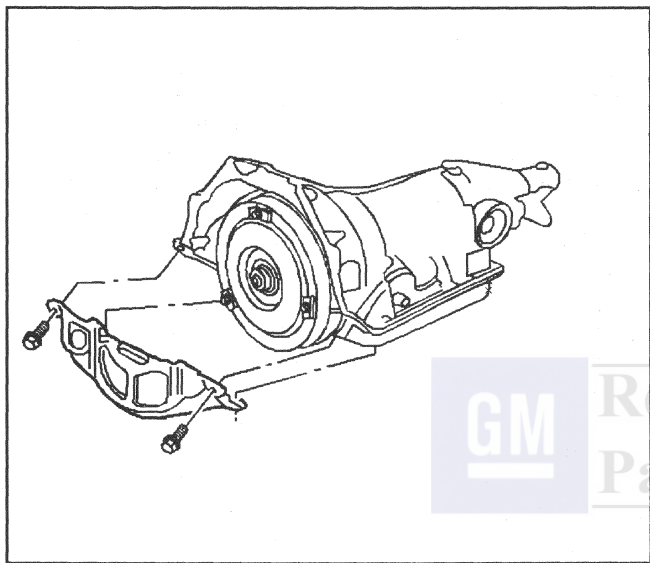
Important: Hand start all torque converter to flywheel bolts before torquing. This will ensure proper alignment and avoid cross threading.

1. Install the flywheel to torque converter bolts.
Use new flywheel to torque converter bolts with retaining compound removed from the first three threads of each bolt.

Tighten

Tighten the bolts to 63 N.m (46 lb ft).

Refer to *Fastener Notice* in General Information.



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2. Install the converter cover and the bolts.

Tighten

Tighten the bolts to 10 N.m (89 lb in).

3. Install the starter. Refer to *Starter Motor Replacement* in Engine Electrical.
4. Lower the vehicle.
5. Connect the negative battery cable.

Tighten

Tighten the cable to 15 N.m (11 lb ft).

6. Start the engine and check for vibration. Repeat this procedure until the best possible balance is obtained.

Torque Converter Clutch Diagnosis

In order to properly diagnose the Torque Converter Clutch (TCC) system, perform all of the electrical testing first. Then do the hydraulic testing.

The TCC is applied by fluid pressure, which is controlled by a solenoid inside of the automatic transmission assembly. The solenoid is energized by completing an electrical circuit through a combination of switches and sensors.

Functional Check Procedure

1. Install a tachometer or a scan tool.
2. Operate the vehicle until you reach proper operating temperature.
3. Drive the vehicle at 80–88 km/h (50–55 mph) with a light throttle (road load).
4. Maintaining the throttle, lightly touch the brake pedal. Check for the release of the TCC and a slight increase in engine speed (RPM).
5. Release the brake. Slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine speed (RPM).

Torque Converter Evaluation

Torque Converter Stator

The torque converter stator roller clutch can have one of two different types of malfunctions:

- Stator assembly freewheels in both directions.
- Stator assembly remains locked up at all times.

Condition A — Poor Acceleration Low Speed

The car tends to have a poor acceleration from a standstill. At speeds above 50–55 km/h (30–35 mph), the car may act normal. If you note poor acceleration, you should first determine that the exhaust system is not blocked and the transmission is in first gear when starting out.

If the engine freely accelerates to high RPM in NEUTRAL (N), you can assume that the engine and exhaust system are normal. Checking for poor performance in DRIVE and REVERSE helps determine if the stator is freewheeling at all times.

Condition B — Poor Acceleration High Speed

Engine RPM and car speed are limited or restricted at high speeds. Performance when accelerating from a standstill is normal. The engine may overheat. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, the stator roller clutch can be checked by inserting two fingers into the splined inner race of the roller clutch and try to turn the race in both directions. The inner race should turn freely clockwise, but the inner race should not turn or be very difficult to turn counterclockwise.

Noise

Torque converter whine usually is noticed when the vehicle is stopped and the transmission is in DRIVE or REVERSE. The noise increases when the engine RPM increases. The noise stops when the vehicle is moving or when the torque converter clutch is applied because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise actually is coming from the converter:

1. Place a foot on the brake.
2. Put the gear selector in DRIVE.

Important: This noise should not be confused with the pump whine noise which is usually noticeable in PARK, NEUTRAL and all other gear ranges. Pump whine varies with pressure ranges.

3. Depress the accelerator to approximately 1200 RPM for no more than six seconds.
A torque converter noise increases under this load.
4. The torque converter should be replaced under any of the following conditions:
 - External leaks in the hub weld area
 - The converter hub is scored or damaged.
 - The converter pillar is broken or damaged or fits poorly into the crankshaft.
 - You find steel particles after flushing the cooler and cooler lines.
 - The pump is damaged or the steel particles are found in the converter.
 - The vehicle has TCC shudder and/or no TCC apply. Replace only after you have made all of the hydraulic and electrical diagnoses. (Converter clutch material may be glazed).
 - The converter has an imbalance which cannot be corrected. (Refer to the Converter Vibration Test Procedure).
 - The converter is contaminated with engine coolant containing antifreeze.
 - Internal failure of stator roller clutch
 - Excess end play.
 - Heavy clutch debris due to overheating (blue converter)
 - Steel particles or clutch lining material found in fluid filter or on magnet when no internal parts in the unit are worn or damaged - indicates that the lining material came from the converter.
5. The torque converter should not be replaced if any of the following conditions exist:
 - The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
 - The threads in one or more of the converter bolt holes are damaged. Correct with thread insert.
 - Transmission failure did not display evidence of damage or worn internal parts, steel particles or the clutch plate lining material in the unit and inside the fluid filter.
 - The vehicle has been exposed to high mileage (only). The exception may be where the torque converter clutch damper plate lining has seen excess wear by the vehicles operated in heavy and/or constant traffic, such as a taxi, deliver or police use.

Torque Converter Clutch Shudder

The key to diagnosing the Torque Converter Clutch (TCC) shudder is to note when the shudder happens and under what conditions:

The TCC shudder should not only occur during the APPLY and/or RELEASE of the converter clutch, and SELDOM after the TCC plate is fully applied.

While the TCC is Applying or Releasing

If the shudder occurs while the TCC is applying, the problem can be within the transmission or the torque converter. Something is not allowing the clutch to release, or the TCC is trying to release and apply the clutch at the same time. This could be caused by leaking turbine shaft seals, a restricted release orifice, a distorted clutch or a housing surface due to long converter bolts, or defective friction material on the TCC plate.

Shudder Occurs after the TCC has Applied

Important: Once the TCC is applied there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before the TCC engagement.

When the shudder occurs after the TCC has applied, most of the time there is nothing wrong with the transmission. As mentioned above, once the TCC has been applied, it is very unlikely that it will slip. Engine problems may go unnoticed under light throttle and load, but engine problems may become noticeable after TCC apply when going up a hill or accelerating, due to the mechanical coupling between the engine and the transmission.

Inspect the following components in order to avoid misdiagnosis of the TCC shudder and possibly disassembling a transmission and/or replacing a torque converter unnecessarily:

1. Spark plugs - Inspect for cracks, high resistance or broken insulator.
2. Plug wires - Look in each end. If there is a red dust (ozone) or a black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire indicating arcing during hard acceleration.
3. Distributor cap and rotor - Look for broken or uncrimped parts.
4. Coil - Look for black on bottom indication arching while engine is misfiring.
5. Fuel injector - Filter may be plugged.
6. Vacuum leak - Engine won't get correct amount of fuel and may run rich or lean, depending on where the leak is located.
7. EGR valve - Valve may let in too much unburnable exhaust has causes engine to run lean.
8. MAP/MAF sensor - Like the vacuum leak, the engine won't get the correct amount of fuel for proper engine operation.
9. Carbon on intake valves - Restricts proper flow or air/fuel mixture into cylinders.
10. Flat cam - Valves don't open enough to let proper fuel/air mixture into cylinders.
11. Oxygen sensor - May command engine too rich or too lean for too long.
12. Fuel pressure - May be too low.
13. Engine mounts - Vibration of mounts can be multiplied by TCC engagement.

14. Axle joints - Check for vibration.
15. TPS – TCC apply and release depends on TPS in many engines. IF TPS is out of specification, TCC may remain applied during the initial engine crowd.
16. Cylinder balance - Bad piston rings or valves that seal poorly can cause low power in a cylinder.
17. Fuel contamination - Causes poor engine performance.

Tech 1 Data Value Examples

If you have completed the On-Board Diagnostic (OBD) system check, if the diagnostics are functioning properly and if no DTCs display, you may use the Typical Scan Values in the table below for comparison within the appropriate transmission. These typical values are an average of display values recorded from normally operating vehicles. They represent the display from a normally functioning system.

You should never use a scan tool that displays faulty data. The problem should be reported to the manufacturer. The use of a faulty scan tool can result in misdiagnosis and the unnecessary replacement of parts.

Only the parameters listed below are used in this manual for diagnosing. If a scan tool displays other parameters, the values are not recommended by General Motors for use in diagnosis.

Scan tests are performed under the following driving conditions:

- Idle
- Lower radiator hose is hot
- Closed throttle
- Park or Neutral
- Closed Loop
- Accessories OFF

Tech 1 Data Value Examples

Tech 1 Parameter	Units Displayed	Typical Scan Values
MAP	kPa, V	20–48 kPa, 1–2V, depending upon altitude
BARO	kPa, V	70–100 kPa, 3.5–4.5V, depending upon altitude
TP Sensor	volts	0.30–0.90V
TP Angle	percent	0%
A/C Clutch	ON/OFF	OFF
Cruise Enabled	ON/OFF	OFF
Hot Mode	ON/OFF	OFF
Adaptable Shift	Yes/No	No
Curr TAP Memory	-16 to +16	varies
Current TAP	0–16	varies
Long Shift Delay	Yes/No	No
Long Shift Time	Yes/No	No
TP Range	Normal/Exceeded	Normal
Standard TAP	Yes/No	No
VSS Delta	Normal/Exceeded	Normal
TP Delta	Normal/Exceeded	Normal
Engine Run Time	hr/min/sec	depends on time since start-up
Ignition 1	volts	13–15V
Gear Ration	ratio	varies
Current Gear	1,2,3,4	1
ECT	C° (F°)	85°–105° C (185°–220° F)
TFT	C° (F°)	82°–94° C (180°–200° F)
TFT Sensor	volts	varies with the outside temperature
TCC Slip Speed	RPM	+/- 50 RPM from the Engine Speed
TCC Brake Sw	Applied/Released	Released
TCC Duty Cycle	Percentage	0%
TCC Enable	On/Off	Off
TCC Duty Open	Yes/No	No

Tech 1 Data Value Examples (cont'd)

Tech 1 Parameter	Units Displayed	Typical Scan Values
TCC Duty Shorted	Yes/No	No
TCC Enable Open	Yes/No	No
TCC Enable Short	Yes/No	No
1/2 Sol.	On/Off	On
2/3 Sol.	On/Off	On
1/2 Sol. Open	Yes/No	No
1/2 Sol. Short	Yes/No	No
2/3 Sol. Open	Yes/No	No
2/3 Sol. Short	Yes/No	No
3/2 Down Shift	Yes/No	No
3/2 DS Open	Yes/No	No
3/2 DS Shorted	Yes/No	No
1/2 Shift Time	seconds	0.00
2/3 Shift Time	seconds	0.00
1/2 Shift Error	seconds	0.00
2/3 Shift Error	seconds	0.00
3/4 Shift Time	seconds	0.00
Latest Shift	seconds	0.00
Latest Shift Err	seconds	0.00
Speed Ratio	ratio	0.00
Upshift Request	Yes/No	No
Upshift in Prog	Yes/No	No
Upshift Desired	Yes/No	No
DS Requested	Yes/No	No
DS in Progress	Yes/No	No
DS Desired	Yes/No	No
3/2 Started	Yes/No	No
3/2 in Progress	Yes/No	No
Vehicle Speed	km/h, mph	0, 0
Engine Speed	RPM	+/- 100 RPM from Desired Engine Speed
PC Act. Current	amps	varies (0.1–1.1 amps)
PC Ref Current	amps	varies (0.1–1.1 amps)
PC Duty Cycle	percentage	40–60%
Power Enrichment	Yes/No	No
KickDown Enabled	Yes/No	No
DTC Set This Ign	Yes/No	No
TR Switch	Invalid, Reverse, Overdrive, Dr 3, Dr 2, Low, Park	Park, Neutral
Traction Control	Inactive/Active	Inactive
Trans. OSS	RPM	0
TFP Switch	On/Off	Off/On/Off
TCC Stator Temp	Normal/High	Normal

Internal Wiring Harness Check**Test Description****Tools Required**

- J 39775 4L60E Jumper Harness
- J 39200 Digital Multimeter
- J 35616 Connector Test Adapter Kit

Important: Resistance values in this chart are given for 20°C (68°F). In order to check the resistance of components at other temperatures, refer to *Component Resistance*. This procedure cannot be used for checking the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val Position Sw.) circuit, or the Automatic Transmission Fluid Temperature (TFT) Sensor circuit. Refer to *Pressure Switch Assembly Resistance Check*, for those circuits.

Internal Wiring Harness Check

Step	Action	Value(s)	Yes	No
1	1. Install a J 39775 Jumper Harness on the transmission 20-way connector. 2. Using a J 39200 DVOM and a J 35616 Connector Test Adapter Kit, measure the resistance between terminals A and E (1-2 Shift Solenoid Valve). Is the resistance within the values indicated?	19-24Ω	Go to Step 3	Go to Step 2
2	1. Disconnect the 1-2 Shift Solenoid Valve (1-2 SS Valve) from the Automatic Transmission Wiring Harness Assembly. 2. Using the J 39200 DVOM, measure the resistance of the 1-2 SS Valve. Is the resistance within the values indicated?	19-24Ω	Go to Step 13	Go to Step 16
3	Measure the resistance between terminals B and E (2-3 Shift Solenoid Valve). Is the resistance within the values indicated?	19-24Ω	Go to Step 5	Go to Step 4
4	1. Disconnect the 2-3 Shift Solenoid Valve (2-3 SS Valve) from the Automatic Transmission Wiring Harness Assembly. 2. Using the J 39200 DVOM, measure the resistance of the 2-3 SS Valve. Is the resistance within the values indicated?	19-24Ω	Go to Step 13	Go to Step 16
5	Measure the resistance between terminals T and E (Torque Converter Clutch (TCC) Solenoid Valve). Is the resistance within the values indicated?	21-26Ω	Go to Step 6	Go to Step 15
6	Measure the resistance between terminals U and E (Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve). Is the resistance within the values indicated?	10-11Ω	Go to Step 8	Go to Step 7
7	1. Disconnect the TCC PWM Solenoid Valve from the Automatic Transmission Wiring Harness Assembly. 2. Using the J 39200 DVOM, measure the resistance of the TCC PWM Solenoid Valve. Is the resistance within the values indicated?	10-11Ω	Go to Step 13	Go to Step 16
8	Measure the resistance between terminals S and E (3-2 Shift Solenoid Valve assembly). Is the resistance within the values indicated?	20-24Ω	Go to Step 10	Go to Step 9
9	1. Disconnect the 3-2 Shift Solenoid Valve assembly (3-2 SS Valve Assy.) from the Automatic Transmission Wiring Harness Assembly. 2. Using the J 39200 DVOM, measure the resistance of the 3-2 SS Valve Assy. Is the resistance within the values indicated?	20-24Ω	Go to Step 13	Go to Step 16

Internal Wiring Harness Check (cont'd)

Step	Action	Value(s)	Yes	No
10	Measure the resistance between terminals C and D (Pressure Control Solenoid Valve). Is the resistance within the values indicated?	3–5Ω	Go to Step 12	Go to Step 11
11	1. Disconnect the Pressure Control Solenoid Valve (PC Sol Valve) from the Automatic Transmission Wiring Harness Assembly. 2. Using the J 39200 DVOM, measure the resistance of the PC Sol Valve. Is the resistance within the values indicated?	3–5Ω	Go to Step 13	Go to Step 16
12	Using the J 39200 DVOM and the J 35616 Connector Test Adapter Kit, measure the resistance from each pin of the A/T Wiring Harness Assy. at the Automatic Transmission 20-way connector to the transmission case. Is the resistance more than the value indicated?	50kΩ	System OK	Go to Step 15
13	Inspect for a short to ground. 1. Using the J 39200 DVOM and the J 35616 Connector Test Adapter Kit, measure the resistance from each pin of the A/T Wiring Harness Assy. at the Automatic Transmission 20-way connector to the transmission case. 2. Inspect for a chafed wire that could short to bare metal or other wiring. 3. If diagnosing for a possible intermittent condition, move or massage the A/T Wiring Harness Assy. while observing the test equipment for a change. Is a short to ground (low resistance) indicated?	—	Go to Step 15	Go to Step 14
14	Inspect for high resistance. 1. Inspect the A/T Wiring Harness Assy. for poor electrical connections at the Automatic Transmission 20-way connector. Inspect for bent, backed-out, or damaged terminals, and weak terminal tension. 2. Inspect the A/T Wiring Harness Assy. for poor electrical connections at the component connectors. Inspect for bent, backed-out, or damaged terminals, and weak terminal tension. 3. If diagnosing for a possible intermittent condition, move or massage the A/T Wiring Harness Assy. while observing the test equipment for a change. Is a high resistance (open) condition indicated?	—	Go to Step 15	—
15	Replace the Automatic Transmission Wiring Harness Assembly. Is the replacement complete?	—	Verify the repair and exit the table	—
16	Replace the component. Is the replacement complete?	—	Verify the repair and exit the table	—

Component Resistance

Component	Pass Thru Pins	Res 20°C	Res 100°C	Res to Grd (Case)
1-2 Shift Solenoid Valve	A, E	19-24 Ω	24-31 Ω	Greater than 250 K Ω
2-3 Shift Solenoid Valve	B, E	19-24 Ω	24-31 Ω	Greater than 250 K Ω
TCC Solenoid Valve	T, E	21-26 Ω	26-33 Ω	Greater than 250 K Ω
TCC PWM Solenoid Valve	U, E	10-11 Ω	13-15 Ω	Greater than 250 K Ω
3-2 Shift Solenoid Valve Ass'y	S, E	20-24 Ω	29-32 Ω	Greater than 250 K Ω
Pressure Control Solenoid	C, D	3-5 Ω	4-7 Ω	Greater than 250 K Ω
Transmission Fluid Pressure (TFP) Manual Valve Position Switch	Refer to <i>Pressure Switch Assembly Resistance Check</i> .			
*Transmission Fluid Temperature (TFT) Sensor	M, L	3088-3942 Ω	159.3-198.0 Ω	Greater than 10 M Ω
Vehicle Speed Sensor	A, B VSS CONN	1150-1250 Ω	1725-1825 Ω	Greater than 10 M Ω
Important: The resistance of this device is necessarily temperature dependant and will therefore vary far more than any other device. Refer to Transmission Fluid Temperature Sensor portion of <i>Electronic Component Description</i> .				



Pressure Switch Assembly Resistance Check

Test Description

Tools Required

- J 39775 4L60E Jumper Harness
- J 39200 Digital Multimeter
- J 35616 Connector Test Adapter Kit

Important: Whenever the transmission 20-way connector is disconnected and the engine is running, multiple DTCs will set. Be sure to clear these codes when you are finished with this procedure.

Important: This procedure tests the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) circuits and the Automatic Transmission Fluid Temperature (TFT) Sensor circuit. Do not use this procedure to test other Automatic Transmission circuits, refer to 4L60-E Automatic Transmission Internal Wiring Harness check.

Pressure Switch Assembly Resistance Check

Step	Action	Value(s)	Yes	No
1	1. Connect J 39775 Jumper Harness to the transmission 20-way connector. 2. Using J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance from terminal N to the transmission case. Is the resistance greater than the value indicated?	50K Ω	Go to Step 3	Go to Step 2
2	1. Disconnect the internal transmission wiring harness from the TFP Val Position Sw. 2. Measure the resistance from terminal C of the TFP Val Position Sw to the switch housing. Is the resistance greater than the value indicated?	50K Ω	Go to Step 12	Go to Step 14
3	Measure the resistance from terminal R to the transmission case. Is the resistance less than the value listed?	200 Ω	Go to Step 5	Go to Step 4
4	1. Disconnect the internal transmission wiring harness from the TFP Val Position Sw. 2. Measure the resistance from terminal E of the TFP Val Position Sw to the switch housing. Is the resistance less than the value indicated?	200 Ω	Go to Step 12	Go to Step 14
5	Measure the resistance from terminal P to transmission case. Is the resistance greater than the value indicated?	50K Ω	Go to Step 7	Go to Step 6
6	1. Disconnect the internal transmission wiring harness from the TFP Val Position Sw. 2. Measure the resistance from terminal D of the TFP Val Position Sw to the switch housing. Is the resistance greater than the value indicated?	50K Ω	Go to Step 12	Go to Step 14
7	1. Run the engine at Idle. 2. Set the parking brake. 3. Place the gear select lever in the Reverse position. 4. Measure the resistance from terminal N to the transmission case. Is the resistance less than the value indicated?	200 Ω	Go to Step 8	Go to Step 14
8	1. Place the gear select lever in the Low (D1) position. 2. Measure the resistance from terminal N to the transmission case. Is the resistance less than the value listed?	200 Ω	Go to Step 9	Go to Step 14

Pressure Switch Assembly Resistance Check (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Place the gear select lever in Manual Third (D3) position. 2. Measure the resistance from terminal R to the transmission case. Is the resistance greater than the value listed?	50K Ω	Go to Step 10	Go to Step 14
10	1. Place the gear select lever in Drive (D4) position. 2. Measure the resistance from terminal P to the transmission case. Is the resistance less than the value listed?	200 Ω	Go to Step 11	Go to Step 14
11	1. Place the gear select lever in Manual Second (D2) position. 2. Measure the resistance from terminal P to the transmission case. Is the resistance greater than the value listed?	50K Ω	No problem found, exit table	Go to Step 14
12	Inspect for high resistance: 1. Inspect the transmission wiring for poor electrical connections at the transmission 20-way connector and at the TFP Val Position Sw. 2. Look for possible bent, backed out, deformed, or damaged terminals. 3. Check for weak terminal tension. Was a high resistance condition found?	—	Verify repair and go to Step 1	Go to Step 13
13	Replace the internal transmission wiring harness. Refer to On-Vehicle Service. Is the replacement complete?	—	Verify repair and go to Step 1	—
14	Replace the TFP Val Position Sw. Refer to On-Vehicle Service. Is the replacement complete?	—	Verify repair and go to Step 1	—

Electronic Component Malfunctions

This table gives some general information about electronic component malfunctions. Use this information to become familiar with possible conditions caused by transmission/vehicle electrical components. Refer to the Diagnosis Charts for more specific information.

Hydra-Matic 4L60-E Electronic Component Malfunctions

COMPONENT/SYSTEM	CAN EFFECT
Throttle Position Sensor	• Shift Pattern (erratic). • Shift quality (firm or soft). • Engine (rough)
Automatic Transmission Output Shaft Speed Sensor	• Shift Pattern (erratic). • TCC Sol Valve apply (at wrong time). • Shift quality (harsh or soft).
Transmission Fluid Pressure (TFP) Manual Valve Position Switch	• TCC Sol Valve apply (no apply if diagnostic code is set). • Shift pattern (no fourth gear in hot mode). • Shift quality (harsh). • Line pressure (high). • Manual downshift (erratic).
Automatic Transmission Fluid Temperature (TFT) Sensor	• TCC Sol Valve control (on or off). • Shift quality (harsh or soft.).
Engine Coolant Temperature Sensor	• TCC Sol Valve control (no apply). • Shift quality (harsh).
Shift Solenoid valves	Gear application (wrong gear, only two gears, no shift).
Brake Switch	• TCC apply (no apply). • No 4th gear if in hot mode.
System Voltage	• Line pressure (high). • Gear application (third gear only). • TCC control (no apply). • No 4th gear if in hot mode).
3-2 Control Shift Solenoid Valve Assembly	• Gear application (third gear only). • 3-2 Downshifts (flare or tie-up).
Pressure Control Solenoid	• Line pressure (high or low) • Shift quality (harsh or soft).
TCC Sol Valve	• TCC Sol Valve apply (no apply) • No 4th gear if in hot mode.
Cruise Control	Delays 3-4 upshift and TCC apply during heavy throttle.
Acceleration Slip Regulation (ASR)	Downshifts.

Oil Pressure High or Low

Checks	Causes
Oil Pump Assembly	• Pressure regulator valve stuck. • Pressure regulator valve spring. • Rotor guide omitted or misassembled. • Rotor cracked or broken. • Reverse boost valve or sleeve stuck, damaged or incorrectly assembled. • Orifice hole in pressure regulator valve plugged. • Sticking slide or excessive rotor clearance. • Pressure relief ball not seated or damaged. • Porosity in pump cover or body. • Wrong pump cover. • Pump faces not flat. • Excessive rotor clearance.
Oil Filter	• Intake pipe restricted by casting flash. • Cracks in filter body or intake pipe. • O-ring seal missing, cut or damaged. • Wrong grease sued on rebuild.
Valve Body	• Manual valve scored or damaged. • Spacer plate or gaskets incorrect, misassembled or damaged. • Face not flat. • 2-3 Shift valve stuck. • Checkballs omitted or misassembled.
Pressure Control Solenoid	• Damage to pins
Pressure Switch Assembly	• Contamination • Damaged seals.
Case	• Case to valve body face not flat

Harsh Shifts

Checks	Causes
Throttle Position Sensor	Open or shorted circuit.
Vehicle Speed Sensor	Open or shorted circuit.
Pressure Switch Assembly	• Contamination • Damaged seals
Trans Fluid Temperature Sensor	Open or shorted circuit.
Engine Coolant Temperature Sensor	Open or shorted circuit.
Pressure Control Solenoid	• Damage to pins • Contamination

Inaccurate Shift Points

Checks	Causes
Oil Pump Assembly	• Stuck pressure regulator valve. • Sticking pump slide.
Valve Body Assembly	Spacer plate or gaskets misassembled, damaged or incorrect
Case	• Porous or damaged valve body pad. • 2-4 Servo Assembly. – 2-4 accumulator porosity – Damaged servo piston seals. – Apply pin damaged or improper length. • 2-4 Band Assembly. – Burned – Anchor pin not engaged.
Throttle Position Sensor	• Disconnected • Damage
Vehicle Speed Sensor	• Disconnected • Damaged • Bolt not tightened
4WD Low Switch	• Disconnected • Damaged.

Slips in 1st Gear

Checks	Causes
Forward Clutch Assembly	• Clutch plates worn • Porosity or damage in forward clutch piston • Forward clutch piston inner and outer seals missing, cut or damaged. • Damaged forward clutch housing. • Forward clutch housing retainer and ball assembly not sealing or damaged.
Forward Clutch Accumulator	• Piston seal missing, cut or damaged. • Piston out of its bore. • Porosity in the piston or valve body. • Stuck abuse valve.
Input Housing and Shaft Assembly	Turbine shaft seals missing, cut or damaged.
Valve Body	• 1-2 Accumulator valve stuck. • Face not flat, damaged lands or interconnected passages. • Spacer plate or gaskets incorrect, mispositioned or damaged.
Low Roller Clutch	• Damage to lugs to inner ramps. • Rollers not free moving. • Inadequate spring tension. • Damage to inner splines. • Lube passage plugged.
Torque Converter	Stator roller clutch not holding.

Slips in 1st Gear (cont'd)

Checks	Causes
1-2 Accumulator Assembly	• Porosity in piston or 1-2 Accumulator cover and pin assembly. • Damaged ring grooves on piston. • Piston seal missing, cut or damaged. • Valve body to spacer plate gasket at 1-2 Accumulator cover, missing or damaged. • Leak between piston and pin. • Broken 1-2 Accumulator spring.
Line Pressure	(See Causes of High or Low Oil Pressure).
2-4 Servo Assembly	4th Servo piston in backwards.

Slipping or Rough 1-2 Shift

Checks	Causes
Valve Body Assembly	• 1-2 Shift valve train stuck. • Gaskets or spacer plate incorrect, mispositioned or damaged. • 1-2 Accumulator valve stuck. • Face not flat.
2-4 Servo Assembly	• Apply pin too long or too short. • 2nd servo apply piston seal missing, cut or damaged. • Restricted or missing oil passages. • Servo bore in case damaged.
2nd Accumulator	• Porosity in 1-2 accumulator housing or piston. • Piston seal or groove damaged. • Nicks or burrs in 1-2 accumulator housing. • Missing or restricted oil passage.
2-4 Band	Worn or mispositioned.
Oil Pump Assembly or Case	Faces not flat.

No 2-3 Shift or 2-3 Shift Slips, Rough or Hunting

Checks	Causes
Valve Body Assembly	• 1-2 Shift valve train stuck. • Gaskets or spacer plate incorrect, mispositioned or damaged. • 1-2 Accumulator valve stuck. • Face not flat.
2-4 Servo Assembly	• Apply pin too long or too short. • 2nd servo apply piston seal missing, cut or damaged. • Restricted or missing oil passages. • Servo bore in case damaged.
2nd Accumulator	• Porosity in 1-2 accumulator housing or piston. • Piston seal or groove damaged. • Nicks or burrs in 1-2 accumulator housing. • Missing or restricted oil passage.
2-4 Band	Worn or mispositioned.
Oil Pump Assembly or Case	Faces not flat.

3-2 Flare or Tie-Up

Checks	Causes
3-2 Control Solenoid	• Shorted or damaged. • Contamination • Damaged Seal

No 3-4 Shift, Slips or Rough 3-4 Shift

Checks	Causes
Oil Pump Assembly	• Pump cover retainer and ball assembly omitted or damaged • Faces not flat
Valve Body Assembly	• Valves stuck – 2-3 Shift valve train – Accumulator valve – 1-2 Shift valve train – 3-2 Control valve • Spacer plate or gaskets incorrect, mispositioned or damaged
2-4 Servo Assembly	• Incorrect band apply pin. • Missing or damaged servo seals. • Porosity in piston, cover or case. • Damaged piston seal grooves. • Plugged or missing orifice cup plug.
Case	• 3rd Accumulator retainer and ball assembly leaking. • Porosity in 3-4 accumulator piston or bore. • 3-4 Accumulator piston seal or seal grooves damaged. • Plugged or missing orifice cup plug. • Restricted oil passage.
Input Housing Assembly	Refer to Slipping 2-3 Shift.
2-4 Band Assembly	Worn or misassembled

No Reverse or Slips in Reverse

Checks	Causes
Input Housing Assembly	• 3-4 Apply ring stuck in applied position. • Forward clutch not releasing • Turbine shaft seals missing, cut or damaged
Manual Valve Link	Disconnect
Valve Body Assembly	• 2-3 Shift valve stuck. • Manual linkage not adjusted • Spacer plate and gaskets incorrect, mispositioned or damaged. • Lo overrun valve stuck • Orificed cup plug restricted, missing or damaged.

No Reverse or Slips in Reverse (cont'd)

Checks	Causes
Reverse Input Clutch Assembly	• Clutch plate worn. • Reverse input housing and drum assembly cracked at weld. • Clutch plate retaining ring out of groove. • Return spring assembly retaining ring out of groove. • Seals cut or damaged • Restricted apply passage • Porosity in piston • Belleville plate installed incorrectly • Excessive clutch plate travel • Oversized housing
Lo and Reverse Clutch	• Clutch plates worn • Porosity in piston • Seals damaged. • Return spring assembly retaining ring mispositioned • Restricted apply passage

No Part Throttle or Delayed Downshifts

Checks	Causes
Input Housing Assembly	• 3-4 Apply ring stuck in applied position. • Forward clutch not releasing • Turbine shaft seals missing, cut or damaged
Manual Valve Link	Disconnect
Valve Body Assembly	• 2-3 Shift valve stuck. • Manual linkage not adjusted • Spacer plate and gaskets incorrect, mispositioned or damaged. • Lo overrun valve stuck • Orificed cup plug restricted, missing or damaged.
Reverse Input Clutch Assembly	• Clutch plate worn. • Reverse input housing and drum assembly cracked at weld. • Clutch plate retaining ring out of groove. • Return spring assembly retaining ring out of groove. • Seals cut or damaged • Restricted apply passage • Porosity in piston • Belleville plate installed incorrectly • Excessive clutch plate travel • Oversized housing
Lo and Reverse Clutch	• Clutch plates worn • Porosity in piston • Seals damaged. • Return spring assembly retaining ring mispositioned • Restricted apply passage

Harsh Garage Shift

Checks	Causes
Valve Body Assembly	• Orifice cup plug missing • Checkball missing

No Overrun Braking - Manual 3-2-1

Checks	Causes
External Linkage	Not adjusted properly
Valve Body Assembly	• 4-3 Sequence valve stuck. • Checkball mispositioned • Spacer plate and gaskets incorrect, damaged or mispositioned
Input Clutch Assembly	• Turbine shaft oil passages plugged or not drilled. • Turbine shaft seal rings damaged. • Turbine shaft sealing balls loose or missing. • Turbine shaft sealing balls loose or missing. • Porosity in forward or overrun clutch piston. • Overrun piston seals cut or damaged. • Overrun piston checkball not sealing.

No TCC Apply

Checks	Causes
Electrical	• 12 Volts not supplied to transmission • Outside electrical connector damaged. • Inside electrical connector, wiring harness or solenoid damaged. • Electrical short (pinched solenoid wire). • Solenoid not grounded.
Converter	Internal damage.
Oil Pump Assembly	• Converter clutch valve stuck or assembled backwards. • Converter clutch valve retaining ring mispositioned. • Pump to case gasket mispositioned • Orifice cup plug restricted or damaged • Solenoid O-ring seal cut or damaged. • High or uneven bolt torque (pump body to cover).
Input Housing and Shaft	• Turbine shaft O-ring seal cut or damaged. • Turbine shaft retainer and ball assembly restricted or damaged.
Pressure Switch Assembly	• Contamination • Damaged seals.
Valve Body Assembly	• TCC signal valve stuck • Solenoid O-ring leaking
Solenoid Screen	Blocked

Torque Converter Clutch Shudder

Checks	Causes
Electrical	• 12 Volts not supplied to transmission • Outside electrical connector damaged. • Inside electrical connector, wiring harness or solenoid damaged. • Electrical short (pinched solenoid wire). • Solenoid not grounded.
Converter	Internal damage.
Oil Pump Assembly	• Converter clutch valve stuck or assembled backwards. • Converter clutch valve retaining ring mispositioned. • Pump to case gasket mispositioned • Orifice cup plug restricted or damaged • Solenoid O-ring seal cut or damaged. • High or uneven bolt torque (pump body to cover).
Input Housing and Shaft	• Turbine shaft O-ring seal cut or damaged. • Turbine shaft retainer and ball assembly restricted or damaged.
Pressure Switch Assembly	• Contamination • Damaged seals.
Valve Body Assembly	• TCC signal valve stuck • Solenoid O-ring leaking
Solenoid Screen	Blocked

No Park

Checks	Causes
Parking Linkage	• Actuator rod assembly bent or damaged. • Actuator rod spring binding or improperly crimped. • Actuator rod not attached to inside detent lever. • Parking lock bracket damaged or not torqued properly • Inside detent lever not torqued properly. • Parking pawl binding or damaged

Oil Out the Vent

Checks	Causes
Oil Pump	Chamber in pump body rotor pocket
Miscellaneous	Fluid level - overfilled.

Vibration in Reverse and Whining Noise in Park

Checks	Causes
Oil Pump	Chamber in pump body rotor pocket
Miscellaneous	Fluid level - overfilled.

Fluid Leak Diagnosis

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

Powder Method

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder, such as foot powder, to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

Dye and Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Detect the leak with the black light.
3. Make the necessary repairs.

Repairing the Leak

Pinpoint the leak and trace it back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore (scratched, burred, or nicked)
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Transmission Oil Pan

- Incorrectly tightened oil pan bolts.
- Improperly installed or damaged oil pan gasket.
- Damaged oil pan or mounting face.
- Incorrect oil pan gasket.

Case Leak

- Damaged or missing fill tube seal.
- Mislocated fill tube bracket.
- Damaged vehicle speed sensor seal.
- Damaged manual shift seal.
- Loose or damaged oil cooler connector fittings.
- Worn or damaged propeller shaft oil seal.
- Loose line pressure pipe plug.
- Porous casting.

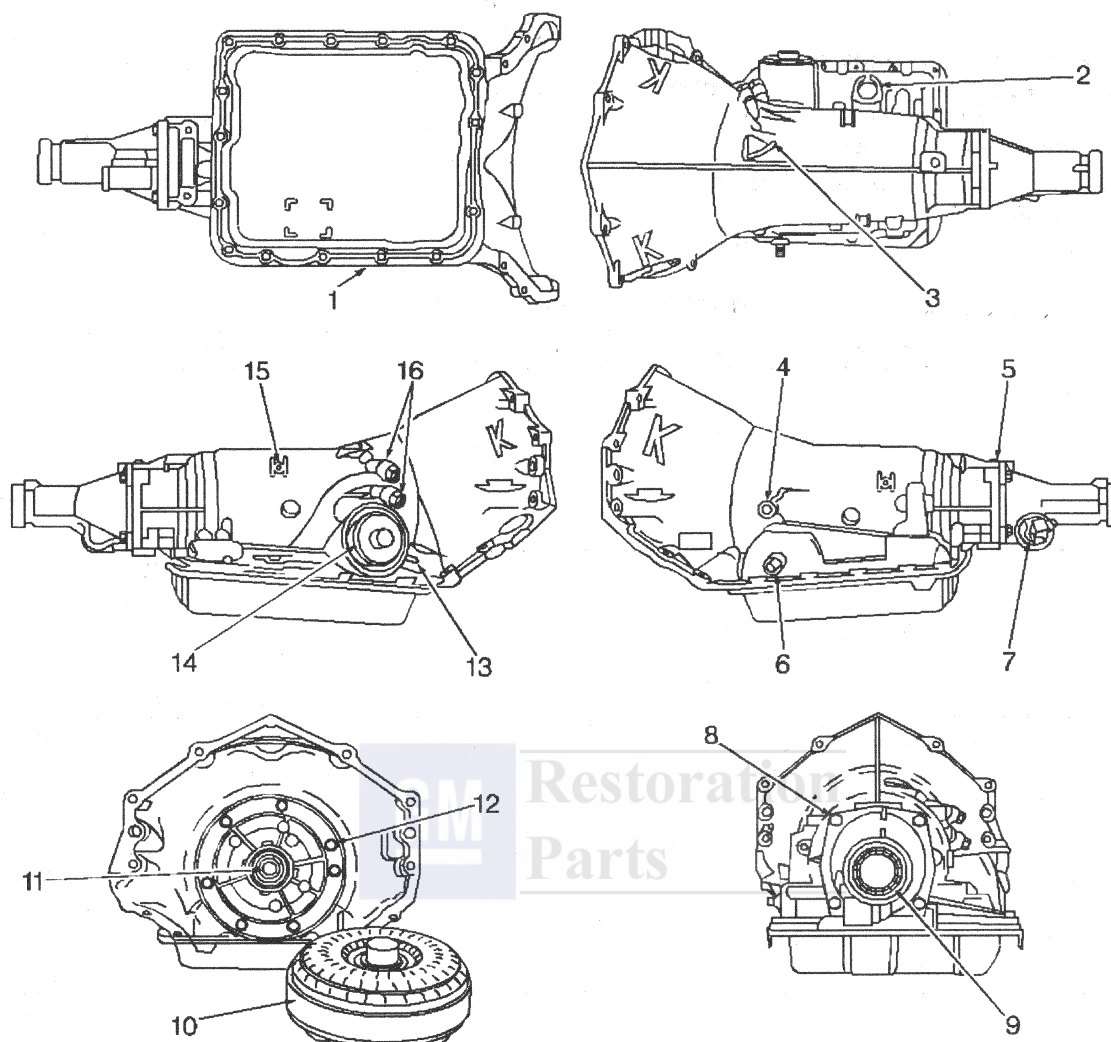
Leak at the Torque Converter End

- Converter leak in the weld area.
- Converter seal lip cut. Check the converter hub for damage.
- Converter seal bushing moved forward and damaged.
- Converter seal garter spring missing from the seal.
- Porous casting of the transmission case or the oil pump.

Leak at the Vent Pipe or the Fluid Fill Tube

- Overfilled system.
- Water or coolant in the fluid. The fluid will appear milky.
- Transmission case porous.
- Incorrect fluid level indicator.
- Plugged vent.
- Drain-back holes plugged.
- Mispositioned oil pump to case gasket, if equipped.

Leak Inspection Points



27187

Legend

- | | |
|-------------------------------|----------------------------|
| (1) Bottom Pan Gasket | (9) Extension Oil Seal |
| (2) Electrical Connector Seal | (10) Converter |
| (3) Vent | (11) Oil Pump Seal |
| (4) Line Pressure Plug | (12) Oil Pump to Case Seal |
| (5) Extension to Case Seal | (13) Oil Fill Tube Seal |
| (6) Manual Shaft Seal | (14) Servo Cover Seal |
| (7) Speed Sensor Seal | (15) Transmission Case |
| (8) Extension to Case Seal | (16) Cooler Connectors |

Case Porosity Repair

1. Clean the leak area with solvent.
2. Allow the area to air dry.

Caution: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

3. Mix a sufficient amount of epoxy adhesive, P/N 1052533, or equivalent.

Follow the manufacturer's recommendations.

4. While the transmission case is hot, apply the epoxy adhesive with a clean, dry soldering acid brush.
5. Allow the epoxy adhesive to cure for three hours before starting the engine.
6. Repeat the fluid leak diagnosis procedures in order to determine if the leak is fixed.

Malfunction Trouble Code

DTC	Description	DTC Type*	Default Action
P0502	Vehicle Speed Sensor (VSS) Circuit – Low Input	A	• DTC P0502 stores in PCM memory • Second gear only • Maximum line pressure • Freeze shift adapts from being updated • Inhibit TCC Sol Valve engagement
P0560	System Voltage Malfunction	D	• DTC P0560 stores in PCM memory • All transmission output devices are off except the TCC PWM solenoid and the 3–2 control solenoid • Freeze shift adapts from being updated
P0712	Automatic Transmission Fluid Temperature (TFT) Sensor Circuit – Low Input (High Temperature Indicated)	B	• DTC P0712 is stored in PCM memory • Transmission temperature defaults to 135°C (275°F) • Freeze shift adapts from being updated
P0713	Automatic Transmission Fluid Temperature (TFT) Sensor Circuit – High Input (Low Temperature Indicated)	B	• DTC P0713 is stored in PCM memory • Transmission temperature defaults to 135°C (275°F) • Freeze shift adapts from being updated
P0719	TCC Sol Valve Brake Switch Circuit – Low Input	A	• DTC P0719 is stored in PCM memory • The brake switch is closed (12 volts) with the brake pedal released • Inhibit TCC Sol Valve engagement • Inhibit 4th gear if in hot mode • Freeze shift adapts from being updated
P0724	TCC Sol Valve Brake Switch Circuit – High Input	D	• DTC P0724 is stored in PCM memory • Freeze shift adapts from being updated
P0742	Torque Converter Clutch (TCC) System Stuck ON	A	• DTC P0742 is stored in PCM memory • Freeze shift adapts from being updated
P0748	Pressure Control Solenoid (PCS) – Electrical	D	• DTC P0748 is stored in PCM memory • Freeze shift adapts from being updated
P0751	1–2 Shift Solenoid Valve – Performance	B	• DTC P0751 is stored in PCM memory • D2 line pressure • Freeze shift adapts from being updated
P0753	1–2 Shift Solenoid Valve – Electrical	A	• DTC P0753 is stored in PCM memory • Maximum line pressure • Freeze shift adapts from being updated

Malfunction Trouble Code (cont'd)

DTC	Description	DTC Type*	Default Action
P0756	2-3 Shift Solenoid Valve – Performance	B	• DTC P0756 is stored in PCM memory • Maximum line pressure • Inhibit TCC Sol Valve engagement • Freeze shift adapts from being updated
P0758	2-3 Shift Solenoid Valve – Electrical	A	• DTC P0758 is stored in PCM memory • Default to 3rd gear • Freeze shift adapts from being updated • Maximum line pressure • Inhibit TCC Sol Valve engagement
P1572	Traction Control Circuit Active Too Long in Park/Neutral	A	• DTC P1572 is stored in PCM memory • TCC is OFF • Freeze shift adapts from being updated • Inhibit 4th gear in Hot mode
P1810	Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch Circuit Malfunction	B	• DTCC 1810 is stored in PCM memory • D2 line pressure • D4 shift pattern • Freeze shift adapts from being updated
P1812	Transmission Fluid Overtemperature	D	• DTC P1812 is stored in PCM memory • Freeze shift adapts from being updated
P1860	TCC PWM Sol Valve Circuit – Electrical	A	• DTC P1860 is stored in PCM memory • Inhibit TCC Sol Valve engagement • Inhibit 4th gear in Hot mode • Maximum line pressure • Freeze shift adapts from being updated
P1864	TCC Sol Valve Circuit – Electrical	A	• DTC P1864 is stored in PCM memory • Inhibit TCC Sol Valve engagement • Inhibit 4th gear in Hot mode • Freeze shift adapts from being updated
P1870	Transmission Component Slipping	A	• DTC P1870 is stored in PCM memory • Inhibit TCC Sol Valve engagement • Maximum line pressure • Inhibit 4th gear in Hot mode • Freeze shift adapts from being updated
P1886	3-2 Shift Solenoid Valve Assembly Circuit—Electrical	A	• DTC P1886 is stored in PCM memory • Inhibit TCC Sol Valve engagement • Maximum line pressure • Inhibit 4th gear in Hot mode • Freeze shift adapts from being updated

*DTC Types:

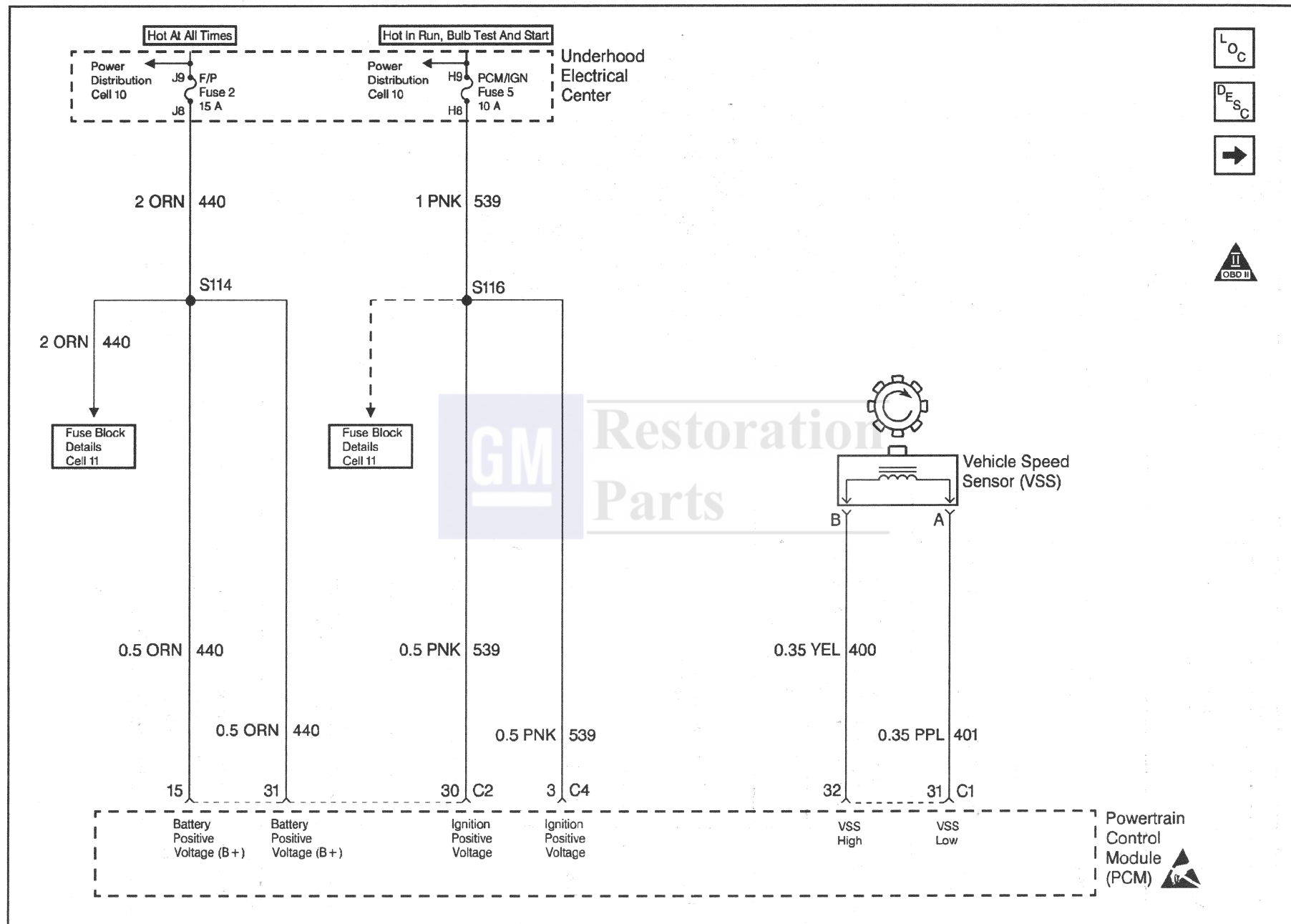
A – Emission-related, turns the MIL ON after the first failure.

B – Emission-related, turns the MIL ON after two consecutive trips with failure.

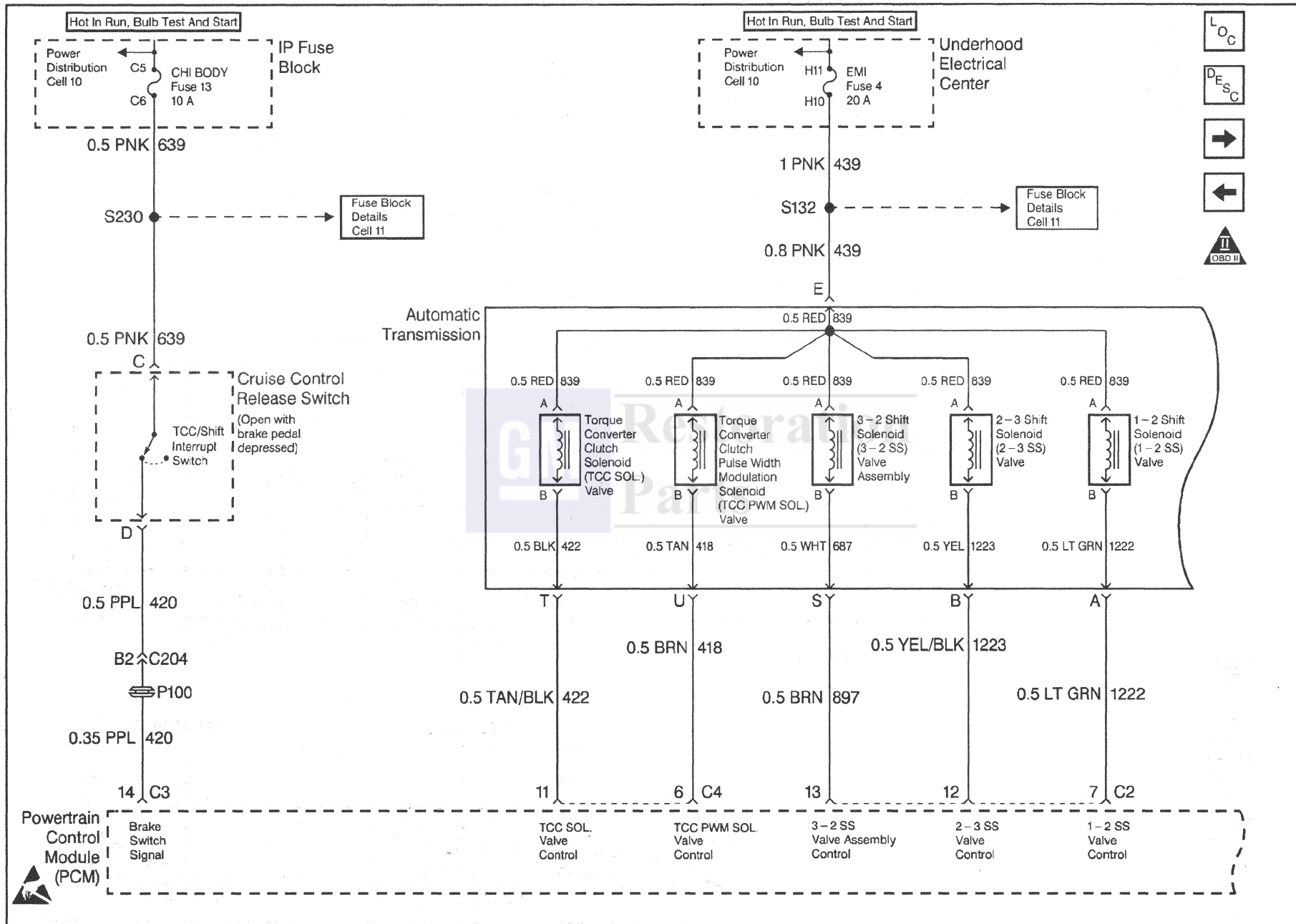
C – Non-emission-related, turns the service lamp ON after the first failure.

D – Non-emission-related, no lamps.

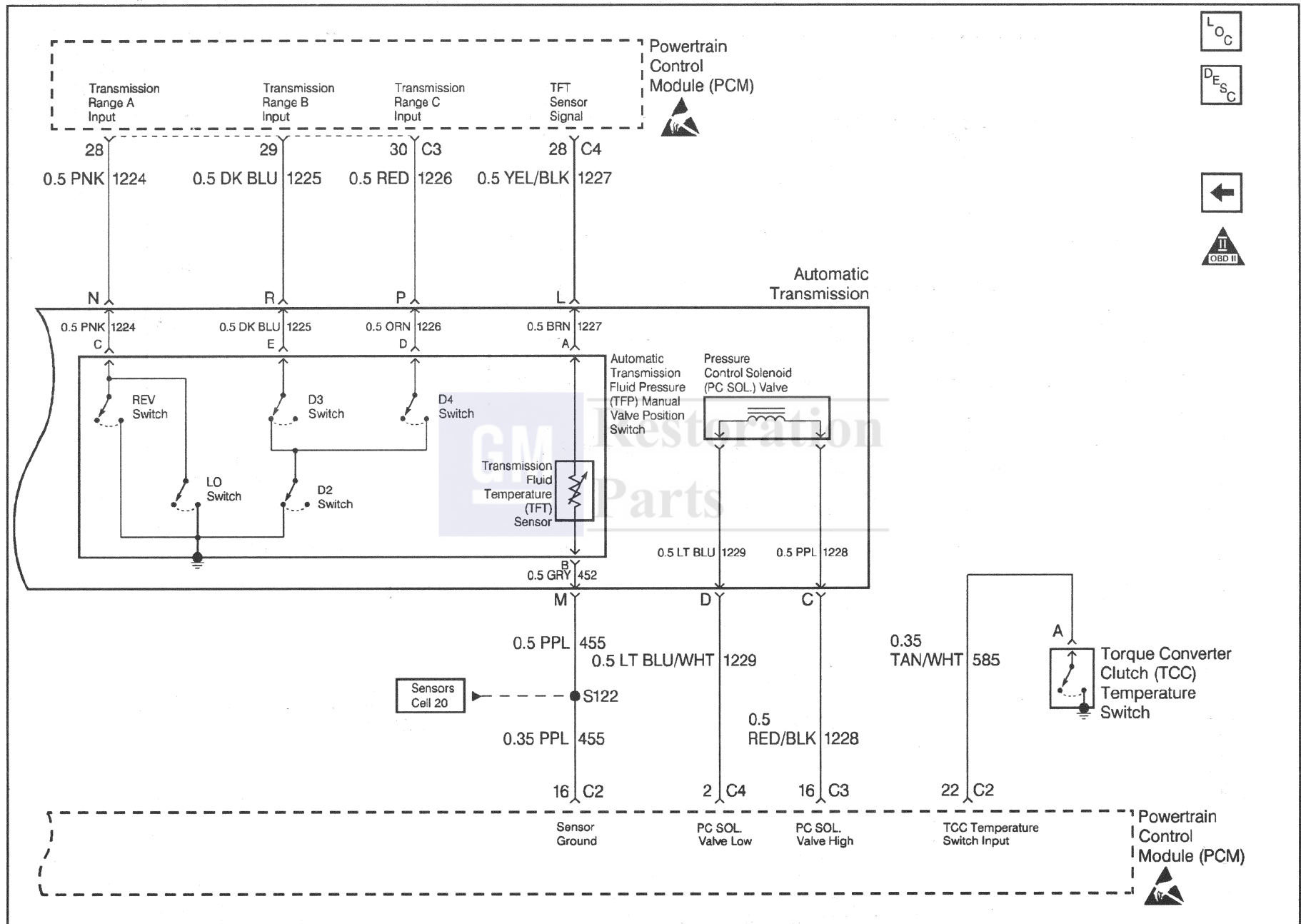
Automatic Transmission Controls - Cell 39 (PCM Power and VSS)



Automatic Transmission Controls - Cell 39 (Brake Switch and Solenoids)



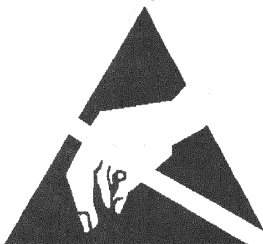
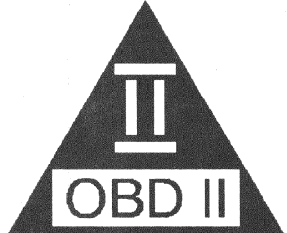
Automatic Transmission Controls - Cell 39 (TFP Val. Position Sw. and PC Sol. Valve)



Automatic Transmission Schematic Reference

Reference Qualifier	Reference on Schematic	Service Category Type Number - Service Category
—	Power Distribution – Cell 10	8A-10-0
—	Fuse Block Details – Cell 11	8A-11-0
—	Sensors – Cell 20	6 – Engine Controls

Automatic Transmission Schematic Icon

Icon	Icon Definition
	Refer to Electrostatic Discharge (ESD) Sensitive Devices in Section 8A-3 Symbols
	Refer to On-Board Diagnostics II (OBD II) Circuits in Section 8A-5 Repair Procedures



Component Locator

Automatic Transmission Component Location

Name	Location	Locator View	Connector End View	Group No.
1-2 Shift Solenoid Valve (1-2 SS Valve)	In the transmission valve body	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—
2-3 Shift Solenoid Valve (2-3 SS Valve)	In the transmission valve body	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—
3-2 Shift Solenoid Valve Assembly	In the transmission valve body	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—
Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.)	In the transmission valve body	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—
Automatic Transmission Fluid Temperature Sensor (TFT Sensor)	In the TFP Val. Position Sw.	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—
Cruise Control Release Switch	Below LH side of IP, mounted on the brake pedal support	—	—	—
IP Fuse Block	Mounted to LH IP, accessible with the LH front door open	8A-201-11 Fig 19	8A-11-0	—
Powertrain Control Module (PCM)	Engine compartment, forward of LH wheelhouse under the air cleaner	6 – Engine Controls	—	—
C1 (32 cavities)	Engine harness to PCM, engine compartment; forward of LH wheelhouse, under the air cleaner	—	6 – Engine Controls	—
C2 (32 cavities)	Engine harness to PCM, engine compartment; forward of LH wheelhouse, under the air cleaner	—	6 – Engine Controls	—
C3 (32 cavities)	Engine harness to PCM, engine compartment; forward of LH wheelhouse, under the air cleaner	—	6 – Engine Controls	—
C4 (32 cavities)	Engine harness to PCM, engine compartment; forward of LH wheelhouse, under the air cleaner	—	6 – Engine Controls	—
Pressure Control Solenoid Valve (PC SOL. Valve)	In the transmission valve body	7 – Automatic Transmission Electronic Component Location	7 – Automatic Transmission Automatic Transmission Connector End Views	—

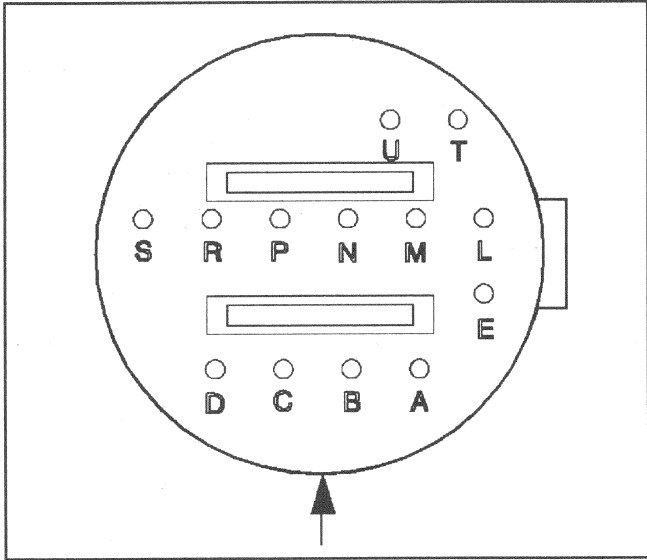
Automatic Transmission Component Location (cont'd)

Name	Location	Locator View	Connector End View	Group No.
<i>Torque Converter Clutch Pulse Width Modulation Solenoid Valve (TCC PWM Sol. Valve)</i>	In the transmission valve body	7 – Automatic Transmission <i>Electronic Component Location</i>	7 – Automatic Transmission <i>Automatic Transmission Connector End Views</i>	—
<i>Torque Converter Clutch Solenoid Valve (TCC Sol. Valve)</i>	In the transmission valve body	7 – Automatic Transmission <i>Electronic Component Location</i>	7 – Automatic Transmission <i>Automatic Transmission Connector End Views</i>	—
Torque Converter Clutch (TCC) Temperature Switch	In the transmission cooler pipe, near the cooler	7 – Automatic Transmission	7 – Automatic Transmission	—
Underhood Electrical Center	Engine compartment, attached to the RH wheelhouse	8A-201-6 Fig 13	8A-11-3	—
<i>Vehicle Speed Sensor (VSS)</i>	Rear RH side of the transmission	7 – Automatic Transmission <i>Electronic Component Location</i>	7 – Automatic Transmission	—
C204 (37 cavities)	Body to engine harness, behind RH side of IP, between the blower motor and IP compartment	8A-201-17 Fig 28	8A-202-3	—
P100	RH IP, forward of the blower motor	8A-201-6 Fig 13	—	—
S114	Engine harness, about 14 cm from the underhood lamp branch breakout	—	—	—
S116	Engine harness, LH side of the engine compartment about 17 cm from the ground G104 breakout	—	—	—
S122	Engine harness, LH side of the engine compartment about 17 cm from the ground G104 breakout	—	—	—
S132	Engine harness, about 13 cm from the underhood electrical center	—	—	—
S230	Body harness, about 4 cm from the BTSI solenoid connector breakout	—	—	—

Visual Identification

Automatic Transmission Connector End Views

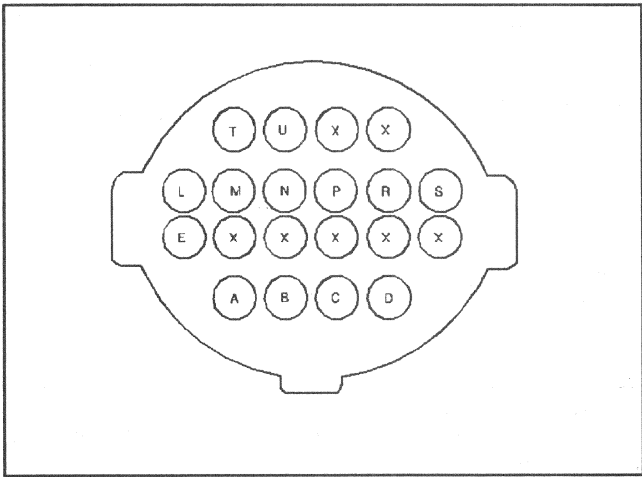
Wiring Harness Assembly 20-way Connector, Transmission Side



13270

Connector Part Information		12160545 20-way F Micro-Pack 100W Series Gray	
Pin	Wire Color	Circuit No.	Fuction
A	0.8 LT GRN	1222	1-2 Shift Solenoid (1-2 SS) Valve Control
B	0.8 YEL	1223	2-3 Shift Solenoid (2-3 SS) Valve Control
C	0.8 PPL	1228	Pressure Control Solenoid (PC Sol.) Valve HIGH Control
D	0.8 LT BLU	1229	PC Sol. Valve LOW Control
E	0.8 RED	839	Transmission Solenoid Power
L	0.8 BRN	1227	Transmission Fluid Temperature (TFT) Sensor HIGH
M	0.8 GRY	452	TFT Sensor LOW
N	0.8 PNK	1224	Range Signal A
P	0.8 ORN	1226	Range Signal C
R	0.8 DK BLU	1225	Range Signal B
S	0.8 WHT	687	3-2 Shift Solenoid (3-2 SS) Valve Assembly Control
T	0.8 BLK	422	Torque Converter Clutch Pulse Width Modulation Solenoid (TCC PWM Sol.) Valve Control
U	0.8 TAN	418	TCC PWM Sol. Valve Control

Wiring Harness Assembly 20-way Connector, Engine Side

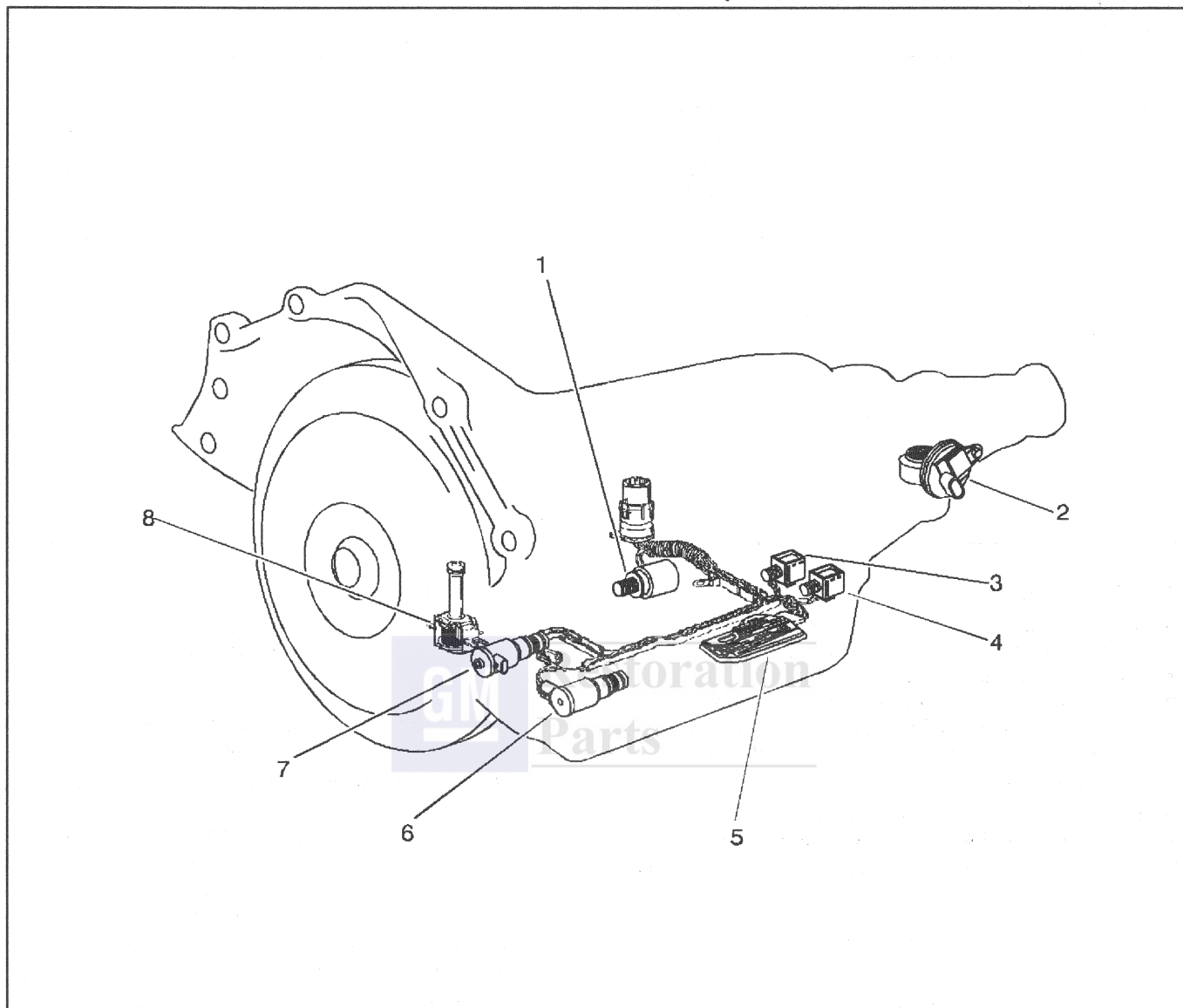


5892

Connector Part Information		12146497 20-way F Micro-Pack 100W Series Gray	
Pin	Wire Color	Circuit No.	Fuction
A	0.5 LT GRN	1222	1-2 Shift Solenoid (1-2 SS) Valve Control
B	0.5 YEL/BLK	1223	2-3 Shift Solenoid (2-3 SS) Valve Control
C	0.5 RED/BLK	1228	Pressure Control Solenoid (PC Sol.) Valve HIGH Control
D	0.5 LT BLU/WHT	1229	PC Sol. Valve LOW Control
E	0.8 PNK	839	Transmission Solenoid Power
L	0.5 YEL/BLK	1227	Transmission Fluid Temperature (TFT) Sensor HIGH
M	0.5 BLK	452	TFT Sensor LOW
N	0.5 PNK	1224	Range Signal A
P	0.5 RED	1226	Range Signal C
R	0.5 DK BLU	1225	Range Signal B
S	0.5 WHT	687	3-2 Shift Solenoid (3-2 SS) Valve Assembly Control
T	0.5 TAN/BLK	422	Torque Converter Clutch Pulse Width Modulation Solenoid (TCC PWM Sol.) Valve Control
U	0.8 BRN	418	TCC PWM Sol. Valve Control

Electronic Component Location

On-Vehicle Serviceable Components

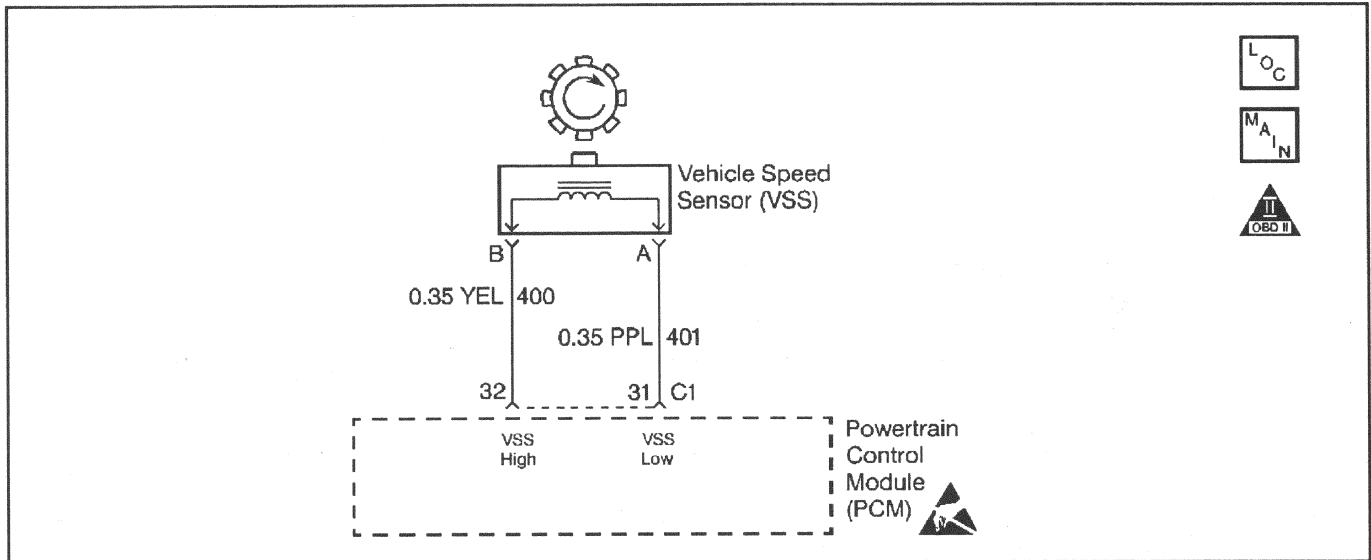


25715

Legend

- | | |
|--|---|
| (1) Pressure Control Solenoid Valve | (6) 3-2 Shift Solenoid Valve Assembly |
| (2) Vehicle Speed Sensor | (7) Torque Converter Clutch Pulse Width Modulation Solenoid Valve |
| (3) 1-2 Shift Solenoid Valve | (8) Torque Converter Clutch Solenoid Valve |
| (4) 2-3 Shift Solenoid Valve | |
| (5) Automatic Transmission Fluid Pressure Manual Valve Position Switch | |

Diagnostic Information and Procedures

DTC P0502 Vehicle Speed Sensor Circuit
Low Input

42252

Circuit Description

The VSS provides vehicle speed information to the PCM. The VSS is a Permanent Magnet (PM) generator. The VSS produces a pulsing AC voltage. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. The PCM converts the pulse to vehicle speed. A scan tool can display the vehicle speed.

When the PCM detects a low vehicle speed when there is a high engine speed in a drive gear range, then DTC P0502 sets. DTC P0502 is a type A DTC.

Conditions for Setting the DTC

- No MAP DTCs P0107 or P0108
- No TP DTCs P0122 or P0123
- No TFP Valve Position Switch DTC P1810
- Not in Park or Neutral
- The TP angle is greater than 17%.
- The engine vacuum is 50–80 kPa.
- The engine speed is 3000–5500 RPM.
- The transmission output speed is less than 250 RPM.
- All conditions met for 3 seconds

Action Taken When the DTC Sets

- The PCM commands second gear only.
- The PCM commands maximum line pressure.
- The PCM freezes shift adapts from being updated.

- The PCM inhibits TCC Solenoid Valve engagement.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- A VSS DTC P0502 sets when no vehicle speed is detected at start-off.
- Inspect the wiring for poor electrical connections at the PCM. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation

- When diagnosing for an intermittent short or open condition, massage the wiring harness while watching test equipment for a change.
- Test circuits 400 and 401 for Electromagnetic Interferences (EMI) induced by a wiring harness incorrectly routed too near the spark plug wires.
- An incorrect calibration may set DTC P0502. Refer to service bulletins to ensure that the calibration is current.
- Inspect for a damaged VSS.
- Inspect for damaged transmission rotor teeth.
- Ensure that the VSS is correctly aligned and torqued securely to the transmission case.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. You must disable the traction control system in order to perform this step. The traction control system turns ON if the ignition switch is cycled OFF then ON. Ensure that you have disabled the traction control system.
3. This Step verifies the integrity of the VSS.
4. This Step verifies the integrity of the VSS circuit.

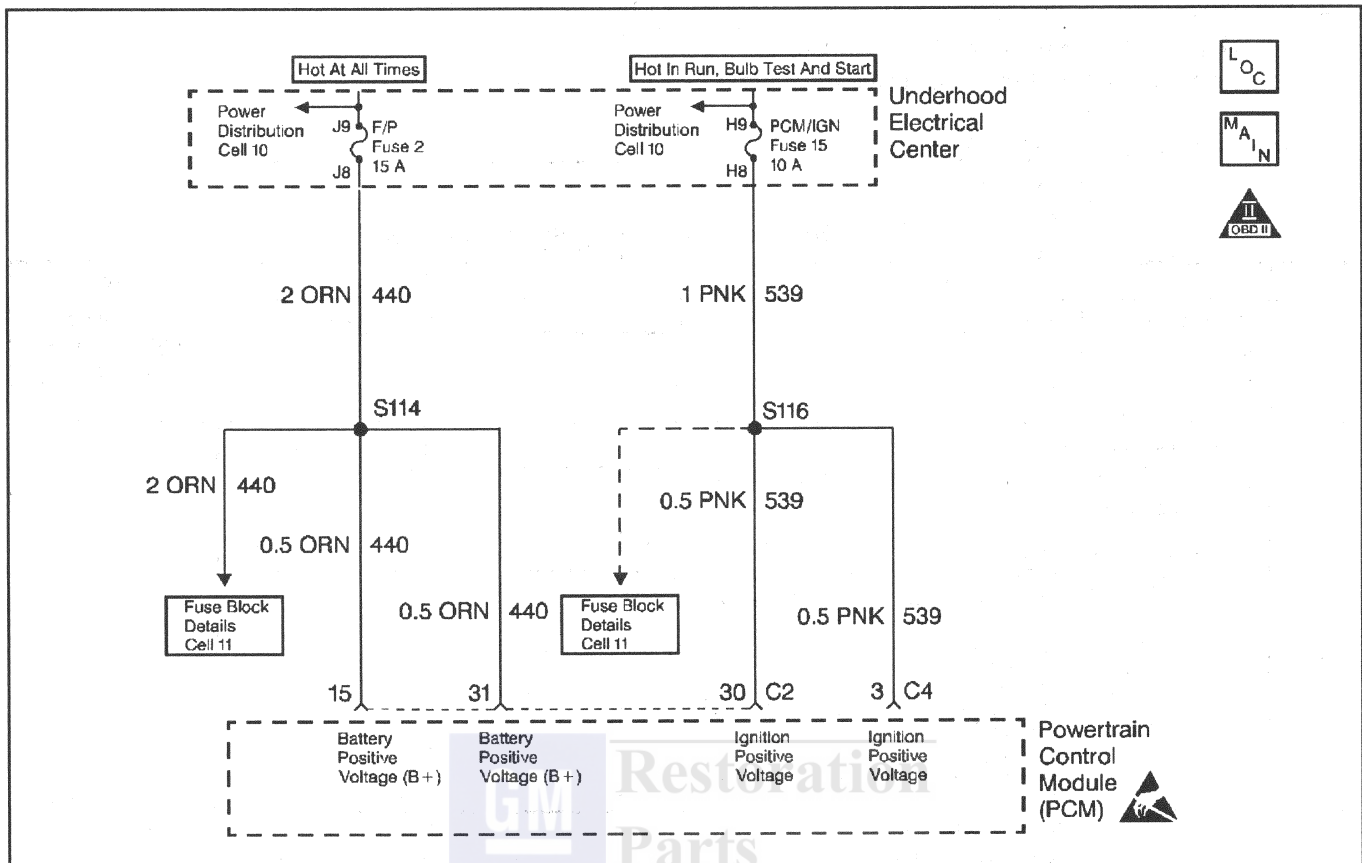
DTC P0502 Vehicle Speed Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing DTCs, use the scan tool in order to record Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. Raise the drive wheels. 5. Start the engine. 6. Disable the traction control system. 7. Place the transmission in any drive range. With the drive wheels rotating, does the Trans Output Speed increase with the drive wheel speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the C1 (red) PCM connector. 3. Connect the <i>J 39200</i> DVOM between harness connector terminals C1-31 and C1-32. 4. Select the AC Volts option. 5. Rotate the rear wheels. Ensure that the driveshaft is turning. Is the voltage measurement greater than the specified value?	0.5V	Go to Step 11	Go to Step 4
4	Measure the resistance between the harness connector terminals C1-31 and C1-32. Is the measured resistance greater than the specified value?	2700Ω	Go to Step 5	Go to Step 6
5	Inspect circuits 400 and 401 for a poor connection or an open circuit. Repair the circuits if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 13	Go to Step 8
6	Is the resistance measured between the harness connector terminals C1-31 and C1-32 less than the specified value?	1480Ω	Go to Step 7	Go to Step 8

DTC P0502 Vehicle Speed Sensor Circuit Low Input (cont'd)

Step	Action	Value(s)	Yes	No
7	Inspect circuits 400 and 401 for a short to ground. Inspect circuits 400 and 401 for a shorted together condition. Repair the circuits if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 13	Go to Step 8
8	1. Reconnect the C1 (red) PCM connector. 2. Disconnect the VSS harness from the VSS. 3. Measure the resistance between the VSS terminals A and B. Is the measured resistance within the specified range?	1480–2700Ω	Go to Step 11	Go to Step 9
9	1. Remove the VSS. 2. Inspect the Automatic Transmission output speed sensor rotor for damage or misalignment. Did you find and correct a problem?	—	Go to Step 13	Go to Step 12
10	Replace the VSS. Refer to <i>Vehicle Speed Sensor Replacement</i> . Is the replacement complete?	—	Go to Step 13	—
11	Inspect the PCM connector terminals for the following conditions: 1. Damaged connector pins 2. Backed out connector pins 3. Weak terminal tension 4. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 13	Go to Step 12
12	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6 Is the replacement complete?	—	Go to Step 13	—
13	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure that the transmission output speed is greater than 251 RPM for 2 seconds. 4. Select Specific DTC. Enter DTC P0502. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0560 System Voltage Malfunction Low



42253

Circuit Description

Circuit 539 is the ignition voltage feed for the PCM. Circuit 440 is the battery voltage feed for the PCM.

When the PCM detects an excessively low or high voltage, then DTC P0560 sets. DTC P0560 is a type D DTC.

Conditions for Setting the DTC

The system voltage is low:

- The engine speed is greater than 1000 RPM.
- The system voltage is less than 10 volts at a maximum transmission temperature of 150°C (302°F).
- The system voltage is less than 7.3 volts at a minimum transmission temperature of -40°C (-40°F).
- All conditions are met for 4 seconds.

A high system voltage causes DTC P0560 to set, if the system voltage is greater than 17 volts for 2 seconds.

Action Taken When the DTC Sets

- All transmission output devices are OFF except the TCC PWM Solenoid Valve and the 3-2 Shift Solenoid Valve Assembly.
- The freeze shift adapts from being updated.

- The PCM will not illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Charging the battery with a battery charger may set DTCs. Jumpstarting an engine may set DTCs.
- If DTCs set when you operate an accessory, inspect the applicable wiring for faulty connections. If DTCs set when you operate an accessory, inspect the applicable wiring for excessive current draw.
- Inspect the starter solenoid for faulty connections.
- Examine the starter solenoid fusible link.
- Inspect the generator for a damaged terminal.
- Inspect the belts for damage.
- Inspect the belt for correct tension.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

4. This Step tests the charging system voltage.
5. This Step tests the battery voltage input at the PCM.
7. This Step tests the ignition voltage input at the PCM.

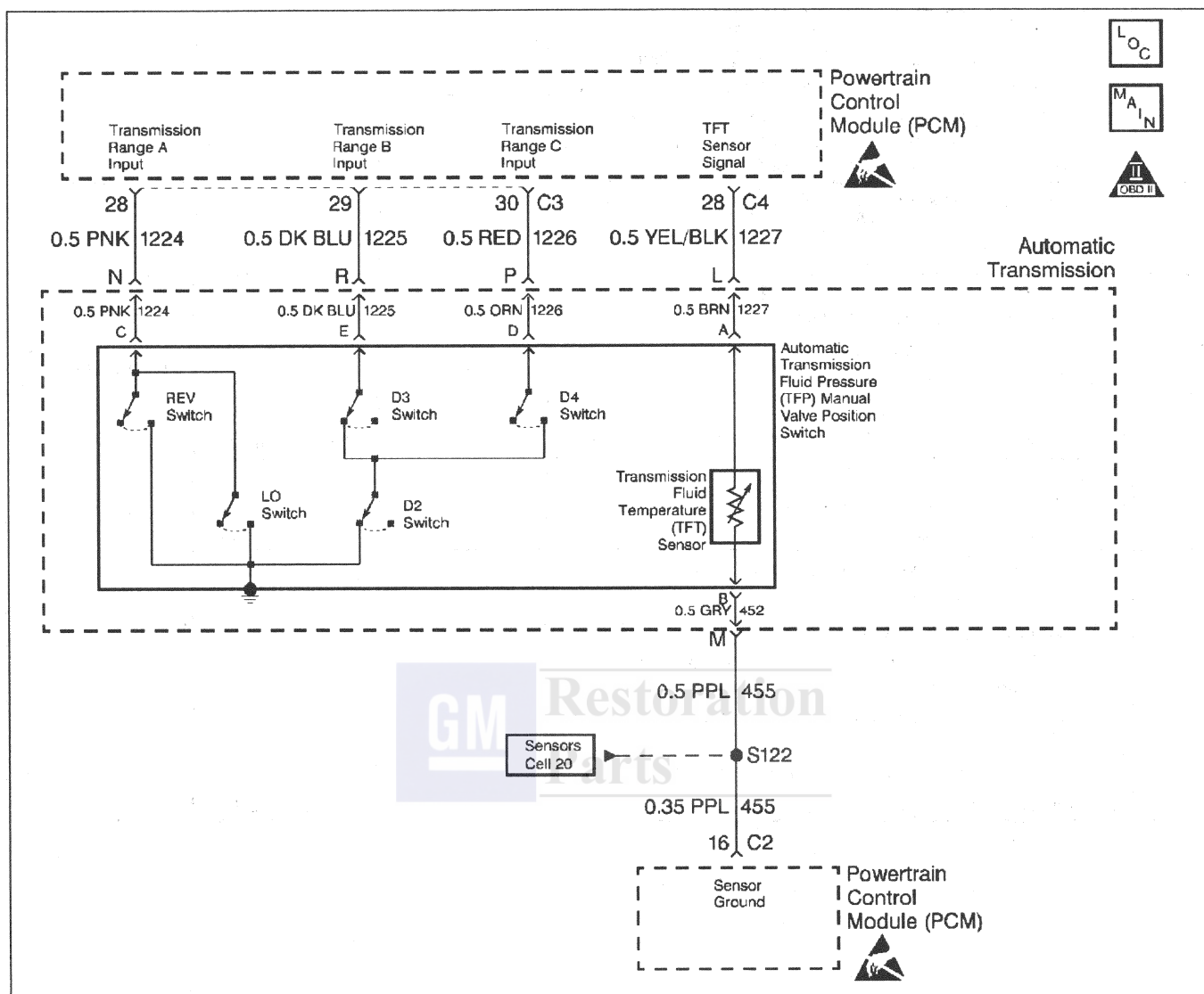
DTC P0560 System Voltage Malfunction Low

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Failure Records. Important: If any other DTCs are present, refer to the applicable diagnostic charts before continuing. 4. Using the <i>J 39200</i> DVOM, measure the battery voltage across the battery terminals. Record the measurement for future reference. Is the measured voltage higher than the specified value?	10.5 volts	Go to Step 3	Go to <i>Battery Diagnosis</i> , Section 6D1
3	Start the engine. Warm the engine to the normal operating temperature. Did the generator (check engine) lamp illuminate?	—	Go to <i>Charging System Diagnosis</i> , Section 6D3	Go to Step 4
4	1. Increase the engine speed to 1000-1500 RPM. 2. Observe the scan tool system voltage. Is the system voltage within the specified range?	12-15 volts	Go to Step 5	Go to <i>Charging System Diagnosis</i> , Section 6D3
5	1. Turn the ignition switch to the OFF position. 2. Disconnect the C2 (black) PCM connector (additional DTCs will set). 3. With the engine OFF, turn the ignition switch to the RUN position. 4. Using the <i>J 39200</i> DVOM and the <i>J 35616</i> Connector Test Adapter Kit, measure the battery voltage input at PCM connector terminals C2-15 and C2-31. Is there a voltage variance between the voltage measured at the battery (taken in Step 2) and at the terminals C2-15 and C2-31 that is greater than the specified value?	0.5 volts	Go to Step 6	Go to Step 7
6	Repair the high resistance condition in circuit 440. Refer to <i>Electrical Diagnosis</i>, Section 8. Have you repaired the circuit?	—	Go to Step 11	—

DTC P0560 System Voltage Malfunction Low (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the C4 (blue) PCM connector. 2. Measure the ignition voltage input at the PCM connector terminals C2-30 and C4-3. Is there a voltage variance between the voltage measured at the battery (taken in Step 2) and at the terminals C2-30 and C4-3 that is greater than the specified value?	0.5 volts	Go to Step 8	Go to Step 9
8	Repair the high resistance condition in circuit 539. refer to Electrical Diagnosis, Section 8A. Have you repaired the circuit?	—	Go to Step 11	—
9	Examine PCM connector terminals C2-15, C2-31, C2-30, and C4-3 for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Did you find and correct a problem?	—	Go to Step 11	Go to Step 10
10	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 11	—
11	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: • Start the vehicle and warm to normal operating temperature. • The PCM must see a system voltage between 10 and 16 volts. 4. Select Specific DTC. Enter DTC P0560. Has the test run and passed?		System OK	Begin the diagnosis again. Go to Step 1

DTC P0712 Fluid Temperature Sensor CKT Low Input



42254

Circuit Description

The Automatic Transmission Fluid Temperature (TFT) sensor is a negative coefficient thermister within the Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch. The TFT sensor controls the signal voltage from the PCM. The PCM supplies a 5-volt reference signal to the sensor on circuit 1227. When the transmission fluid is cold, the sensor resistance is high, and the PCM detects high signal voltage. As the transmission fluid temperature increases, the sensor resistance decreases and the detected voltage decreases. At the transmission's normal operating temperature of 100°C (212°F), the voltage is approximately 1.5–2 volts.

When the PCM detects a continuous short to ground in the TFT signal circuit or the TFT sensor, then DTC P0712 sets. DTC P0712 is a type B DTC.

Conditions for Setting the DTC

- The system voltage is 10–17 volts.
- The ignition is ON.
- The TFT sensor indicates a voltage less than 0.196 volts.
- All conditions met for 10 seconds

Action Taken When the DTC Sets

- The transmission default temperature will be 135°C (275°F).
- The freeze shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- If a transmission fluid overtemperature DTC P1812 is also set, inspect the transmission cooling system for blockage and restrictions.
- Inspect the harness routing for a short to ground in circuit 1227. The scan tool TFT display should rise steadily to about 100 °C (212 °F), then stabilize.
- Inspect the wiring for poor electrical connections at the PCM. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or open condition, massage the wiring harness while watching test equipment for changes.
- Use the temperature versus resistance scale in order to test the TFT sensor at the various temperatures. Test the TFT sensor at the various temperatures in order to eliminate the possibility of a skewed (mis-scaled) sensor. A skewed sensor could result in delayed garage shifts or TCC complaints.
- Inquire about the customer's driving habits, trailer towing, etc. . .

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step tests for a short to ground and for a skewed sensor.
- This Step creates an open. The Step uses the open in order to test for an internal fault within the transmission.
- This Step verifies that the resistance of the TFT wiring and the TFT Sensor is within specifications at 20 °C (68 °F). In order to verify the resistance at other transmission fluid temperatures, you must refer to the 4L60-E TFT vs Resistance chart.

DTC P0712 Fluid Temperature Sensor CKT Low Input

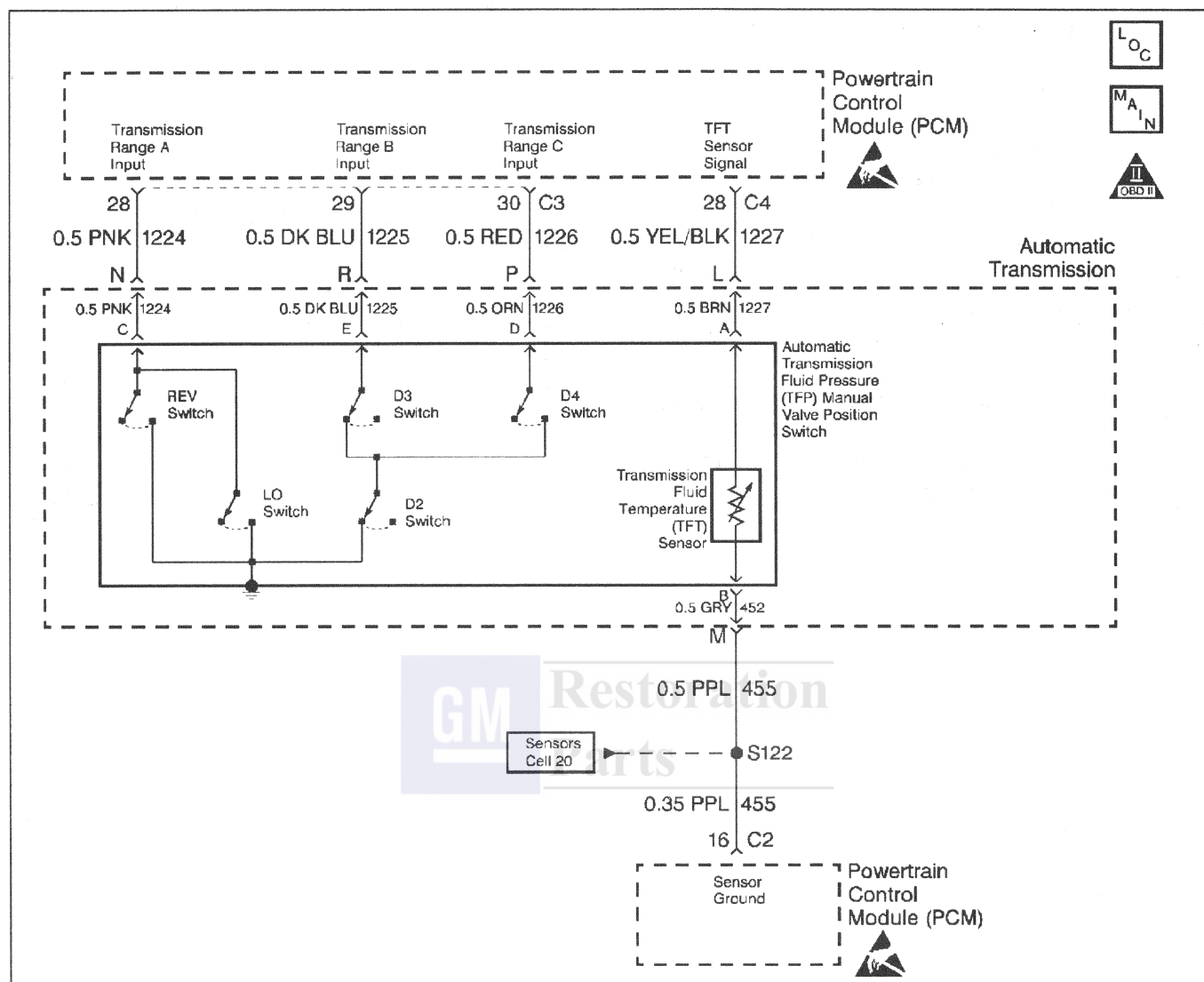
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check, Section 6E
2	Check the transmission fluid. Refer to <i>Transmission Fluid Checking Procedure</i> . Have you performed the fluid checking procedure?	—	Go to Step 3	Go to Transmission Fluid Checking Procedure
3	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. Does the scan tool display a TFT Sensor signal voltage less than the voltage specified?	0.196 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the transmission 20-way connector. 3. Turn the ignition switch to the RUN position. Does the TFT Sensor signal voltage change to match the voltage specified?	4.92 volts	Go to Step 5	Go to Step 9
5	1. Install the J 39775 Jumper Harness on the transmission side of the 20-way connector. 2. Using the J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance between terminals L and M. 3. This resistance range is valid at 20°C (68°F). In order to verify the TFT Sensor at other temperatures, refer to the TFT Resistance Chart. Is the resistance within specifications?	3088–3941Ω	Go to Diagnostic Aids	Go to Step 6
6	1. Remove the transmission oil pan. Refer to <i>Oil Pan Replacement</i>. 2. Inspect the automatic transmission wiring harness for a short to ground. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 8	Go to Step 7
7	1. Disconnect the automatic transmission wiring harness at the TFT sensor. 2. Measure the resistance of the TFT sensor. 3. This resistance range is valid at 20°C (68°F). In order to verify the TFT Sensor at other temperatures, refer to the TFT Resistance Chart. Is the resistance within specifications?	3088–3941Ω	Go to Diagnostic Aids	Go to Step 8
8	Replace the TFP Valve Position Switch. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Replacement. Is the replacement complete?	—	Go to Step 12	—
9	Check circuit 1227 for a short to ground. Refer to Electrical Diagnosis, section 8. Did you find and correct a problem?	—	Go to Step 12	Go to Step 10

DTC P0712 Fluid Temperature Sensor CKT Low Input (cont'd)

Step	Action	Value(s)	Yes	No
10	Inspect the PCM connector terminals for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 12	Go to Step 11
11	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 12	—
12	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure that the TFT sensor indicates a voltage greater than 0.33 volts for 2 seconds. 4. Select Specific DTC. Enter DTC P0712. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1



DTC P0713 Fluid Temperature Sensor CKT High Input



42254

Circuit Description

The Automatic Transmission Fluid Temperature (TFT) sensor is a negative coefficient thermistor within the Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch. The TFP controls the signal voltage from the PCM. The PCM supplies a 5-volt reference signal to the TFT sensor on circuit 1227. When the transmission fluid is cold, the sensor resistance is high, and the PCM detects high signal voltage. As the transmission fluid warms, the sensor resistance decreases and the detected voltage decreases. At the transmission's normal operating temperature of 100°C (212°F) the voltage is approximately 1.5 –2 volts.

When the PCM detects a continuous open or short to power in the TFT signal circuit or the TFT sensor, then DTC P0713 sets. DTC P0713 is a type B DTC.

Conditions for Setting the DTC

- The system voltage is 10–17 volts.
- The ignition is ON.
- The TFT sensor indicates a voltage greater than 4.94 volts.
- All conditions met for 50 seconds

Action Taken When the DTC Sets

- The transmission default temperature becomes 135°C (275°F).
- The freeze shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the harness for a faulty connection or an open in circuit 1227.
- Inspect the wiring for poor electrical connections at the PCM. Inspect the wiring at the 20-way harness. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or open condition, massage the wiring harness while watching test equipment for changes.
- The scan tool displays the transmission fluid temperature in degrees. After the transmission is operating, the temperature should rise steadily to about 100°C (212°F).
- Use the temperature versus resistance scale in order to test the TFT sensor at various temperatures. Test the TFT sensor at the various temperatures in order to eliminate the possibility of a skewed (mis-scaled) sensor. A skewed sensor can result in firm shifts or TCC complaints.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

3. This Step verifies that a problem exists in the TFT sensor circuit.
4. This Step simulates a TFT sensor DTC P0712. If the PCM receives the low signal voltage (indicating high temperature), and the scan tool displays 146°C (296°F) or greater, then the PCM and wiring are functioning normally.
5. This Step tests the TFT sensor and the Automatic Transmission wiring harness.

DTC P0713 Fluid Temperature Sensor CKT High Input

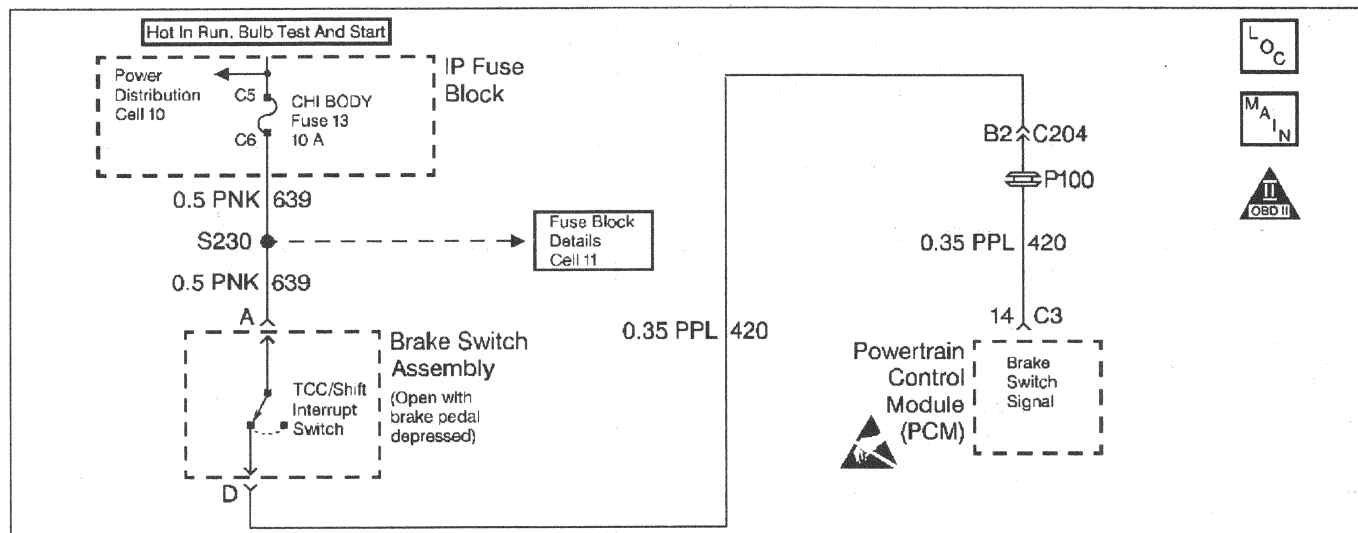
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Section 6E
2	Check the transmission fluid. Refer to <i>Transmission Fluid Checking Procedure</i> . Have you checked the fluid?	—	Go to Step 3	Go to <i>Transmission Fluid Checking Procedure</i>
3	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. Does the scan tool display a TFT Sensor signal voltage greater than the specified voltage?	4.94 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition switch to the OFF position. 2. <i>Automatic Transmission</i> Disconnect the transmission 20-way connector. 3. Install the J 39775 Jumper Harness on the engine side of the 20-way connector. 4. Install a fused jumper wire from the terminal L to the terminal M on the engine harness. 5. Turn the ignition switch to the RUN position. Does the TFT Sensor signal voltage decrease to less than the specified value?	0.196 volts	Go to Step 5	Go to Step 9
5	1. Turn the ignition switch to the OFF position. 2. Install the J 39775 Jumper Harness on the transmission side of the 20-way connector. 3. Using the J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance between the terminal L and the terminal M. Important: This resistance range is valid at 20 °C (68 °F). In order to verify the TFT sensor at other temperatures, refer to the TFT Resistance Chart. Is the resistance within specifications?	3088–3941Ω	Go to Diagnostic Aids	Go to Step 6
6	1. Remove the transmission oil pan. Refer to <i>Oil Pan Replacement</i>. 2. Check the automatic transmission wiring harness for an open. Refer to Electrical Diagnosis, Section 8A. Have you found and corrected a problem?	—	Go to Step 13	Go to Step 7
7	1. Disconnect the automatic transmission wiring harness at the TFT sensor. 2. Measure the resistance of the TFT sensor. Important: This resistance range is valid at 20 °C (68 °F). In order to verify the TFT sensor at other temperatures, refer to the TFT Resistance Chart. Is the resistance within specifications?	3088–3941Ω	Go to Diagnostic Aids	Go to Step 8
8	Replace TFP Valve Position Switch. Is the replacement complete?	—	Go to Step 13	—

DTC P0713 Fluid Temperature Sensor CKT High Input (cont'd)

Step	Action	Value(s)	Yes	No
9	Check circuit 1227 for an open. Check circuit 1227 for a short to B+. Refer to Electrical Diagnosis, Section 8A. Have you found and corrected a problem?	—	<i>Go to Step 13</i>	<i>Go to Step 10</i>
10	Check circuit 455 for an open. Refer to Electrical Diagnosis, Section 8A. Have you found and corrected a problem?	—	<i>Go to Step 13</i>	<i>Go to Step 11</i>
11	Inspect the PCM connector terminals for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Repair the connectors if necessary. Did you find and correct a problem?	—	<i>Go to Step 13</i>	<i>Go to Step 12</i>
12	Replace the PCM. Refer to Section 6. Is the replacement complete?	—	<i>Go to Step 13</i>	—
13	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure that the TFT sensor indicates a voltage less than 4.92 volts for 2 seconds. 4. Select Specific DTC. Enter DTC P0713. Has the test run and passed?	—	System OK	<i>Begin the diagnosis again. Go to Step 1</i>



DTC P0719 TCC Brake Switch Circuit Low



42256

Circuit Description

The TCC/Shift Interrupt switch indicates the status of the brake pedal. This normally-closed switch within the brake switch assembly supplies a B+ signal on the circuit 420 to the PCM. Applying the brake pedal opens the signal voltage circuit. The PCM de-energizes the TCC Solenoid Valve when the PCM receives the signal.

When the PCM detects an open brake switch during accelerations, then DTC P0719 sets. DTC P0719 is a type A DTC.

Conditions for Setting the DTC

- No VSS DTC P0502
- The PCM detects an open TCC/Shift Interrupt switch/circuit (0 volts) for 15 minutes without going off for 2 seconds, and the following events occur seven consecutive times:

The vehicle speed is less than 8 km/h (5 mph);

Then the vehicle speed is 8–32 km/h (5 and 20 mph) for 6 seconds;

Then the vehicle speed is greater than 32 km/h (20 mph) for 4 seconds.

Action Taken When the DTC Sets

- The TCC/Shift Interrupt switch remains closed (12 volts) with the brake pedal released.
- The PCM inhibits engagement of the TCC Solenoid Valve.
- The PCM Inhibits 4th gear if in hot mode
- The PCM freezes shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the brake switch assembly. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for changes.
- Ask the customer about the customer's driving habits. Ask if the customer has any unusual driving conditions (e.g. stop-and-go, expressway, etc.).
- Check for the most current calibration ID. Check for the latest bulletins.
- Inspect the brake switch assembly for proper mounting and adjustment.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

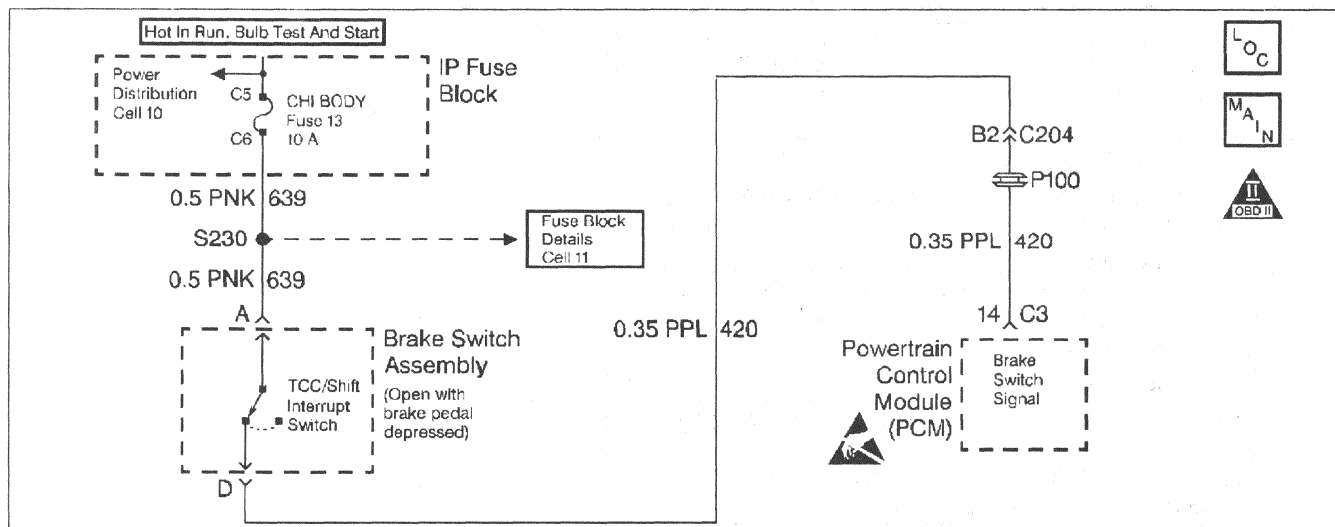
- This Step tests for voltage at the brake switch assembly.
- This Step verifies that the TCC/Shift Interrupt switch is functioning normally.
- This Step verifies that circuit 420 is functioning normally at the PCM.

DTC P0719 TCC Brake Switch Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	<i>Go to Step 2</i>	Go to <i>Powertrain OBD System Check</i>
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. 3. If an ABS code is set, inspect the applicable fuse. Repair the fuse if necessary. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 4. Record the DTC Freeze Frame and Failure Records. 5. Apply the brake pedal. Release the brake pedal. When you apply the brake pedal, does the scan tool display the TCC Brake Switch as Applied; then as Released when you release the brake?	—	Go to Diagnostic Aids	<i>Go to Step 3</i>
3	1. Connect a test lamp to ground. 2. Probe ignition feed circuit 639 at the brake switch assembly. Does the test lamp illuminate?	—	<i>Go to Step 4</i>	<i>Go to Step 5</i>
4	1. Connect a test lamp to ground. 2. Probe circuit 420 at the brake switch assembly. Does the test lamp illuminate?	—	<i>Go to Step 6</i>	<i>Go to Step 7</i>
5	Repair the open condition in ignition feed circuit 639 to the brake switch Assembly. Refer to Electrical Diagnosis, Section 8A. If the CHI Body 1 fuse is open, examine circuit 420 for a short to ground. Is the repair complete?	—	<i>Go to Step 15</i>	—
6	Apply the brake pedal. Is the test lamp OFF when you apply the brake pedal?	—	<i>Go to Step 9</i>	<i>Go to Step 8</i>
7	Inspect the brake switch Assembly for incorrect adjustment. Did you find and correct a problem?	—	<i>Go to Step 15</i>	<i>Go to Step 10</i>
8	Inspect circuit 420 for a short to B+. Did you find and correct a problem?	—	<i>Go to Step 15</i>	<i>Go to Step 10</i>
9	1. Release the brake pedal. 2. Turn the ignition switch to the OFF position. 3. Disconnect the C3 (clear) PCM connector. 4. With the engine OFF, turn the ignition switch to the RUN position. 5. Connect a test lamp to ground and probe the PCM connector C3-14. Did the test lamp illuminate?	—	<i>Go to Step 11</i>	<i>Go to Step 12</i>
10	Replace the brake switch Assembly. Refer to Brake switch Assembly Replacement. Is the replacement complete?	—	<i>Go to Step 15</i>	

DTC P0719 TCC Brake Switch Circuit Low (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition switch to the OFF position. 2. Reconnect the C3 (clear) PCM connector. 3. Turn the ignition switch to the RUN position. 4. Apply the brake pedal. Release the brake pedal. With the brake applied, does the scan tool display TCC Brake Switch as Applied, then Released with the brake pedal released?	—	Go to Diagnostic Aids	Go to Step 13
12	Repair the open condition in circuit 420 from the TCC brake switch to the PCM. Refer to Electrical Diagnosis, Section 8A. Is the repair complete?	—	Go to Step 15	
13	Inspect the PCM connector terminals for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 15	Go to Step 14
14	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 15	
15	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure that the TCC/brake switch signal indicates 0 volts for 2 seconds with the brake pedal applied. 4. Select Specific DTC. Enter DTC P0719. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0724 TCC Brake Switch Circuit High

42256

Circuit Description

The TCC/Shift Interrupt switch indicates the brake pedal status. This normally-closed switch within the Brake Switch Assembly, supplies a B+ signal on circuit 420 to the PCM. The signal voltage circuit opens when you apply the brakes. The PCM uses this signal to de-energize the TCC Solenoid Valve.

When the PCM detects a closed brake switch during a deceleration, then DTC P0724 sets. DTC P0724 is a type D DTC.

Conditions for Setting the DTC

- No VSS DTC P0502
- The PCM detects a closed TCC/Shift Interrupt switch/circuit (12 volts) for 2 seconds and the following events occur seven consecutive times:
 - The vehicle speed is greater than 32 km/h (20 mph) for 6 seconds;
 - Then the vehicle speed is between 8 and 32 km/h (5 and 20 mph) for 4 seconds;
 - Then the vehicle speed is less than 8 km/h (5 mph).

Action Taken When the DTC Sets

- The freeze shift adapts from being updated.
- The PCM will NOT illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the brake switch assembly. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for changes.
- Ask the customer about the customer's driving habits. Ask if the customer has any unusual driving conditions (e.g. stop-and-go, expressway, etc.).
- Check for the most current calibration ID. Check for the latest bulletin.
- Inspect the brake switch assembly for proper mounting and adjustment.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

3. This Step tests for voltage at the brake switch Assembly.
6. This Step tests the TCC/Shift Interrupt switch.

DTC P0724 TCC Brake Switch Circuit High

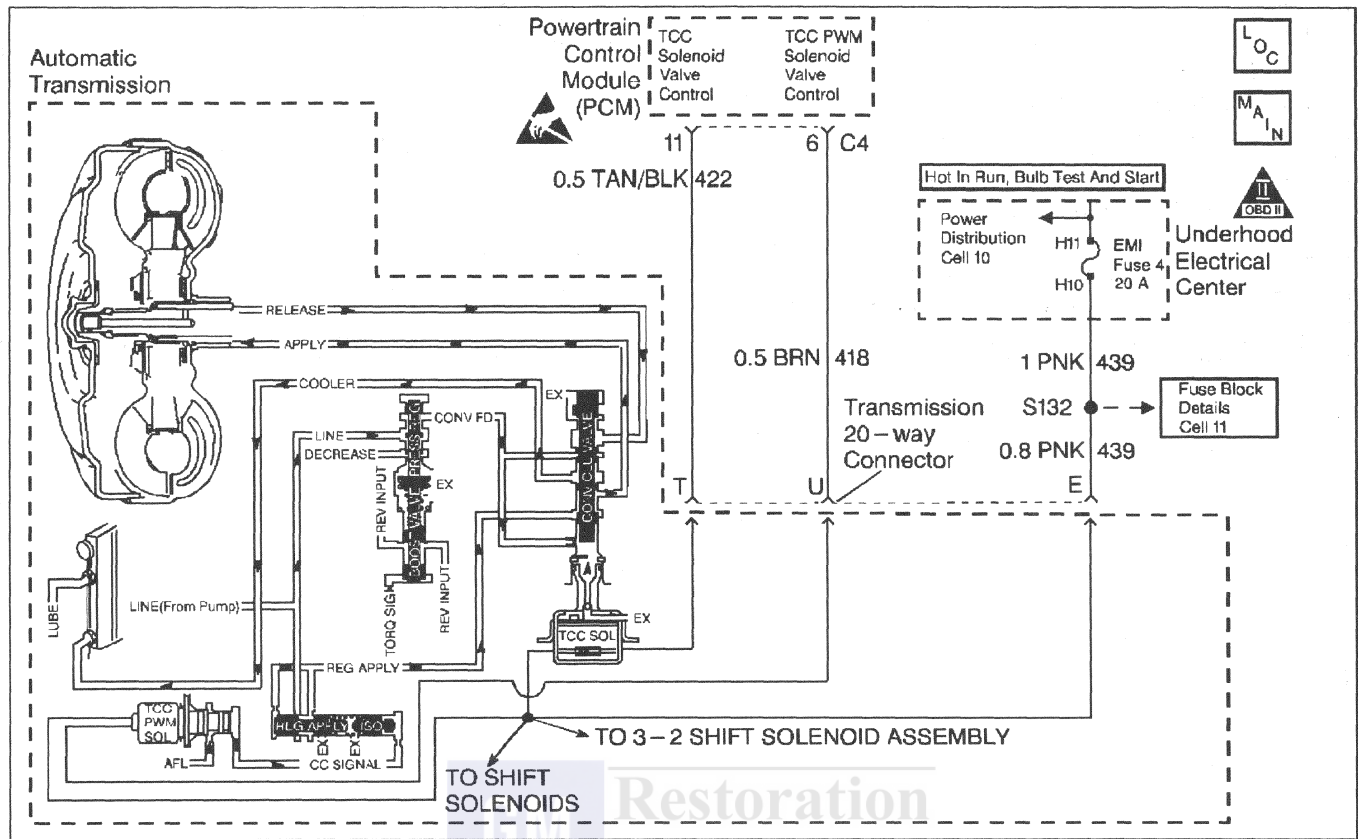
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. Apply the brake pedal. Release the brake pedal. When you apply the brake pedal, does the scan tool display the TCC Brake Switch as Applied; then as Released when you release the brake?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Connect the test lamp to ground. 2. Probe ignition feed circuit 639 at the brake switch Assembly. Did the test lamp illuminate?	—	Go to Step 4	Go to Step 5
4	1. Connect the test lamp to ground. 2. Probe circuit 420 at the brake switch assembly. Did the test lamp illuminate?	—	Go to Step 6	Go to Step 8
5	Repair the open in ignition feed circuit 639 to the brake switch assembly. Is the repair complete?	—	Go to Step 13	—
6	Apply the brake pedal. Is the test lamp OFF when you apply the brake pedal?	—	Go to Step 7	Go to Step 9
7	1. Apply the brake pedal. 2. Release the brake pedal. Does the scan tool display TCC Brake Switch as Applied when you apply the brake, and does the scan tool display Released when you release the brake pedal?	—	Go to Diagnostic Aids	Go to Step 11
8	Examine the brake switch assembly for proper adjustment. Did you find and correct a problem?	—	Go to Step 13	Go to Step 10
9	Inspect circuit 420 for a short to B+. Refer to Electrical Diagnosis, Section 8. Did you find a short?	—	Go to Step 13	Go to Step 10
10	Replace the brake switch assembly. Refer to Brake Switch Assembly Replacement. Is the replacement complete?	—	Go to Step 13	—
11	Inspect the PCM connector terminals for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 13	Go to Step 12

DTC P0724 TCC Brake Switch Circuit High (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 13	—
13	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure that the TCC brake switch signal indicates 12 volts for 2 seconds with the brake pedal released. 4. Select Specific DTC. Enter DTC P0724. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1.



DTC P0742 TCC Stuck On



42257

Circuit Description

The PCM energizes the TCC Solenoid Valve by creating a ground path on circuit 422. When grounded (energized) by the PCM, the TCC Solenoid Valve stops converter signal oil exhaust. Converter signal oil pressure will increase. Increased converter signal oil pressure will move the TCC valve. The TCC Solenoid Valve will de-energize when the PCM no longer provides a ground path. When the TCC Solenoid Valve is de-energized, the valve will release fluid and release the TCC.

When the PCM detects a low torque converter slip when the TCC is OFF, then DTC P0742 sets. DTC P0742 is a type A DTC.

Conditions for Setting the DTC

DTC P0742 will set if the following conditions occur once per TCC cycle, three consecutive times.

- No TP DTCs P0122 or P0123
- No VSS DTC P0502
- No TFP Valve Position Switch DTC P1810
- No TCC PWM Solenoid Valve DTC P1860
- No TCC Solenoid Valve DTC P1864
- The TP angle is greater than 13%.
- The engine speed is greater than 450 RPM for greater than 2 seconds and less than 5500 RPM.

- The engine vacuum is between 40 and 80 kPa.
- The commanded gear is not 1st.
- The gear range is D4, D3, or D2.
- The TCC is commanded OFF.
- The TCC slip speed is between -20 and 20 RPM for greater than 5.6 seconds.

Action Taken When the DTC Sets

- The PCM freezes shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- The TCC may mechanically stick ON with the parking brake applied and any gear range selected. In this case, the TCC fluid will mechanically apply the TCC. Mechanically applying the TCC may cause an engine stall.
- A stuck TP sensor will set this code.

Test Description

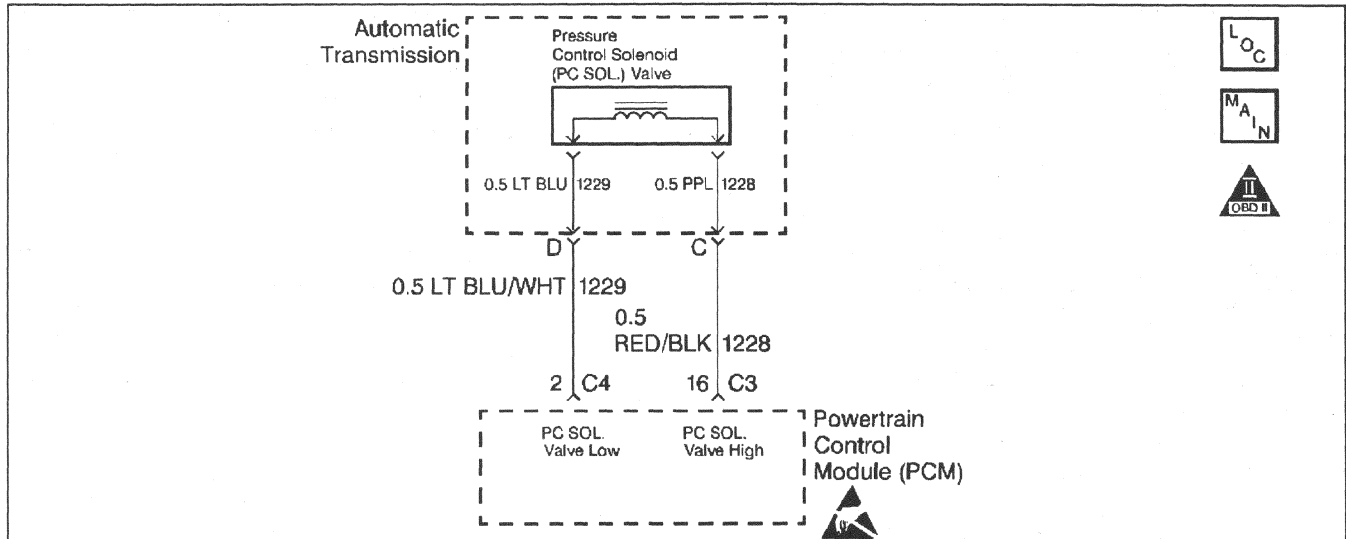
The numbers below refer to the step numbers on the diagnostic chart.

- This Step tests the TCC for a mechanical malfunction. When the PCM commands the TCC Solenoid Valve OFF, the slip speed should increase.

DTC P0742 TCC Stuck On

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. Use the scan tool in order to verify the TP Sensor operation. Are the TP Sensor values within the range shown?	0.6 - 5.0 volts	Go to Step 3	Go to Diagnostic Aids
3	Drive the vehicle in the D4 drive range in fourth gear under steady acceleration, with a TP angle greater than 25%. Display the TCC Solenoid Valve state on the scan tool. While the valve state is OFF, does the scan tool display a TCC Slip Speed in the range shown?	-20 to +20 RPM	Go to Step 4	Go to Diagnostic Aids
4	The TCC is mechanically stuck ON. Inspect the TCC for the following conditions: • A clogged exhaust orifice in the TCC Solenoid Valve • The converter clutch apply valve is stuck in the apply position. • A misaligned valve body gasket • A damaged valve body gasket • Restricted release passage • Refer to On Vehicle Service Did you find and correct a problem?	—	Go to Step 5	—
5	1. After the repair is complete, select DTC. 2. Select Clear Info. • Hold the throttle at 25%. Accelerate to 88 km/h (55 mph). If the throttle moves more than 3%, stop the vehicle and begin again. • Ensure that the TCC slip speed is between -50 and 2500 RPM for 10 seconds, with the TCC OFF. 3. Select Specific DTC. Enter DTC P0742. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0748 PCS Valve Circuit Electrical



42258

Circuit Description

The Pressure Control Solenoid (PC Sol.) Valve is a PCM-controlled device that regulates the transmission line pressure. The PCM compares the TP voltage, the engine RPM, and other inputs in order to determine the appropriate line pressure for a given load. The PCM regulates the pressure by applying a varying amperage to the PCS. The applied amperage varies from 0.1 to 1.1 amps. The applied amperage is monitored by the PCM. When the PCM detects a continuous open or a continuous short to ground in the PCS circuit, then DTC P0748 sets. DTC P0748 is a type D DTC.

Conditions for Setting the DTC

- The system voltage is 10–17 volts.
- The PCM recognizes that the Pressure Control Solenoid Valve has reached the valve's electrical high limit.
- The PCM recognizes that the Pressure Control Solenoid Valve has reached the valve's electrical low limit.

Action Taken When the DTC Sets

- The PCM freezes shift adapts from being updated.
- The PCM will **not** illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.

- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This Step verifies that the PCM can command the PC Sol. Valve.
3. This Step verifies that the PC Sol. Valve has the correct resistance. This Step verifies that the Automatic Transmission wiring harness has the correct resistance.

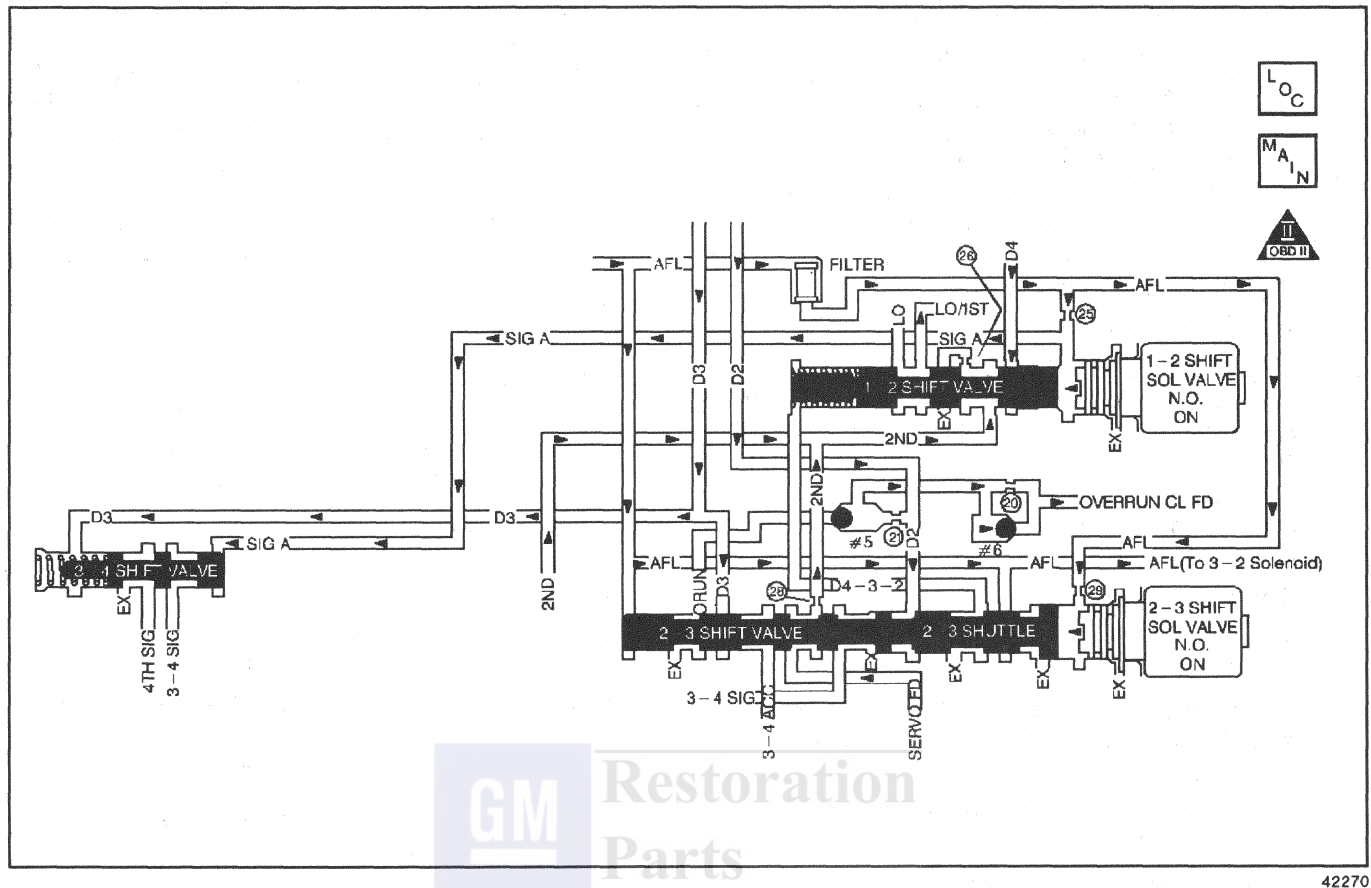
DTC P0748 PCS Valve Circuit Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Failure Records. 4. While the engine is operating, put the transmission in Park. 5. Using the scan tool, apply 0.1 through 1.0 amp while observing PC Ref Current and PC Act. Current. Does the PC Act. Current remain within the specified range?	PC Ref Current ± 0.16 amp	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the transmission 20-way connector. 3. Install the J 39775 Jumper Harness on the transmission side of the 20-way connector. 4. Using the J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance between terminals C and D. Is the resistance within the specified range?	3-7 Ω	Go to Step 7	Go to Step 4
4	1. Remove the transmission oil pan. 2. Disconnect the Automatic Transmission wiring harness at the PC Solenoid Valve. 3. Measure the resistance of the PC Solenoid Valve. Is the resistance within the specified range?	3-7 Ω	Go to Step 6	Go to Step 5
5	Replace the PC Solenoid Valve. Is the replacement complete?	—	Go to Step 10	—
6	Repair the Automatic Transmission wiring harness for an open. Refer to Electrical Diagnosis, Section 8A. Is the repair complete?	—	Go to Step 11	—
7	1. Inspect circuits 1228 and 1229 for an open. 2. Repair circuits 1228 and 1229 if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 11	Go to Step 8
8	1. Inspect circuits 1228 and 1229 for a short to ground. 2. Inspect circuits 1228 and 1229 for poor connections. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 11	Go to Step 9
9	Inspect the PCM connector terminals for the following conditions: • Damaged connector pins • Backed out connector pins • Weak terminal tension Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 11	Go to Step 10

DTC P0748 PCS Valve Circuit Electrical (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> PCM Replacement, Section 6. Is the replacement complete?	—	Go to Step 11	—
11	1. After the repair is complete, select DTC. 2. Select Clear Info. • Ensure that the duty cycle is not at the duty cycle's electrical high limit. • Ensure that the duty cycle is not at the duty cycle's electrical low limit. 3. Select Specific DTC. Enter DTC P0748. Has the test run and passed?	—	System OK	<i>Begin the diagnosis again.</i> Go to Step 1





- Commanded 2-3 shift
- The TP angle is between 17 and 32%.
- The TP angle is constant within $\pm 5\%$.
- Vehicle speed is between 32 and 72 km/h (20 and 45 mph).
- Within 1.7 seconds, the engine speed in 3rd gear must be 75 RPM less than the last speed in 2nd gear.

Condition 3

- Commanded 3-4 shift
- The TP angle is between 17 and 30%.
- The TP angle is constant within +/-3%.
- The vehicle speed is between 45 and 105 km/h (28 and 65 mph).
- Within 3 seconds, the engine speed in 4th gear must be 20 RPM greater than the last speed in 3rd gear.

Condition 4

- Commanded 4th gear
- The TCC is ON.
- The TP angle is between 13 and 26%.
- The speed ratio is between 0.85 and 1.2 (the speed ratio is the engine speed ÷ the output speed).
- The TCC slip speed is between 300 and 2000 RPM for greater than 4 seconds.

Condition 5

- Commanded 4th gear
- The TCC is ON.
- The TP is between 13 and 26%.
- The Speed ratio is between 0.5 and 0.788. (the speed ratio is the engine speed ÷ the output speed).
- The TCC slip speed is between -20 and 20 RPM for greater than 4 seconds.

Action Taken When the DTC Sets

- D2 line pressure
- The freeze shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the 4L60-E shift speed chart.
- More than one shift may occur because of other internal transmission failures.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This Step verifies that the TFP Valve Position Switch is functioning normally.
3. This Step verifies that the following sequence occurs:

The scan tool commands all shifts.

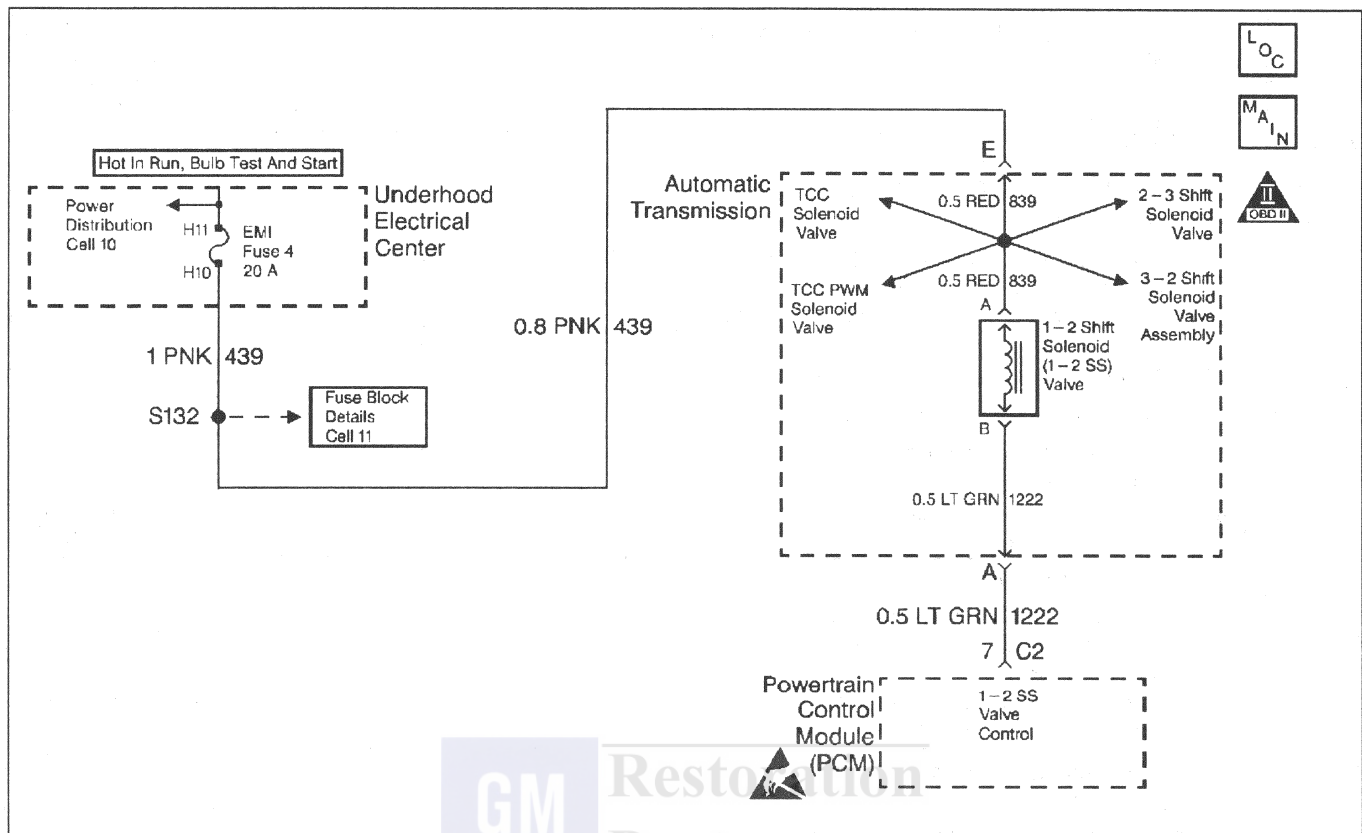
All the shift solenoids respond properly.

Not all the shifts occur.

DTC P0751 1-2 (A) Shift Solenoid Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. While the engine is operating, apply the brake pedal. Select each transmission range Low, Dr 2, Dr 3, Overdrive, Park, and Reverse. Does each selected transmission range match the TR Switch displayed on the scan tool?	—	Go to Step 3	Go to <i>Pressure Switch Assembly Resistance Check</i>
3	1. While the engine is operating, raise the drive wheels. 2. Put the transmission in D4 range. Using the scan tool, command 1st, 2nd, 3rd, and 4th gears while accelerating the vehicle. Was a 1-1-4-4 or 2-2-3-3 only shift pattern detected? (Road testing the vehicle may be necessary.)	—	Go to Step 4	Go to Diagnostic Aids
4	• Examine the shift solenoid valves for an internal malfunction. • Inspect the shift solenoid valves for damaged seals. • Refer to the diagnosis charts. Did you find and correct a problem?	—	Go to Step 5	—
5	1. After the repair is complete, select DTC. . 2. Select Clear Info. 3. Operate the vehicle under the following conditions (only if the traffic and road conditions permit): • Hold the throttle at 20% and accelerate to. If the throttle moves more than 3%, stop the vehicle and start over. • Drive at 88 km/h (55 mph) for three km (two miles). 4. Select Specific DTC and enter DTC P0751. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0753 1-2 (A) Shift Solenoid Electrical



42259

Circuit Description

The 1-2 Shift Solenoid Valve (1-2 SS Valve) controls the fluid flow acting on the 1-2 and 3-4 shift valve. The solenoid is a normally-open exhaust valve. The combination of the 2-3 Shift Solenoid Valve and the 1-2 SS Valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. Circuit 439 supplies ignition voltage directly to the 1-2 SS Valve. The PCM controls the solenoid by providing a ground path through circuit 1222.

When the PCM detects a continuous open or a short to ground in the 1-2 SS Valve circuit or the 1-2 SS Valve, then DTC P0753 sets. DTC P0753 is a type A DTC.

Conditions for Setting the DTC

- The ignition is ON.
- The system voltage is 10–17 volts.
- The PCM commands the solenoid ON and the voltage remains high (B+).
- The PCM commands the solenoid OFF and the voltage remains low (0 volts).
- All conditions met for 5 seconds

Action Taken When the DTC Sets

- Maximum line pressure
- The PCM freezes shift adapts from being updated.

- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the TCC brake switch. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation

- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for changes.
- An open feed circuit can set multiple DTCs.

Gear	1-2 Shift Solenoid	2-3 Shift Solenoid
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step verifies that the 1-2 SS Valve and the Automatic Transmission wiring harness are functioning normally.
- This Step verifies that the ignition supplies power to the 1-2 SS Valve through the EMI fuse.
- This Step verifies that the valve's resistance is within specifications.

DTC P0753 1-2 (A) Shift Solenoid Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. Have DTCs P0753, P0758, P1860, P1864, and P1886 set?	—	Go to Step 3	Go to Step 4
3	Inspect circuit 1339, the solenoid, the EMI fuse, and the Automatic Transmission wiring harness for short to ground. Repair the harness, the solenoid, and the circuit if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 22	—
4	Command the 1-2 SS Valve ON and OFF three times while listening to the bottom of the transmission pan (a stethoscope may be necessary). Did the solenoid click when commanded?	—	Go to Step 5	Go to Step 6
5	1. Inspect every connection at the PCM. 2. Inspect the transmission 20-way harness for the following conditions: • Poor connections • Bent connector pins • Backed out connector pins Did you find and correct a problem?	—	Go to Step 22	Go to Diagnostic Aids
6	1. Turn the ignition switch to the OFF position. 2. <i>Automatic Transmission</i> Disconnect the transmission 20-way connector (additional DTCs will set). 3. Install the J 39775 Jumper Harness on the engine harness connector. 4. With the engine OFF, turn the ignition switch to the RUN position. 5. Connect a test lamp from J 39775 Jumper Harness cavity E to ground. Did the test lamp illuminate?	—	Go to Step 7	Go to Step 8

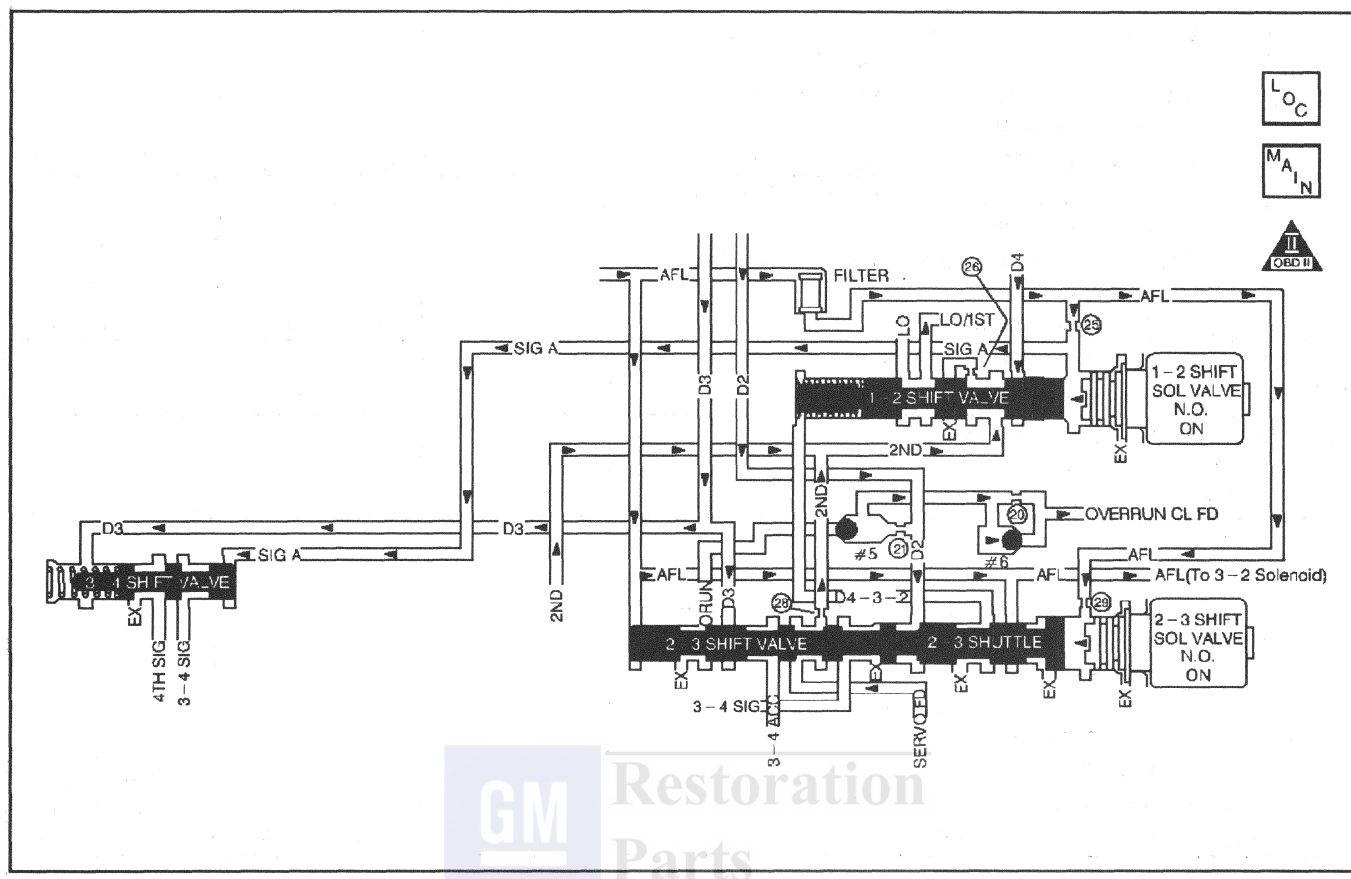
DTC P0753 1-2 (A) Shift Solenoid Electrical (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Install a test lamp between the cavity E and the cavity A of the J 39775 Jumper Harness. 2. Using the scan tool, command the 1-2 Shift Solenoid Valve ON and OFF three times. Does the test lamp illuminate when you command the solenoid valve ON, and turn OFF when you command the solenoid valve OFF?	—	Go to Step 14	Go to Step 9
8	Repair the open or short to ground in the ignition feed circuit 439 to the 1-2 SS Valve. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 22	—
9	Monitor the test lamp. Was the test lamp OFF continuously?	—	Go to Step 10	Go to Step 11
10	1. Inspect circuit 1222 for an open. 2. Inspect circuit 1222 for a poor PCM connection. 3. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	Go to Step 13
11	Was the test lamp illuminated continuously?	—	Go to Step 12	—
12	1. Inspect circuit 1222 for a short to ground. 2. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	Go to Step 13
13	Inspect the PCM connector terminals for the following conditions: 1. Damaged connector pins 2. Backed out connector pins 3. Weak terminal tension 4. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 22	Go to Step 21
14	1. Turn the ignition switch to the OFF position. 2. Install the J 39775 Jumper Harness on the transmission 20-way connector. 3. Measure the resistance between terminals A and E. Is the resistance within the specified range?	19-31Ω	Go to Step 16	Go to Step 15
15	1. Disconnect the Automatic Transmission wiring harness from the 1-2 SS Valve. 2. Measure the resistance of the 1-2 SS Valve. Is the resistance within the specified range?	19-31Ω	Go to Step 17	Go to Step 20
16	1. Turn the ignition switch to the OFF position. 2. Measure the resistance between the terminal A and ground. 3. Measure the resistance between the terminal E and ground. Are both readings greater than the specified value?	250kΩ	Go to Diagnostic Aids	Go to Step 18
17	1. Inspect the Automatic Transmission wiring harness for an open circuit. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	—

DTC P0753 1-2 (A) Shift Solenoid Electrical (cont'd)

Step	Action	Value(s)	Yes	No
18	1. Disconnect the Automatic Transmission wiring harness from the 1-2 SS Valve. 2. Measure the resistance from the component's terminals to ground. Are both readings greater than the specified value?	250k Ω	Go to Step 19	Go to Step 20
19	1. Inspect the Automatic Transmission wiring harness for a short to ground. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	—
20	Replace the 1-2 SS Valve. Refer to <i>Valve Body</i> . Is the replacement complete?	—	Go to Step 22	—
21	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 22	—
22	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: - When the 1-2 SS Valve is commanded ON, the voltage decreases to zero. - When the 1-2 SS Valve is commanded OFF, the voltage increases to B+ - All conditions met for 5 seconds. 4. Select Specific DTC. Enter DTC P. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0756 2-3 (B) Shift Solenoid Performance



42270

Circuit Description

The 2-3 Shift Solenoid Valve (2-3 SS Valve) controls the fluid flow acting on the 2-3 shift valves. The solenoid is a normally-open exhaust valve. The combination of the 2-3 SS Valve and the 1-2 Shift Solenoid Valve allows four different shift combinations.

When the PCM detects a 1-2-2-1 only shift pattern or a 4-3-3-4 only shift pattern depending on the mechanical failure, then DTC P0756 sets. DTC P0756 is a type B DTC.

Conditions for Setting the DTC

Failure Criteria

- No TP DTCs P0122 or P0123
- No VSS DTC P0502
- No TFT Sensor DTCs P0712 or P0713
- No TCC Stuck ON DTC P0742
- No 2-3 SS Valve DTC P0758
- No 1-2 SS Valve DTC P0753.
- No 3-2 SS Valve Assembly DTC P1886.
- No TCC PWM Sol. DTC P1860
- No TCC Sol. DTC P1864.
- No TFP Valve Position Switch DTC P1810
- The vehicle speed is greater than 24 km/h (15 mph).

- The gear range is D4.
- The engine vacuum is between 20 and 99 kPa.
- The engine speed is greater than 450 RPM for 2 seconds and less than 5500 RPM.
- The transmission fluid temperature is between 20° and 130° C (68° and 266° F).
- The TCC is OFF.
- All of the above conditions are met and either one of the following fail-conditions occurs:
 - The solenoid is stuck ON and Conditions 2 and 3 occur two consecutive times.
 - The solenoid is stuck OFF and Conditions 1 and 3 occur two consecutive times.

Condition 1

- The TP angle is greater than 38%.
- First gear is commanded for 2.5 seconds.
- The speed ratio is between 0.5 and 2.59 (speed ratio is engine speed ÷ output speed).
- The transmission output speed is between 600 and 1500 RPM.
- The TCC slip speed is between -93 and -2000 RPM for 1.6 seconds.

Condition 2

- The TP angle is between 13 and 55%.
- The TP angle is within +/- 3%.
- Third gear is commanded for 1 second.
- Third gear speed ratio is greater than the last 2nd gear speed ratio minus 0.2.
- Third gear TCC slip speed is greater than or equal to the last 2nd gear TCC slip speed plus 200 RPM for 1.3 seconds.
- Discontinue the test if the time since shift commanded is greater than 5 seconds.

Condition 3

- TP angle is greater than 18%.
- Fourth gear is commanded for 1 second.
- Speed ratio is between 2.05 and 8. (speed ratio is engine speed ÷ output speed).
- Transmission output speed is 0–8191 RPM.
- TCC slip speed is 1000–4000 RPM for 3 second.

Action Taken When the DTC Sets

- The PCM commands maximum line pressure.
- The PCM freezes shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the 4L60–E shift speed chart.
- Other internal transmission failures may cause more than one shift to occur.

Gear	1-2 Shift Solenoid	2-3 Shift Solenoid
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

Test Description

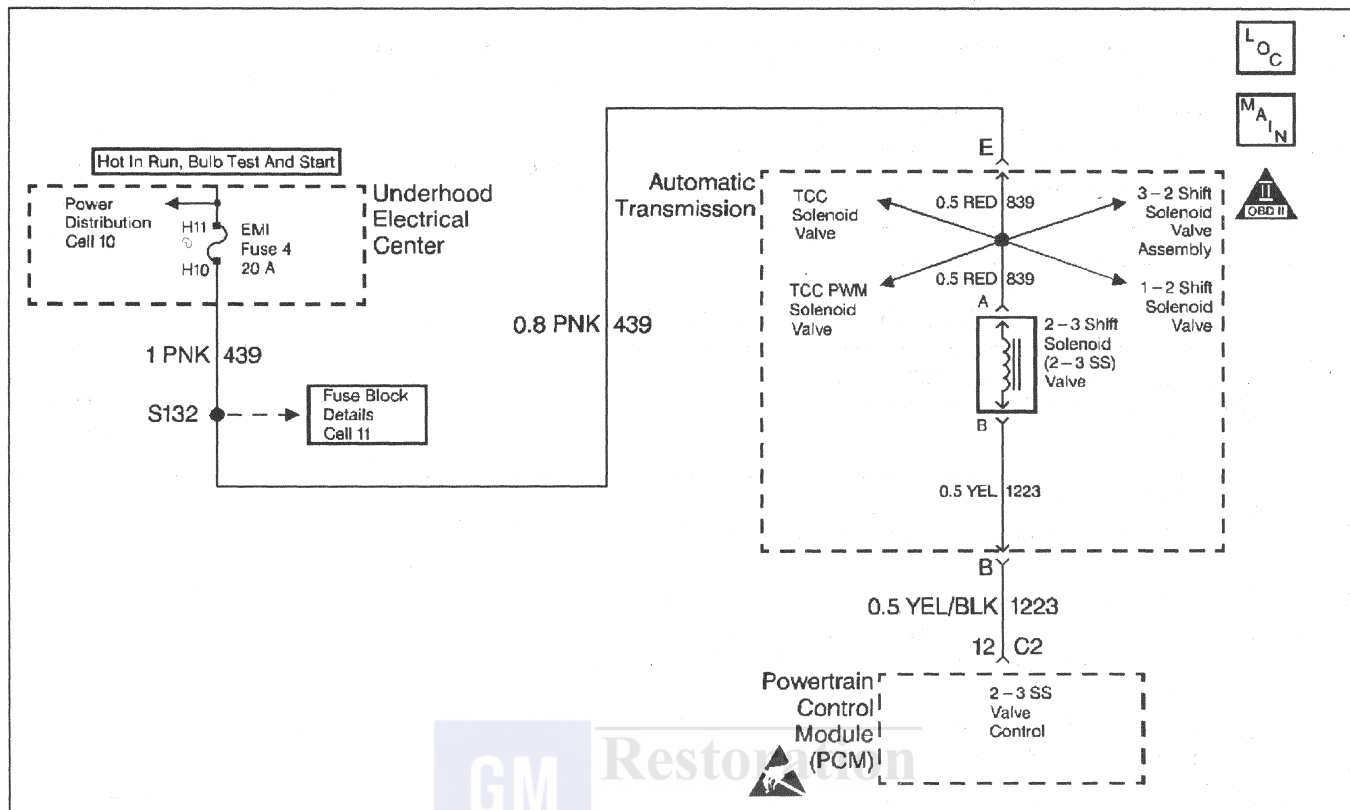
The numbers below refer to the step numbers on the diagnostic chart.

- This Step verifies that the TFP Valve Position Switch is functioning normally.
- This Step tests for a selected gear ratio vs a ratio not obtainable under normal driving conditions.

DTC P0756 2-3 (B) Shift Solenoid Performance

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. 4. While the engine is operating, apply the brake pedal and select each transmission range Low, Dr 2, Dr 3, Overdrive, Reverse, and Park. Does each selected transmission range match the TR Switch on the scan tool?	—	Go to Step 3	Go to Pressure Switch Assembly Resistance Check
3	1. While the engine is operating, raise the drive wheels. 2. With the transmission in D4 range, use the scan tool in order to command 1st, 2nd, 3rd, and 4th gears while accelerating the vehicle. Was 1st gear commanded and not achieved, or 4th gear commanded and other than 4th gear occurred? (Road testing the vehicle may be necessary).	—	Go to Step 4	Go to Diagnostic Aids
4	Check the shift circuit for the following conditions: • An internal malfunction in the shift solenoids. • Damaged seals on the shift solenoids. • Refer to the diagnosis charts. Did you find and correct a problem?	—	Go to Step 5	—
5	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions (only if driving conditions allow you): • Hold the throttle at 50% and accelerate to 88 km/h (55 mph). If the throttle moves more than 3%, stop the vehicle and start again. • Hold the throttle at 20% and accelerate to 88 km/h (55 mph). 4. Select Specific DTC. Enter DTC P0756. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P0758 2-3 (B) Shift Solenoid Electrical



42260

Circuit Description

The 2-3 Shift Solenoid Valve (2-3 SS Valve) controls the fluid acting on the 2-3 shift valves. The solenoid is a normally-open exhaust valve. In combination with the 1-2 Shift Solenoid Valve, the 2-3 SS Valve allows four different shifting combinations. The solenoid is attached to the control valve body within the transmission. Circuit 439 supplies ignition voltage directly to the 2-3 SS Valve. The PCM controls the solenoid by providing the ground path through circuit 1223.

When the PCM detects a continuous open or short to ground in the 2-3 SS Valve circuit or in the 2-3 SS Valve, then DTC P0758 sets. DTC P0758 is a type A DTC.

Conditions for Setting the DTC

- The ignition is ON.
- The system voltage is 10–17 volts.
- The PCM commands the solenoid ON and the voltage remains high (B+).
- The PCM commands the solenoid OFF and the voltage remains low (0 volts).
- All conditions met for 5 seconds

Action Taken When the DTC Sets

- Third gear only
- The PCM commands maximum line pressure
- The PCM freezes shift adapts from being updated.

- The PCM inhibits TCC engagement.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the TCC brake switch. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation

- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.

Gear	1-2 Shift Solenoid	2-3 Shift Solenoid
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step verifies that the 2-3 SS Valve and the Automatic Transmission wiring harness are functioning normally.
- This Step verifies that the ignition supplies power to the 2-3 SS Valve through the EMI fuse.
- This Step verifies that the valve's resistance is within specifications.

DTC P0758 2-3 (B) Shift Solenoid Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check
2	- Install the scan tool. - With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. - Record the DTC Freeze Frame and Failure Records. Were the DTCs P0753, P0758, P1860, P1864, and P1886 set?	—	Go to Step 3	Go to Step 4
3	- Inspect circuit 439, the solenoid, the EMI fuse and the automatic transmission wiring harness for an open or a short to ground. - Repair the circuit, the solenoid, and the harness if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 22	—
4	Command the 2-3 SS Valve ON and OFF three times while listening to the bottom of the transmission pan (a stethoscope may be necessary). Does the solenoid click when commanded?	—	Go to Step 5	Go to Step 6
5	- Examine every connection at the PCM. - Inspect the transmission 20-way connector for the following conditions: - Poor connections - Bent connector pins - Backed out connector pins Did you find and correct a problem?	—	Go to Step 22	Go to Diagnostic Aids
6	- Turn the ignition switch to the OFF position. - Automatic Transmission Disconnect the transmission 20-way connector (additional DTCs will set). - Install the J 39775 Jumper Harness on the engine harness connector. - With the engine OFF, turn the ignition switch to the RUN position. - Connect a test lamp from J 39775 Jumper Harness cavity E to ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 8

DTC P0758 2-3 (B) Shift Solenoid Electrical (cont'd)

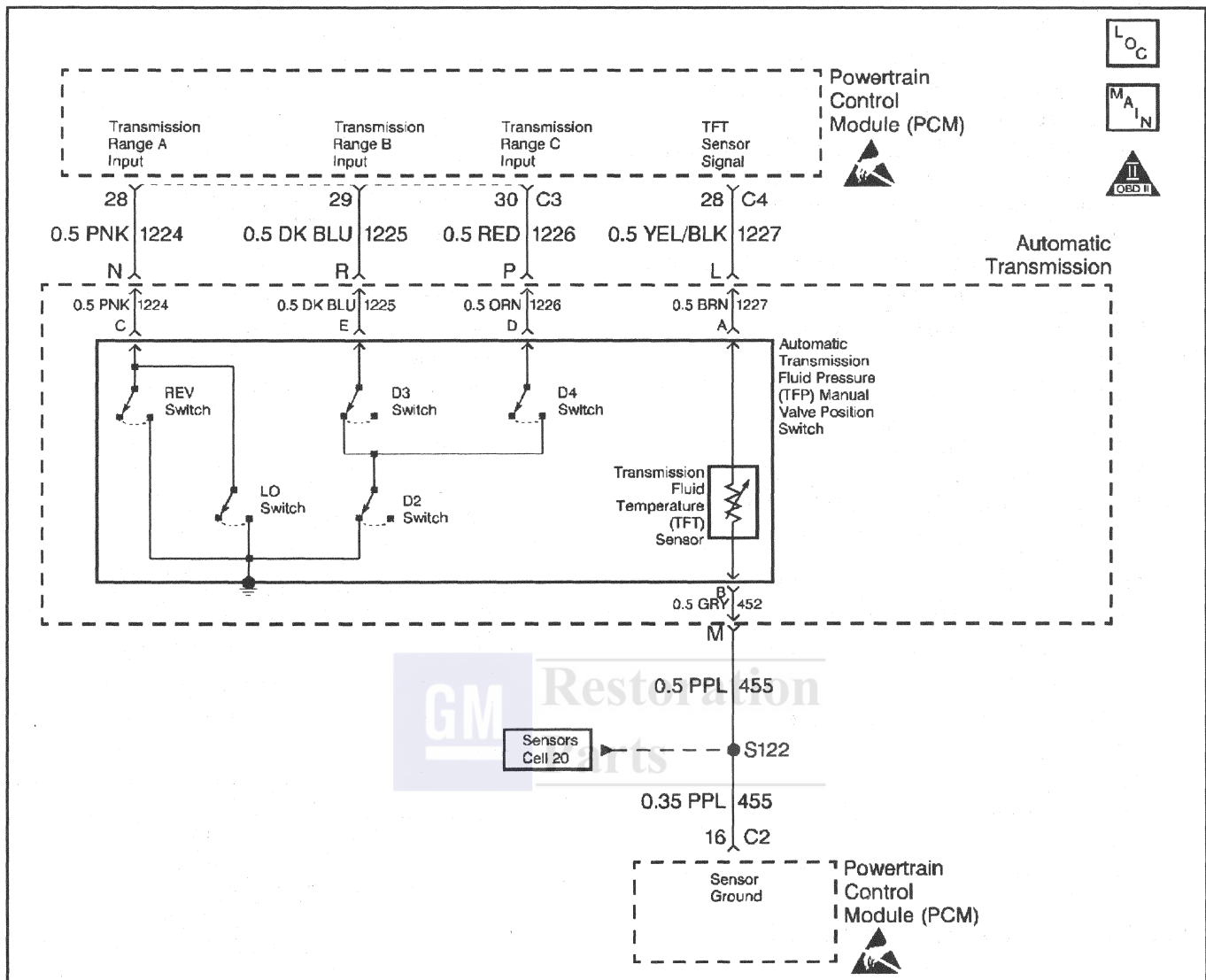
Step	Action	Value(s)	Yes	No
7	1. Install a test lamp from the cavity E to the cavity B of the J 39775 Jumper Harness. 2. Using the scan tool, command the 2-3 shift solenoid ON and OFF three times. Does the test lamp illuminate when you command the 2-3 shift solenoid ON, and turn OFF when you command the solenoid OFF?	—	Go to Step 14	Go to Step 9
8	Repair the open or short to ground in ignition feed circuit 439 to the 2-3 SS Valve. Refer to Electrical diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 22	—
9	Was the test lamp OFF continuously?	—	Go to Step 10	Go to Step 11
10	Inspect circuit 1223 for an open or poor PCM connection. Repair the circuit if necessary. Did you find and repair a problem?	—	Go to Step 22	Go to Step 13
11	Was the test lamp illuminated continuously?	—	Go to Step 12	—
12	Inspect circuit 1223 for a short to ground. Repair circuit 1223 if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 22	Go to Step 13
13	1. Inspect the PCM connector terminals for the following conditions: – Damged connector pins – Backed out connector pins – Weak terminal tension 2. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 22	Go to Step 21
14	1. Turn the ignition OFF. 2. Install the J 39775 Jumper Harness on the transmission 20-way connector. 3. Measure the resistance between the terminals B and E. Is the resistance within the specified range?	19-31Ω	Go to Step 16	Go to Step 15
15	1. Disconnect the Automatic Transmission wiring harness from the 2-3 SS Valve. 2. Measure the resistance of the 2-3 SS Valve. Is the resistance within the specified range?	19-31Ω	Go to Step 17	Go to Step 20
16	1. Turn the ignition OFF. 2. Using J 39200 DVOM, measure the resistance between the terminals B and E and ground. Are both readings greater than the specified value?	250kΩ	Go to Diagnostic Aids	Go to Step 18
17	1. Inspect the Automatic Transmission wiring harness for an open circuit. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	—
18	1. Disconnect the Automatic Transmission wiring harness from the 2-3 SS Valve. 2. Using J 39200 DVOM, measure the resistance from the component's terminals to ground. Are both readings greater than the specified value?	250kΩ	Go to Step 19	Go to Step 20

DTC P0758 2-3 (B) Shift Solenoid Electrical (cont'd)

Step	Action	Value(s)	Yes	No
19	1. Inspect the Automatic Transmission wiring harness for a short to ground. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 22	—
20	Replace the 2-3 SS Valve. Refer to <i>Valve Body</i> . Is the replacement complete?	—	Go to Step 22	—
21	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> PCM Replacement, Section 6. Is the replacement complete?	—	Go to Step 22	—
22	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: - The 2-3 SS Valve is commanded ON and the voltage decreases to zero. - The 2-3 SS Valve is commanded OFF and the voltage increases to B+. - All conditions are met for 5 seconds. 4. Select Specific DTC. Enter DTC P. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1



DTC P1810 TFP Valve Position Sw CKT Malfunction



42254

Circuit Description

The Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch consists of five pressure switches (two normally-closed and three normally-open), and an automatic transmission fluid temperature (TFT) sensor. The combined unit mounts on the valve body. The PCM supplies battery voltage to each range signal. The PCM grounds one or more of the range signal circuits through various combinations of the pressure switches. The PCM monitors the combinations, in order to detect what manual valve position has been selected. The PCM compares the actual voltage combination of the switches to a TFP Valve Position Switch combination chart stored in the memory.

The TFP Valve Position Switch cannot distinguish between Park and Neutral because the monitored valve body pressures are identical. With the ignition ON and the engine OFF, the valve pressures indicate Park or Neutral. Disconnecting the

transmission 20-way connector, removes the ground potential for the three range signals to the PCM. This disconnected state, with the ignition ON, displays as D2.

When the PCM detects an invalid state of the TFP Valve Position Switch or the TFP Val Position Sw circuit, then DTC P1810 sets. The PCM deciphers the TFP Val. Position Sw. inputs. DTC P1810 is a type B DTC.

Conditions for Setting the DTC

DTC P1810 sets if any of the following Conditions occurs:

Condition 1

This condition detects an illegal switch combination.

- The system voltage is 10–17 volts.
- The engine is running.
- The PCM detects an illegal TFP state.
- All conditions satisfied for 5 seconds.

Condition 2

This condition detects D2, D4, or Rev during an engine start.

- No VSS DTC P0502
- The system voltage is 10 17 volts.
- The engine speed is less than 100 RPM for 0.3 seconds; then
the engine speed is between 100 and 600 RPM for 0.3 seconds; then
the engine speed is greater than 600 RPM for 3 seconds.
- The vehicle speed is less than 3 km/h (2 mph).
- The detected gear range is D2, D4, or Rev.
- All conditions satisfied for 3 seconds

Condition 3

This condition detects P/N when the vehicle should be in D4.

- No VSS DTC P0502
- The engine speed is less than 2000 RPM.
- The speed ratio is between 0.39 and 0.8 (speed ratio is engine speed ÷ transmission output speed).
- The engine vacuum is between 35 and 70 kPa.
- The TCC is locked ON.
- The detected gear range is Park/Neutral.
- All conditions satisfied for 5 seconds

Action Taken When the DTC Sets

- D2 line pressure.
- D4 shift pattern.
- The PCM freezes shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Refer to the TFP Valve Position Switch Logic Table for the normal range signals and the illegal combinations.
- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.
- Refer to the Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch Resistance Check or the Functional Test Procedure for further information.

TFP Valve Position Switch Logic

Gear Position	Range signal A	Range signal B	Range signal C
Park	OFF	ON	OFF
Reverse	ON	ON	OFF
Neutral	OFF	ON	OFF
Overdrive	OFF	ON	ON
Dr 3	OFF	OFF	ON
Dr 2	OFF	OFF	OFF
Low	ON	OFF	OFF
—	—	—	—
Illegal	ON	OFF	ON
Illegal	ON	ON	ON

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step compares the indicated range signal to the manual valve you actually select.
- This Step verifies that the transmission 20-way connector receives the correct voltage from the PCM.

DTC P1810 TFP Valve Position Sw CKT Malfunction

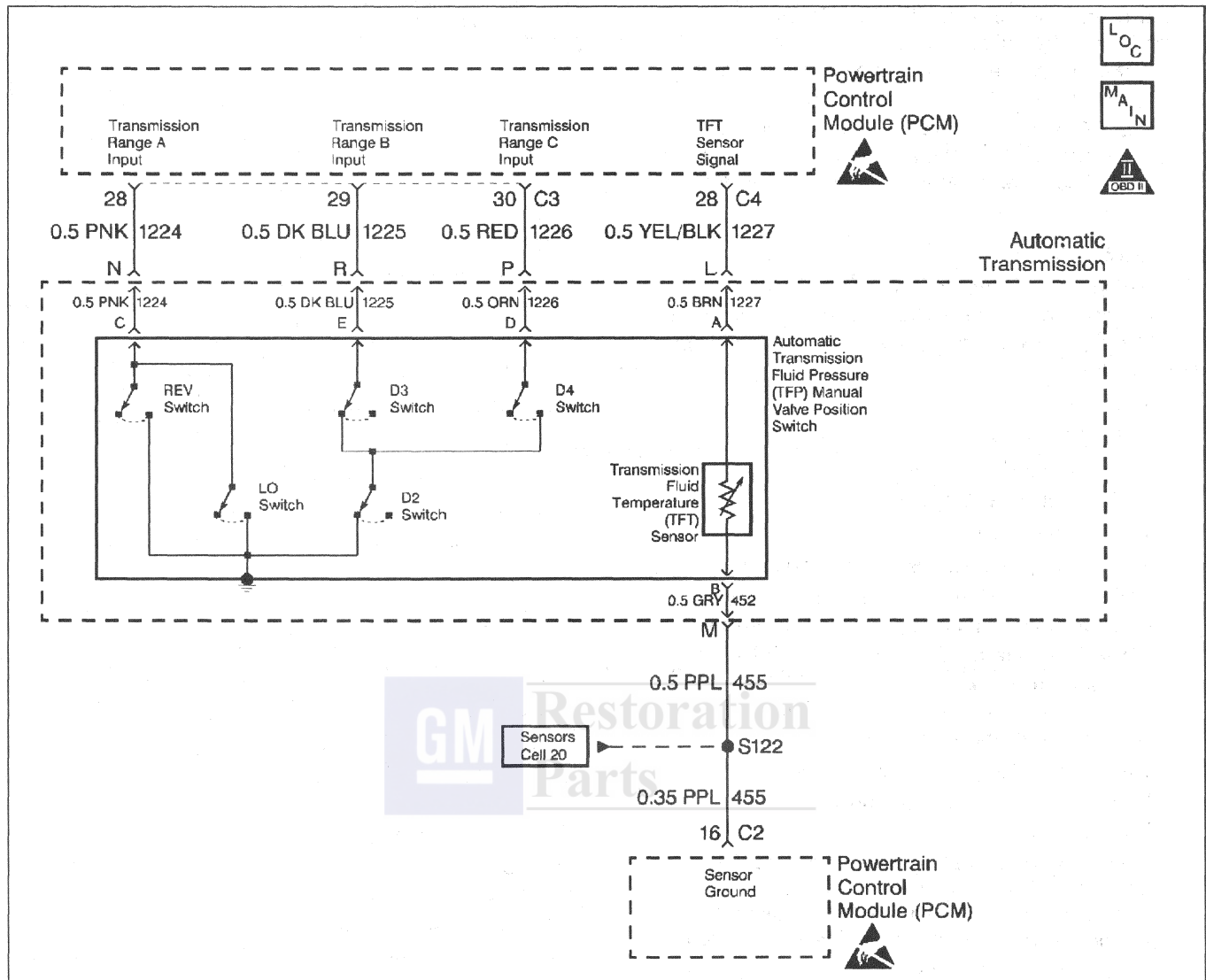
Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	- Verify that the transmission linkage from the select lever to the TFP manual valve position switch is adjusted properly. - Perform the TFP Val. Position Sw. resistance check. - Perform the fluid checking procedure. Have you completed the procedure?	—	Go to Step 3	Go to 4L60-E Transmission Fluid Checking Procedure
3	- Install the scan tool. - With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. - Record the DTC Freeze Frame and Failure Records. - While the engine idles at the normal operating temperature, apply the parking brake. - Select each transmission range: Low, Dr 2, Dr 3, Overdrive, Reverse, and Park. Does each selected transmission range match the Trans Range displayed on the scan tool?	—	Go to Diagnostic Aids	Go to Step 4
4	- Turn the ignition switch to the OFF position. - Disconnect the transmission 20-way connector (additional DTCs may set). - Install the J 39775 Jumper Harness on the engine side of the transmission 20-way connector. Refer to <i>Automatic Transmission</i>. - With the engine OFF, turn the ignition switch to the RUN position. - Using the J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the voltage at the connector terminals N, R, and P. Did you measure battery voltage on all three circuits?	—	Go to Step 6	Go to Step 5
5	Inspect the circuits that did not indicate battery voltage for an open or a short to ground. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 9	Go to Step 7
6	Verify that circuits 1224, 1225, and 1226 are not shorted together. Use a fused jumper to separately ground each circuit while monitoring the scan tool TFP Switch A/B/C display. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 9	Refer to <i>Pressure Switch Assembly Resistance Check</i> TFP Manual Valve Position Switch Resistance Check

DTC P1810 TFP Valve Position Sw CKT Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Inspect the PCM connector terminals for the following conditions: – Damaged connector pins – Backed out connector pins – Weak terminal tension 2. Repair the connectors if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 9	Go Step 8
8	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 9	—
9	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: 3.1. Turn the ignition switch to the RUN position for at least 2 seconds. 3.2. Start the vehicle and idle for 5 seconds. 3.3. Drive in D4 until the TCC locks for 20 seconds. 4. Select Specific DTC and enter DTC P1810. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1



DTC P1812 Transmission Fluid Overtemp



42254

Circuit Description

The Transmission Fluid Temperature (TFT) sensor is a negative coefficient thermistor within the Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch. The TFT sensor controls the signal voltage to the PCM. The PCM supplies a 5 volt reference to the sensor on circuit 1227.

When the transmission fluid is cold, the sensor resistance is high and the PCM senses high signal voltage. As the fluid temperature warms to a normal transmission operating temperature of 100°C (212°F), the sensor resistance decreases and the voltage decreases to 1.5 – 2.0 volts.

When the PCM detects a high transmission temperature for a long period of time, then DTC P1812 sets. DTC P1812 is a type D DTC.

Conditions for Setting the DTC

- No TFT DTCs P0712 or P0713.
- The TFT is greater than 130°C (266°F).
- All conditions met for 15 minutes.

Action Taken When the DTC Sets

- The PCM freezes shift adapts from being updated.
- The PCM does **not** illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the TCC brake switch. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for changes.
- The scan tool should show the TFT sensor temperature rising steadily to about 100°C (212°F), then stabilize.
- Check for a torque converter stator problem.
- Verify the customer's driving habits, trailer towing, etc. . .
- A skewed (mis-scaled) sensor can result in firm shifts or TCC complaints. Evaluate the possibility of a skewed sensor by using the temperature to resistance value scale. With the temperature to resistance scale you can inspect the TFT sensor at various temperature levels.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

Test Description

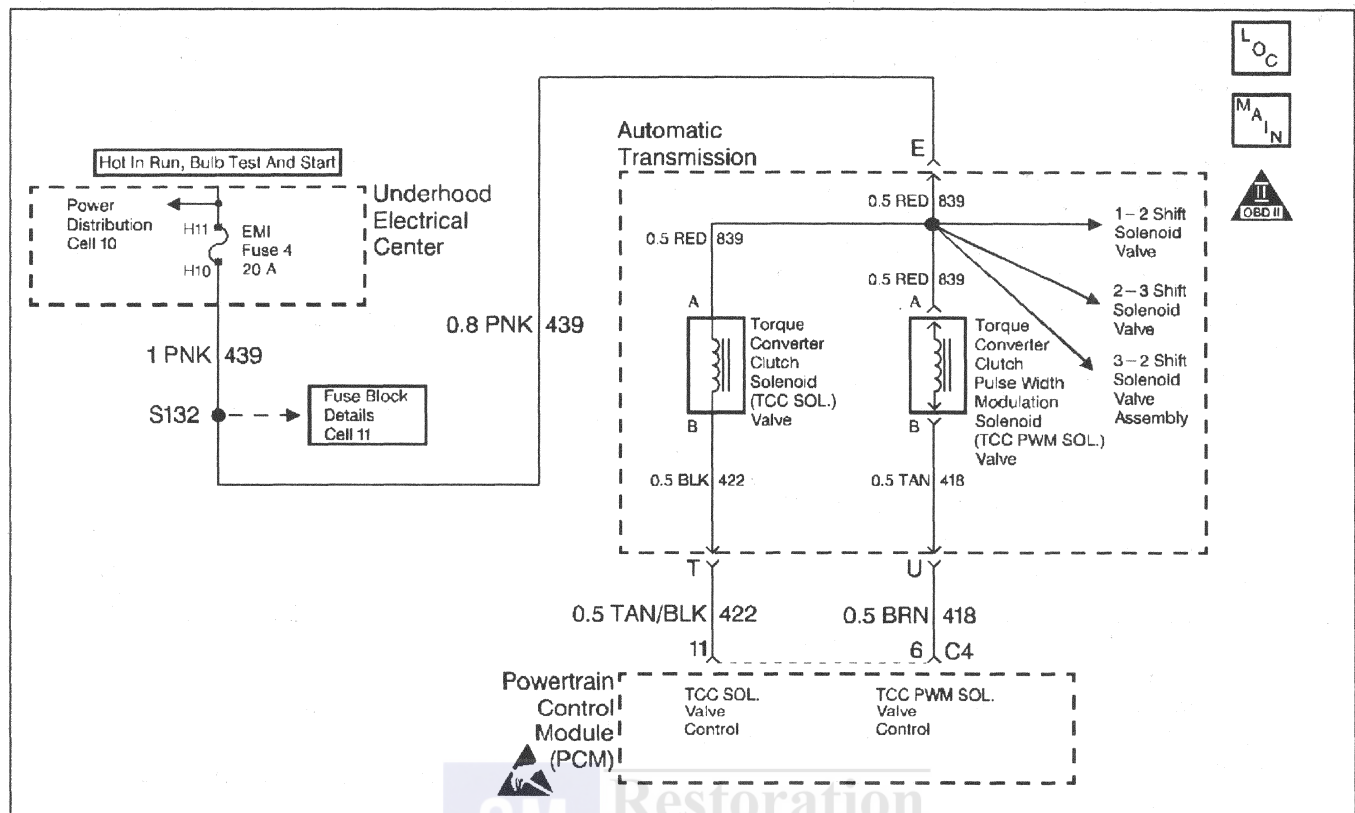
The numbers below refer to the step numbers on the diagnostic chart.

3. This Step verifies that the sensor is not skewed (mis-scaled). This Step also checks for a shorted circuit.
4. This Step simulates a TFT DTC P0713.

DTC P1812 Transmission Fluid Overtemp

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	- Check for possible transmission problems. Check for possible engine cooling system problems. - Perform the transmission fluid checking procedure. Refer to <i>Transmission Fluid Checking Procedure</i>. Have you completed the inspections?	—	Go to Step 3	Go to 4L60-E Transmission Fluid Checking Procedure
3	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Failure Records. Is the TFT Sensor signal voltage less than the specified voltage?	0.33 volt	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the transmission 20-way connector (additional DTCs may set). Is the TFT Sensor signal voltage greater than the specified voltage?	4.92 volts	Go to <i>Internal Wiring Harness Check</i>	Go to Step 5
5	Inspect circuit 1227 for a short to ground. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 8	Go to Step 6
6	1. Inspect the PCM connector terminals for the following conditions: 2. Damged connector pins 3. Backed out connector pins 4. Weak terminal tension 5. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 8	Go to Step 7
7	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 8	—
8	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure the following conditions are met: - Turn the ignition switch to the RUN position. - The scan tool must indicate a TFT less than 129 °C (264 °F) for at least 5 seconds. 4. Select Specific DTC and enter DTC P1812. Has the test run and passed?	—	System OK	Begin diagnosis the again. Go to Step 1

DTC P1860 TCC PWM Solenoid Electrical



42261

Circuit Description

The TCC PWM Solenoid Valve controls the fluid acting on the converter clutch valve, which then controls the application and release of the TCC. The solenoid attaches to the control valve body within the transmission. Circuit 439 supplies ignition voltage directly to the solenoid. The PCM controls the solenoid by providing a ground path on circuit 418. Current flows through the solenoid coil according to the duty cycle (percentage of ON and OFF time). The TCC PWM Solenoid Valve provides a smooth engagement of the torque converter clutch by operating during a duty cycle percent of ON time.

When the PCM detects a continuous open or a short to ground in the TCC PWM circuit or the TCC PWM Solenoid Valve, then DTC P1860 sets. DTC P1860 is a type A DTC.

Conditions for Setting the DTC

- The system voltage is 10–17 volts.
- No 2-3 shift solenoid Valve DTCs P0756 or P0758
- No 1-2 shift solenoid Valve DTCs P0751 or P0753
- The ignition is ON.
- First gear commanded
- The PCM commands the solenoid to 0% and the voltage remains high (B+).
- All conditions met for 5 seconds

Runs only during intrusive test:

- The TCC is at 100% duty cycle for greater than 0.1 second.
- The TCC is at 0% duty cycle for greater than 5 seconds.
- Once per key cycle

Action Taken When the DTC Sets

- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if in hot mode
- The PCM freezes shift adapts from being updated.
- The PCM commands maximum line pressure
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation

- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step verifies that the solenoid receives current.
- This Step verifies the ability of the PCM and the wiring to control the ground circuit.
- This Step measures the resistance of the TCC PWM Sol. Valve and the Automatic Transmission wiring harness.

DTC P1860 TCC PWM Solenoid Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and the DTC Failure Records. Are DTCs P0753, P0758, P1860, P1864, and P1886 set?	—	Go to Step 3	Go to Step 4
3	Inspect circuit 439, the EMI fuse, the solenoid, and the Automatic Transmission wiring harness for an open or a short to ground. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 17	—
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the transmission 20-way connector (additional DTCs may set). 3. Install the J 39775 Jumper Harness on the engine harness connector. <i>Automatic Transmission</i> 4. With the engine OFF, turn the ignition switch to the RUN position. 5. Connect a test lamp from the J 39775 Jumper Harness cavity E to ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open or short to ground in the ignition feed circuit 439 to the TCC PWM Solenoid Valve. Refer to Electrical Diagnosis, Section 8A. Is the repair complete?	—	Go to Step 17	—
6	1. Install the test lamp from cavities E to U of the J 39775 Jumper Harness. 2. Command the TCC PWM Solenoid Valve ON and OFF 3 times. Does the test lamp illuminate when you command the TCC PWM Solenoid Valve ON, and turn OFF when you command the valve OFF?	—	Go to Step 8	Go to Step 7

DTC P1860 TCC PWM Solenoid Electrical (cont'd)

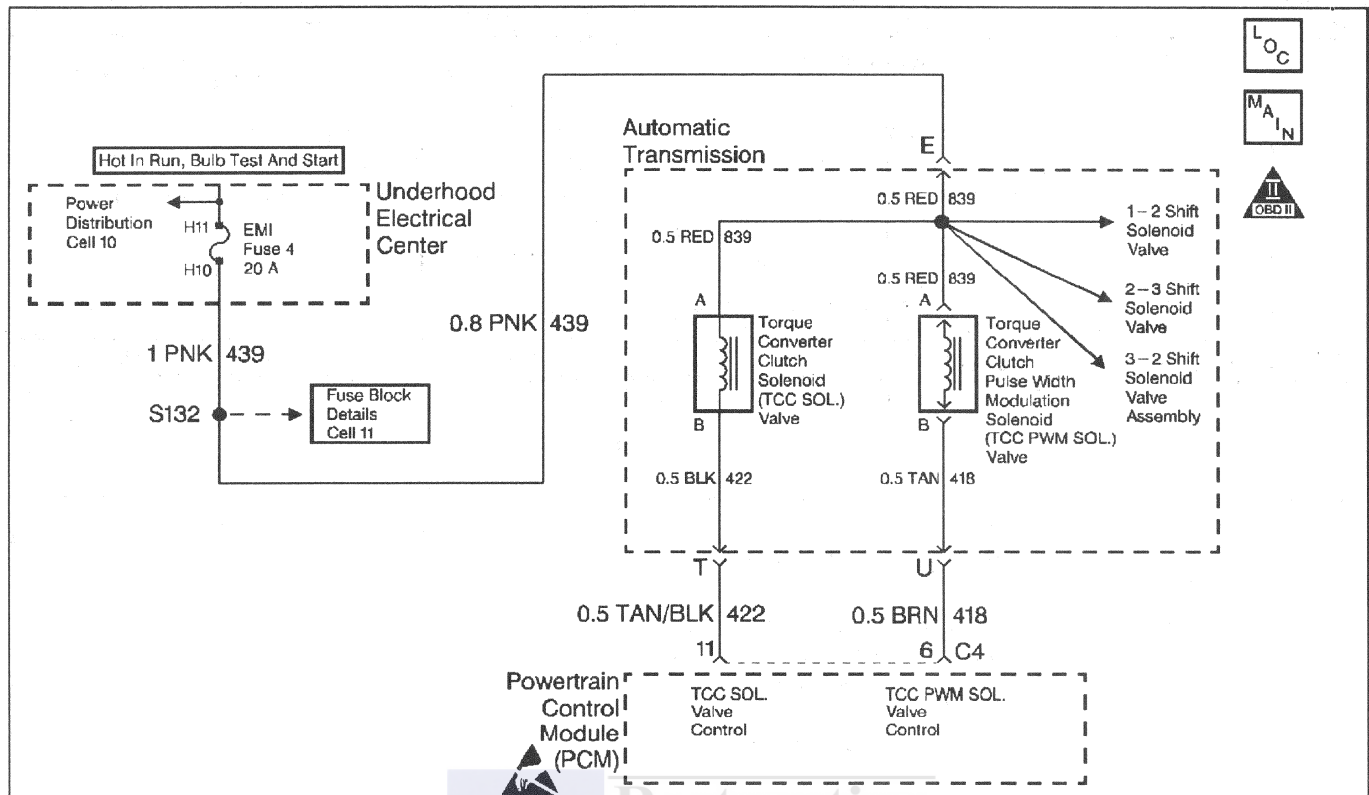
Step	Action	Value(s)	Yes	No
7	1. Inspect circuit 418 for an open and a short to ground. 2. Repair circuit 418 if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 17	Go to Step 9
8	1. Install the J 39775 Jumper Harness on the transmission 20-way connector. 2. Using the J 39200 DVOM and the J 35616 Connector Test Adapter Kit, measure the resistance between terminals E and U. Is the resistance within the specified range?	10-15Ω	Go to Step 11	Go to Step 10
9	1. Inspect the PCM connector terminals for the following conditions: 2. Damaged connector pins 3. Backed out connector pins 4. Weak terminal tension 5. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 17	Go to Step 16
10	1. Disconnect the Automatic Transmission wiring harness at the TCC PWM Solenoid Valve. 2. Measure the resistance of the TCC PWM Solenoid Valve. Is the resistance within the specified range?	10-15Ω	Go to Step 12	Go to Step 15
11	Measure the resistance between terminal E and the transmission case (ground). Measure the resistance between terminal U and ground. Are both readings greater than the specified value?	250Ω	Go to Diagnostic Aids	Go to Step 13
12	Inspect the Automatic Transmission wiring harness for an open. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and repair a problem?	—	Go to Step 17	—
13	1. Disconnect the Automatic Transmission wiring harness at the TCC PWM Solenoid Valve. 2. Measure the resistance between each of the component terminals and the transmission case (ground). Are both readings greater than the specified value?	250Ω	Go to Step 14	Go to Step 15
14	Inspect the Automatic Transmission wiring harness for a short to ground. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Was a problem found and corrected?	—	Go to Step 17	—
15	Replace the TCC PWM Solenoid Valve. Refer to <i>Valve Body</i> . Is the replacement complete?	—	Go to Step 17	—
16	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 17	—

DTC P1860 TCC PWM Solenoid Electrical (cont'd)

Step	Action	Value(s)	Yes	No
17	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Ensure the following conditions: • When you command the TCC PWM Solenoid Valve ON, the voltage drops to zero. • When you command the TCC PWM Solenoid Valve OFF, the voltage increases to B+. • All conditions met for 5 seconds. 4. Select Specific DTC and enter DTC P1860. Has the test run and passed?	—	System OK	<i>Begin diagnosis the again. Go to Step 1</i>



DTC P1864 TCC Solenoid Electrical



42261

Circuit Description

In conjunction with the TCC PWM Solenoid Valve, the TCC Solenoid Valve controls fluid acting on the TCC Valve. The TCC Valve controls the application and release of the TCC. The TCC solenoid is a normally-open, ON/OFF device. The solenoid attaches to the transmission case assembly extending into the pump cover. The PCM monitors the TP voltage, the vehicle speed, and other inputs in order to determine when to energize the TCC Solenoid Valve. Circuit 439 supplies ignition voltage directly to the TCC Solenoid Valve. The PCM controls the solenoid by providing the ground path through circuit 422.

When the PCM detects a continuous open or a short to ground in the TCC Solenoid Valve circuit or the TCC Solenoid Valve, then DTC P1864 sets. DTC P1864 is a type A DTC.

Conditions for Setting the DTC

- The system voltage is 10–17 volts.
- The ignition is ON.
- The PCM commands the solenoid ON and the voltage remains high (B+).
- The PCM commands the solenoid OFF and the voltage remains low (0 volts).
- All conditions met for 5 seconds.

Action Taken When the DTC Sets

- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if in hot mode.

- The PCM freezes shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the TCC brake switch. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.

- With the TCC engaged, the TCC slip speed should be -20 to +20 RPM.
- A short to ground in the TCC Solenoid Valve circuit may also set a TCC Stuck On DTC P0742.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

- This Step verifies that the solenoid receives current.
- This Step verifies the ability of the PCM and the wiring to control the ground circuit.
- This Step measures the resistance of the TCC Solenoid Valve and the automatic transmission wiring harness.

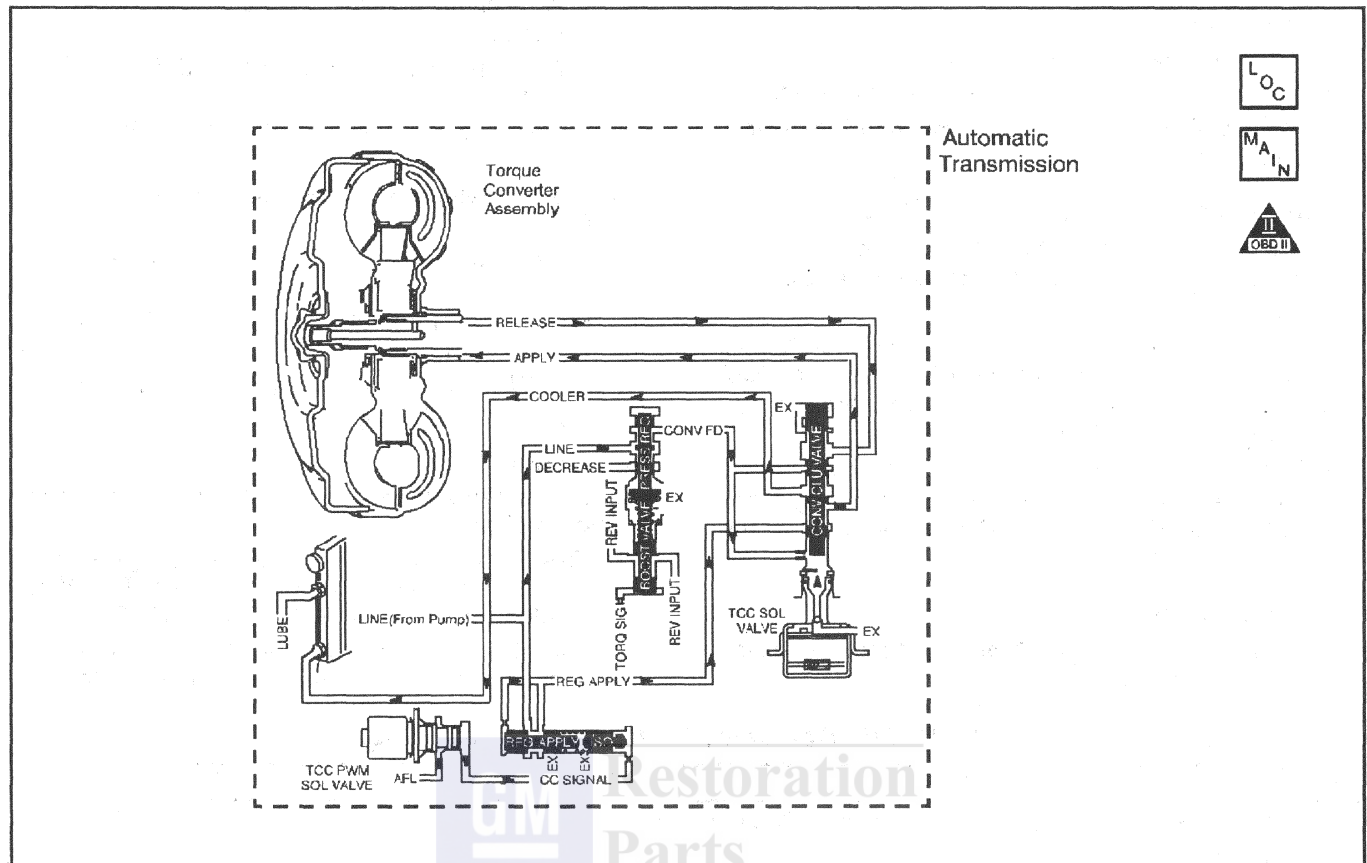
DTC P1864 TCC Solenoid Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to Powertrain OBD System Check, Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and the Failure Records. Are DTCs P0753, P0758, P1860, P1864 and P1886 set?	—	Go to Step 3	Go to Step 4
3	Inspect circuit 439, the solenoid, the EMI fuse, and the Automatic Transmission wiring harness for an open and a short to ground. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 15	—
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the transmission 20-way connector (additional DTCs may set). 3. Install the J 39775 Jumper Harness on the engine harness connector. <i>Automatic Transmission</i> 4. With the engine OFF, turn the ignition switch to the RUN position. 5. Connect a test lamp from cavity E of the J 39775 Jumper Harness to a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open or short to ground in the ignition feed circuit 439 to the TCC Solenoid Valve. Refer to Electrical Diagnosis, Section 8A. Is the repair complete?	—	Go to Step 15	—
6	1. Install the test lamp between the cavities E and T of the J 39775 Jumper Harness. 2. Using the scan tool, command the TCC Solenoid Valve ON and OFF 3 times. Does the test lamp illuminate when you command the TCC Solenoid Valve ON, and turn OFF when you command OFF?	—	Go to Step 8	Go to Step 7

DTC P1864 TCC Solenoid Electrical (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Inspect circuit 422 for an open. 2. Inspect circuit 422 for a short to ground. 3. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 15	Go to Step 9
8	1. Inspect the PCM connector terminals for the following conditions: 2. Damaged connector pins 3. Backed out connector pins 4. Weak terminal tension 5. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 15	Go to Step 14
9	1. Install the J 39775 Jumper Harness on the transmission 20-way connector. 2. Using the J 39200 DVOM and the J 35616 Connector Test Adapter Kit, measure the resistance between the terminal E and the transmission case (ground). 3. Measure the resistance between the terminal T and the transmission case (ground). Are both readings greater than the specified value?	250k Ω	Go to step 11	Go to Step 10
10	1. Inspect the Automatic Transmission wiring harness for a short to ground. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 15	—
11	1. Install the J 39775 Jumper Harness on the transmission 20-way connector. 2. Using the J 39200 DVOM and the J 35616 Connector Test Adapter Kit, measure the resistance between the terminals T and E. Is the resistance within the range shown?	21-33 Ω	Go to Diagnostic Aids	Go to Step 10
12	1. Inspect the Automatic Transmission wiring harness for an open. 2. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 15	Go to Step 13
13	Replace the TCC Solenoid Valve. Refer to <i>Valve Body and Wiring Harness Removal</i> . Is the replacement complete?	—	Go to Step 15	—
14	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 15	—
15	1. After the repair is complete, select DTC. 2. Select Clear Info. 3. Operate the vehicle. Ensure the following conditions: • Commanding the TCC Solenoid Valve ON causes the voltage to decrease to zero. • Commanding the TCC Solenoid Valve OFF causes the voltage to increase to B+. • All conditions met for 5 seconds. 4. Select Specific DTC and enter DTC P1864. Has the test run and passed?	—	System OK	Begin the diagnosis again. Go to Step 1

DTC P1870 Transmission Component Slipping



Range	Gear	1-2 SS Valve	2-3 SS Valve	2-4 Band	Forward Clutch	Forward Sprag Clutch Assembly	3-4 Clutch
OVER DRIVE	2nd	Off	On	Applied	Applied	Holding	—
3rd	Off	Off	—	Applied	Holding	Applied	
4th	On	Off	Applied	Applied	—	Applied	

Circuit Description

The PCM monitors the difference between the engine speed and the transmission output speed. In D3 drive range with the TCC engaged, the engine speed should closely match the transmission output speed. In D4 drive range with the TCC engaged, the TCC slip speed should be -20 to +20 RPM.

When the PCM detects excessive TCC slip when the TCC should be engaged, then DTC P1870 sets.

DTC P1870 is a type A DTC.

Conditions for Setting the DTC

The following conditions are met for three TCC cycles with reported excessive TCC slip conditions:

- No TP DTCs P0122 or P0123
- No VSS DTC P050
- No TFT sensor DTCs P0172 or P0173
- No 1-2 SS Valve DTCs P0751 or P0753
- No 2-3 SS Valve DTCs P0756 or P0758
- No TFP Valve Position Switch DTC P1810
- No TCC PWM Solenoid Valve DTC P1860
- No TCC Solenoid Valve DTC P1864
- The engine speed is less than 5500 RPM.
- The engine vacuum is between 35 and 70 kPa. (10.4–20.7 in Hg).
- The gear range is D4.
- Not in 1st gear
- The TP angle is between 13 and 36%.
- The TFT is between 20° and 130°C (68° and 266°F).
- The TCC is ON for greater than 0.1 second.
- The TCC is at maximum apply for 0.1 second.
- The Shift Solenoid performance counter is zero.
- The TCC slip speed is greater than 130 RPM for greater than 8 seconds.

Action Taken When the DTC Sets

- Inhibit TCC engagement
- Maximum line pressure
- Inhibit 4th gear if in hot mode
- The freeze shift adapts from being updated.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- A TFP Valve Position Switch malfunction could set DTC P1870.

- The following mechanical conditions could set DTC P1870:

- A mechanical failure of the shift solenoid valves
- A mechanical failure of the TCC Solenoid Valve
- A mechanical failure of the TCC PWM Solenoid Valve

- Internal transmission failures may set a DTC P1870.
- An engine misfire may erroneously set a DTC P1870.

- Ensure that the final drive ratio matches the PCM's calibration.

- A PRNDL DTC may falsely set DTC P1870.

Refer to 4L60-E Shift Speed Chart.

Test Description

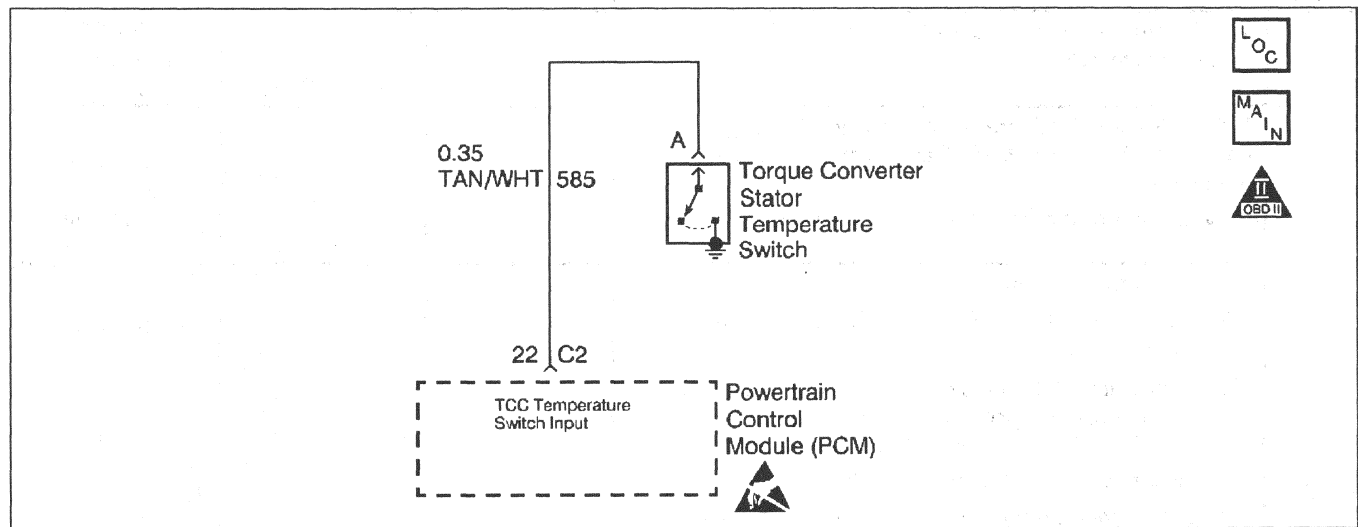
The numbers below refer to the step numbers on the diagnostic chart.

- This Step compares the indicated range signal to the actual selected range. A faulty TFP Valve Position Switch could set a DTC P1870.
- This Step tests for slippage while the torque converter is in a commanded lock-up state.

DTC P1870 Transmission Component Slipping

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and the Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and the Failure Records. 4. Apply the brake pedal. 5. Select each transmission range: Low, Dr 2, Dr 3, Overdrive, Reverse and Park. Does each selected transmission range match the scan tool TR Switch display?	—	Go to Step 3	Go to <i>Pressure Switch Assembly Resistance Check</i>
3	Drive the vehicle in 4th gear while the TCC is engaged. At any time is the TCC Slip Speed greater than the specified value for 10 seconds?	130 RPM	Go to System Diagnosis Charts	Go to Diagnostic Aids

DTC P1873 Torque Conv Stator Temp Switch Ckt Low



42262

Circuit Description

The torque converter stator temperature switch is a normally-open, temperature-sensitive switch which sends a signal to the PCM to begin action in order to cool the torque converter. At transmission fluid temperatures of 164°C (327°F) or higher, the switch closes and the signal to the PCM changes to 0 volts. The torque converter stator temperature switch is a single lead switch that grounds through the transmission fluid cooler pipes.

When the PCM detects that the torque converter stator switch indicates a hot mode at a low transmission temperature, then DTC P1873 sets. DTC P1873 is a type D DTC.

Conditions for Setting the DTC

1. No TFT DTCs P0712 or P0713.
2. The TFT is less than 60°C (140°F).
3. The torque converter stator temperature switch circuit indicates a hot mode.
4. All conditions are met for 5 seconds.

Action Taken When the DTC Sets

- The torque converter stator temperature switch does not indicate a hot mode.
- The PCM freezes shift adapts from being updated.
- The PCM does **not** illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.

- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

1. If the switch and the external wiring are OK, verify the circuit ground integrity through the transmission fluid cooler pipes.
2. Inspect the wiring for poor electrical connections at the PCM. Inspect the wiring for poor electrical connections at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
3. When diagnosing for an intermittent short or open condition, massage the wiring harness while watching the test equipment for a change.

Test Description

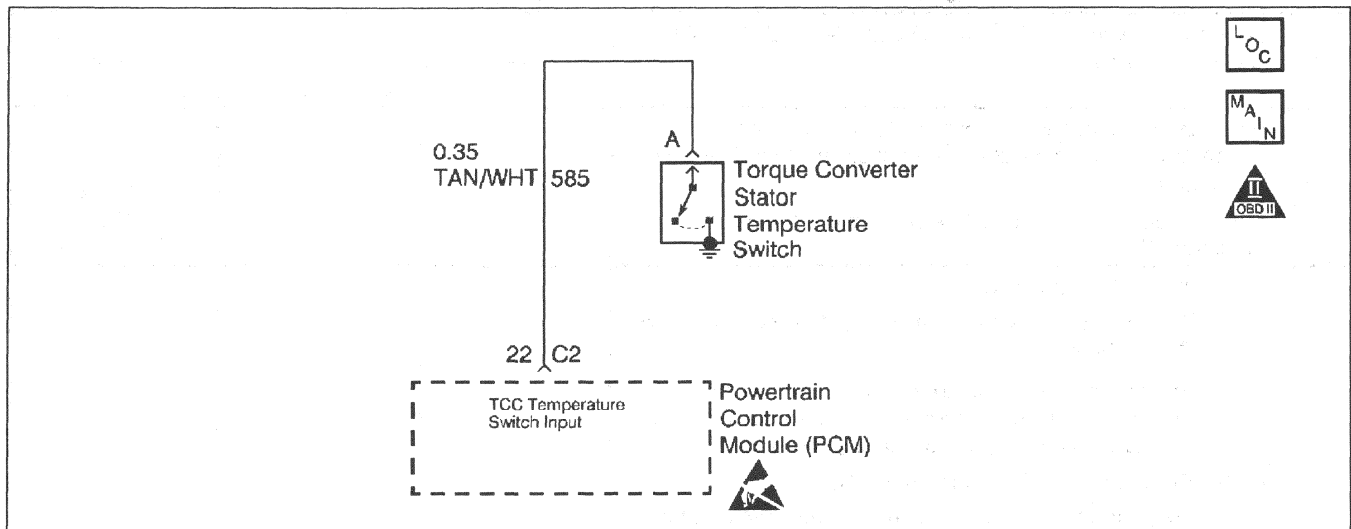
The numbers below refer to the step numbers on the diagnostic chart.

3. Step 3 verifies the electrical integrity of the wiring and the PCM.

DTC P1873 Torque Conv Stator Temp Switch Ckt Low

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to OBD Powertrain System Check
2	Perform the automatic transmission fluid checking procedure. Refer to 4L60-E Transmission Fluid Checking Procedure. Did you perform the transmission fluid checking procedure?	—	Go to Step 3	Go to the Transmission Fluid Checking Procedure
3	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Failure Records. 4. Disconnect the torque converter stator temperature switch. 5. Using a grounded test lamp, probe the torque converter stator temperature switch connector. Does the scan tool display "TCC Stator Temp. as High (closed switch) with the test lamp connected, and Normal (open switch) with the test lamp disconnected?	—	Go to Step 6	Go to Step 4
4	Is High (closed switch) displayed at all times?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the short to ground in circuit 585. Refer to Electrical Diagnosis, Section 8. Is the repair complete?	—	Go to Step 7	—
6	Replace the torque converter stator temperature switch. Is the replacement complete?	—	Go to Step 7	—
7	In order to verify your repair, perform the following procedure: 1. Select DTC. 2. Select Clear Info. 3. Ensure that the torque converter stator temperature switch circuit does not indicate a hot mode when the transmission fluid temperature is less than 60°C (140°F). 4. Select Specific DTC. 5. Enter DTC P1873. Has the test run and passed?	—	System OK	Begin diagnostic again. Go to Step 1

DTC P1874 Torque Conv Stator Temp Switch Ckt High



42262

Circuit Description

The torque converter stator temperature switch is a normally-open, temperature-sensitive switch which sends a signal to the PCM to begin action in order to cool the torque converter. At transmission fluid temperatures of 164°C (327°F) or higher, the switch closes and the signal to the PCM changes to 0 volts. The torque converter stator temperature switch is a single lead switch that grounds through the transmission fluid cooler pipes.

When the PCM detects that the torque converter stator switch does not indicate a hot mode at a high transmission temperature, then DTC P1873 sets. DTC P1873 is a type D DTC.

Conditions for Setting the DTC

1. No TFT DTCs P0712 or P0713.
2. The TFT is less than 140°C (284°F).
3. The torque converter stator temperature switch circuit does not indicate hot mode.
4. All conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The torque converter stator temperature switch indicates a hot mode.
- The PCM freezes shift adapts from being updated.
- The PCM does **not** illuminate the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the DTC

- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.

- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

1. If the switch and the external wiring are OK, verify the circuit ground integrity through the transmission fluid cooler pipes.
2. Inspect the wiring for poor electrical connections at the PCM. Inspect the wiring for poor electrical connections at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
3. When diagnosing for an intermittent short or open condition, massage the wiring harness while watching the test equipment for a change.

Test Description

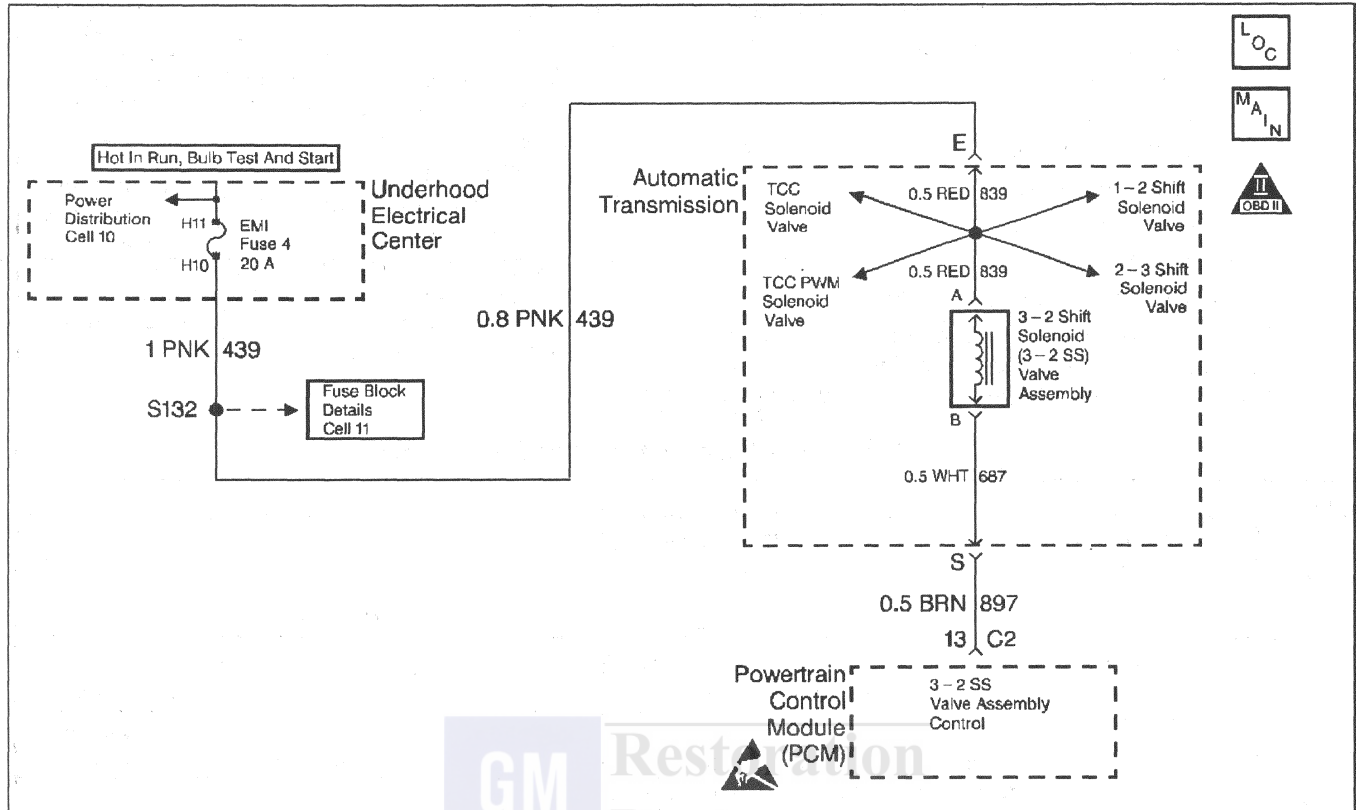
The numbers below refer to the step numbers on the diagnostic chart.

3. Step 3 verifies the electrical integrity of the wiring and the PCM.

DTC P1874 Torque Conv Stator Temp Switch Ckt High

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	<i>Go to Step 2</i>	Go to OBD Powertrain System Check
2	Perform the automatic transmission fluid checking procedure. Refer to 4L60-E Transmission Fluid Checking Procedure. Did you perform the transmission fluid checking procedure?	—	<i>Go to Step 3</i>	Go to the Transmission Fluid Checking Procedure
3	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Failure Records. 4. Disconnect the torque converter stator temperature switch. 5. Using a grounded test lamp, probe the torque converter stator temperature switch connector. Does the scan tool display "TCC Stator Temp. as High (closed switch) with the test lamp connected, and Normal (open switch) with the test lamp disconnected?	—	<i>Go to Step 6</i>	<i>Go to Step 4</i>
4	Is Normal (open switch) displayed at all times?	—	<i>Go to Step 5</i>	Go to Diagnostic Aids
5	1. Inspect circuit 585 for an open or short to battery voltage. 2. Repair circuit 585 if necessary. Refer to Electrical Diagnosis, Section 8. Is the repair complete?	—	<i>Go to Step 7</i>	—
6	Replace the torque converter stator temperature switch. Is the replacement complete?	—	<i>Go to Step 7</i>	—
7	In order to verify your repair, perform the following procedure: 1. Select DTC. 2. Select Clear Info. 3. Ensure that the torque converter stator temperature switch circuit indicates a hot mode when the transmission fluid temperature is greater than 140 °C (284 °F) for at least 15 seconds. 4. Select Specific DTC. 5. Enter DTC P1874. Has the test run and passed?	—	System OK	<i>Begin diagnostic again. Go to Step 1</i>

DTC P1886 3-2 SS Valve Assembly CKT Electrical



42263

Circuit Description

The 3-2 Shift Solenoid Valve Assembly (3-2 SS Valve Assy) is a normally-closed, 3-port, on/off device. The device controls the 3-2 downshift. The solenoid attaches to the control valve body within the transmission. Circuit 439 supplies ignition voltage directly to the solenoid. The PCM controls the solenoid by providing a ground path on circuit 897. During a 3-2 downshift, the 2-4 band applies as the 3-4 clutch releases. The PCM varies the timing between the 3-4 clutch release and the 2-4 band apply depending on the vehicle speed and the throttle position.

When the PCM detects a continuous open or short to ground in the 3-2 SS Valve Assy circuit or the 3-2 SS Valve Assy., then DTC P1886 sets. DTC P1886 is a type A DTC.

Conditions for Setting the DTC

- The System Voltage is 10–17 volts.
- The ignition is ON.
- The PCM commands the solenoid ON and the voltage remains high (B+).
- The PCM commands the solenoid OFF and the voltage remains low (0 volts).
- All conditions are met in 5 seconds.

Action Taken When the DTC Sets

- The PCM commands a soft landing to third gear.
- The PCM commands maximum line pressure.
- The PCM freezes shift adapts from being updated.
- The PCM inhibits the TCC engagement.
- The PCM inhibits 4th gear if in hot mode.
- The PCM illuminates the Malfunction Indicator Lamp (MIL).

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after three consecutive ignition cycles without a failure reported.
- A scan tool can clear the DTC from the PCM history. The PCM clears the DTC from the PCM history if the vehicle completes 40 warm-up cycles without a failure reported.
- The PCM cancels the DTC default actions when the fault no longer exists and the ignition is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the wiring for any poor electrical connections at the PCM. Inspect the wiring at the transmission 20-way connector. Look for the following conditions:
 - A bent terminal
 - A backed out terminal
 - A damaged terminal
 - Poor terminal tension
 - A chafed wire
 - A broken wire inside the insulation
- When diagnosing for an intermittent short or an open condition, massage the wiring harness while watching the test equipment for a change.

Test Description

The item numbers below refer to the Step numbers on the diagnostic chart.

4. This Step verifies that the PCM can control the 3-2 shift solenoid valve assembly.
5. This Step verifies that the 3-2 Shift Solenoid Valve Assembly receives power from the ignition through the fuse.
7. This Step verifies that the PCM and the wiring properly control the ground circuit.
9. This Step measures the resistance of the automatic transmission wiring harness. This Step then compares the actual resistance to the expected resistance.

DTC P1886 3-2 SS Valve Assembly CKT Electrical

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to <i>Powertrain OBD System Check</i> , Section 6E
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the RUN position. Important: Before clearing the DTCs, use the scan tool in order to record the Freeze Frame and Failure Records for reference. The Clear Info function will erase the data. 3. Record the DTC Freeze Frame and Failure Records. Have the DTCs P0753, P0758, P1860, P1864, or P1886 set?	—	Go to Step 3	Go to Step 4
3	Inspect circuit 439, the solenoid, the EMI fuse, and the Automatic Transmission wiring harness for an open or a short to ground. Repair the circuit, the solenoid, and the harness if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 18	—
4	Command the 3-2 Shift Solenoid Valve Assembly ON and OFF three times, while listening to the bottom of the transmission pan (a stethoscope may be necessary). Does the solenoid click when commanded?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTCs will set). 3. Install the J 39775 Jumper Harness on the engine harness connector. <i>Automatic Transmission</i> 4. With the engine OFF, turn the ignition to the Run position. 5. Connect a test lamp, from the J 39775 Jumper Harness cavity E to ground. Did the test lamp illuminate?	—	Go to Step 7	Go to Step 6
6	Repair the open or short to ground in the ignition feed circuit 439 to the 3-2 Shift Solenoid Valve Assembly. Refer to Electrical Diagnosis, Section 8A. Is the repair complete?	—	Go to Step 18	—

DTC P1886 3-2 SS Valve Assembly CKT Electrical (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Install a test lamp between cavity E and cavity S of the J 39775 Jumper Harness. 2. Command the 3-2 shift solenoid valve assembly ON and OFF three times. Does the test lamp illuminate when you command the shift solenoid valve assembly ON, and turn OFF when you command OFF?	—	Go to Step 9	Go to Step 8
8	1. Inspect circuit 897 for an open or short to ground. 2. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 18	Go to Step 10
9	1. Install the J 39775 Jumper Harness on the transmission 20-way connector. 2. Using the J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance between the terminals E and S. Is the resistance within the specified range?	20–32Ω	Go to Step 13	Go to Step 11
10	1. Inspect the PCM connector terminals for the following conditions: – Damaged connector pins – Backed out connector pins – Weak terminal tension 2. Repair the connectors if necessary. Did you find and correct a problem?	—	Go to Step 18	Go to Step 17
11	1. Disconnect the Automatic Transmission wiring harness from the 3-2 shift solenoid valve assembly. 2. Measure the resistance of the 3-2 shift solenoid valve assembly. Is the resistance within the specified range?	20–32Ω	Go to Step 12	Go to Step 16
12	1. Inspect the Automatic Transmission wiring harness for an open circuit. 2. Repair the circuit if necessary. Refer to Electrical Diagnosis, Section 8A. Did you find and correct a problem?	—	Go to Step 18	—
13	• Measure the resistance between the terminal S and ground. • Measure the resistance between the terminal E and ground. Are both measurements greater than the specified value?	250kΩ	Go to Diagnostic Aids	Go to Step 14
14	1. Disconnect the Automatic Transmission wiring harness from the 3-2 shift solenoid valve assembly. 2. Measure the resistance between the component's terminals and ground. Are both readings greater than the specified value?	250kΩ	Go to Step 15	Go to Step 16
15	Inspect the Automatic Transmission wiring harness for a short to ground. Repair the harness if necessary. Refer to Electrical Diagnosis, Section 8. Did you find and correct a problem?	—	Go to Step 18	—
16	Replace the 3-2 shift solenoid. Refer to <i>Valve Body</i>. Is the replacement complete?	—	Go to Step 18	—

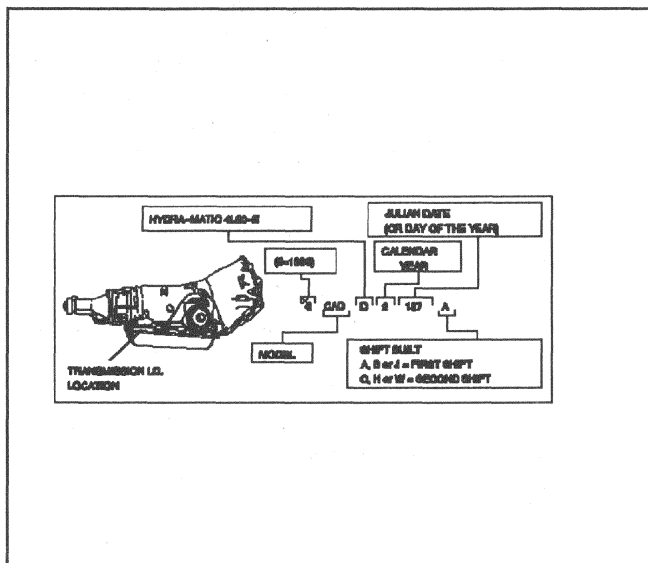
DTC P1886 3-2 SS Valve Assembly CKT Electrical (cont'd)

Step	Action	Value(s)	Yes	No
17	Replace the PCM. Refer to <i>PCM Replacement/Programming</i> , Section 6. Is the replacement complete?	—	Go to Step 18	—
18	- After the repair is complete, select DTC. - Select Clear Info. - Operate the vehicle. Ensure the following conditions are satisfied: - When you command the 3-2 shift solenoid ON, the voltage decreases to zero. - When you command the 3-2 shift solenoid OFF, the voltage increases to B+. - All conditions are satisfied for 5 seconds. - Select Specific DTC. Enter DTC P1886. Has the test run and passed?	—	System OK	<i>Begin the diagnosis again.</i> Go to Step 1



Description and Operation

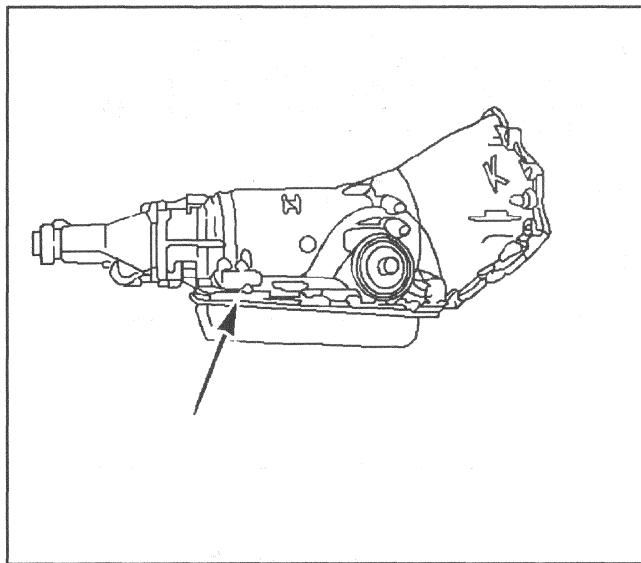
Transmission ID Information



13268

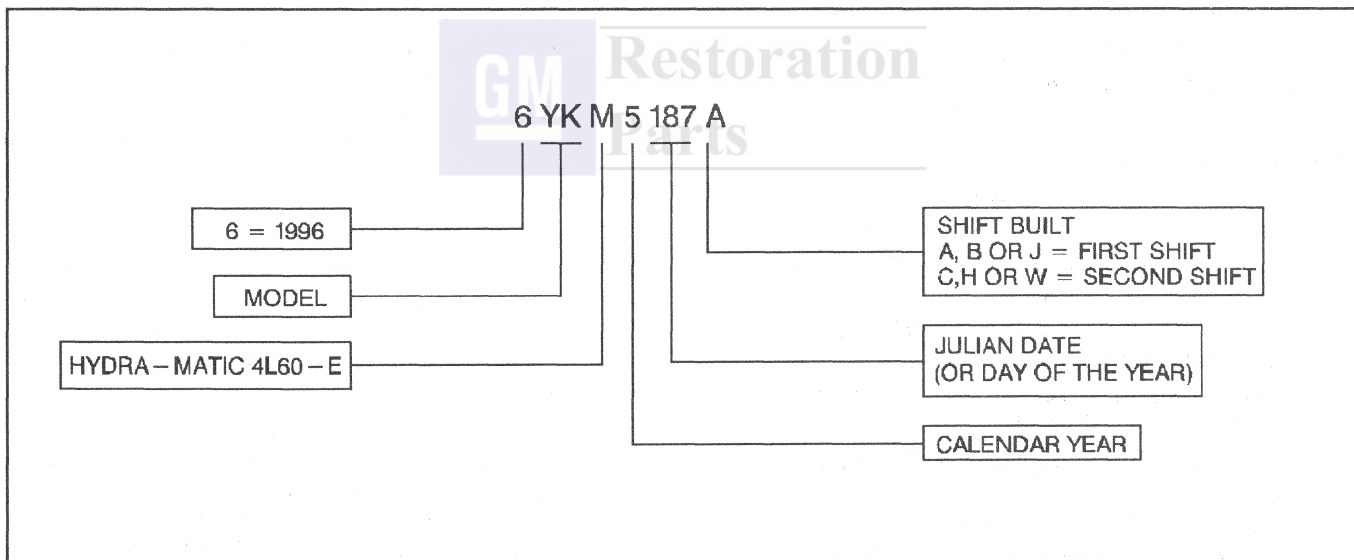
Transmission General Information

Transmission Identification Information



6477

The HYDRA-MATIC 4L60-E transmission has the identification information stamped into the case pan rail.

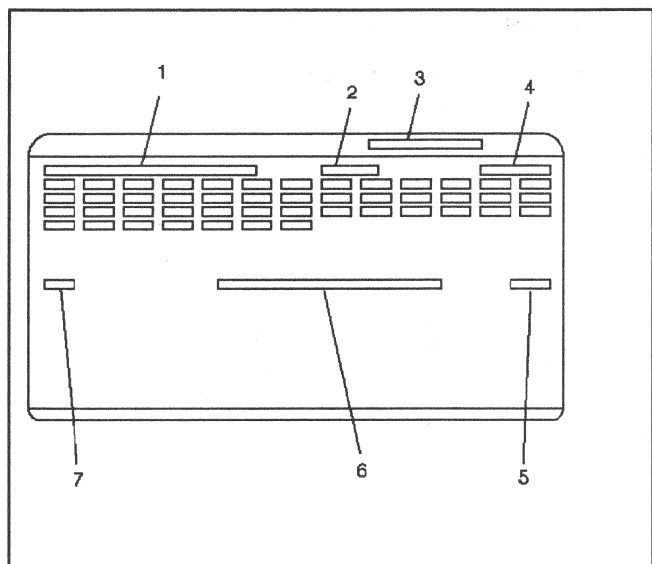


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This information helps the service technician order the correct replacement parts from a GM parts catalog.

Additional transmission identification information is provided on the Service Parts Identification label.

This label shows the Regular Production Options (RPO) as well as the standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant. For more information, refer to Section 0A.



6480

Legend

- (1) Vehicle Identification Number
- (2) Wheel Base
- (3) Part Number Location
- (4) Model Designation
- (5) Order Number
- (6) Exterior Color
- (7) Paint Technology

Throttle Positions

- Minimum Throttle — The least amount of throttle opening required for an upshift.
- Light Throttle — Approximately 1/4 of the accelerator pedal travel.
- Medium Throttle — Approximately 1/2 of the accelerator pedal travel.
- Heavy Throttle — Approximately 3/4 of the accelerator pedal travel.
- Wide Open Throttle (WOT) — Full travel of the accelerator pedal.
- Full Throttle Detent Downshift — A quick apply of the accelerator pedal to its full travel, forcing a downshift.
- Zero Throttle Coast Down — A full release of the accelerator pedal while the vehicle is in motion and in the drive range.
- Engine Braking — A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coast-down.

Shift Conditions

- Bump — A sudden and forceful apply of a clutch or band.
- Chuggle — A bucking or jerking condition that may be engine related. This condition may be most noticeable when the converter clutch is engaged. Similar to the feel of towing a trailer.

- Delayed — A condition where a shift is expected but does not occur for a period of time. This condition could be described as clutch or band engagement not occurring as quickly as expected during a part throttle or wide open throttle apply of the accelerator, or when manually downshifting to a lower range. Also defined as LATE or EXTENDED shift.
- Double Bump (Double Feel) — Two sudden and forceful applies of a clutch or band.
- Early — A condition where the shift occurs before the vehicle has reached a proper speed and tends to labor the engine after the upshift.
- End Bump — A firmer feel at the end of a shift as compared to the feel at the start of a shift. Also defined as END FEEL or SLIP BUMP.
- Firm — A noticeable quick apply of a clutch or band that is considered normal with a medium to heavy throttle shift. Do not confuse with HARSH or ROUGH.
- Flare — A quick increase in engine RPM accompanied with a momentary loss of torque. This most generally occurs during a shift. Also defined as SLIPPING.
- Harsh (Rough) — A more noticeable apply of a clutch or band as compared to FIRM. This condition is considered undesirable at any throttle position.
- Hunting — A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM. An example could be described as a 4-3-4 shift pattern. Also defined as BUSYNESS.
- Initial Feel — A distinct firmer feel at the start of a shift as compared to the finish of the shift.
- Late — A shift that occurs when the engine is at a higher than normal RPM for a given amount of throttle.
- Shudder — A repeating jerking sensation similar to CHUGGLE but more severe and rapid in nature. This condition may be most noticeable during certain ranges of the vehicle speed. You may also use Shudder to define the condition after converter clutch engagement.
- Slipping — A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band engagement.
- Soft — A slow, almost unnoticeable clutch or band apply with very little shift feel.
- Surge — A repeating engine related feeling of acceleration and deceleration that is less intense than CHUGGLE.
- Tie-Up — A condition where two opposing clutches and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

- Gear Noise — A whine, most noticeable in first gear and reverse, that is related to the vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.
- Pump Noise — A high pitch whine that increases in intensity with engine RPM. This condition may also be noticeable in P (Park) or N (Neutral) operating ranges with the vehicle stationary.

Preliminary Checking Procedure

Transmission performance may be influenced by one, or more of the following items:

- Fluid level high/low.
- Engine performance.
- Manual linkage adjustment.
- Internal fluid leaks.
- Electrical system.
- Transmission or other mechanical component.

These items should be checked and corrected, if necessary, before attempting transmission diagnosis.

Transmission Fluid Checking Procedure

Checking fluid level, color, and condition at regular intervals will provide early diagnostic information about the transmission. This information may then be used to correct a condition that, if not detected early, could result in major transmission repair.

Refer to Section 0B for maintenance information and servicing intervals.

Important: New automatic transmission fluid is red. Red dye is added in order to help the assembly plant distinguish this fluid from engine oil and antifreeze. The red dye is not permanent. After some driving, the transmission fluid will look darker. Eventually, the fluid may appear light brown.

- Wait at least 30 minutes before checking the transmission fluid, if the vehicle has been driven under the following conditions:
 - Outside temperature is above 32°C (90°F)
 - At high speed for more than 15 minutes
 - In heavy traffic during hot weather
 - While pulling a trailer
- In order to get the correct reading, the fluid should be at a normal operating temperature, which is 82°C-94°C (180°F-200°F).
- Do the following for a hot check:

Warm up the vehicle by driving about 24 km (15 miles), when the outside temperature is above 10°C (50°F).

If the temperature is colder than 10°C (50°F), you may have to drive the vehicle longer.

- Do the following for a cold check:

Do a cold check when the transmission temperature is 24°C-29°C (75°F-85°F).

Let the engine run at slow idle for 5 minutes, if the outside temperature is 10°C (50°F) or higher.

If the outside temperature is colder than 10°C (50°F), you may have to idle the engine longer than 5 minutes.

- Do the following for a hot or a cold transmission fluid check:
 1. Idle the engine.
 2. Park the vehicle on a level surface.
 3. Place the shift lever in the P (Park) position.
 4. Apply the parking brake.
 5. With you foot on the brake pedal, move the shift lever through each gear, pausing for about 3 seconds in each range. Then, put the shift lever in P (Park).
 6. Idle the engine for 3 minutes or more.
- Now, do the following in order to check the fluid level:
 1. Pull out the dipstick. Wipe the dipstick well with a clean rag or a paper towel.
 2. Push the dipstick in all the way. Wait 3 seconds. Then, pull the dipstick back out again.
 3. Check both sides of the dipstick, reading the lower level.
 - For a cold check, the fluid level must be in the COLD area.
 - For a hot check, the fluid level must be in the HOT or crosshatched area.
 4. If the fluid level is OK, push the dipstick back in all the way.

Notice: Do not overfill the transmission. Overfilling will result in foaming, loss of fluid, and possible damage to the transmission.
 5. If the fluid level is low, add only enough DEXRON®-III (or, if unavailable, DEXRON®-IIE) to bring the fluid level up to the COLD area for a cold check or the HOT area for a hot check.

Generally, this will require less than a pint of fluid. Do not overfill.
 6. After adding the fluid, recheck the fluid level as described above. When the fluid level is correct, push the dipstick in all the way.
- Transmission fluid should be red in color when the fluid is new.

Automatic Transmission Diagnosis

Throttle Positions

This section provides general information on transmissions, a detailed description of HYDRA-MATIC 4L60-E operation, and the diagnostic procedures. When diagnosing any condition on the 4L60-E, begin with the "Functional Test Procedure" in this section. After you determine the cause of a condition, refer to On-Vehicle Service for repair procedures.

Minimum Throttle: The least amount of throttle opening required for upshift.

Light Throttle: Approximately $\frac{1}{4}$ of the accelerator pedal.

Medium Throttle: Approximately $\frac{1}{2}$ of the accelerator pedal travel.

Heavy Throttle: Approximately $\frac{3}{4}$ of the accelerator pedal travel.

Wide Open Throttle (WOT): Full travel of the accelerator pedal.

Full Throttle Detent Densified: A quick application of the accelerator pedal to its full travel in order to force a downshift.

Engine Braking: A condition in which you use the engine in order to slow the car by downshifting manually during a zero-throttle coastdown.

Zero throttle Coastdown: A full release of the accelerator pedal while the car is in motion and in drive range.

Shift Conditions

Bump: A sudden and forceful engagement of a clutch or band.

Chuggle: A bucking or jerking that is most noticeable when the converter clutch is engaged. A Chuggle is similar to the feel of towing a trailer.

Delayed: A condition in which a shift is expected but does not occur for a period of time. Delayed is also defined as late or Extended.

Double Bump (Double Feel): Two sudden and forceful engagements of a clutch or a band.

Early: A condition in which the shift occurs before the car has reached the proper speed. The early condition tends to labor the engine after the upshift.

End Bump: A firmer feel at the end of a shift as compared to the feel at the start of the shift. End bump also is defined as "End Feel" or "Slip Bump".

Firm: A noticeably quick engagement of a clutch or band that is considered normal with a medium to heavy throttle. This should not be confused with "Harsh" or "Rough".

Flare: A quick increase in engine rpm along with a momentary loss of torque. This generally occurs during a shift. Flare is also defined as "Slipping".

Harsh (Rough): a more noticeable engagement of a clutch or a band as compared with "Firm". This condition is considered undesirable at any throttle position.

Hunting: A repeating quick series of upshifts and downshifts that causes a noticeable change in engine rpm. An example is a 4-3-4 shift pattern. Hunting also is defined as "Busyness".

Initial Feel: a distinct sturdy feel at the start of a shift as compared to the end of the shift.

Late : A shift occurs when the engine is at a higher than normal rpm for a given amount of throttle.

Shudder: A continuous jerking condition similar to "Chuggle" but more severe rapid. This condition is most noticeable during certain car speed ranges.

Slipping: A noticeable increase in engine rpm without a car speed increase. A slip usually occurs during or after the initial clutch or band engagement.

Soft: A slow, almost unnoticeable clutch or band engagement with very little shift feel.

Surge: A repeating acceleration and deceleration that is engine-related. This condition is less intense than "Chuggle".

Tie Up: A condition in which two opposing clutches and/or bands are attempting to engage at the same time, causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

Planetary Gear Noise: A whine related to the car speed that is most noticeable in the first gear or reverse. Planetary Gear Noise is less noticeable after an upshift.

Pump Noise: A high pitch whine that increases with engine rpm.

Transmission Scan Tool Data Definitions

BARO: Displays a range of 10–104 kPa, 0.00–5.00V. The BARO Sensor measures barometric pressure during the ignition ON cycle and during Wide Open Throttle (WOT). This allows the PCM to make fuel delivery, spark timing, and transmission line pressure adjustments for changing altitudes.

MAP (Manifold Absolute Pressure): Displays a range of 10–104 kPa, 0.00–5.00V. The MAP sensor, which is attached to the intake manifold, measures changes in intake manifold pressure. These changes result from engine speed and load changes. The PCM uses this information to adjust fuel delivery and spark plug timing according to incoming air density.

TP (Throttle Position) Sensor: Displays a range of 0.00–5.00V. The TP sensor is used by the PCM to determine the amount of throttle demanded by the driver. Voltage is below 1 volt at idle and above 4 volts at Wide Open Throttle (WOT).

TP (Throttle Position) Angle: Displays a range of 0–100%. The TP angle is computed by the PCM from the TP sensor voltage. The TP angle should read 0% at idle and 100% at Wide Open Throttle (WOT).

A/C Clutch: Displays ON or OFF. This parameter indicates the commanded state of the A/C control relay. The clutch should be engaged when ON displays.

Cruise Enabled: Displays ON or OFF. This parameter indicates whether the PCM is allowing cruise operation. The PCM has the ability to disable cruise control under certain conditions.

Hot Mode: Displays ON or OFF. This parameter monitors transmission temperature. OFF indicates the transmission temperature has not exceeded 127°C (261°F). ON indicates the transmission temperature has exceeded 135°C (275°F).

Adaptable Shift: Displays Yes or No. This parameter is the monitor of the upshift adapt. YES indicates that the adapt capability is functional and displays during shift calculation until the commanded gear changes. NO indicates that the adapt is not functional.

Current TAP (Transmission Adaptive Pressure)

Memory: Displays a range of -16 to +16 psi. This parameter is the amount of pressure that is added to base line pressure to adjust the holding effort of a clutch or a band, while shifting.

Current TAP (Transmission Adaptive Pressure):

Displays a TP cell range of 0–16. This parameter indicates the current throttle position cell used for line pressure modification (adaptation).

Long Shift Delay: Displays Yes or No. This parameter indicates whether a long shift delay occurred during the last shift. YES indicates that a long shift delay occurred. NO indicates that a long shift delay did not occur. A shift delay is determined from the time that the PCM commands the shift until the start of the engine RPM drop. When a shift delay is within a range that enables shift adapts, NO is indicated.

Long Shift Time: Displays Yes or No. This parameter indicates whether a long shift time occurred during the last shift. YES indicates that a long shift time occurred. NO indicates that a long shift time did not occur. Shift time is calculated from the beginning of the engine RPM drop to the beginning of the engine RPM increase. When shift time is within a range that enables shift adapts, NO is indicated.

TP Range: Displays Normal or Exceeded. This parameter indicates when the throttle position is within a range that enables shift adapts. Normal indicates that the TP is within the range. Exceeded indicates that the TP is not within the range.

Standard TAP (Transmission Adaptive Pressure):

Displays Yes or No. The standard TAP is an amount of pressure that is added to the base line pressure. If the shift requires standard TAP to achieve the shift, then the scan tool displays Yes. If the shift requires more or less than the standard TAP to achieve the shift, then the scan tool displays No, indicating that the TAP is out of the standard range.

VSS Delta: Displays Normal or Exceeded. This parameter indicates when the VSS is within a range that enables shift adapts. Normal indicates that the VSS is within the range. Exceeded indicates that the VSS is not within the range.

TP Delta: Displays Normal or Exceeded. This parameter indicates when the TPS is within a TPS delta range that enables shift adapts. A TPS delta range is how much the TPS is moved during the shift calculation. Normal indicates that the TPS is within the range. Exceeded indicates that the TPS is not within the range.

Engine Run Time: Displays a range of 0:00:00–18:12:15 hr/min/sec. This parameter measures how long the engine has been operating. When the ignition switch is turned OFF, the value is reset to zero.

Ignition 1: Displays a range of 0.0–25.5V. This represents the system voltage measured by the PCM at its ignition feed.

Gear Ratio: Displays a range of 0.00–3.98–1. This parameter is the actual gear ratio of the current commanded gear.

Current Gear: Displays 1, 2, 3, or 4. This parameter indicates the current commanded state of the shift solenoids.

TFT (Automatic Transmission Fluid Temperature):

Displays a range of -40°C to 151°C (-40°F to 304°F). This parameter is the input signal of the transmission fluid temperature sensor. Transmission fluid temperature is high (151°C) when signal voltage is low (0V), and transmission fluid temperature is low (-40°C) when signal voltage is high (5V).

ECT (Engine Coolant Temperature): Displays a range of -40°C to 151°C (-40°F to 304°F). This parameter is the input signal of the engine coolant temperature sensor. The engine coolant temperature is high (151°C) when the signal voltage is low (0V), and the engine coolant temperature is low (-40°C) when the signal voltage is high (5V).

TFT (Transmission Fluid Temperature) Sensor:

Displays a range of 0.00–5.00V. When the transmission fluid is cold, the sensor resistance is high and the PCM will sense high signal voltage. As the transmission fluid temperature warms to normal operating temperature, the sensor resistance becomes less and the voltage decreases to about 1.5–2.0V.

TCC (Torques Converter Clutch) Slip Speed:

Displays a range of -4080 to 4079 RPM. This parameter is the difference between transmission output speed and engine speed. A negative value indicates that the engine speed is less than the output speed (deceleration). A positive value indicates that the engine speed is greater than the output speed (Acceleration). A value of zero indicates that the engine speed is equal to the output speed (TCC applied).

TCC Brake Switch: Displays Open or Closed. This parameter indicates the state of the TCC brake switch circuit input. Open indicates a zero voltage input (brake switch open, brake pedal applied). Closed indicates a B+ voltage input (brake switch closed, brake pedal released).

TCC Duty Cycle: Displays a range of 0–100%. This parameter is the commanded percentage of ON time of the TCC PWM solenoid. 90% represents an ON (energized) commanded state. 0% represents an OFF (non-energized) commanded state. This commanded state is applied at a vehicle speed greater than approximately 16 km/h (10 mph).

TCC Enable: Displays ON or OFF. This parameter is the commanded state of the TCC solenoid. ON indicates a commanded energized state (current is flowing through the solenoid). OFF indicates a commanded non-energized state (current is not flowing through the solenoid). This commanded state occurs at various vehicle speeds between applications.

TCC Duty Open: Displays Yes or No. This parameter indicates whether an open or a short to ground exists in the TCC PWM solenoid feedback signal to the PCM.

TCC Duty Shorted: Displays Yes or No. This parameter indicates whether a short to B+ exists in the TCC PWM solenoid feedback signal to the PCM.

TCC Enable Open: Displays Yes or No. This parameter indicates whether an open or a short to ground exists in the TCC solenoid feedback signal to the PCM.

TCC Enable Short: Displays Yes or No. This parameter indicates whether a short to B+ exists in the TCC solenoid feedback signal to the PCM.

1–2 Sol / 2–3 Sol: Displays ON or OFF. These parameters are the commanded status of the 1–2 and the 2–3 shift solenoid valves. ON represents a commanded energized state (current is flowing through the solenoid). OFF represents a non-commanded state (current is not flowing through the solenoid).

1–2 Sol. Open: Displays Yes or No. this parameter indicates if an open or short to ground exists in the 1–2 shift solenoid valve feedback signal to the PCM.

1–2 Sol. Short: Displays Yes or No. this parameter indicates if a short to B+ exists in the 1–2 shift solenoid valve feedback signal to the PCM.

2–3 Sol. Open: Displays Yes or No. this parameter indicates if an open or short to ground exists in the 2–3 shift solenoid valve feedback signal to the PCM.

2–3 Sol. Short: Displays Yes or No. this parameter indicates if a short to B+ exists in the 2–3 shift solenoid valve feedback signal to the PCM.

3–2 Downshift: Displays Yes or No. This parameter indicates if the 3–2 downshift control solenoid is currently commanded On or Off. Yes indicates that the 3–2 shift solenoid is ON. No indicates that the 3–2 shift solenoid is OFF. The solenoid commanded state is based on the transmission temperature. The solenoid will change states during a 3–2 downshift to regulate the appropriate pressure. The commanded state of the solenoid occurs at approximately 30 mph with a throttle increase.

3–2 DS (Downshift) Open: Displays Yes or No. This parameter indicates if an open or short to ground exists in the 3–2 shift solenoid feedback signal to the PCM.

3–2 DS (Downshift) Shorted: Displays Yes or No. This parameter indicates if a short to B+ exists in the 3–2 shift solenoid feedback signal to the PCM.

1–2 Shift Time: Displays a range of 0.00–6.38 seconds. This parameter is the actual time of the last 1–2 shift. The shift time is based on the engine RPM drop after the commanded 1–2 shift. This value is only accurate if the Adaptable Shift parameter indicates Yes.

2–3 Shift Time: Displays a range of 0.00–6.38 seconds. This parameter is the actual time of the last 2–3 shift. The shift time is based on the engine RPM drop after the commanded 2–3 shift. This value is only accurate if the Adaptable Shift parameter indicates Yes.

1–2 Shift Error: Displays a range of -6.38 to +6.38 seconds. This parameter is the difference between the desired 1–2 shift time and the actual 1–2 shift time. This value is only accurate if the Adaptable Shift parameter indicates Yes.

2–3 Shift Error: Displays a range of -6.38 to +6.38 seconds. This parameter is the difference between the desired 2–3 shift time and the actual 1–2 shift time. This value is only accurate if the Adaptable Shift parameter indicates Yes.

3–4 Shift Time: Displays a range of 0.00–6.38 seconds. This parameter is the actual time of the last 3–4 shift. The shift time is based on the engine RPM drop after the commanded 3–4 shift. This value is only accurate if the Adaptable Shift parameter indicates Yes.

Latest Shift: Displays a range of 0.00–6.38 seconds. This parameter is the actual shift time of the last upshift. This value is only accurate if the Adaptable Shift parameter indicates Yes.

Latest Shift Error: Displays a range of -6.38 to +6.38 seconds. This parameter is the difference between the latest desired shift time and the latest actual shift time. This value is only accurate if the Adaptable Shift parameter indicates Yes.

Speed Ratio: Displays a range of 0.00–7.99. This parameter indicates engine speed divided by transmission output speed. This value is used to estimate transmission gear ratio.

Upshift Request: Displays Yes or No. This parameter indicates when the PCM is requesting an upshift. Yes indicates an upshift is requested. No indicates an upshift is not requested.

Upshift In Progress: Displays Yes or No. This parameter indicates if the transmission is currently in an upshift. Yes indicates an upshift is in progress. No indicates an upshift is not in progress.

Upshift Desired: Displays Yes or No. This parameter indicates when the PCM is requesting an upshift. Yes indicates an upshift is requested. No indicates an upshift is not requested.

DS Requested: Displays Yes or No. This parameter indicates when the PCM is requesting a downshift. Yes indicates a downshift is requested. No indicates a downshift is not requested.

DS In Progress: Displays Yes or No. This parameter indicates if the transmission is currently in a downshift. Yes indicates a downshift is in progress. No indicates a downshift is not in progress.

DS Desired: Displays Yes or No. This parameter indicates when the PCM is requesting a downshift. Yes indicates a downshift is requested. No indicates a downshift is not requested.

3-2 Started: Displays Yes or No. This parameter indicates when the transmission has started a 3-2 downshift. Yes indicates a 3-2 downshift has started. No indicates a 3-2 downshift has not started.

3-2 In Progress: Displays Yes or No. This parameter indicates whether the transmission is currently in a 3-2 downshift. Yes indicates a 3-2 downshift is in progress. No indicates a 3-2 downshift is not in progress.

Vehicle Speed: Displays a range of 0-255 km/h (0-158 mph). This parameter is the input signal from the vehicle speed sensor.

Engine Speed: Displays a range of 0-8192 RPM. This parameter indicates the rotational speed of the engine expressed as revolutions per minute.

PC Act. Current: Displays a range of 0.00-1.10 amps. This parameter is the actual current of the pressure control solenoid circuit at the control module. Zero amp (no current flow) indicates actual higher line pressure. Actual lower line pressure is indicated by 1.1 amps (high current flow).

PC Ref. (Reference) Current: Displays a range of 0.00-1.10 amps. This parameter is the commanded current of the pressure control solenoid circuit. Zero amp (no current flow) indicates commanded higher line pressure. Commanded lower line pressure is indicated by 1.1 amps (high current flow).

PC Duty Cycle: Displays a range of 0-100%. This parameter is the commanded state of the pressure control solenoid expressed as a percent of energized ON time. 0% indicates zero ON time (non-energized) or no current flow. Approximately 60% at idle indicates maximum ON time (energized) or high current flow.

Power Enrichment: Displays Yes or No. This parameter indicates when the power enrichment mode is active (moderate to heavy acceleration). Yes indicates that the power enrichment mode is active. No indicates that the power enrichment mode is not active.

Kickdown Enabled: Displays Yes or No. This parameter indicates whether enabling conditions exist for an acceleration mode downshift. No indicates that enabling conditions such as throttle position, vehicle speed, or input speed do not exist for an acceleration mode downshift. Yes indicates that enabling conditions exist for an acceleration mode downshift.

DTC Set This Ign: Displays Yes or No. This parameter displays Yes if a DTC is active during the current ignition cycle.

TR Switch: Displays a range of Invalid, Reverse, Overdrive, Drive3, Drive2, Low, or Park/Neutral. These parameters are the decoded status of the three A/B/C range inputs from the Automatic Transmission Fluid Pressure Manual Valve Position Switch Assembly. These parameters represent the position of the transmission manual valve.

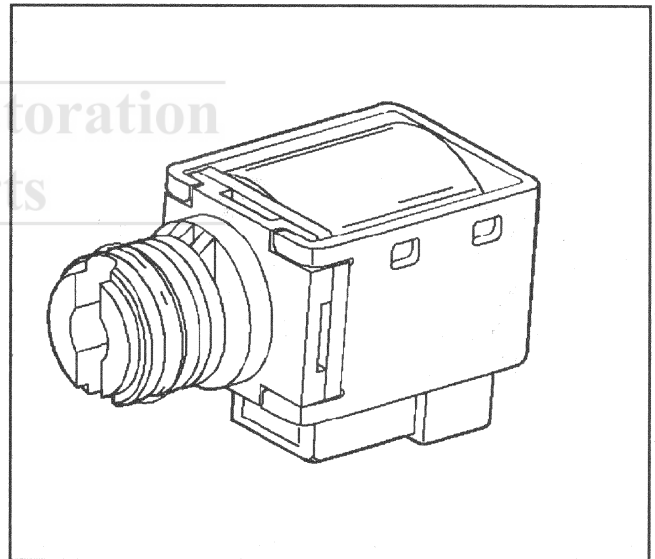
Traction Control: Displays Active or Inactive. This parameter indicates the status of the TCS/ASR.

Trans OSS (Output Shaft Speed) sensor: Displays a range of 0-8192 RPM. This parameter indicates the rotational speed of the transmission output shaft expressed as revolutions per minute.

TFP Switch: Displays On/Off, On/Off, On/Off. These parameters are the three inputs from the Automatic Transmission Fluid Pressure Manual Valve Position Switch Assembly. On represents a 0 voltage signal. Off represents a B+ voltage signal.

Electronic Component Description

1-2 and 2-3 Shift Solenoid Valves



8885

Important: The shift solenoid valve resistance should measure 20-40 ohms minimum when measured at 20°C (68°F). The shift solenoid current flow should not exceed 0.75 amps. The shift solenoid should energize at a voltage of 7.5 volts or more (measured across the terminals). The shift solenoid should de-energize when the voltage is one volt or less. If both solenoids lose power, only the third gear only results.

The 1-2 and 2-3 shift solenoid valves (also called A and B solenoids) are identical devices that control the movement of the 1-2 and 2-3 shift valves (the 3-4 shift valve is not directly controlled by a shift solenoid). The solenoids normally are open exhaust valves that work in four combinations to shift the transmission into different gears.

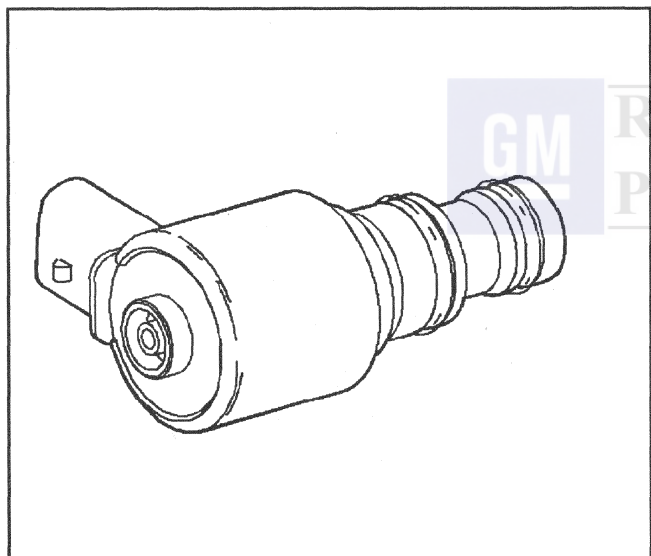
The PCM energizes each solenoid by grounding the solenoid through an internal quad driver. This sends current through the coil winding in the solenoid and moves the internal plunger out of the exhaust position. When ON, the solenoid redirects fluid to move a shift valve.

The PCM-controlled shift solenoids eliminate the need for TV and governor pressures to control shift valve operation.

The pressure control solenoid takes the place of the throttle valve that was used on the past model transmissions.

Important: The manual valve hydraulically can override the shift solenoids. Only in D4 are the shift solenoid states totally determining what gear the transmission is in. In the other manual valve positions, the transmission shifts hydraulically and the shift solenoid states "catch up" when the throttle position and the vehicle speed fall into the correct ranges. Diagnostic trouble codes 081 and 082 indicate shift solenoid circuit voltage faults.

3-2 Shift Solenoid Valve Assembly



8890

Important: The 3-2 shift solenoid valve assembly resistance should be a minimum of 9–14 ohms at 20°C (68°F), if it is operated using the pulse width modulation at a frequency of 50 Hz.

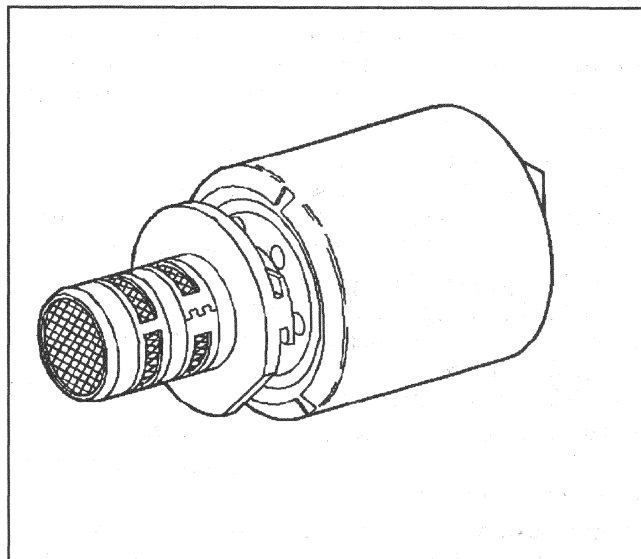
The 3-2 shift solenoid valve assembly is a pulse-width modulated solenoid that is used in order to improve the 3-2 downshift. The solenoid regulates the release of the 3-4 clutch and the 2-4 band apply.

The solenoid uses duty cycle in order to regulate the pressures that smoothly release the clutch and apply the band. The duty cycle normally is about 0% in the first gear, 90% in all other drive gears and drops

during the 3-2 downshift. Throttle position, vehicle speed and the commanded gear are used to determine the duty cycle.

If a voltage fault is detected in the 3-2 shift solenoid circuit, diagnostic trouble code 066 will set.

Transmission Pressure Control Solenoid



8884

Important: Transmission pressure control solenoid resistance should measure 3.5–8Ω when measured at 20°C (68°F).

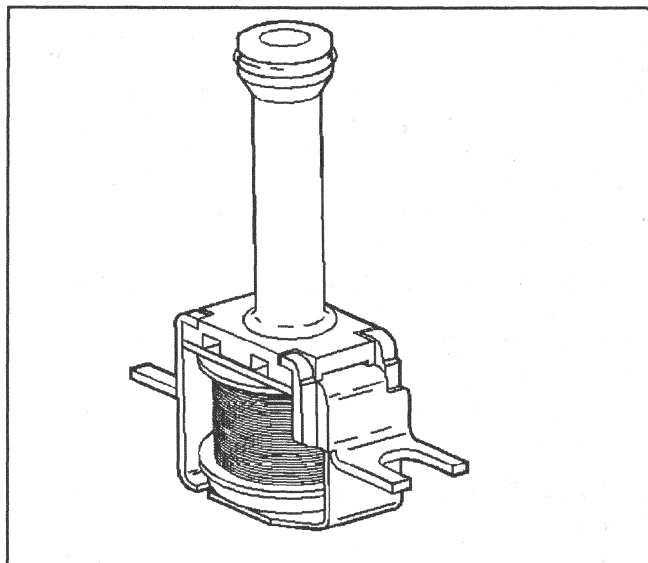
The transmission pressure control solenoid (or force motor) is an electronic pressure regulator that controls pressure based on the current flow through its coil winding. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve.

The PCM controls the pressure control solenoid by commanding current between 0 and 1.1 amps. This changes the duty cycle of the solenoid, which can range between 0% and 60%. 1.1 amps correspond to the minimum line pressure, and 0 amps is the maximum line pressure (if the solenoid loses power, the transmission still has the maximum line pressure).

The PCM calculates the line pressure values, using inputs such as the throttle position sensor.

The pressure control solenoid takes the place of the throttle valve that was used on the past model transmissions.

If there is a difference between the amperage commanded by the PCM and the actual amperage, the diagnostic trouble code 073 will set. Unlike the pressure control solenoid on the HYDRA-MATIC 4L80-E, the 4L60-E pressure control solenoid does not pulse every 10 seconds for a cleaning cycle.

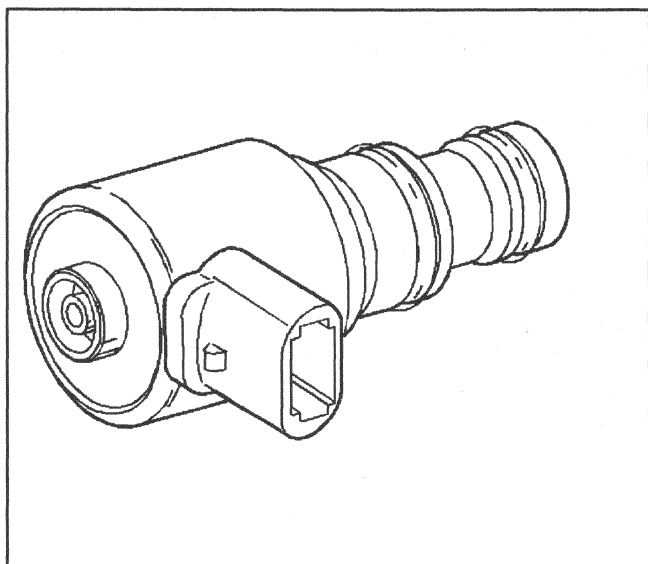
Torque Converter Clutch Solenoid Valve

8882

The torque converter clutch solenoid valve is a normally open exhaust valve that is used to control torque converter clutch apply and release. When grounded (energized) by the PCM, the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and to shift the TCC solenoid valve to shift into the apply position.

The brake switch is an input to the PCM, and the PCM directly controls the TCC apply based on the brake switch status.

Important: The TCC solenoid resistance should be 20–40 ohms minimum when measured at 20°C (68°F).

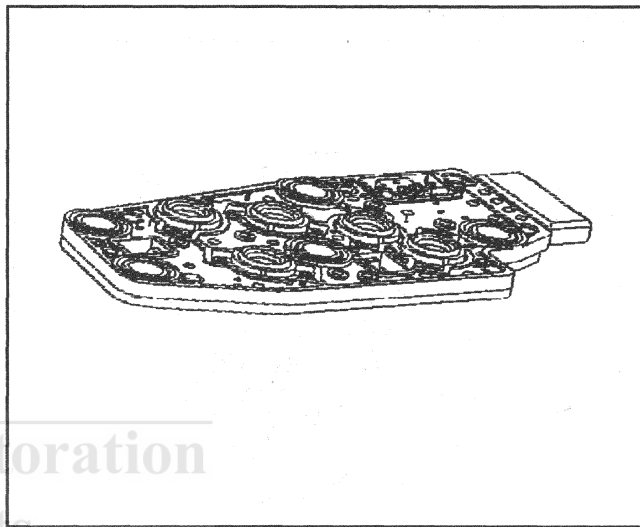
Torque Converter Clutch PWM Solenoid Valve

10336

Important: TCC PWM solenoid valve resistance should be 10–11 ohms when measured at 20°C (68°F), and 3–15 ohms when measured at 100°C (212°F).

The torque converter clutch PWM solenoid valve controls the fluid acting on the converter clutch valve, which then controls the TCC apply and release. This solenoid is attached to the control valve body assembly within the transmission. The TCC PWM solenoid valve provides smooth engagement of the torque converter clutch by operating on a negative duty cycle a variable percent of ON time.

If a fault is detected in the TCC PWM circuit, code 083 will set.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

8889

Important: Seven valid components and two invalid combinations are available from the TFP: Valid combinations for Circuit A, B and C are shown below. Invalid combinations are the following:

- A=0V, B=0v AND C=0V
- A=0V, B=12v AND C=0V

The transmission fluid pressure (TFP) Manual Valve Position switch is a set of five pressure switches on the valve body that sense whether fluid pressure is present in five different valve body passages. The combination of which switches are open and closed is used by the PCM in order to determine actual manual valve position. The TFP assembly, however, cannot distinguish between PARK and NEUTRAL because the monitored valve body pressures are identical in both cases.

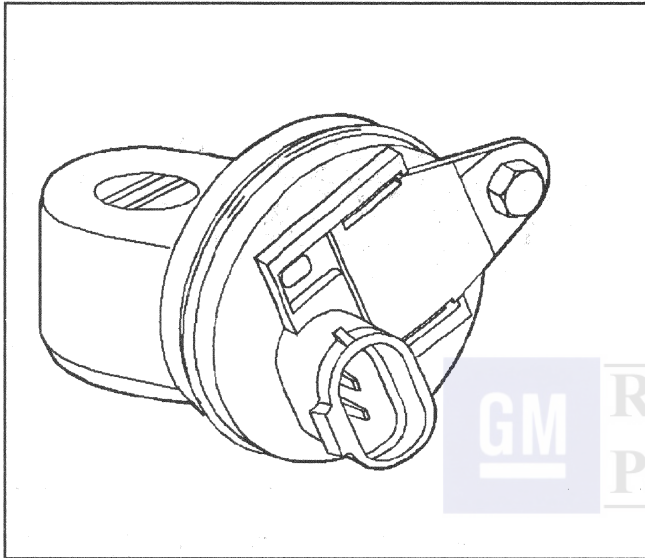
The switches are wired to provide three signal lines that are monitored by the PCM. These inputs are used to help control the line pressure, the torque converter clutch apply and the shift solenoid operation. Voltage at each of the signal lines is either zero or twelve volts.

In order to monitor the TFP assembly operation, the PCM compares the actual voltage combination of the switches to a TFP combination chart stored in its memory. If the PCM sees one of two 'illegal' voltage combinations a code 028 will result. A Code 28 indicates a short circuit condition in either the range signal A or the range signal C circuits.

The TFP assembly signal voltage can be measured from each pin-to-ground and compared to the combination chart. On the transmission wiring harness, pin N is range signal A, pin R is range signal B and pin P is range signal C. With the wiring harness connected and the engine running, a voltage measurement of these three lines will indicate a high reading (near 12 volts) when a circuit is open, and a low (zero volts) when the circuit is switched to ground.

The transmission temperature sensor is part of the transmission fluid pressure switch assembly.

Vehicle Speed Sensor



8886

Important: The sensor resistance should be 1260–1540 ohms when measured at 20 °C (68 °F). Output voltage varies with speed from a minimum of 0.5 volts AC at 100 RPM to more than 100 Volts AC at 8000 RPM.

The vehicle speed sensor (or transmission output speed sensor) controls shift points and calculates the TCC slip.

The speed sensor contains a coil that gives off a continuous magnetic field. A rotor rotates past the sensor and the rotor teeth break the magnetic field. Each break in the field sends a pulse to the VSSB (Vehicle Speed Sensor Buffer). The VSSB sends two signals to the PCM. The first is a 2002 pulse per mile (PPM) signal that is used by the engine. The second is the transmission/transfer case 40 pulse per revolution (PPR) signal that is used in order to control the transmission.

In two wheel drive (2WD) applications, the vehicle speed sensor is located on the transmission extension housing. Trans Output Speed = Transfer Case Speed.

Codes 024 or 072 will set if a fault exists in the vehicle speed sensor circuit 40 PPR line.

Automatic Transmission Fluid Temperature Sensor

The Automatic Transmission Fluid Temperature (TFT) Sensor is part of the Automatic Transmission Fluid Pressure Manual Valve Position (TPF Val. Position) switch assembly. This sensor helps control torque converter clutch apply and shift quality.

The temperature sensor is a resistor, or thermistor, which changes value based on temperature. At low temperatures the resistance is high, and at high temperatures the resistance is low.

The PCM sends a 5-volt signal to the temperature sensor and the PCM measures the voltage drop in the circuit. You will measure a high voltage when the transmission is cold and a low voltage when the transmission is hot..

If the temperature sensor circuit has a fault, code P0712 or P0713 is set. A code P0712 indicates a short circuit condition, while a code P0713 indicates an open circuit condition. Code P1812 is set if the transmission is operating at a high temperature for a period of time.

Transmission Sensor

°C	R Low (Ohms)	R High (Ohms)
Temperature to Resistance to Voltage (Approximate)		
-40	73556.4	127857.6
-35	54156.0	90760.0
-30	40171.0	65197.0
-25	30074.1	47301.9
-20	22677.4	34676.6
-15	17244.9	25651.1
-10	13199.0	19153.0
-5	10184.3	14413.7
0	7902.2	10943.8
5	6192.6	8379.4
10	4875.8	6466.2
15	3869.6	5028.4
20	3088.6	3941.4
25	2481.3	3108.7
30	1992.6	2481.4
35	1610.1	1991.9
40	1308.4	1609.6
45	1068.6	1307.4
50	875.7	1070.0
55	723.6	884.0
60	600.3	734.0
65	501.3	613.0
70	420.3	514.0
75	353.7	432.0
80	298.8	365.0
85	253.8	310.0
90	216.9	266.0
95	185.4	229.0
100	159.3	198.0
105	136.8	172.0
110	118.8	150.0
115	103.5	132.0
120	89.9	116.0
125	78.7	102.0
130	69.1	90.1
135	60.9	79.8
140	53.8	70.9
145	47.8	63.2
150	42.5	56.6

Torque Converter Clutch Electrical Controls

The Torque Converter Clutch (TCC) system uses controls that are internal as well as external to the transmission. For the internal control components of the TCC system, refer to *Torque Converter Clutch Diagnosis*.

The TCC system includes the following external control components:

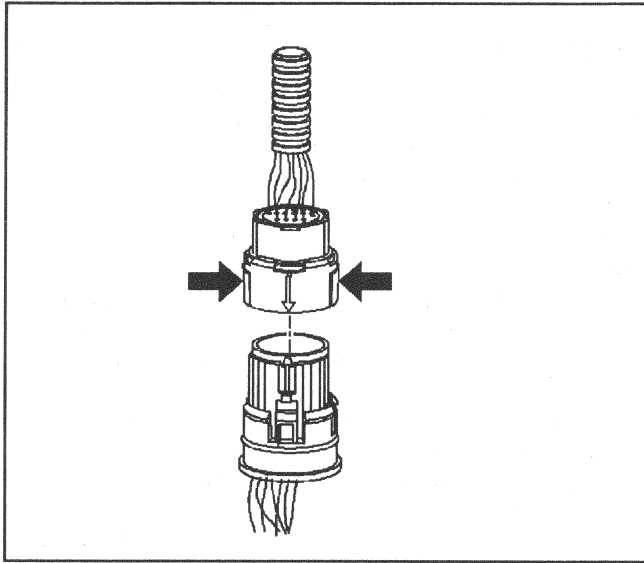
- Cruise Control Release Switch — In order to avoid stalling the engine when braking, the converter clutch releases anytime the brake pedal is applied.
- Powertrain Control Module (PCM) — The PCM receives input signals and grounds TCC solenoid to apply clutch when the proper operating conditions are met.
- Throttle Position (TP) Sensor — The TP Sensor sends throttle position information to the Powertrain Control Module (PCM).
- Vehicle Speed Sensor (VSS) — The VSS sends vehicle speed information to the Powertrain Control Module (PCM).
- Manifold Absolute Pressure (MAP) Sensor — The MAP Sensor sends engine vacuum (load) information to the Powertrain Control Module (PCM).
- Engine Coolant Temperature (ECT) Sensor — The ECT Sensor sends engine coolant temperature information to the Powertrain Control Module (PCM).

Electrical Connector

The transmission electrical connector is an important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set Diagnostic Trouble Codes (DTCs) or affect proper operation.

The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection
- Wires backing away from the pins or coming uncrimped (in either the internal or the external wiring harness)
- Dirt contamination entering the connector when disconnected
- Pins in the internal wiring connector backing out of the connector or pushed out of the connector during reconnection
- Excessive transmission fluid leaking into the connector, wicking up into the external wiring harness and degrading the wire insulation
- Moisture intrusion in the connector
- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly
- Pin corrosion from contamination
- Damaged connector assembly



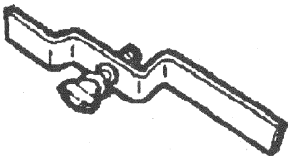
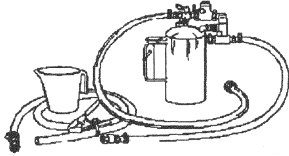
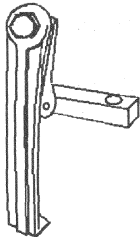
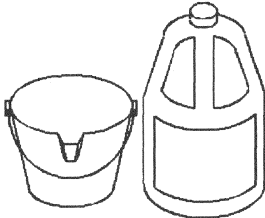
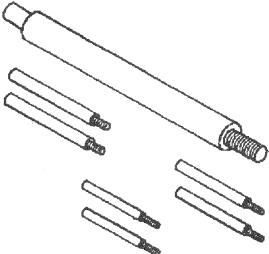
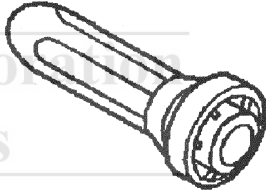
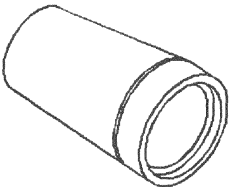
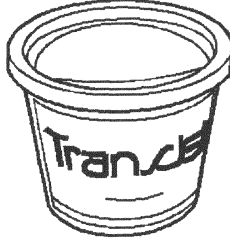
13265

Remember the following points:

- In order to remove the connector, squeeze the two tabs toward each other and pull straight up.
- Limit twisting or wiggling the connector during removal. Bent pins can occur.
- Do not pry the connector off with a screwdriver or other tool.
- In order to reinstall the external wiring connector, first orient the pins by lining up the arrows on each half of the connector. Push the connector straight down into the transmission without twisting or angling the mating parts.
- The connector should click into place with a positive feel and/or noise.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating, DTCs will set. Clear these DTCs after reconnecting the external connector.



Special Tools and Equipment

	J 21366 Converter Holding Strap		J 35944-A Oil Cooler and Line Flusher
	J 29714-A Servo Cover Depressor		J 35944-20 Cooler Flushing Fluid
	J 25025-B Pump and Valve Body Alignment Pin Set		J 21426 Output Shaft Sleeve and Case Extension Oil Seal Installer
	J 28458 Power Piston Seal Protector and Diaphragm Retainer Installer		J 36850 Transmission Lubricant (Transjel™)



1996 Chevrolet Caprice, Impala SS/Buick Roadmaster/ Chevrolet Wagon and Buick Wagon Service Manual

Book 2

Foreword

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 1996 Chevrolet Caprice, Impala SS/Buick Roadmaster/Chevrolet Wagon and Buick Wagon.

BOOK 1 contains all sections EXCEPT Engine Controls (Section 6E), Automatic Transaxle Diagnosis (Section 7A) and Electrical Diagnosis (Section 8A).

BOOK 2 contains Engine Controls (Section 6E), Automatic Transaxle Diagnosis (Section 7A) and Electrical Diagnosis (Section 8A).

This service manual replaces the 1996 Caprice, Impala SS/Buick Roadmaster Preliminary Service Manual (GMP/96-B-2P).

Information on unit repair (overhaul) can be found in the 1996 Transmission/Transaxle/Transfer Case Unit Repair Manual (TURM), GMPT/96-TURM, available separately. The TURM manual contains information on automatic and manual transmissions and transaxles, and transfer cases for all GM passenger cars and light duty trucks, including the fluid flow and circuit description information.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better serve the vehicle owners.

When this manual refers to a brand name, a number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication approval. General Motors reserves the right to make changes at any time without notice.

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ELECTRICAL DIAGNOSIS
1996 CHEVROLET/BUICK

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DIAGNOSTIC INFORMATION

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- Electrical Schematics
- Component Location Lists
- Harness Connector Faces
- Troubleshooting Hints
- System Checks
- System Diagnosis
- Circuit Operation Descriptions
- Harness Routing Views

Using these elements together will make electrical troubleshooting faster and easier. Each element is described below.

The **Circuit Schematic** shows the electrical current paths when a circuit is operating properly. It is essential to understand how a circuit should work before trying to diagnose a failure.

The **Component Location List** helps to find where the components of a system can be located. A brief statement of the location is given and also a reference to a drawing that shows the component and its connecting wires. These **Component Location Views** are in SECTION 8A-201.

The **Harness Connector Faces** show the cavity or terminal locations in all the 4 pin or larger connectors shown in the schematic. Together with the wire colors and terminals given in the schematic, they help locate test points. The drawings show the connector faces as seen after the harness connector has been disconnected from a component or mating connector.

The **Troubleshooting Hints** offer short-cuts or checks to help determine the cause of a complaint. They

are not intended to be a rigid procedure for solving an electrical situation. Rather, Troubleshooting Hints represent a common-sense approach, based on an understanding of the circuit.

The **System Check** gives a summary of how the system should be operated and what should happen. This is especially important when working on a new system. The System Check will help identify symptoms, lead to diagnosis and confirm normal operation of the system after repair.

The **System Diagnosis** provides a procedure to follow that will locate the condition in a circuit causing a malfunction. If your own knowledge of the system and the Troubleshooting Hints have not produced a quick fix, follow the System Diagnosis. All procedures are based on symptoms to assist in locating the condition as fast as possible.

The **Circuit Operation** describes the components and how the circuit works.

Harness Routing Views are found in SECTION 8A-203. These views show the routing of the major wiring harnesses and the in-line connectors between the major harnesses.

SECTION/PAGE NUMBER

Sections are organized by subsystems with most containing a circuit schematic and the associated text. This makes the section easy to use, since the page number will stay the same year after year. For example, the Cruise Control schematic will always begin on page 8A-34-0. The other information for Cruise Control follows and is pagged 8A-34-1, 8A-34-2, etc.

Some sections may have more than one circuit schematic, such as Power Distribution, Interior Lights and Air Conditioning. The circuit of interest can either be

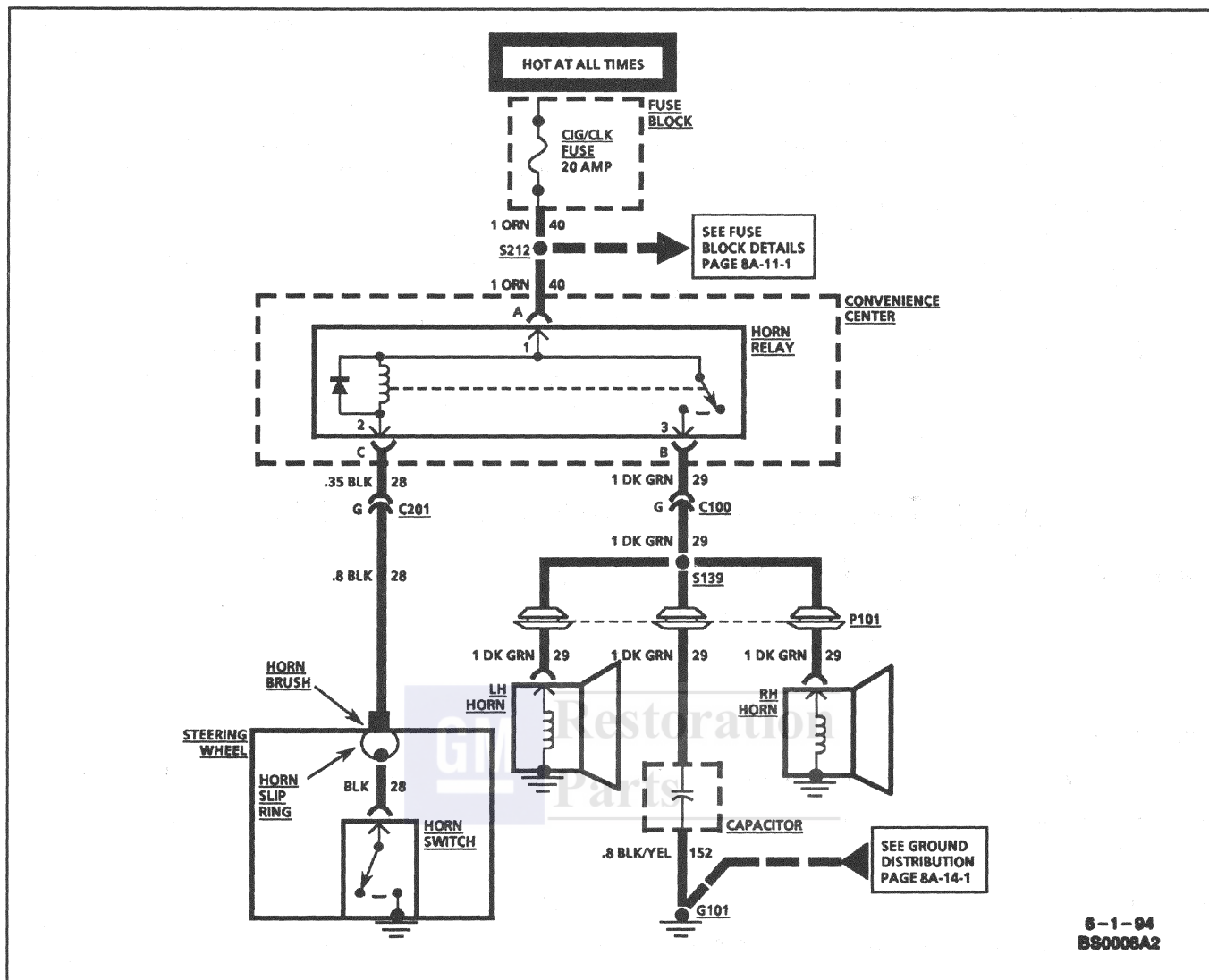


Figure 1—Typical Horn Schematic

located by using the Index or by a quick look through the related section.

All the engine circuits for a particular engine VIN type are in the same section. This makes that section easy to use, since schematics for other engines are not in your way. The Instrument Panel schematics are organized similarly. If you are working on a vehicle with a Digital Cluster, only the schematics that apply to that vehicle's Digital Cluster will be in the section you use. Information on the Indicators and Gages Clusters will be in other sections.

SCHEMATICS

Schematics break the entire electrical system down into individual circuits. Wiring which is not part of the circuit of interest is referenced to another page, where the circuit is shown complete.

! Important:

- It is important to realize that no attempt is made on the schematic to represent components and wiring as they physically appear on the vehicle. For example, a 4-foot length of wire is treated no differently in a schematic from one which is only a few inches long. The number of cavities for each connector is listed in the Component Location List. Similarly, switches and other components are shown as simply as possible, with regard to function only.

When diagnosing a Horn problem, the technician would reference the Horn section. The schematic in Figure 1 is a typical example of what would be found in a Horn section of SECTION 8A, along with the following text.

Voltage is applied to the Horn Relay at all times. When the relay coil is grounded by closing the Horn Switch, the relay contacts close. When the relay contacts are closed, both the LH and RH Horns are energized.

INTRODUCTION

COMPONENT LOCATIONS

To locate the schematic components on the vehicle, use the Component Location List. Refer to "Typical Entries in the Component Location List."

Listed in the left hand column are the components, connectors, grounds and splices shown on the schematic. To the right of the component is the location, "Under RH side of I/P." Reference to LH and RH is made as though the technician was sitting in the driver's seat. On the same line, in the next two columns, are page and figure references for SECTION 8A-201, "Component Location Views." In this case, you are directed to Figure 4 on page 8A-201-1.

Where connectors are listed, the number of cavities is provided. This represents the total number of cavities in the connector, regardless of how many are actually used. This information is provided to help identify connectors on the vehicle. In the far right column is a page reference where a view of the connector face may be found. Connectors with 3 cavities or less are not included in SECTION 8A-202, "Harness Connector Faces."

Grounds are listed next in the table. The location description for G101 reads, "Behind LH Composite Headlamp." You are directed to page 8A-201-8, Figure 14.

Nearly every component, connector, ground or splice shown on a schematic can be pinpointed visually by using the Component Location View figures.

Typical Entries in the Component Location List

COMPONENT	LOCATION	201-PG	FIG.	CONN
Convenience Center	Under RH side of I/P	1	4	
Fuse Block.....	Behind I/P Compartment Door	0	2	
CONNECTORS				
C100 (34 cavities).....	Mounted to LH Hood Hinge.....	7	11	Fig. 27
C210 (15 cavities).....	Above Convenience Center, behind I/P Compartment.....	18	23	Fig. 32
GROUND				
G101.....	Behind LH Composite Headlamp	8	14	
SPLICES				
S139	Forward Lamp Wiring Harn, behind RH Composite Headlamp.....	8	15	
S212	I/P Wiring Harn, behind I/P, above Steering Column.....	6	8	

Figure 2—Typical Entries in the Component Location List

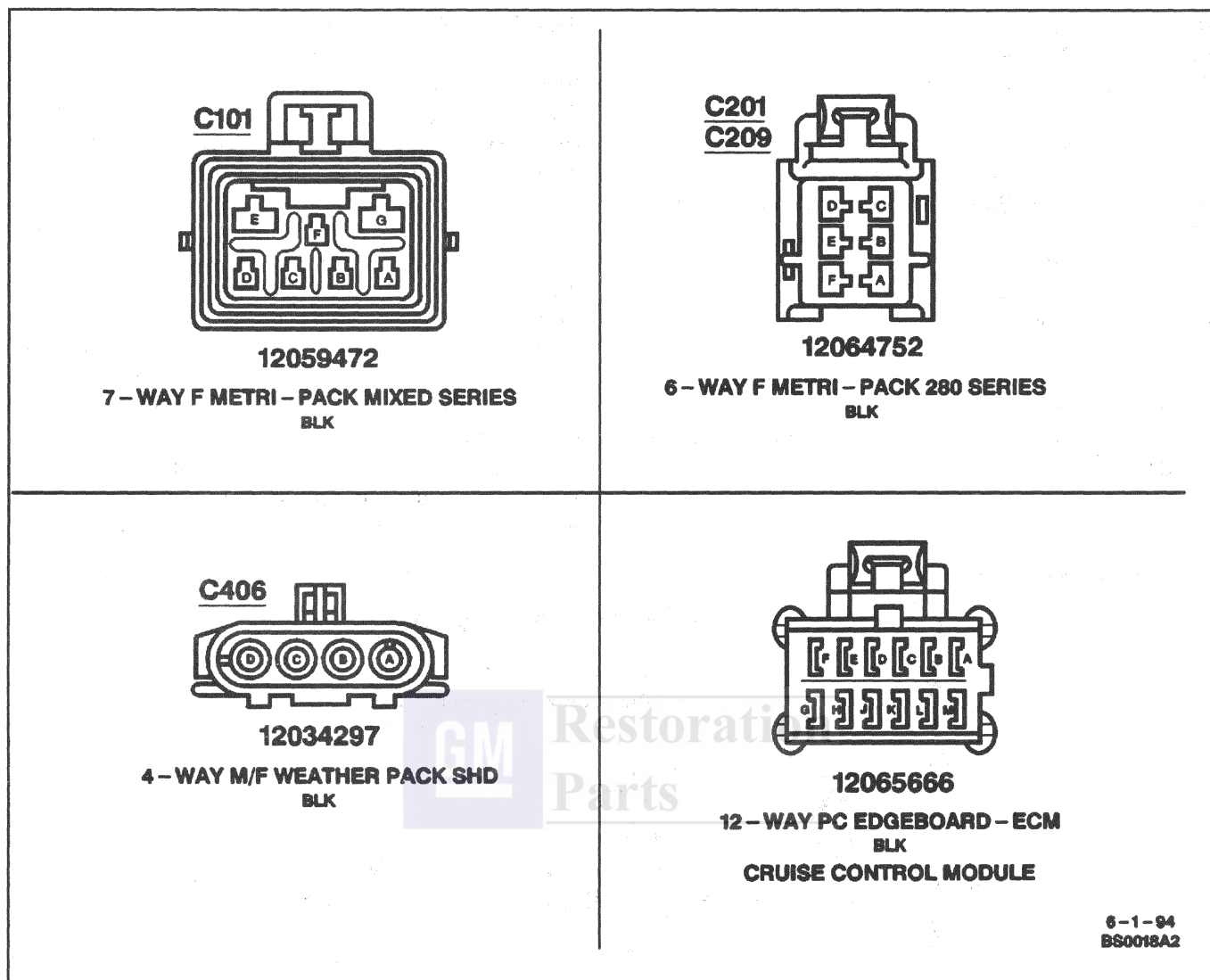


Figure 3—Typical Harness Connector Faces

HARNESS CONNECTOR FACES

The connectors (see Figure 3) are labeled with the component they are connected to, or the connector number. In addition the color of the connector is given along with the family/series name.

If you need to backprobe a connector while it is on the component (refer to page 8A-4-3 for probing procedures), the order of the terminals must be mentally reversed. The wire color is a help in this situation. If there is more than one wire of the same color, you may need to locate a test point from its terminal number. A useful trick is to imagine that you are probing a terminal from behind the page you are looking at. Then mentally locate that terminal with respect to the keyway or other reference mark.

OTHER INFORMATION

VIN REFERENCES

If schematics for more than one variation of an engine type—V6, for example—are shown, then the schematics will be labeled with VIN designation to distinguish the variations.

SERVICE PARTS IDENTIFICATION LABEL

To aid service and parts personnel in identifying options and parts originally installed, a Service Parts Identification Label has been placed in the vehicle. See SECTION 0A for the location of the label and the definition of the option codes.

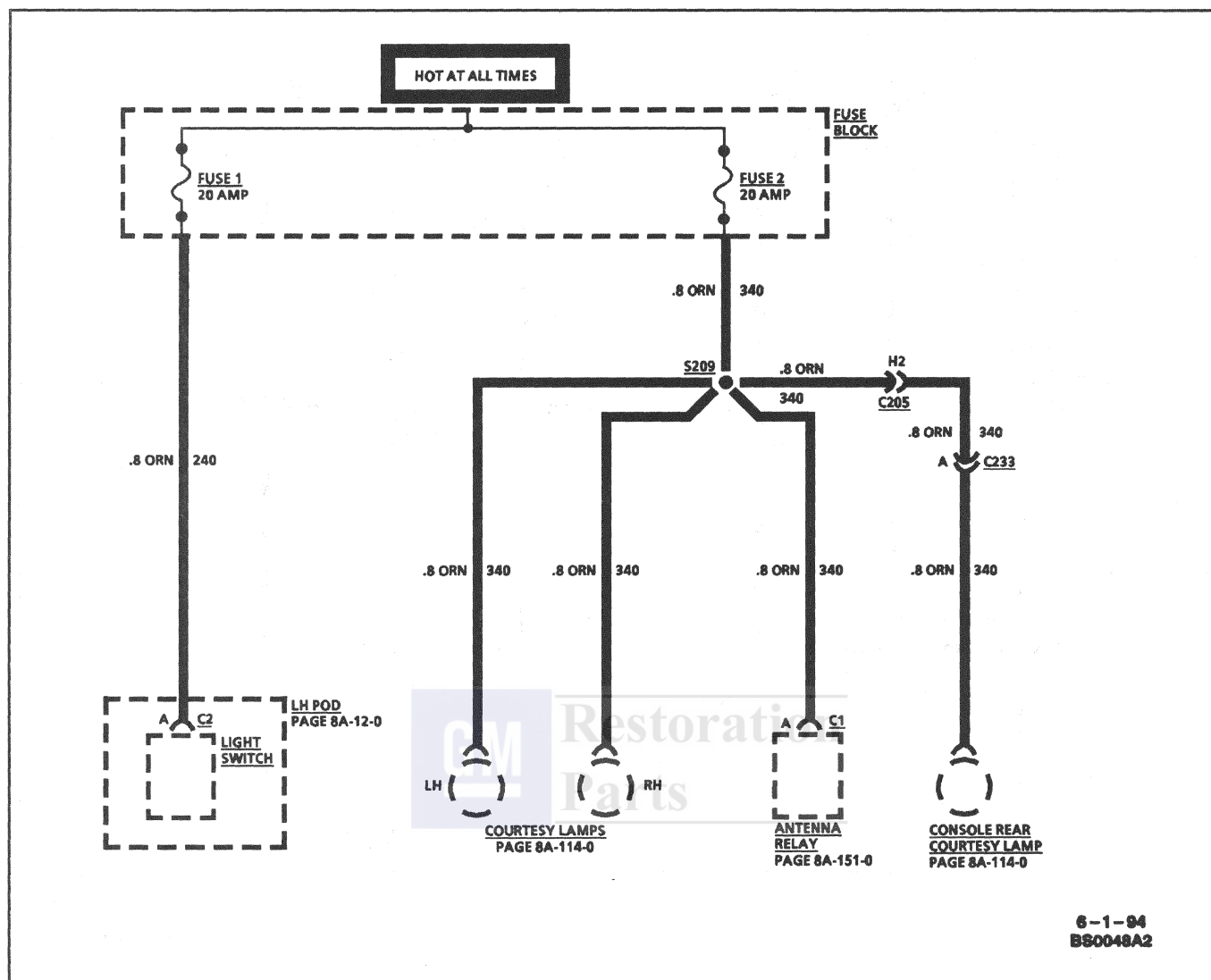


Figure 5—Typical Fuse Block Details Schematic

battery voltage is applied to the Starter Solenoid, Fusible Link D, Fuses 1 and 2 in the Fuse Block and the Light Switch in the LH Pod. These fuses are said to be Hot At All Times, since battery voltage is always applied to them.

Notice that battery voltage is also applied to Fusible Link F and Coolant Fan Relay.

FUSE BLOCK DETAILS

The Fuse Block Details schematic (see Figure 5) shows all of the wiring between a fuse and the components connected to the fuse. The Fuse Block Details schematic is extremely helpful in locating a short circuit that causes a fuse to open.

INTRODUCTION

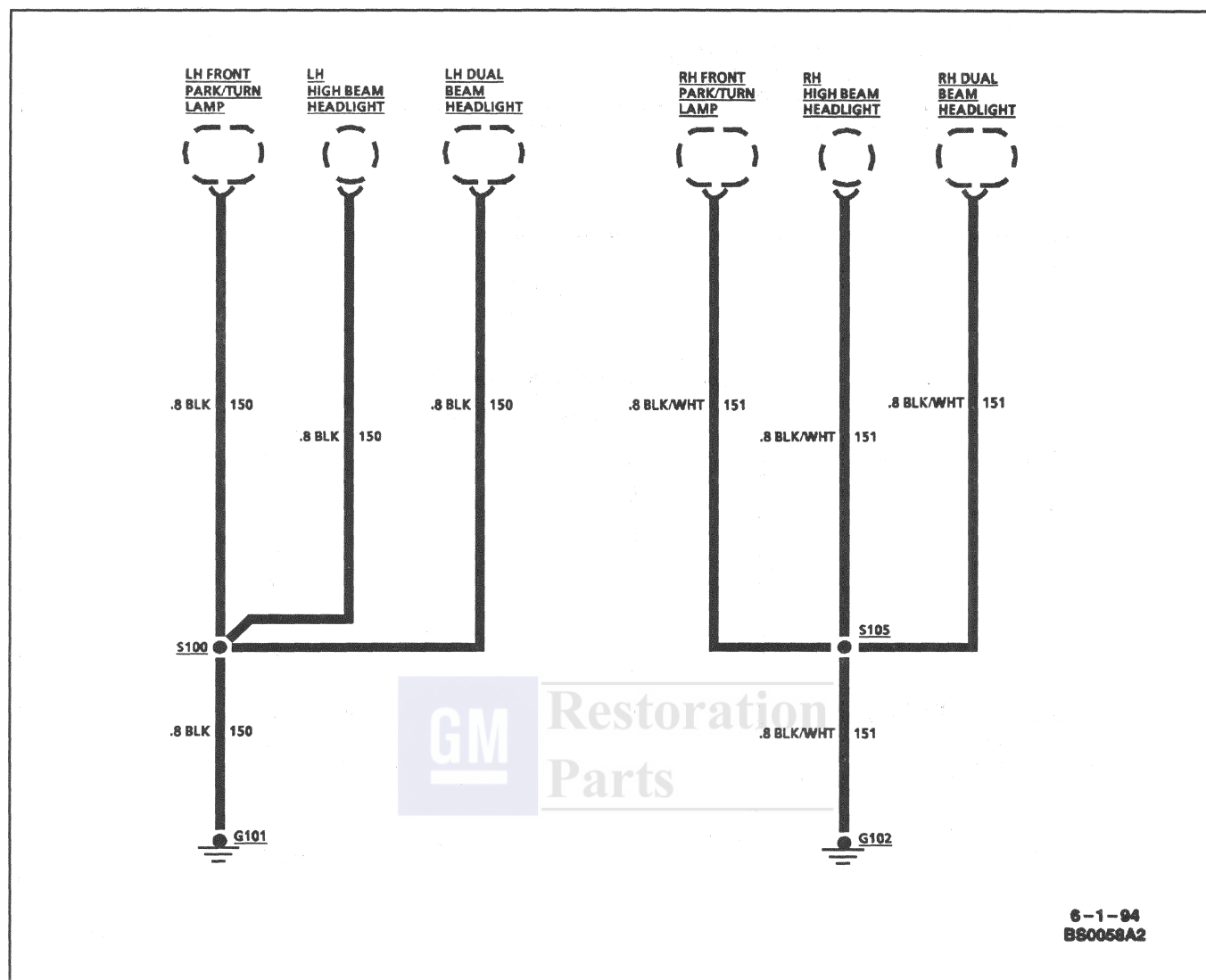


Figure 6—Typical Ground Distribution Schematic

GROUND DISTRIBUTION

Figure 6 is a sample Ground Distribution schematic for the Headlamps. It shows exactly which components share each ground. This information can often be a time-saver when troubleshooting ground circuits.

For example, if both Headlamps and the Park/Turn Lamp on one side are out, suspect an open in their common ground wire or the ground connection itself. On the other hand, if one of the lamps work, the ground and the wire up to the splice are good. You have learned this just by inspecting the schematic and knowing the vehicle's symptoms. No actual work on the lighting system was needed.



SYMBOLS

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Handling Procedures	8A-3-0
Measuring Procedures	8A-3-0
Supplemental Inflatable Restraint (SIR) System	8A-3-0
On-Board Diagnostics II (OBDII) Symbol	8A-3-1
Schematic Symbols	8A-3-2
Vacuum Motors and Devices	8A-3-4

ELECTROSTATIC DISCHARGE (ESD)
SENSITIVE DEVICES

All ESD sensitive components are Solid State and the following information applies to them.

The ESD symbol (Figure 1) is used on schematics (Figure 2) to indicate which components are ESD sensitive. When handling any electronic part, the service technician should follow the guidelines below to reduce any possible electrostatic charge build-up on the service technician's body and inadvertent discharge to the electronic part. If it is not known whether or not a component is ESD sensitive, assume it is susceptible.

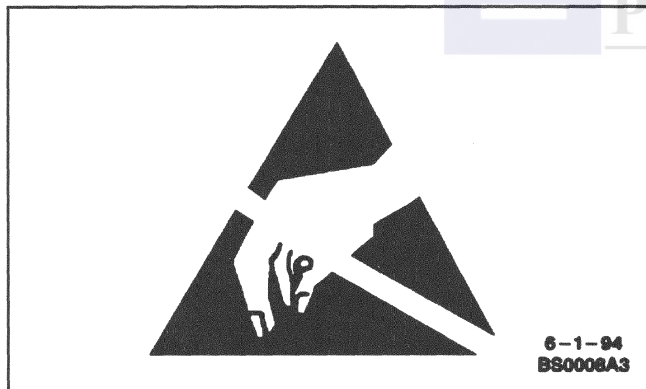


Figure 1 - ESD Symbol

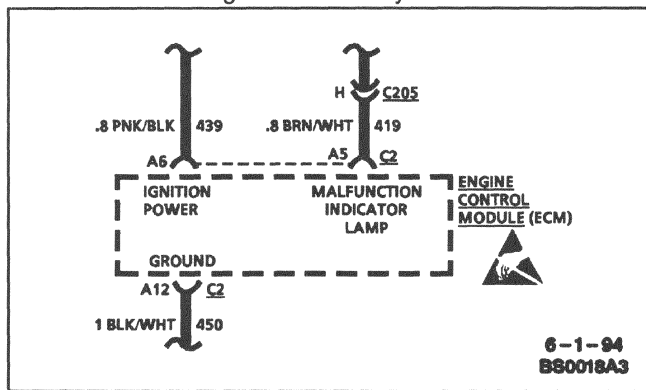


Figure 2 - Typical Schematic

HANDLING PROCEDURES

1. Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position or walking a distance.
2. Avoid touching electrical terminals of the part, unless so instructed by a written diagnostic procedure.
3. When using a voltmeter, be sure to connect the ground lead first.
4. Do not remove a part from its protective package until it is time to install the part.
5. Before removing the part from its package, ground the package to a known good ground on the vehicle.

MEASURING PROCEDURES

The circuits shown within the boxes are greatly simplified. Do not troubleshoot by measuring resistance at any terminal of these devices unless so instructed by a written diagnostic procedure. Due to the simplification of the schematics, resistance measurements could be misleading, or could lead to electrostatic discharge.

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

The SIR symbol (Figure 3) is used on schematics to alert the technician to the following important caution:



Figure 3 - SIR Symbol

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to **CAUTIONS** in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in SECTION 9J before performing service on or around SIR components or wiring. Failure to follow **CAUTIONS** could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

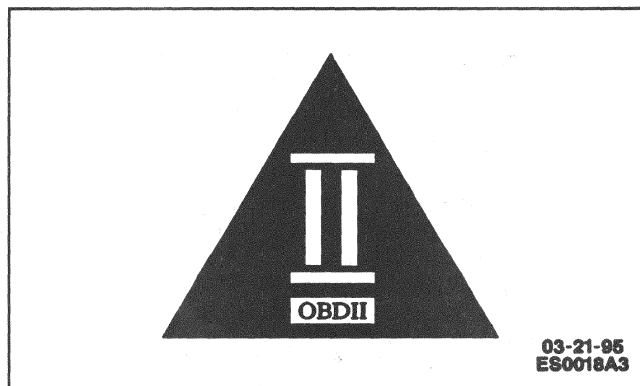


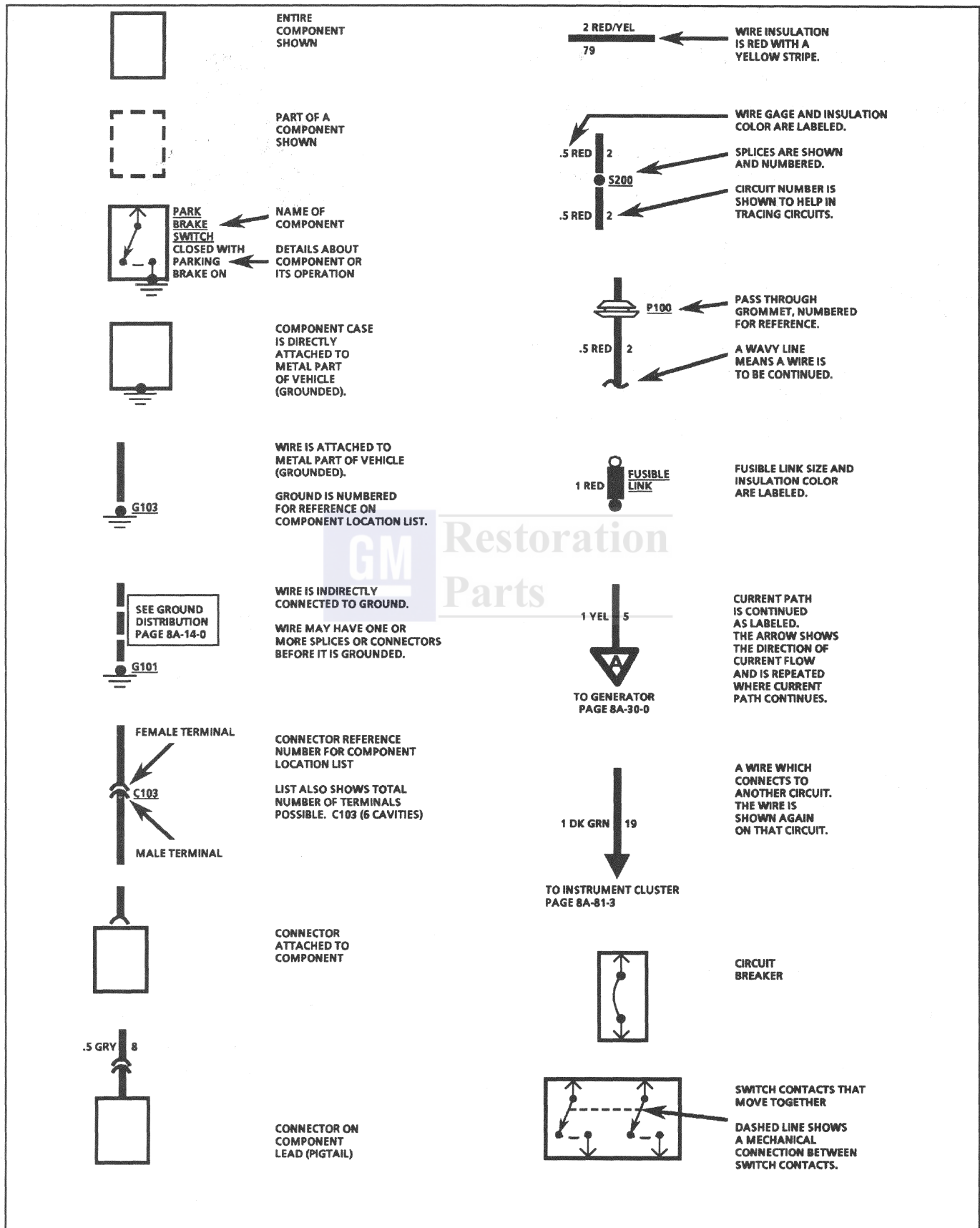
Figure 4 - OBDII Symbol

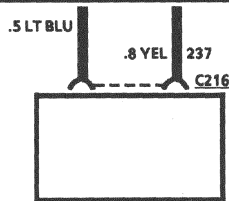
ON-BOARD DIAGNOSTICS II (OBDII) SYMBOL

The OBDII symbol (Figure 4) is used on circuit diagrams to alert the technician that the circuit is essential for proper OBDII emission control circuit operation. Any circuit which, if it fails, causes the SERVICE ENGINE SOON indicator to turn on, is identified as an OBDII circuit.



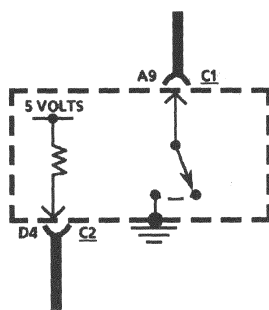
SYMBOLS





TWO TERMINALS
IN THE SAME
CONNECTOR

DASHED LINE SHOWS
A PHYSICAL
CONNECTION
BETWEEN PARTS
(SAME CONNECTOR).



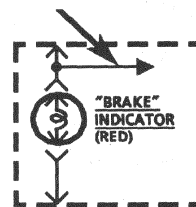
ECM CONNECTOR IDENTIFICATION

C1 - BLACK - 32 WAY
C2 - BLACK - 24 WAY

ENGINE
CONTROL
MODULE (ECM)

ELECTROSTATIC DISCHARGE
(ESD) SENSITIVE DEVICES
ARE IDENTIFIED. REFER TO
PAGE 8A-3-0 FOR HANDLING
AND MEASURING PROCEDURES.

INDICATES THIS CIRCUIT
CONTINUES WITHIN DEVICE;
I.E., OTHER BULBS

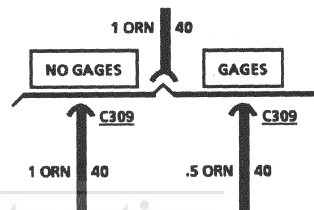


AN INDICATOR
WHICH DISPLAYS
THE LIGHTED
WORD "BRAKE"

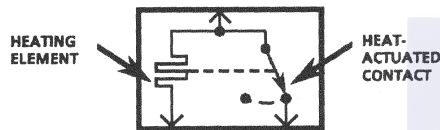


SEE GROUND
DISTRIBUTION
PAGE 8A-14-0

INDICATES THAT
THE CIRCUITRY IS
NOT SHOWN IN
COMPLETE DETAIL
BUT IS COMPLETE ON
THE INDICATED PAGE

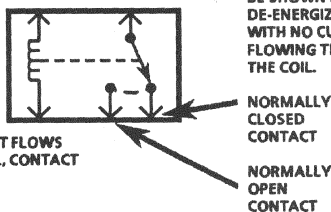


WIRE CHOICES
FOR OPTIONS
OR DIFFERENT
MODELS ARE
SHOWN AND
LABELED.



HEATING
ELEMENT

HEAT-
ACTUATED
CONTACT



WHEN CURRENT FLOWS
THROUGH COIL, CONTACT
WILL TOGGLE.

UNLESS NOTED,
THE RELAY WILL
BE SHOWN IN A
DE-ENERGIZED STATE
WITH NO CURRENT
FLOWING THROUGH
THE COIL

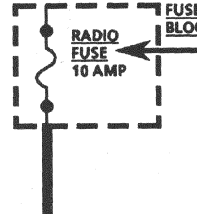
NORMALLY
CLOSED
CONTACT

NORMALLY
OPEN
CONTACT

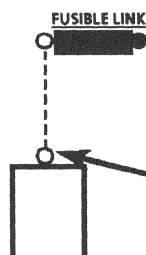
INDICATES THAT
POWER IS
SUPPLIED WITH
IGNITION SWITCH
IN "ACCY" AND
"RUN" POSITIONS

HOT IN ACCY OR RUN

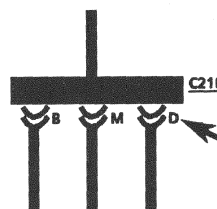
LABEL OF
FUSE BLOCK
CONNECTOR
CAVITY



DIODE
ALLOWS CURRENT
TO FLOW IN ONE
DIRECTION ONLY



FUSIBLE LINK
CONNECTS TO
SCREW TERMINAL.
SHOWN SEPARATED

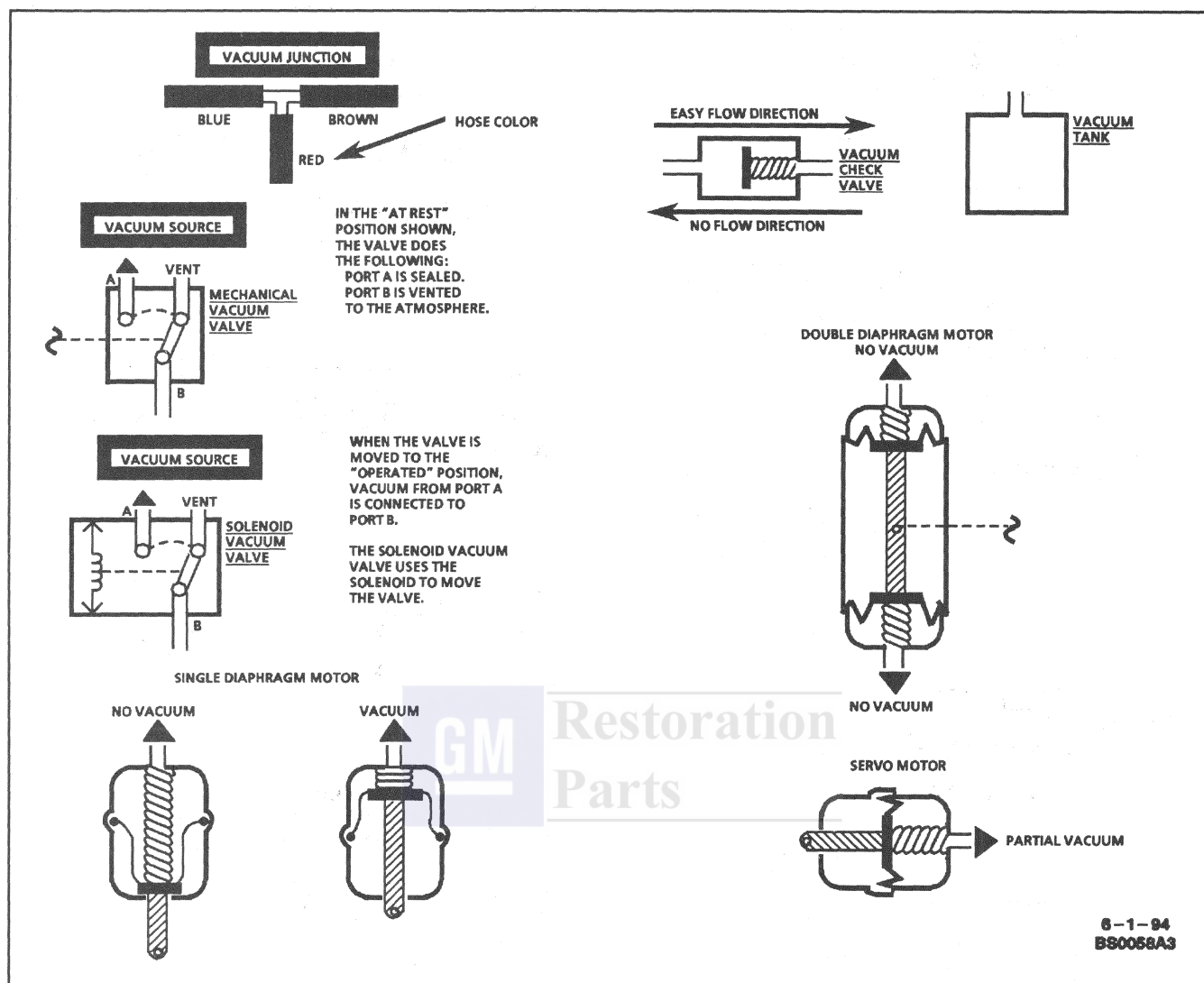


3 CONNECTORS ARE
SHOWN CONNECTED
TOGETHER AT A
JUNCTION BLOCK.
FOURTH WIRE IS
SOLDERED TO COMMON
CONNECTION ON
BLOCK.

NUMBER FOR TOTAL
CONNECTOR

LETTERS FOR EACH
CONNECTOR TERMINAL

SYMBOLS



VACUUM MOTORS AND DEVICES

Vacuum Motors operate like electrical solenoids, mechanically pushing or pulling a shaft between two fixed positions. When vacuum is applied, the shaft is pulled in. When no vacuum is applied, the shaft is pushed all the way out by a spring.

Double Diaphragm Motors can be operated by vacuum in two directions. When there is no vacuum, the motor is in the center "at rest" position.

Some Vacuum Motors such as the Servo Motor in the Cruise Control can position the actuating arm at any position between fully extended and fully retracted. The servo is operated by a control valve that applies varying amounts of vacuum to the motor. The higher the vacuum level, the greater the retraction of the motor arm. Servo Motors work like the two position motors; the only difference is in the way the vacuum is applied. Servo Motors are generally larger and provide a calibrated control.



TROUBLESHOOTING PROCEDURES

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BASIC KNOWLEDGE REQUIRED

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in this section. You should understand the basic theory of electricity and know the meaning of voltage, current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.

The following four-step troubleshooting procedure is recommended:

Step 1: Check the Problem

Perform a System Check to determine a symptom. Don't waste time fixing part of the problem! Do not begin disassembly or testing until you have narrowed down the possible causes.

Step 2: Read the Electrical Schematic

Study the schematic. Read the Circuit Operation text if you do not understand how the circuit should work. Check circuits that share wiring with the problem circuit. (Shared

circuits are shown on Power Distribution, Ground Distribution, Fuse Block Details and Light Switch Details pages.) Try to operate the shared circuits. If the shared circuits work, then the shared wiring is OK. The cause must be within the wiring used only by the problem circuit. If several circuits fail at the same time, chances are the power (fuse) or ground circuit is faulty.

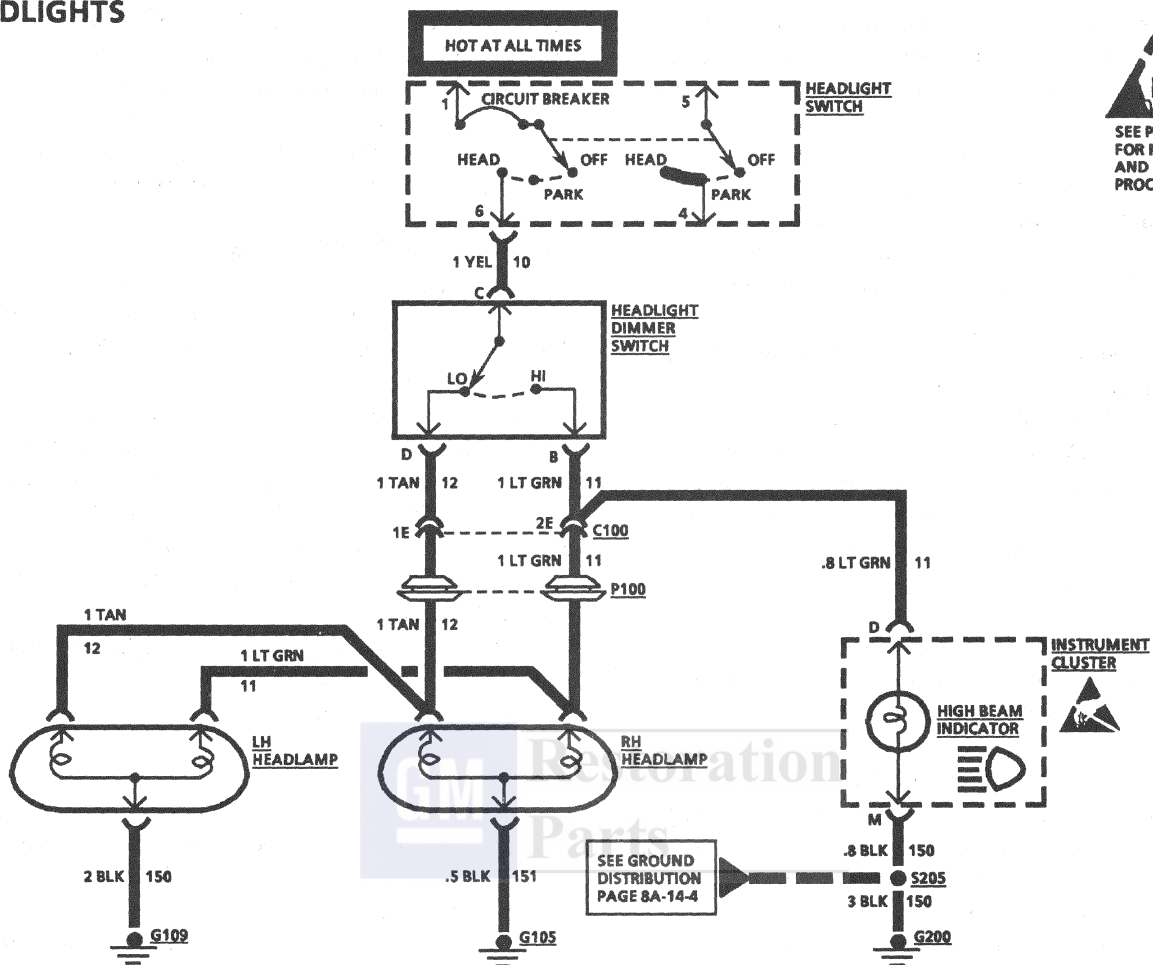
Step 3: Find the fault and repair

- Narrow down the possible causes.
- Use the Troubleshooting Hints.
- Make the necessary measurements or checks as given in the System Diagnosis.
- Before replacing a component, check power, signal and ground wires at the component harness connector. If the checks and connections are OK, the most probable cause is component failure.

Step 4: Test the Repair

Repeat the System Check to verify that the fault has been corrected and that no other faults were induced during the repair.

HEADLIGHTS



SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES

6-3-94
BS0008A4

Figure 1—Typical Headlights Schematic

Example:

A customer brings in a vehicle and says that the HI beams do not work.

Step 1: Perform a System Check on the Headlight Circuit

You may discover that both LO beams operate. In "HI," you may notice that the HI Beam Indicator comes on, but neither HI beam operates.

Step 2: Read the Headlights Electrical Schematic (Figure 1)

This is the step that will save time and labor. Remember, it is essential to understand how a circuit should work, before trying to figure out why it doesn't.

After you understand how the circuit should operate, read the schematic again, this time keeping in mind what you have learned by operating the circuit.

Since both LO beams work, you know that the Headlight Switch, the YEL wire, the LO contacts of the Headlight Dimmer Switch, terminal "1E" of C100, the TAN wires and grounds G105 and G109 are all good.

Furthermore, since you saw that the HI Beam Indicator came on when the Headlight Dimmer Switch was moved to "HI," you know that the HI contacts of the Headlight Dimmer Switch and the LT GRN wire between the Headlight Dimmer Switch and C100 are good.

At this point, you could test for voltage at the RH Headlamp with the Headlight Dimmer Switch in "HI." However, it is extremely unlikely that the HI beam filaments have burned out in both headlamps, or that both headlamps connections are bad. The cause must be a bad connection at C100, or a break in the LT GRN wire between C100 and the RH Headlamp.

You have quickly narrowed the possible causes down to one specific area, and have done absolutely no work on the vehicle itself.

TROUBLESHOOTING PROCEDURES

Step 3: Find the fault and repair it

Using the Component Location List and the corresponding figure, you can quickly find C100 and the LT GRN wire, locate the exact trouble point and make the repair.

Step 4: Check the repair by performing a System Check on the Headlights Circuit

This, of course, means making sure that both HI beams, both LO beams and the HI Beam Indicator are all working.

Now suppose that the symptoms were different. You may have operated the Headlamps and found that the LO beams were working, but neither the HI beams nor the HI Beam Indicator were working. Looking at the schematic, you might conclude that it is unlikely that both HI beam filaments and the HI Beam Indicator have all burned out at once. The cause is probably the Headlight Dimmer Switch or its connector.

TROUBLESHOOTING TOOLS

Electrical troubleshooting requires the use of common electrical test equipment.

TEST LIGHT/DIGITAL VOLTMETER

Use a test light to check for voltage. A Test Light (J 34142-B) is made up of a 12 volt light bulb with a pair of leads attached. After grounding one lead, touch the other lead to various points along the circuit where voltage should be present. When the bulb goes on, there is voltage at the point being tested.

A DVM can be used instead of a test light. While a test light shows whether or not voltage is present, a DVM indicates how much voltage is present.

An increasing number of circuits include solid state control modules. One example is the Engine Control Module (ECM). Voltages in these circuits should be tested only with a 10-megohm or higher impedance DVM or multimeter (J 39200). Unless directed to within the diagnostics, never use a test light on circuits that contain solid state components, since damage to these components may result.

When testing for voltage or continuity at the connection, it is not necessary to separate the two halves of the connector. Unless testing a Weather Pack® or a Metri Pack® connector 150 series and below, always probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems. A terminal contact checking procedure can be found on page 8A-4-5.

CONNECTOR TEST ADAPTERS

Connector Test Adapter Kit (J 35616-A) is available for making tests and measurements at separated connectors. This kit contains an assortment of probes which mate with many of the types of terminals you will see. Avoid using paper clips and other substitutes since they can damage terminals and cause incorrect measurements.

SELF-POWERED TEST LIGHT

A self-powered test light (J 21008-A) can be used to check for continuity. This tool is made up of a light bulb, Battery and two leads. If the leads are touched together, the bulb will go on.

A self-powered test light is used only on an unpowered circuit. First remove the fuse which feeds the circuit you're working on. Select two specific points along the circuit through which there should be continuity. Connect one lead of the self-powered test light to each point. If there is continuity, the test light circuit will be completed and the bulb will go on.

Never use a self-powered test light on circuits that contain solid state components, since damage to these components may result.

OHMMETER

An ohmmeter can be used instead of a self-powered test light. The ohmmeter shows how much resistance there is between two points along a circuit. Low resistance means good continuity.

Circuits which include any solid state control modules, such as the Engine Control Module (ECM), should be tested only with a 10-megohm or higher impedance digital multimeter (J 39200).

When measuring resistance with a DVM, the vehicle Battery should be disconnected. This will prevent incorrect readings. DVMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

Diodes and solid state components in a circuit can cause an ohmmeter to give a false reading. To find out if a component is affecting a measurement, take a reading once, reverse the leads and take a second reading. If the readings differ, the solid state component is affecting the measurement.

FUSED JUMPER WIRE

A fused jumper (J 36169) is available with small clamp connectors providing adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 amp fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

NOTICE: A fused jumper may not protect solid state components from being damaged.

SHORT FINDER

Short Finders (J 8681-A) are available to locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows you the location of the short through body trim or sheet metal.

FUSE TESTER

A simple tester (J 34764) can detect a blown fuse. To check a fuse, the tester is applied directly to the fuse in the Fuse Block. Two probes contact the fuse, either into the slots of a flat fuse or to the metal ends of a glass fuse. With power on, a red LED in the tester lights if the fuse is open. The handle of the tester is a tool for removing either type of fuse.

TROUBLESHOOTING TESTS

AFTERMARKET ACCESSORIES

Do not tie aftermarket accessories into SIR circuits. All such circuits are indicated on circuit diagrams with the SIR symbol. (See SECTION 8A-3.)

Do not tie aftermarket accessories into OBDII circuits. All such circuits are indicated on circuit diagrams with the OBDII symbol. (See SECTION 8A-3.)

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Some possible causes of vehicle problems related to aftermarket accessories include:

1. Power feeds connected to points other than the Battery.
2. Antenna location.
3. Transceiver wiring located too close to vehicle electronic modules or wiring.
4. Poor shielding or poor connectors on antenna feed line.

Refer to 1990/1991 model year bulletin entitled, "Installation Guidelines for Aftermarket Accessories" for specific information.

PROBING

After probing, when reconnecting connectors or replacing terminals, always be sure to reinstall Connector Position Assurance (CPA) and Terminal Position Assurance (TPA).

Frontprobe

When frontprobing of connectors is required, always use a mating terminal adapter from Connector Test Adapter Kit (J 35616-A). The use of proper adapters will ensure

that proper terminal contact integrity is maintained. For a terminal contact checking procedure, refer to page 8A-4-5.

Backprobe

Only backprobe connector terminals when specifically called for in diagnostic procedures. Since backprobing can be a source of damage to connector terminals, extra care must be taken to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large a test probe.

After backprobing any connector, always check for terminal damage. If terminal damage is suspected, check for proper terminal contact (refer to "Checking Terminal Contact," page 8A-4-5).

TESTING FOR VOLTAGE (Figure 2)

1. Connect one lead of a test light to a known good ground. When using a DVM, be sure the voltmeter's negative lead is connected to ground.
2. Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).
3. If the test light illuminates, there is voltage present. When using a DVM, note the voltage reading.

TESTING FOR CONTINUITY (Figure 3)

1. Remove the fuse to the circuit involved.
2. Connect one lead of a self-powered test light or ohmmeter to one end of the part of the circuit you wish to test.
3. Connect the other lead to the other end of the circuit.
4. If the self-powered test light glows, there is continuity. When using an ohmmeter, low or no resistance means good continuity.

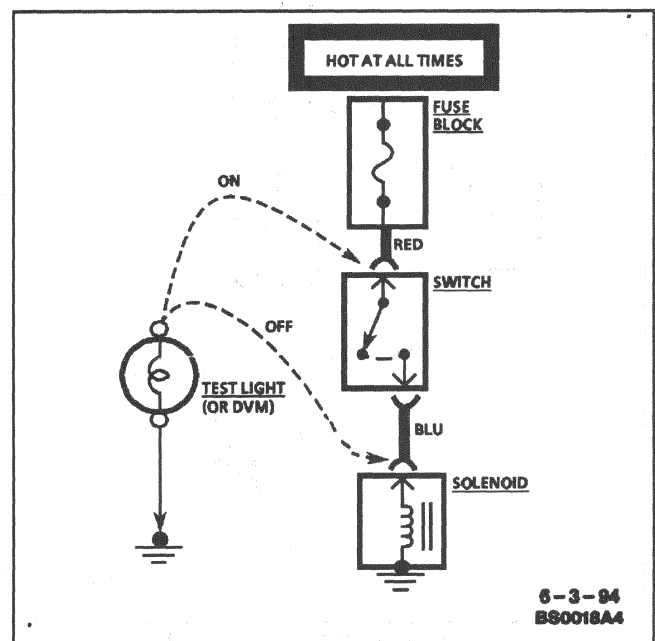


Figure 2—Voltage Check

TROUBLESHOOTING PROCEDURES

TESTING FOR VOLTAGE DROP (Figure 4)

This test checks for voltage being lost along a wire, or through a connection or switch.

1. Connect the positive lead of a DVM to the end of the wire (or to one side of the connection or switch) which is closer to the Battery.

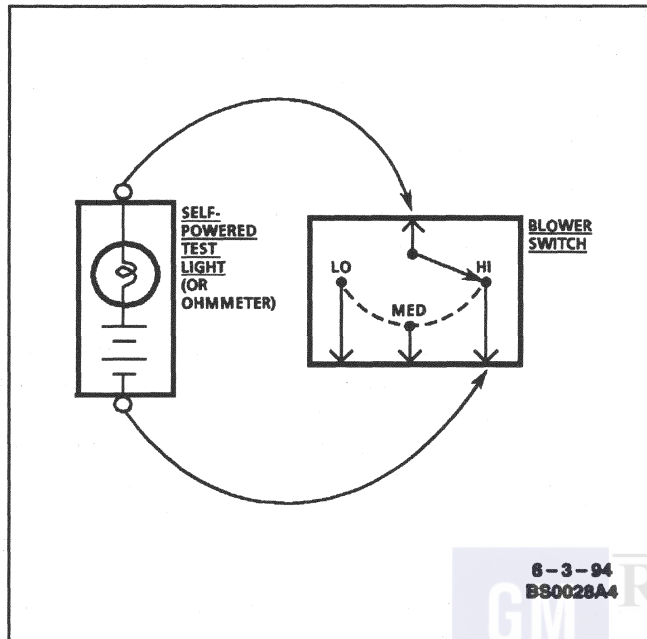


Figure 3—Continuity Check through a Switch

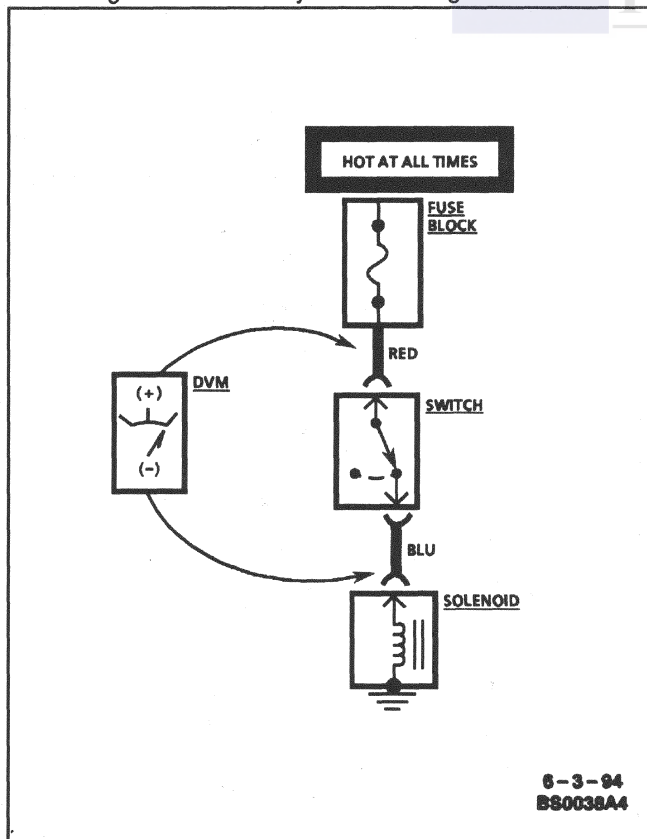


Figure 4—Voltage Drop Test

2. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
3. Operate the circuit.
4. The DVM will show the difference in voltage between the two points.

TESTING FOR SHORT TO GROUND

With a Test Light or DVM (Figure 5)

1. Remove the blown fuse and disconnect the load.
2. Connect a test light or voltmeter across the fuse terminals (be sure that the fuse is powered).
3. Beginning near the Fuse Block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test light or DVM.
4. When the test light glows, or the DVM registers, there is a short to ground in the wiring near that point.

With a Self-Powered Test Light or Ohmmeter (Figure 6)

1. Remove the blown fuse and disconnect the Battery and load.
2. Connect one lead of a self-powered test light or ohmmeter to the fuse terminal on the load side.
3. Connect the other lead to a known good ground.

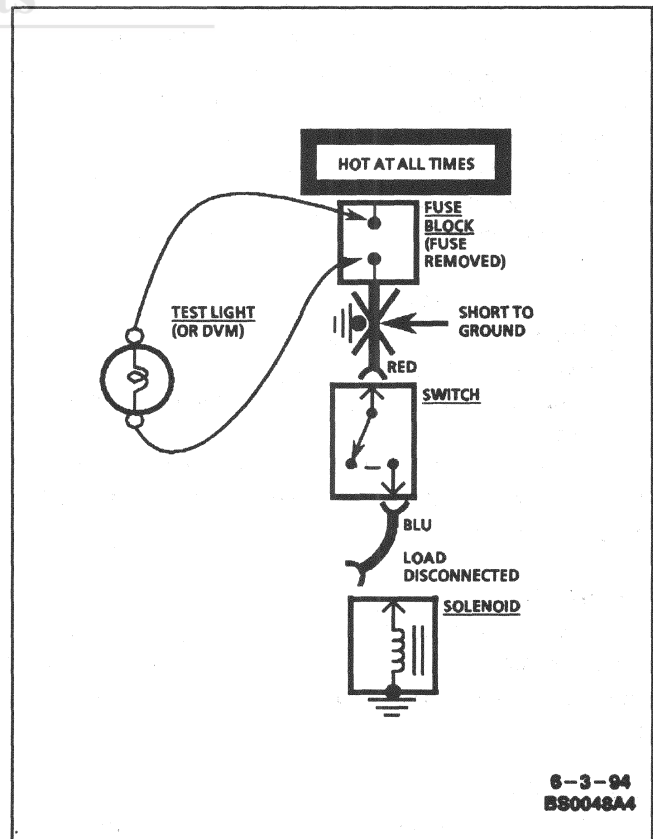


Figure 5—Testing for Short with Test Light or DVM

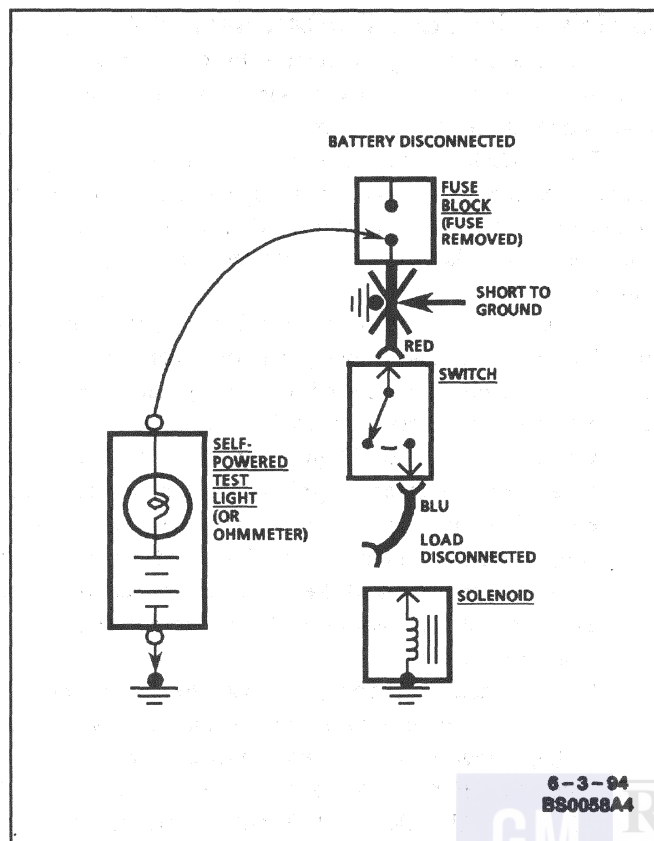


Figure 6—Testing for Short with Self-Powered Test Light or Ohmmeter

4. Beginning near the Fuse Block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the self-powered test light or ohmmeter.
5. When the self-powered test light glows, or the ohmmeter registers, there is a short to ground in the wiring near that point.

Fuses Powering Several Loads

1. Find the schematic in "Fuse Block Details," page 8A-11-0, for the fuse that has blown.
2. Open the first connector or switch leading from the fuse to each load.
3. Replace the fuse.
 - If the fuse blows, the short is in the wiring leading to the first connector or switch. Use a test light or meter as described on previous page.
 - If fuse does not blow, refer to next step.
4. Close each connector or switch until the fuse blows in order to find which circuit has the short. Connect test lamp or meter at the connector to the suspect circuit (disconnected) rather than at the fuse terminals.

JUMP STARTING PROCEDURE

Refer to SECTION 6D-1 for jump starting procedure.

INTERMITTENT AND POOR CONNECTIONS

Most intermittents are caused by faulty electrical connections or wiring, although occasionally a sticking relay or solenoid can be a problem. Some items to check are:

- Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).
- Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact.
- Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.
- Improperly formed or damaged terminals. All connector terminals in problem circuits should be checked carefully to ensure good contact tension. Use a corresponding mating terminal to check for proper tension. Refer to "Checking Terminal Contact" in this section for the specific procedure.
- The J 35616-A Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the adapter will ensure that no damage to the terminal will occur, as well as giving an idea of whether contact tension is sufficient. If contact tension seems incorrect, refer to "Checking Terminal Contact" in this section for specifics.
- Poor terminal-to-wire connection. Some conditions which fall under this description are poor crimps, poor solder joints, crimping over wire insulation rather than the wire itself, corrosion in the wire-to-terminal contact area, etc.
- Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.
- Wiring broken inside the insulation. This condition could cause a continuity check to show a good circuit, but if only 1 or 2 strands of a multi-strand type wire are intact, resistance could be far too high.

To avoid any of the above problems when making wiring or terminal repairs, always follow the instructions for wiring and terminal repair outlined in SECTION 8A-5.

CHECKING TERMINAL CONTACT

When diagnosing an electrical system that utilizes Metri-Pack 150/280/480/630 series terminals (refer to Terminal Repair Kit, J 38125-A, instruction manual, J 38125-4 for terminal identification), it is important to check terminal contact between a connector and component, or between in-line connectors, before replacing a suspect component.

TROUBLESHOOTING PROCEDURES

Frequently, a diagnostic chart leads to a step that reads: "Check for poor connection." Mating terminals must be inspected to assure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination is caused by the connector halves being improperly connected, a missing or damaged connector seal, or damage to the connector itself, exposing the terminals to moisture and dirt. Contamination, usually in underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter, improperly joining the connector halves or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact (see Figure 7), causing an open or intermittently open circuit.

Follow the procedure below to check terminal contact.

1. Separate the connector halves. Refer to Terminal Repair Kit, J 38125-A, instruction manual, J 38125-4.
2. Inspect the connector halves for contamination. Contamination will result in a white or green build-up within the connector body or between terminals, causing high terminal resistance, intermittent contact or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals and connector body.
3. Using an equivalent male terminal from the Terminal Repair Kit, J 38125-A, check the retention force of the female terminal in question by inserting and removing the male terminal to the female terminal in the connector body. Good terminal contact will require a certain amount of force to separate the terminals.
4. Using an equivalent female terminal from the Terminal Repair Kit, J 38125-A, compare the retention force of this terminal to the female terminal in question by joining and separating the male terminal to the good female terminal, and then joining and separating the male terminal to the female terminal in question. If the retention force is significantly different between the two female terminals, replace the female terminal in question (refer to Terminal Repair Kit, J 38125-A).

If a visual (physical) check does not reveal the cause of the problem, the vehicle may be able to be driven with a DVM connected to the suspected circuit. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit.

DETECTING ELECTRICAL INTERMITTENTS

Use the following procedure to detect intermittent terminal contact or a broken wire with an intermittent connection inside the insulation.

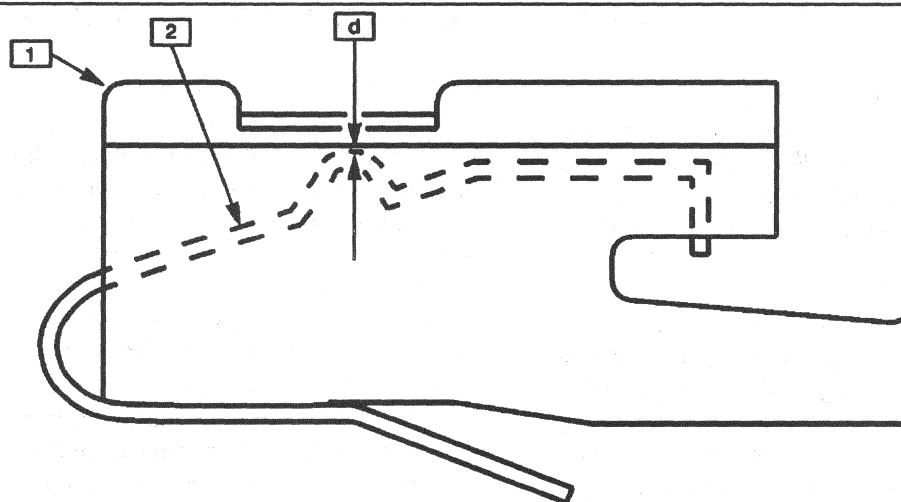
The J 39200 Digital Multimeter has the ability to monitor current, resistance, or voltage while recording the minimum (MIN) and maximum (MAX) values measured. The meter can also be set to display the average (AVG) value measured.

When diagnosing circuits that have voltage applied, use the voltage setting to monitor a connector (or length of a circuit) which is suspected of having an intermittent connection but is currently operating normally.

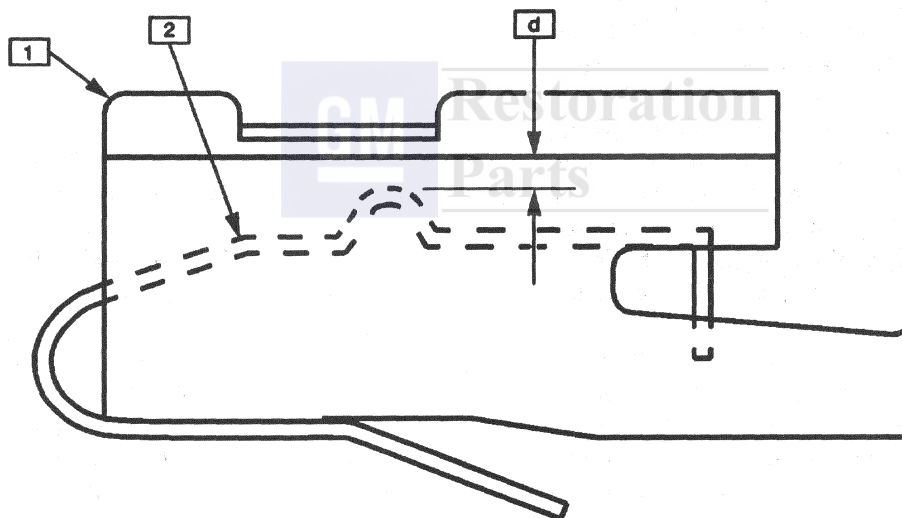
1. Connect the J 39200 Digital Multimeter to both sides of a suspect connector (still connected) or from one end of a suspect circuit to the other. This will continuously monitor the terminal contacts or length of wire being checked. See "Meter Connections" for examples of the various methods for connecting the meter to the circuit.
2. Set the meter for voltage. Since the "MIN MAX" mode does not use auto ranging, manually select the voltage range necessary before proceeding.
3. Press the "MIN MAX" button. The meter should read "100 ms RECORD" (100 millisecond record) and emit a 1/4 second beep. The meter is now ready to record and will generate an audible tone for any change in voltage. At this point, you may wish to press the "PEAK MIN MAX" button, which will record any voltage variations that occur for at least 1 millisecond.
4. Try to simulate the condition that is potentially causing an intermittent connection, either by wiggling connections or wiring, test driving or performing other operations. If an open or resistance is created, a voltage will be present and the meter will emit a tone for as long as the open or resistance exists. Any change in voltage will cause the meter to emit a tone for no less than 1/4 second. (Listening for a tone while manipulating wiring is very helpful for narrowing down an intermittent connection.)

Use the MIN and MAX values when the meter is out of sight or sound range, in noisy areas or for test driving when it may not be possible to monitor the meter.

To check the MIN and MAX recorded voltages press "MIN MAX" once for MAX and twice for MIN. A variation between MIN and MAX recorded voltages (unless nearly 0 volts) suggests an intermittent open or that resistance exists and should be repaired as necessary. Refer to SECTION 8A-5 of any current GM Service Manual for approved repair procedures.



d ABOUT EQUAL TO 0, GOOD TERMINAL CONTACT



d MUCH GREATER THAN 0, POOR TERMINAL CONTACT

- 1 TYPICAL METRI-PACK 150/280/480/630 SERIES FEMALE TERMINAL
(150 SERIES PUSH-TO-SEAT SHOWN)
- 2 CONTACT TANG
- d AMOUNT OF DEFORMATION

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Figure 7—Deformation of a Typical Metri-Pack 150/280/480/630 Series Female Terminal

TROUBLESHOOTING PROCEDURES



Important:

- The “100 ms RECORD” (100 millisecond record) mode is NOT the amount of time allowed to perform a specific procedure. It is the amount of time used to record each snapshot of information used for calculating “AVG” when in the “MIN MAX” mode.

METER CONNECTIONS

The previous diagnostic procedure was written to detect intermittents using the meter set to voltage. Whether using the current, voltage or resistance setting to detect intermittents, it is necessary to connect the meter to the circuit.

Following are examples of the various methods of connecting the meter to the circuit to be checked:

- Backprobe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while performing other operations or test driving. (Do not backprobe “Weather Pack®” type connectors.)
- Disconnect the harness at both ends of the suspect circuit where it connects either to a component or to other harnesses.
- Use Connector Test Adapter Kit J 35616-A to connect the meter to the circuit.
- If the system being diagnosed has a specified pinout or breakout box, it may be used to simplify connecting the meter to the circuit or for checking multiple circuits quickly.

ADDITIONAL INFORMATION

NOTICE: Turn off power to the test circuit before attempting in-circuit resistance measurements to prevent false readings or damage to the meter. Do not use the meter to measure resistance through a solid state module.

Continuity tests that work well for detecting intermittent shorts to ground can be performed by setting the meter to “ohms” then pressing the “PEAK MIN MAX” button. An audible tone will be heard whenever the meter detects continuity for at least 1 millisecond.

The J 39200 Instruction Manual is a good source of information and should be read thoroughly upon receipt of the meter as well as kept on hand for reference during new procedures.

GM Restoration
Parts



REPAIR PROCEDURES

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ELECTRICAL REPAIRS

This section provides instruction in the following repairs:

- Circuit Protection
- Typical Electrical Repairs
- Splicing Copper Wire
- Splicing Twisted/Shielded Cable
- Repairing Connectors (Except Weather Pack®)
- Repairing Weather Pack® (Environmental) Connectors
- Terminal Repair
- Diode Replacement
- Heated Oxygen Sensor (HO2S) Repair
- OBDII Circuit Repair
- GMSP0 Service Parts Ordering

After any electrical repair is made, always test the circuit afterwards by operating the devices in the circuit. This confirms not only that the repair is correct but, also, that it was the cause of the complaint.

Repair of circuits which are part of the OBDII (On-Board Diagnostics II) emissions control system have several special requirements which must be followed to ensure proper system operation. These requirements are listed on page 8A-5-12 under OBDII CIRCUIT REPAIRS.

CIRCUIT PROTECTION

The purpose of circuit protection is to protect the wiring assembly during normal and overload conditions. An overload is defined as a current requirement that is higher than normal. This overload could be caused by a short circuit or system malfunction. The short circuit could be the result of a pinched or cut wire or an internal device short circuit, such as an electronic module failure.

The circuit protection device is only applied to protect the wiring assembly, and not the electrical load at the end of the assembly. For example, if an electronic component short circuits, the circuit protection device will assure a minimal amount of damage to the wiring assembly.

However, it will not necessarily prevent damage to the component.

There are three basic types of circuit protection devices: Circuit Breaker, Fuse and Fusible Link.

CIRCUIT BREAKERS

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. There are two basic types of circuit breakers used in GM vehicles: cycling and non-cycling.

CYCLING CIRCUIT BREAKER

The cycling breaker will open due to heat generated when excessive current passes through it for a period of time. Once the circuit breaker cools, it will close again after a few seconds. If the cause of the high current is still present it will open again. It will continue to cycle open and closed until the condition causing the high current is removed.

NON-CYCLING CIRCUIT BREAKER

There are two types of non-cycling circuit breakers. One type is mechanical and is nearly the same as a cycling breaker. The difference is a small heater wire within the non-cycling circuit breaker. This wire provides enough heat to keep the bimetallic element open until the current source is removed.

The other type is solid state, called out in this section as Electronic Circuit Breaker (ECB). This device has a Positive Temperature Coefficient. It increases its resistance greatly when excessive current passes through it. The excessive current heats the ECB. As it heats, its resistance increases, therefore having a Positive Temperature Coefficient. Eventually the resistance gets so high that the circuit is effectively open. The ECB will not reset until the circuit is opened, removing voltage from its terminals. Once voltage is removed, the circuit breaker will re-close within a second or two.

FUSES

The most common method of automotive wiring circuit protection is the fuse (Figure 1). A fuse is a device that, by the melting of its element, opens an electrical circuit when the current exceeds a given level for a sufficient time. The action is non-reversible and the fuse must be replaced each time a circuit is overloaded or after a malfunction is repaired.

Fuses are color coded. The standardized color identification and ratings are shown in Figure 2. For service replacement, non-color coded fuses of the same respective current rating can be used.

Examine a suspect fuse for a break in the element. If the element is broken or melted, replace the fuse with one of equal current rating.

There are additional specific circuits with in-line fuses. These fuses are located within the individual wiring harness and will appear to be an open circuit if blown.

AUTOFUSE

The Autofuse, normally referred to simply as "Fuse," is the most common circuit protection device in today's vehicle. The Autofuse is most often used to protect the wiring assembly between the Fuse Block and the system components.

MAXIFUSE

The MaxiFuse was designed to replace the fusible link and Pacific Fuse elements. The MaxiFuse is designed to protect cables, normally between the battery and fuse block, from both direct short circuits and resistive short circuits.

Compared to a fusible link or a Pacific Fuse element, the MaxiFuse performs much more like an Autofuse, although the average opening time is slightly longer. This is because the MaxiFuse was designed to be a slower blowing fuse, with less chance of nuisance blows.

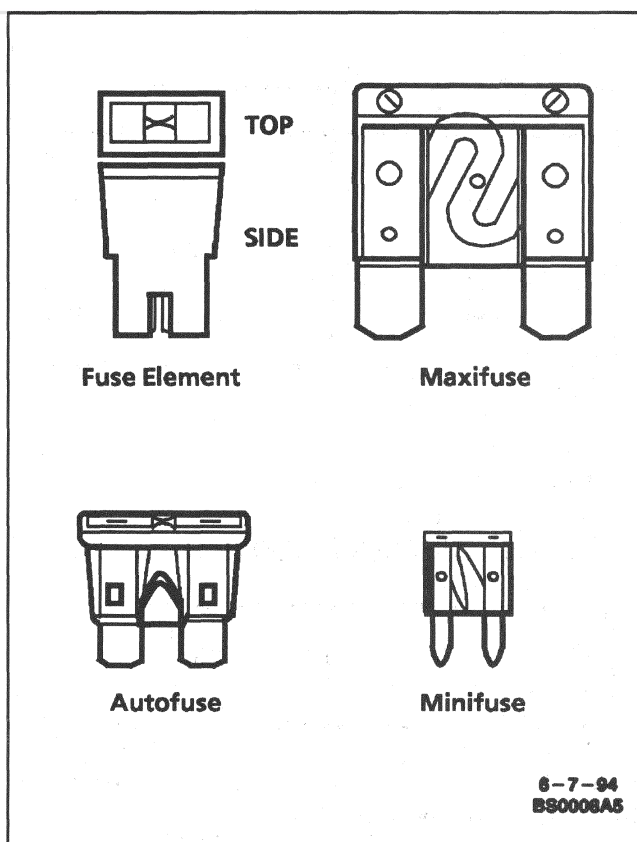


Figure 1 - Fuse Devices

REPAIR PROCEDURES

AUTOFUSE

CURRENT RATING	COLOR
3	VIOLET
5	TAN
7.5	BROWN
10	RED
15	BLUE
20	YELLOW
25	NATURAL
30	GREEN

MAXIFUSE

CURRENT RATING	COLOR
20	YELLOW
30	GREEN
40	AMBER
50	RED
60	BLUE
70	BROWN
80	NATURAL

MINIFUSE

CURRENT RATING	COLOR
5	TAN
7.5	BROWN
10	RED
15	BLUE
20	YELLOW
25	NATURAL
30	GREEN

PACIFIC FUSE ELEMENT

CURRENT RATING	COLOR
30	PINK
40	GREEN
50	RED
60	YELLOW

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MINIFUSE

The MiniFuse is a smaller version of the Autofuse and has a similar performance. As with the Autofuse, the MiniFuse is usually used to protect the wiring assembly between a fuse block and system components. Since the MiniFuse is a smaller device, it allows for more system specific fusing to be accomplished within the same amount of space as Autofuses.

PACIFIC FUSE ELEMENT/MAXIFUSE

The Pacific Fuse Element and MaxiFuse were developed to be a replacement for the fusible link. Like a fusible link, the fuses are designed to protect wiring from a direct short to ground. These elements are easier to service and inspect than a fusible link and will eventually replace fusible links in all future vehicle applications.

FUSIBLE LINKS

In addition to circuit breakers and fuses, some circuits use fusible links to protect the wiring. Like fuses, fusible links are "one-time" protection devices that will melt and create an open circuit (see Figure 3).

Not all fusible link open circuits can be detected by observation. Always inspect that there is battery voltage past the fusible link to verify continuity.

Fusible links are used instead of a fuse in wiring circuits that are not normally fused, such as the ignition circuit. For AWG sizes, each fusible link is four wire gage sizes smaller than the wire it is designed to protect. For example: to protect a 10 gage wire use a 14 gage link or for metric, to protect a 5 mm² wire use a 2 mm² link (see Figure 6). Links are marked on the insulation with wire-gage size because the heavy insulation makes the link appear to be a heavier gage than it actually is. The same wire size fusible link must be used when replacing a blown fusible link.

Fusible links are available with three types of insulation: Hypalon®, Silicone/GXL (SIL/GXL) and Expanded Duty. All future vehicles that use fusible links will utilize the Expanded Duty type of fusible link. When servicing fusible links, all fusible links can be replaced with the Expanded Duty type. SIL/GXI fusible links can be used to replace either SIL/GXI or Hypalon® fusible links. Hypalon® fusible links can only be used to replace Hypalon® fusible links.

Determining characteristics of the types of fusible links are:

- Hypalon® (limited use): only available in 0.35 mm² or smaller and its insulation is one color all the way through.
- SIL/GXL (widely used): available in all sizes and has a white inner core under the outer color of insulation.

Figure 2 - Fuse Rating and Color

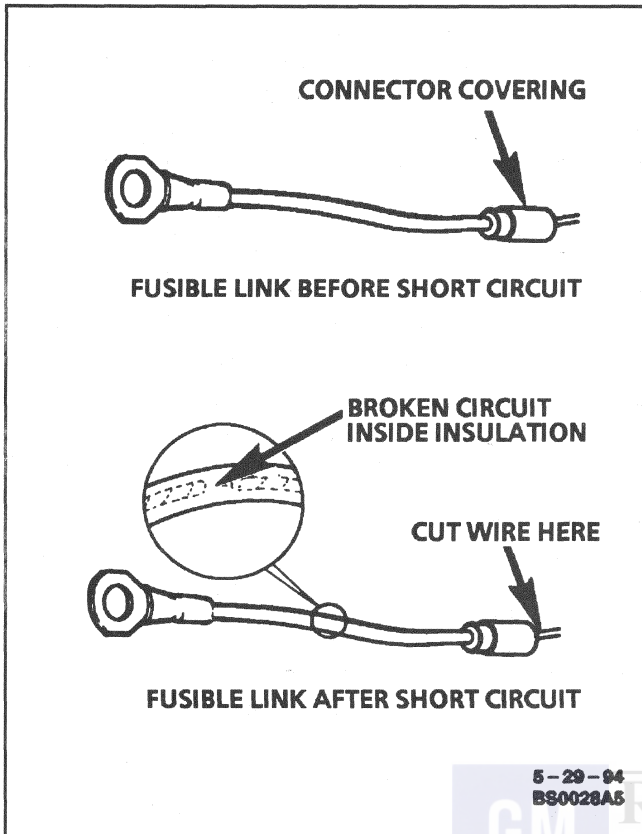


Figure 3 - Good and Damaged Fusible Links

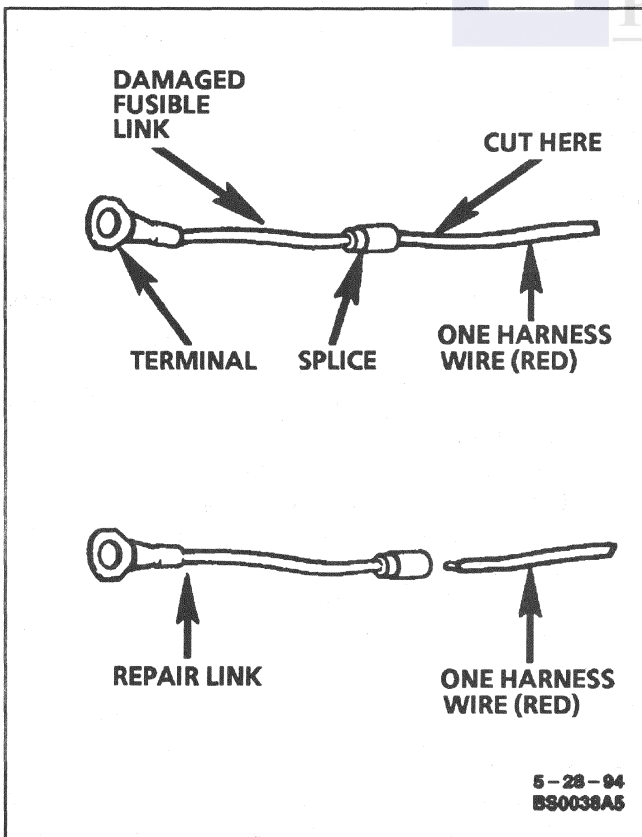


Figure 4 - Single Wire Feed Fusible Link

— Expanded Duty: available in all sizes, has an insulation that is one color all the way through and has three dots following the writing on the insulation. Service fusible links are available in many lengths. Choose the shortest length that is suitable. If the fusible link is to be cut from a spool, it should be cut 150-225 mm (approx. 6-9 in.) long. NEVER make a fusible link longer than 225 mm (approx. 9 in.).

CAUTION: Fusible links cut longer than 225 mm (approx. 9 in.) will not provide sufficient overload protection.

To replace a damaged fusible link (Figure 4), cut it off beyond the splice. Replace with a repair link. When connecting the repair link, strip wire and use staking-type pliers to crimp the splice securely in two places. For more details on splicing procedures, see "Splicing Copper Wire." Use crimp and seal splices whenever possible. When using splice clips, refer to page 8A-5-4; when using crimp and seal splice sleeves, refer to page 8A-5-6.

To replace a damaged fusible link which feeds two harness wires, cut them both off beyond the splice. Use two repair links, one spliced to each harness wire (see Figure 5).

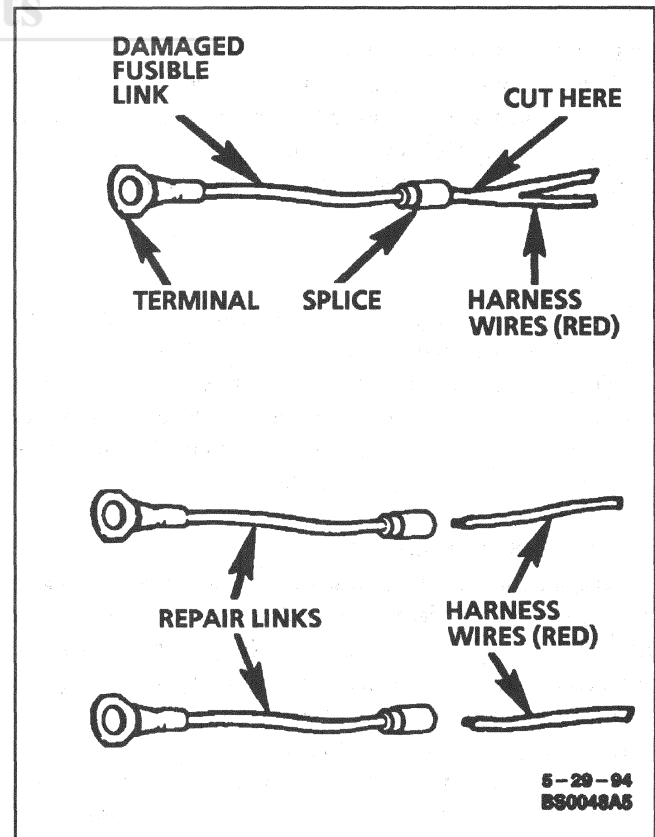


Figure 5 - Double Wire Feed Fusible Link

REPAIR PROCEDURES

TYPICAL ELECTRICAL REPAIRS

An open circuit is an incomplete circuit. Power cannot reach the load or reach ground. If a circuit is open, active components do not energize. A short circuit is an unwanted connection between one part of the circuit and either ground or another part of the circuit. A short circuit causes a fuse to blow or a circuit breaker to open.

REPAIRING SHORT CIRCUITS CAUSED BY DAMAGED WIRE INSULATION

- Locate the damaged wire.
- Find and correct the cause of the wire insulation damage.
- For minor damage, tape over the wire. If damage is more extensive, replace the faulty segment of the wire (refer to the splicing instructions for copper or shielded cable for the correct splicing procedure).

SPLICING COPPER WIRE USING SPLICE CLIPS

Splice clips are included in the J 38125-A Terminal Repair Kit. The splice clip is a general purpose wire repair device. It may not be acceptable for applications having special requirements such as moisture sealing. Refer to the appropriate Service Manual section to determine if there are any special requirements.

Step 1: Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" to cut open the harness (available from sewing supply stores). If the harness has a black plastic conduit, simply pull out the desired wire.

Step 2: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of the wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40 mm (1.5 in.) away from other splices, harness branches or connectors.

Step 3: Strip the Insulation

When replacing a wire, use a wire of the same size as the original wire or larger. The schematics list wire size in metric units. The following table (Figure 6) shows the commercial (AWG) wire sizes that can be used to replace each metric wire size. Each AWG size is either equal to or larger than the equivalent metric size.

To find the correct wire size either find the wire on the schematic page and convert the metric size to the AWG size, or use an AWG wire gage.

If you aren't sure of the wire size, start with the largest opening in the wire stripper and work down until a clean strip of the insulation is removed. Be careful to avoid nicking or cutting any of the wires.

METRIC WIRE SIZES (mm ²)	AWG SIZES
0.22	24
0.35	22
0.5	20
0.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4
32.0	2

Figure 6 - Wire Size Conversion Table

Step 4: Crimp the Wires

Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included in the J 38125-A Terminal Repair Kit. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the stripped wire ends and hold them between your thumb and forefinger as shown in Figure 7. Then, center the splice clip under the stripped wires and hold it in place.

- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the former touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes (see Figure 8).
- Before crimping the ends of the clip, be sure that:
 - The wires extend beyond the clip in each direction.
 - No strands of wire are cut loose.
 - No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires (see Figure 9).

Step 5: Solder

Apply 60/40 rosin core solder to the opening in the back of the clip (see Figure 10). Follow the manufacturer's instruction for the solder equipment you are using.

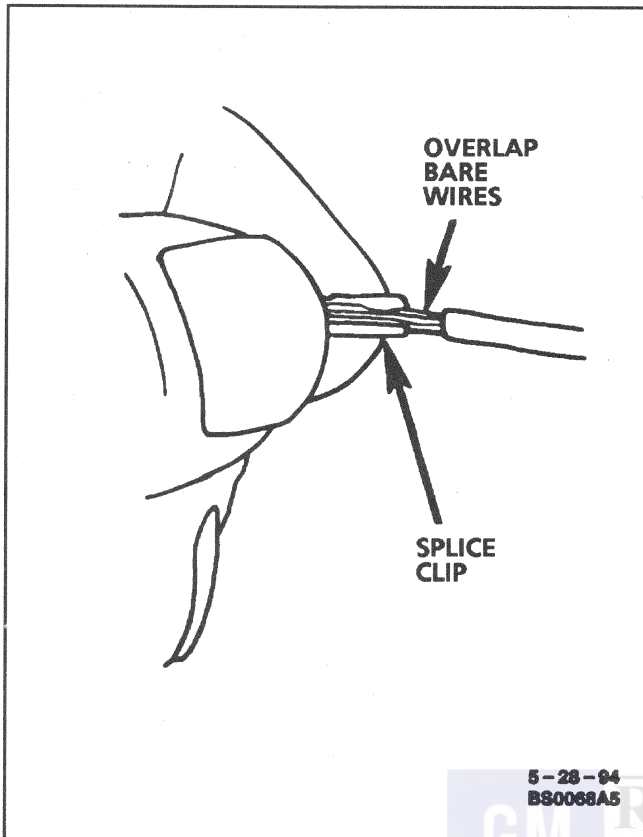


Figure 7 - Centering the Splice Clip

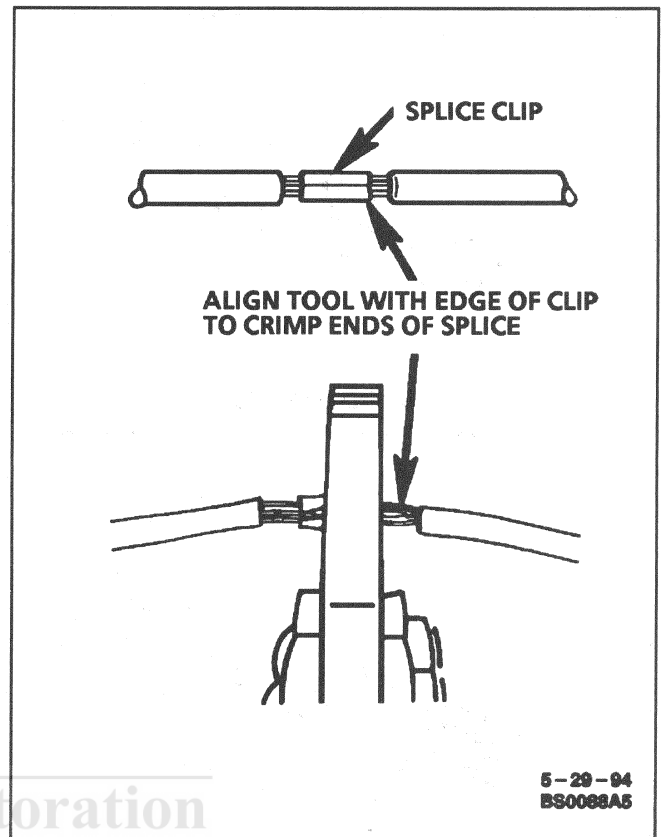


Figure 9 - Completing the Crimp

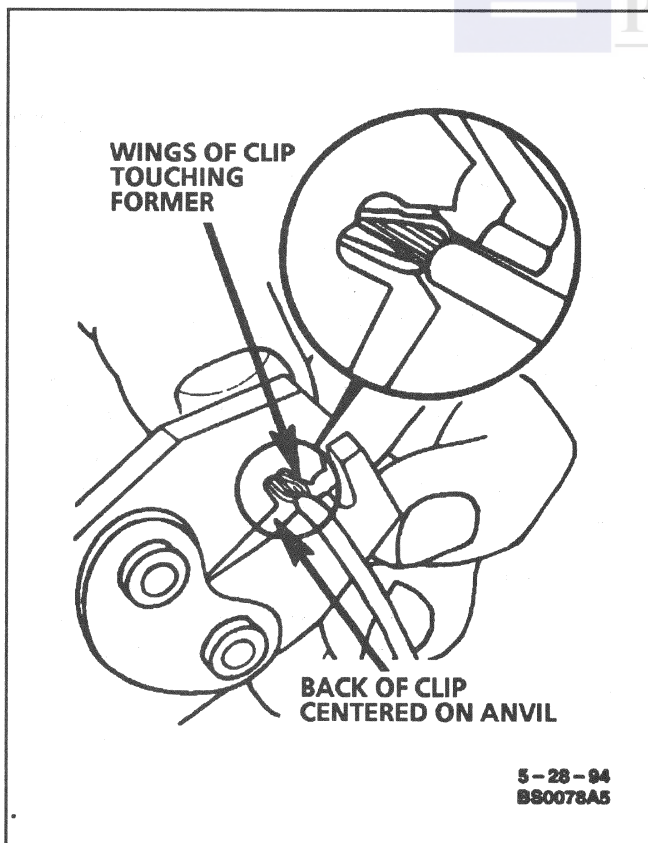


Figure 8 - Crimping the Splice Clip

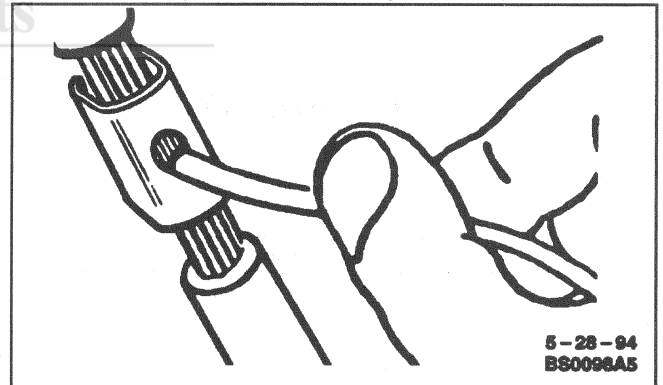


Figure 10 - Applying the Solder

Step 6: Tape the Splice

Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness (see Figure 11).

If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape (Figure 12).

REPAIR PROCEDURES

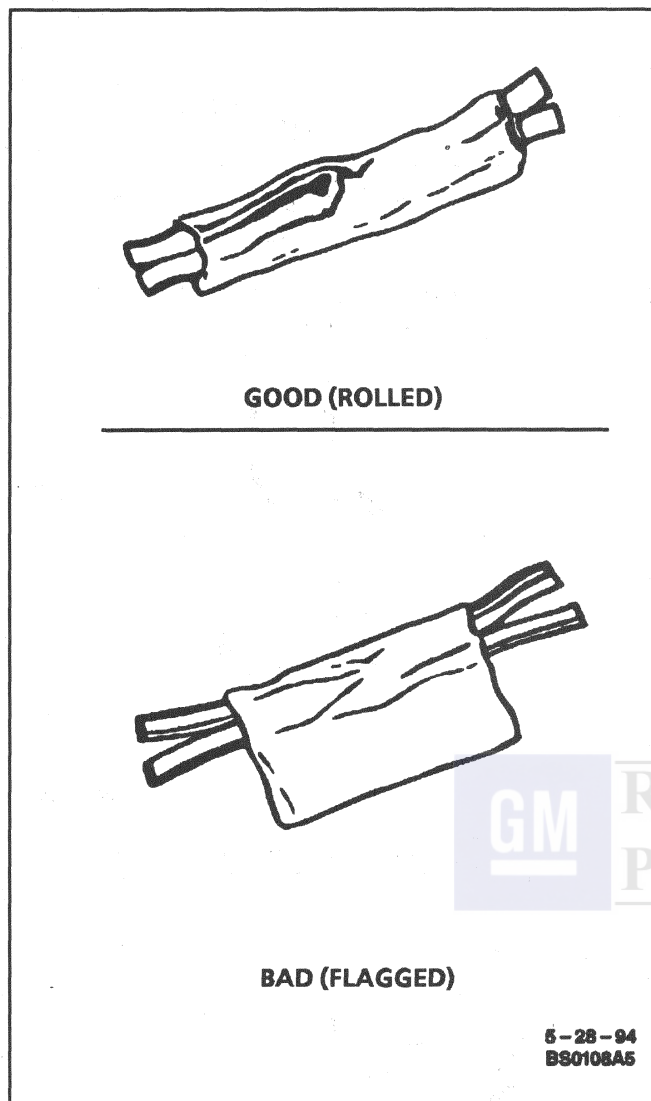


Figure 11 - Proper First Taping

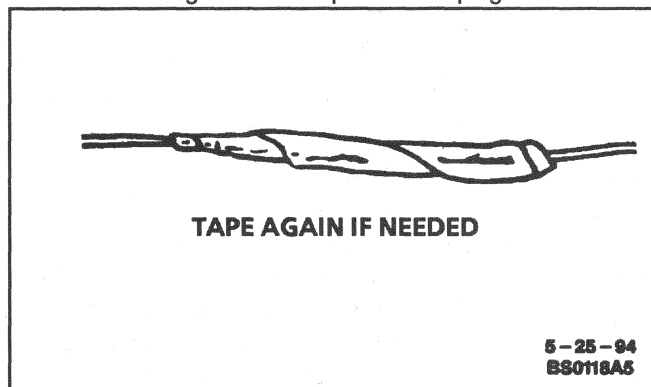


Figure 12 - Proper Second Taping

SPlicing COPPER WIRE USING CRIMP AND SEAL SPLICE SLEEVES

Crimp and seal splice sleeves may be used on all types of insulation except Tefzel and coaxial to form a one-to-one splice. They are to be used where there are special requirements such as moisture sealing. Refer to the appropriate section of the Service Manual to determine if the crimp and seal is necessary. Crimp and seal splice sleeves are included in the J 38125-A Terminal Repair Kit.

Step 1: Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" to cut open the harness (available from sewing supply stores). The crimp and seal splice sleeves may be used on all types of insulation except Tefzel and coaxial and may only be used to form a one-to-one splice.

Step 2: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40 mm (1.5 in.) away from other splices, harness branches or connectors. This will help prevent moisture from bridging adjacent splices and causing damage.

Step 3: Strip the Insulation

If it is necessary to add a length of wire to the existing harness, be certain to use the same size as the original wire (refer to Figure 6, "Wire Size Conversion Table").

To find the correct wire size either find the wire on the schematic and convert the metric size to the equivalent AWG size or use an AWG wire gage. If unsure about the wire size, begin with the largest opening in the wire stripper and work down until a clean strip of the insulation is removed. Strip approximately 7.5 mm (5/16 in.) of insulation from each wire to be spliced. Be careful to avoid nicking or cutting any of the wires. Check the stripped wire for nicks or cut strands. If the wire is damaged, repeat this procedure after removing the damaged section.

Step 4: Select and Position the Splice Sleeve

Select the proper splice sleeve according to wire size. The splice sleeves and tool nests are color coded (see following chart).

CRIMP AND SEAL SPLICE SLEEVE CHART

Color splice sleeve	Crimp tool nest color	Wire gage AWG/(metric)
Salmon (yellowish-pink)	Red	20, 18/(0.5, 0.8)
Blue	Blue	16, 14/(1.0, 2.0)
Yellow	Yellow	12, 10/(3.0, 5.0)

Using the J 38125-8 splice crimp tool (Figure 13), position the splice sleeve in the proper color nest of the hand crimp tool. Place the splice sleeve in the nest so that the crimp falls midway between the end of the barrel and the stop.

The sleeve has a stop in the middle of the barrel to prevent the wire from going further (see Figure 14). Close the hand crimper handles slightly to hold the splice sleeve firmly in the proper nest.

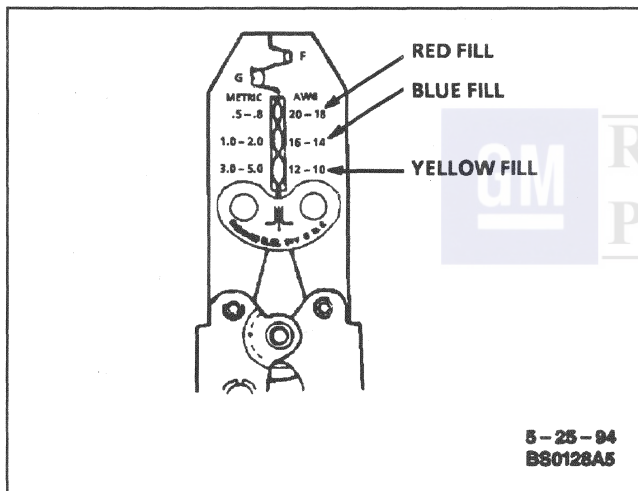


Figure 13 - Hand Crimp Tool

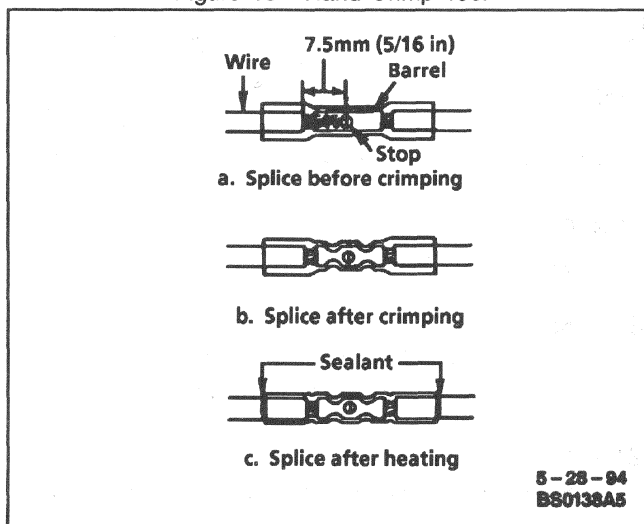


Figure 14 - Seal Splice Sequence

Step 5: Insert Wires into Splice Sleeve and Crimp

Insert the wire into the splice sleeve until it hits the barrel stop and close the handles of the J 38125-8 crimper tightly until the crimper handles open when released. The crimper handles will not open until the proper amount of pressure is applied to the splice sleeve. Repeat steps 4 and 5 for opposite end of the splice.

Step 6: Shrink the Insulation Around the Splice

Using the Ultratorch J 38125-5 (follow instructions that accompany Ultratorch), apply heat where the barrel is crimped. Gradually move the heat barrel to the open end of the tubing, shrinking the tubing completely as the heat is moved along the insulation. A small amount of sealant will come out of the end of the tubing when sufficient shrinking is achieved (Figure 14).

SPLICING TWISTED/SHIELDED CABLE

Twisted/shielded cable is sometimes used to protect wiring from electrical noise (stray signals). For example, two-conductor cable of this construction is used between the ECM and the distributor. See Figure 15 for a breakdown of twisted/shielded cable construction.

Step 1: Remove Outer Jacket

Remove the outer jacket and discard it. Be careful to avoid cutting into the drain wire or the mylar tape.

Step 2: Unwrap the Tape

Unwrap the aluminum/mylar tape, but do not remove it. The tape will be used to rewrap the twisted conductors after the splices have been made.

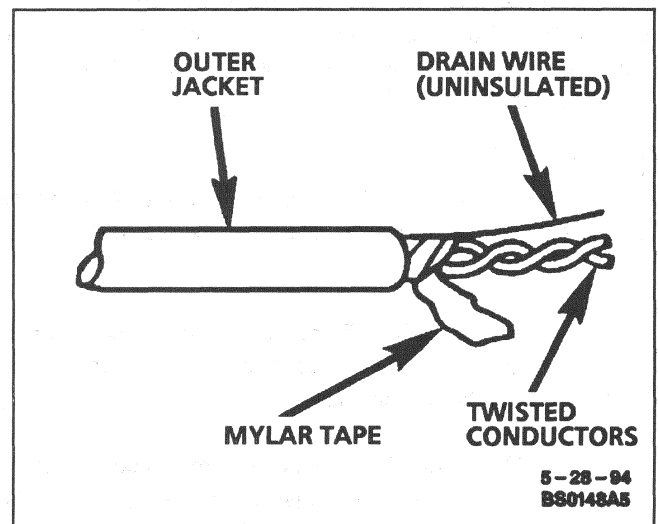


Figure 15 - Twisted/Shielded Cable

REPAIR PROCEDURES

Step 3: Prepare the Splice

Untwist the conductors. Then, prepare the splice by following the splicing instructions for copper wire presented earlier. Remember to stagger splices to avoid shorts (Figure 16).

Step 4: Re-assemble the Cable

After you have spliced and taped each wire, rewrap the conductors with the mylar tape. Be careful to avoid wrapping the drain wire in the tape.

Next, splice the drain wire following the splicing instructions for copper wire. Then, wrap the drain wire around the conductors and mylar tape (Figure 17).

Step 5: Tape the Cable

Tape over the entire cable using a winding motion (see Figure 18). This tape will replace the section of the jacket you removed to make the repair.

REPAIRING CONNECTORS

- The following general repair procedures can be used to repair most types of connectors. The repair procedures are divided into three general groups: Push-to-Seat and Pull-to-Seat and Weather Pack®.
- See "Harness Connector Faces," page 8A-202-0, to determine which type of connector is to be serviced.
- Use the proper Pick(s) or Tool(s) that apply to the terminal.
- The Terminal Repair Kit (J 38125-A) contains further information.

PUSH-TO-SEAT AND PULL-TO-SEAT CONNECTOR REPAIR

Follow the steps below to repair Push-to-Seat (Figure 19) or Pull-to-Seat (Figure 20) connectors. The steps are illustrated with typical connectors. Your connector may differ, but the repair steps are similar. Some connectors do not require all the steps shown. Skip those that don't apply.

Step 1:

Remove any CPA (Connector Position Assurance) Locks. CPAs are designed to retain connectors when mated.

Step 2:

Remove any TPA (Terminal Position Assurance) Locks. TPAs are designed to keep the terminal from backing out of the connector.

NOTICE: The TPA must be removed prior to terminal removal and must be replaced when the terminal is repaired and resealed.

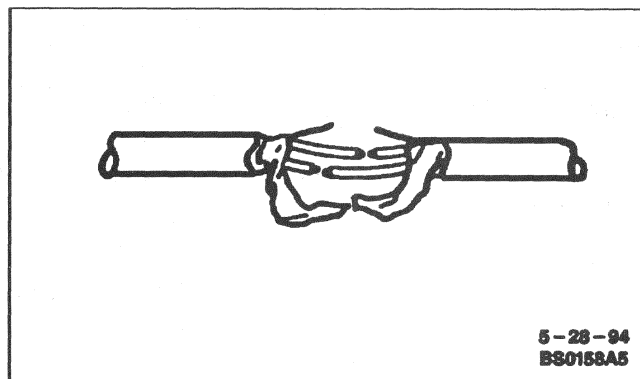


Figure 16 - The Untwisted Conductors

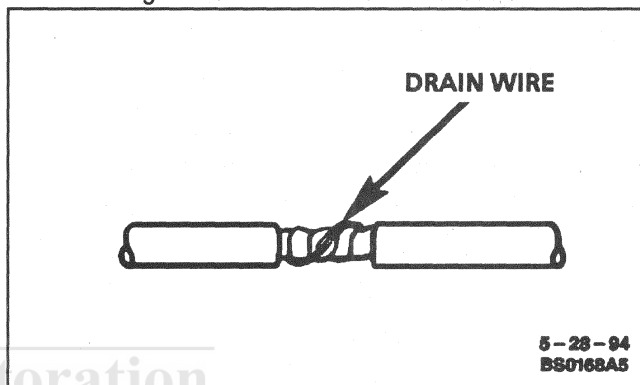


Figure 17 - The Re-assembled Cable

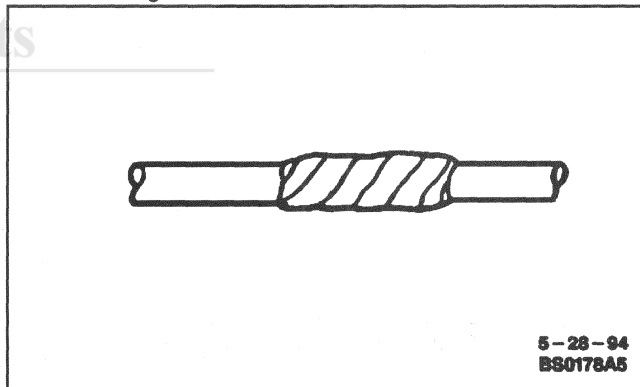


Figure 18 - Proper Taping

Step 3:

Open any secondary locks. A secondary lock aids in terminal retention and is usually molded to the connector.

Step 4:

Separate the connector halves and back out seals.

Step 5:

Grasp the lead and push the terminal to the forward most position. Hold the lead at this position.

Step 6:

Locate the terminal lock tang in the connector canal.

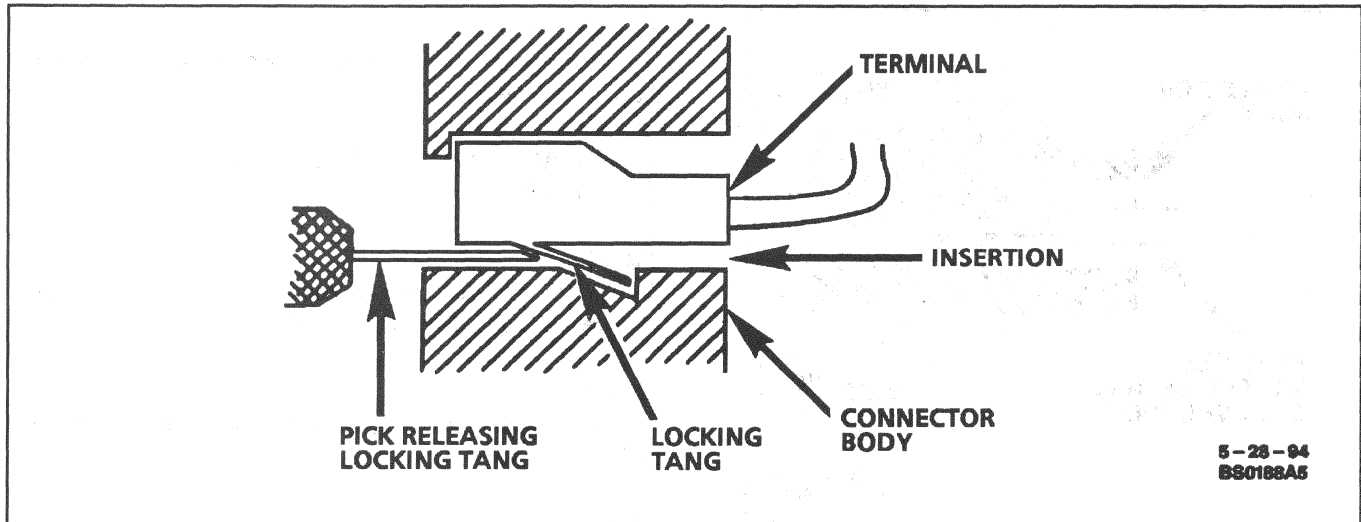


Figure 19 - Typical Push-to-Seat Connector and Terminal

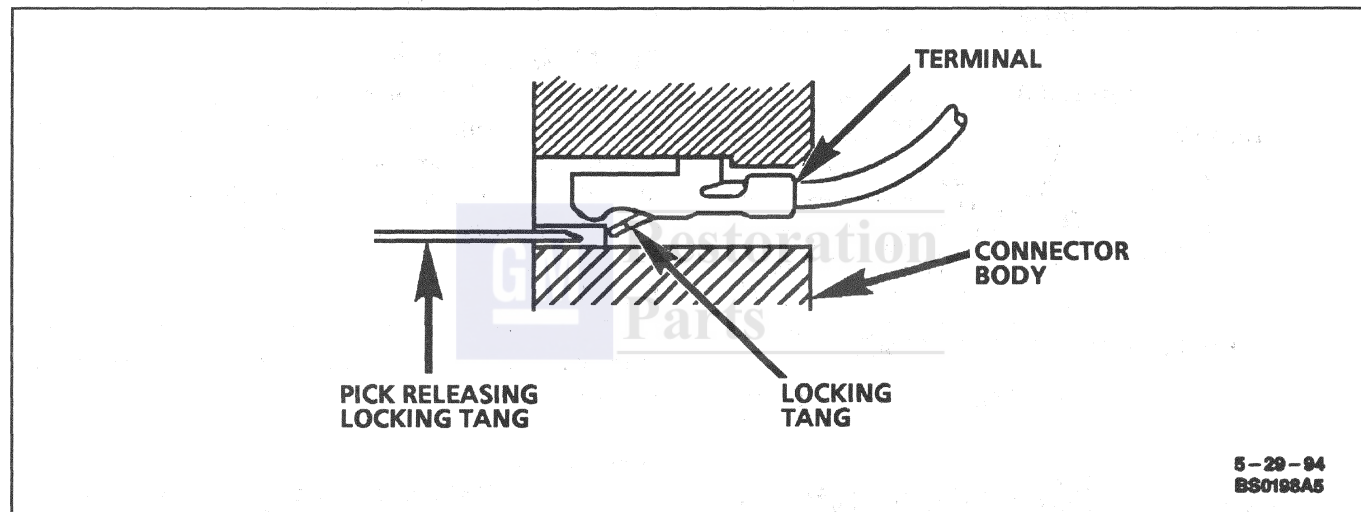


Figure 20 - Typical Pull-to-Seat Connector and Terminal

Step 7:

Insert the proper size pick (refer to Terminal Repair Kit J 38125-A) straight into the connector canal at the mating end of the connector.

Step 8:

Depress the locking tang to unseat the terminal.

- Push-to-Seat—Gently pull on the lead to remove the terminal through the back of the connector.
- Pull-to-Seat—Gently push on the lead to remove the terminal through the front of the connector.

NOTICE: Never use force to remove a terminal from a connector.

Step 9:

Inspect terminal and connector for damage. Repair as necessary (see "Terminal Repair," page 8A-5-10).

Step 10:

Reform lock tang and reseal terminal in connector body. Apply grease if connector was originally equipped with grease.

Step 11:

Install any CPAs or TPAs, close any secondary locks and join connector halves.

WEATHER PACK® CONNECTOR REPAIR

Follow the steps below to repair Weather Pack® connectors (Figure 21).

Step 1:

Separate the connector halves.

Step 2:

Open secondary lock. A secondary lock aids in terminal retention and is usually molded to the connector.

REPAIR PROCEDURES

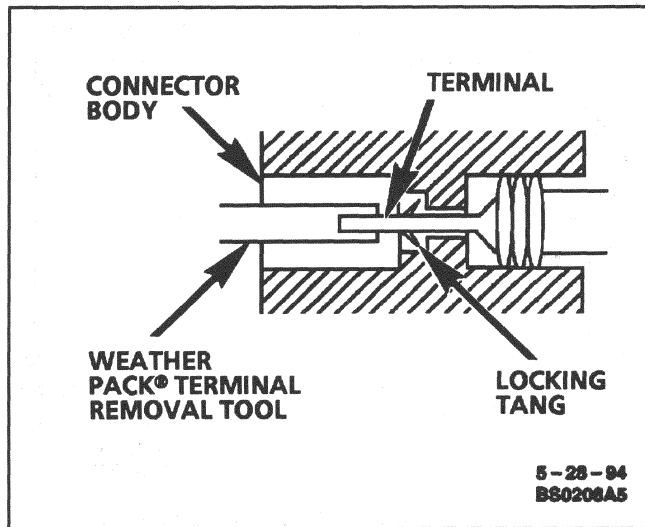


Figure 21 - Typical Weather Pack® Connector and Terminal

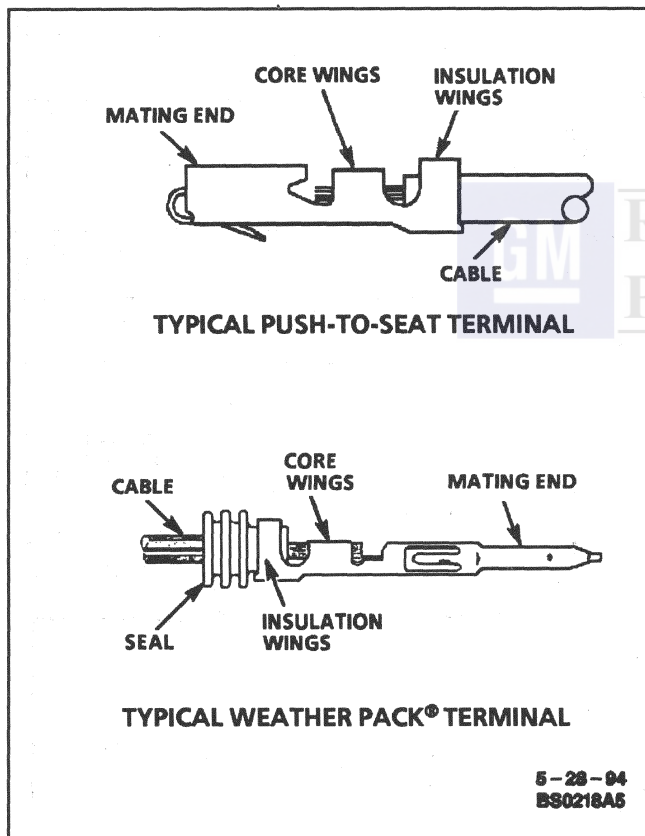


Figure 22 - Terminal Repair

Step 3:

Grasp the lead and push the terminal to the forward most position. Hold the lead at this position.

Step 4:

Insert the Weather Pack® terminal removal tool into the front (mating end) of the connector cavity until it rests on the cavity shoulder.

Step 5:

Gently pull on the lead to remove the terminal through the back of the connector.

NOTICE: Never use force to remove a terminal from a connector.

Step 6:

Inspect the terminal and connector for damage. Repair as necessary (see "Terminal Repair," on this page).

Step 7:

Re-form the lock tang and reseal terminal in connector body.

Step 8:

Close secondary locks and join connector halves.

TERMINAL REPAIR

The following repair procedures can be used to repair Push-to-Seat, Pull-to-Seat or Weather Pack® terminals (Figure 22). Some terminals do not require all steps shown. Skip those that don't apply. The Terminal Repair Kit (J 38125-A) contains further information.

Step 1:

Cut off terminal between core and insulation crimp (minimize wire loss) and remove seal for Weather Pack® terminals.

Step 2:

Apply correct seal per gauge size of wire and slide back along wire to enable insulation removal (Weather Pack® terminals only).

Step 3:

Remove insulation.

Step 4:

Align seal with end of cable insulation (Weather Pack® terminals only).

Step 5:

Position strip (and seal for Weather Pack®) in terminal.

Step 6:

Hand crimp core wings.

Step 7:

Hand crimp insulation wings (non-Weather Pack®). Hand crimp insulation wings around seal and cable (Weather Pack®).

Step 8:

Solder all hand crimped terminals.

DIODE REPLACEMENT

Many vehicle electrical systems use a diode to isolate circuits and protect the components from voltage spikes. When installing a new diode, use the following procedure:

Step 1: Open the Harness

If the diode is taped to the harness, remove all of the tape.

Step 2: Remove Inoperative Diode

Paying attention to current flow direction, remove inoperative diode from the harness with a suitable soldering tool. If the diode is located next to a connector terminal, remove the terminal(s) from the connector to prevent damage from the soldering tool.

Step 3: Strip the Insulation

Carefully strip away a section of insulation next to the old soldered portion of the wire(s). Do not remove any more than is needed to attach the new diode.

Step 4: Install New Diode

Check current flow direction of the new diode, being sure to install the diode with correct bias. Reference the appropriate service manual wiring schematic to obtain the correct diode installation position. Reference Figure 23 for replacement diode symbols and current flow explanations. Attach the new diode to the wire(s) using 60/40 rosin core

solder. Use a heat sink (aluminum alligator clip) attached across the diode wire ends to protect the diode from excess heat. Follow the manufacturer's instructions for the soldering equipment you are using.

Step 5: Install Terminal(s)

Install terminal(s) into the connector body if previously removed in Step 2.

Step 6: Tape Diode to Harness

Tape the diode to the harness or connector using electrical tape. To prevent shorts to ground and water intrusion, completely cover all exposed wire and diode attachment points.

ACCEPTABLE DIODE REPLACEMENTS

Diode Brand	Rating Number	Rating	P/N
GMSP0	1N4004	1 amp, 400 PIV	12112421
GMSP0	1N5404	3 amp, 400 PIV	12112422
GMSP0	1N4001	1 amp, 50 PIV	16020519
GMSP0	1N4005	1 amp, 600 PIV	16011840
GMSP0	1N4004	1 amp, 400 PIV	16039386

In the event 1 amp, 50 PIV (Peak Inverse Rating) diodes are unavailable, a universal diode with a 1 amp, 400 PIV rating can be used for the following applications:

- A/C Compressor Clutch
- ABS/4WAL (the ABS Diode on the Delco Moraine is hidden inside of an electrical connector under the carpet at the right panel)

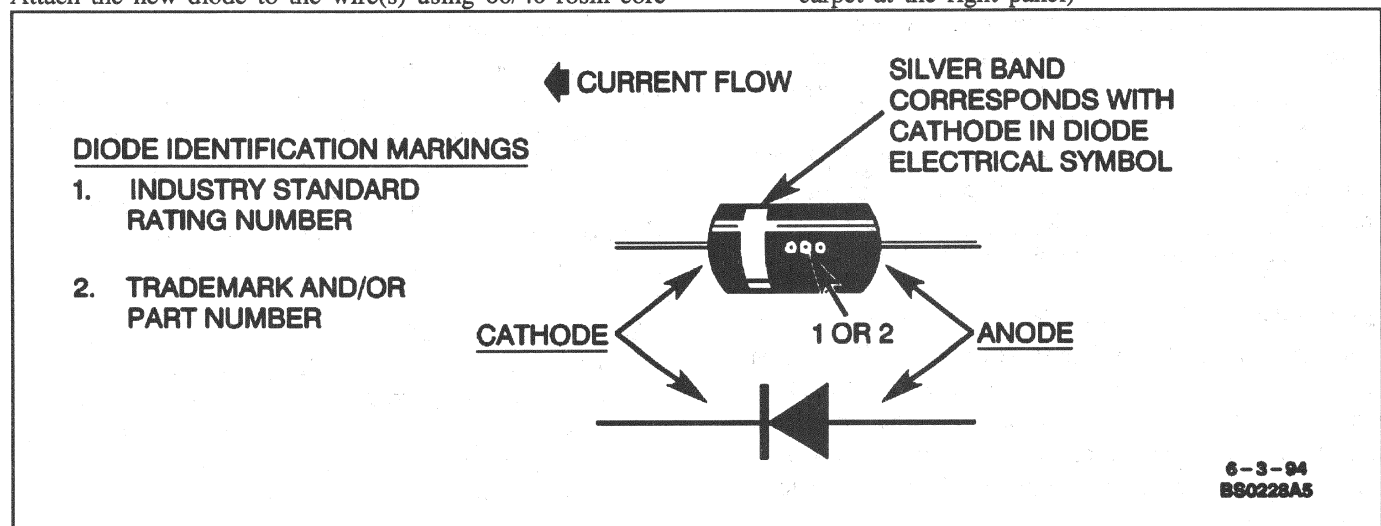


Figure 23 - Diode Identification

REPAIR PROCEDURES

- Wiper
- Charging System (hidden in wire harness)
- Parking Brake (vehicle with ABS)
- Relays
- Solenoids
- Diesel Glow Plug Circuit

HEATED OXYGEN SENSOR (HO2S) REPAIR

If the Heated Oxygen Sensor pigtail wiring, connector or terminal is damaged, the entire Oxygen Sensor Assembly must be replaced. Do not attempt to repair the wiring, connector or terminals. In order for the sensor to function properly, it must have provided to it a clean air reference. This clean air reference is obtained by way of the Oxygen Sensor signal and heater wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference and degraded Oxygen Sensor performance.

The following guidelines should be used when servicing the Heated Oxygen Sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance. Also, the sensor pigtail and harness wires must not be damaged in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Neither the sensor or vehicle lead wires should be bent sharply or kinked. Sharp bends, kinks, etc., could block the reference air path through the lead wire.
- Do not remove or defeat the Oxygen Sensor ground wire (where applicable). Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will also cause poor engine performance.
- To prevent damage due to water intrusion, be sure that the peripheral seal remains intact on the vehicle harness connector.

The Engine Harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit J 38125-A. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.

OBDII CIRCUIT REPAIRS

Repairs for On-Board Diagnostics II (OBDII) emission control circuits follow the procedures stated in SECTION 8A-5. When servicing OBDII circuits, the following guidelines are also essential:

- Do not move or alter grounds from their manufactured locations.
- Do not tie aftermarket accessories into OBDII circuits.

- Only repair OBDII circuits in accordance with the manufactured configuration.
- Always replace a relay in an OBDII circuit the same replacement part. Damaged relays should be discarded, not repaired.
- Refer to SECTION 8A-11 to identify OBDII circuit fusing.
- Make sure that CPA (connector position assurance) locks and TPA (terminal position assurance) locks are reinstalled on connectors that use them.
- After repair of connectors or connector terminals, make sure to achieve proper terminal retention. Refer to REPAIRING CONNECTORS on page 8A-5-8 for procedures.
- Before repairing OBDII heated oxygen sensors and related wiring, always review the special repair guidelines provided on page 8A-5-12 under HEATED OXYGEN SENSOR REPAIR.
- When installing an electrical ground fastener, be sure to apply the specified torque. Ground torque specifications are listed in SECTION 8A-14.
- After repair of connectors, make sure to reinstall connector seals, where used. Inspect seals for wear and damage. Replace worn or damaged seals.

GMSP0 SERVICE PARTS**GMSP0 STANDARD PARTS CATALOG**

Check the GMSP0 Standard Parts Catalog, Group 8.965. Fuses, circuit breakers, connectors, terminals, conduit, pigtail kits, and seals are listed in that group.

GMSP0 CARLINE PARTS CATALOG

The GMSP0 Carline Parts Catalog, Group 2.535 contains connector repair kits with terminals and leads.

COMPLETE HARNESS

In many cases repairs can be made by ordering pigtail assemblies (prewired connectors) rather than the entire wiring harness. Only order complete harnesses when there is major damage to the wiring harness. Always repair minor damage. Complete harnesses and pigtail part numbers can be found in the GMSP0 Carline Parts Catalog.

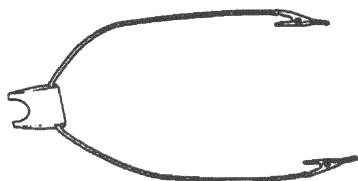
ORDERING SERVICE PARTS

1. If you can't find the repair parts you need in the J 38125-A Terminal Repair Kit, GMSP0 Standard Parts Catalog, or the GMSP0 Carline Parts Catalog, refer to SECTION 8A-202 (Harness Connector Faces) to find a listing of the OE part number(s).

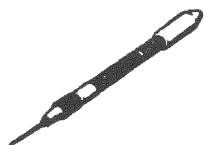
2. Call PARTECH (1-800-433-6961) and give the PARTECH advisor the OE part number(s). The PARTECH advisor can determine if there is a GMSPO part number(s) for the OE part number(s).
3. If PARTECH cannot find a GMSPO part number, call the Service Parts Assistance Center (SPAC) with the OE part number(s). The SPAC advisor will assist you in placing a priority order using the "No Part Number" process with the Packard Electric Division. The SPAC advisor may have you place the order with the Packard Electric Division (1-800-PACKARD). Parts are typically shipped within 24 hours direct to your dealership.



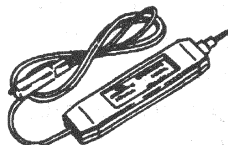
REPAIR PROCEDURES



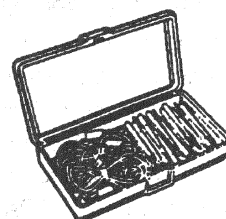
J 36169
Jumper Wire



J 35689 - A
Micro-Pack Connector
Terminal Remover



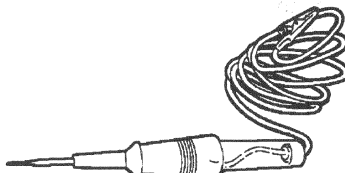
J 34636
Solenoid, Relay
and Circuit Tester



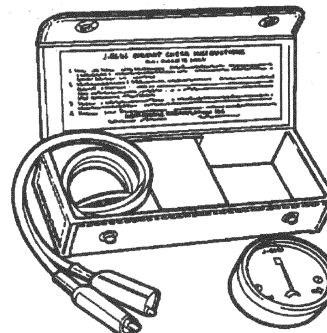
J 35616 - A
Connector Test Adapter Kit



J 36400 - 5
Weather Pack II Terminal Remover



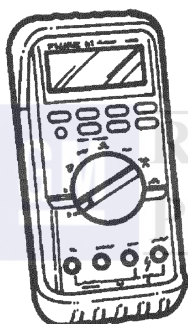
J 34142 - B
Unpowered Test Light



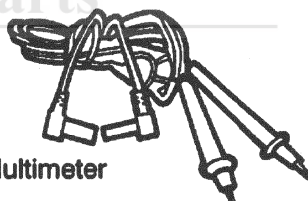
J 8681 - A
Universal Short Checker



J 22727
Electrical Terminal Remover



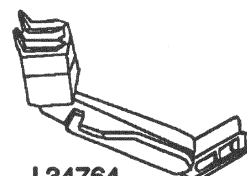
J 39200
Digital Multimeter



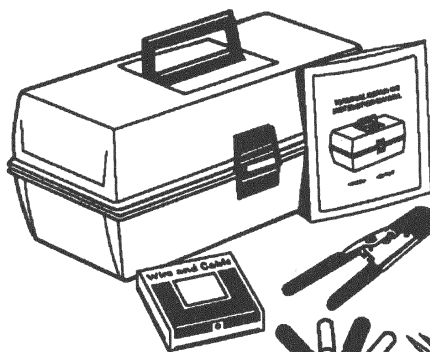
J 21008 - A
Self-Powered Test Light



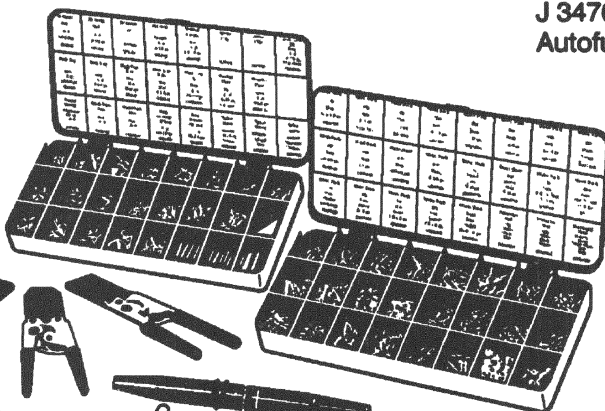
J 33095
Terminal Remover: Micro Pack,
Com-Pack III and ECM Edgeboard
Connectors



J 34764
Autofuse Tester

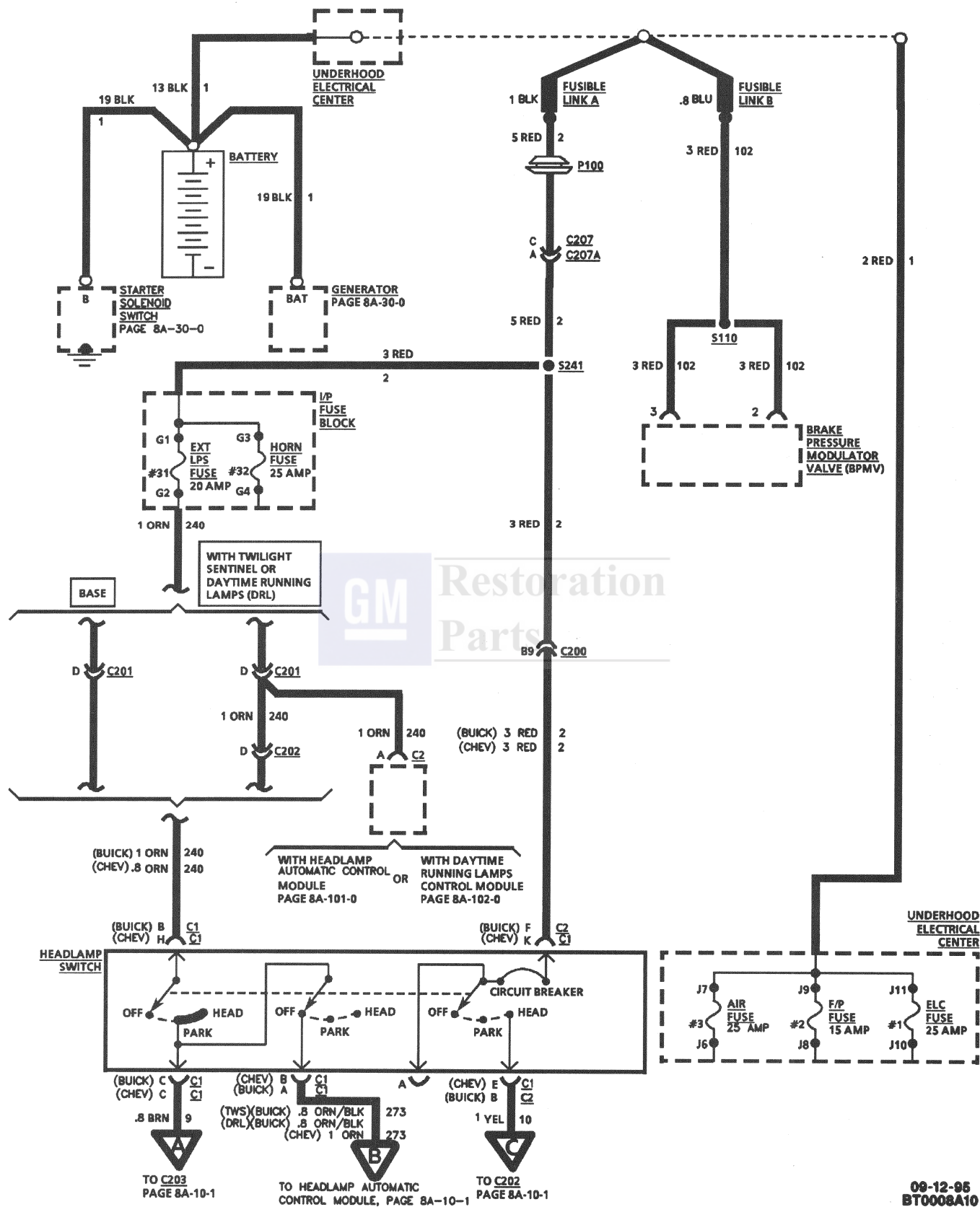


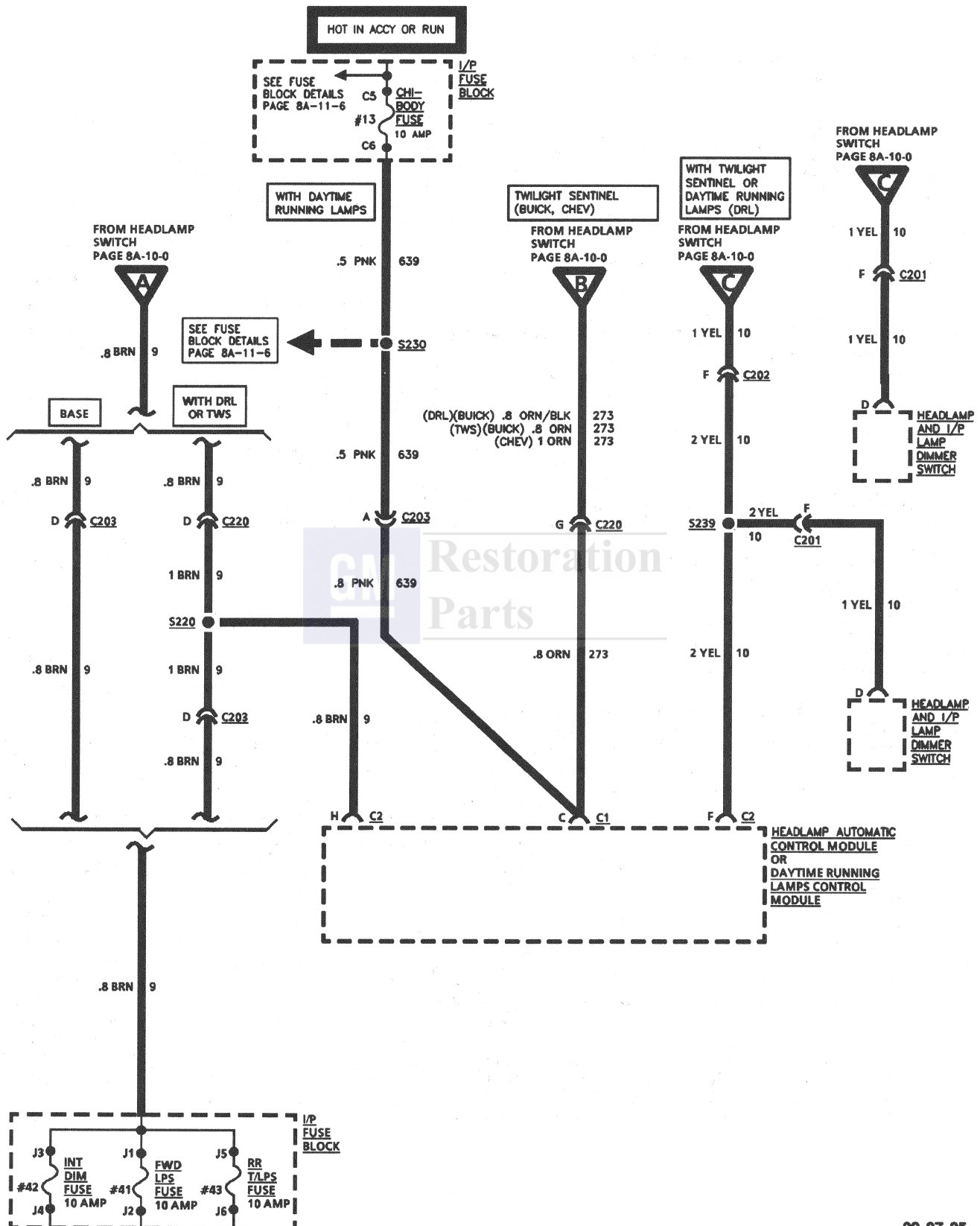
J 38125 - A
Terminal Repair Kit





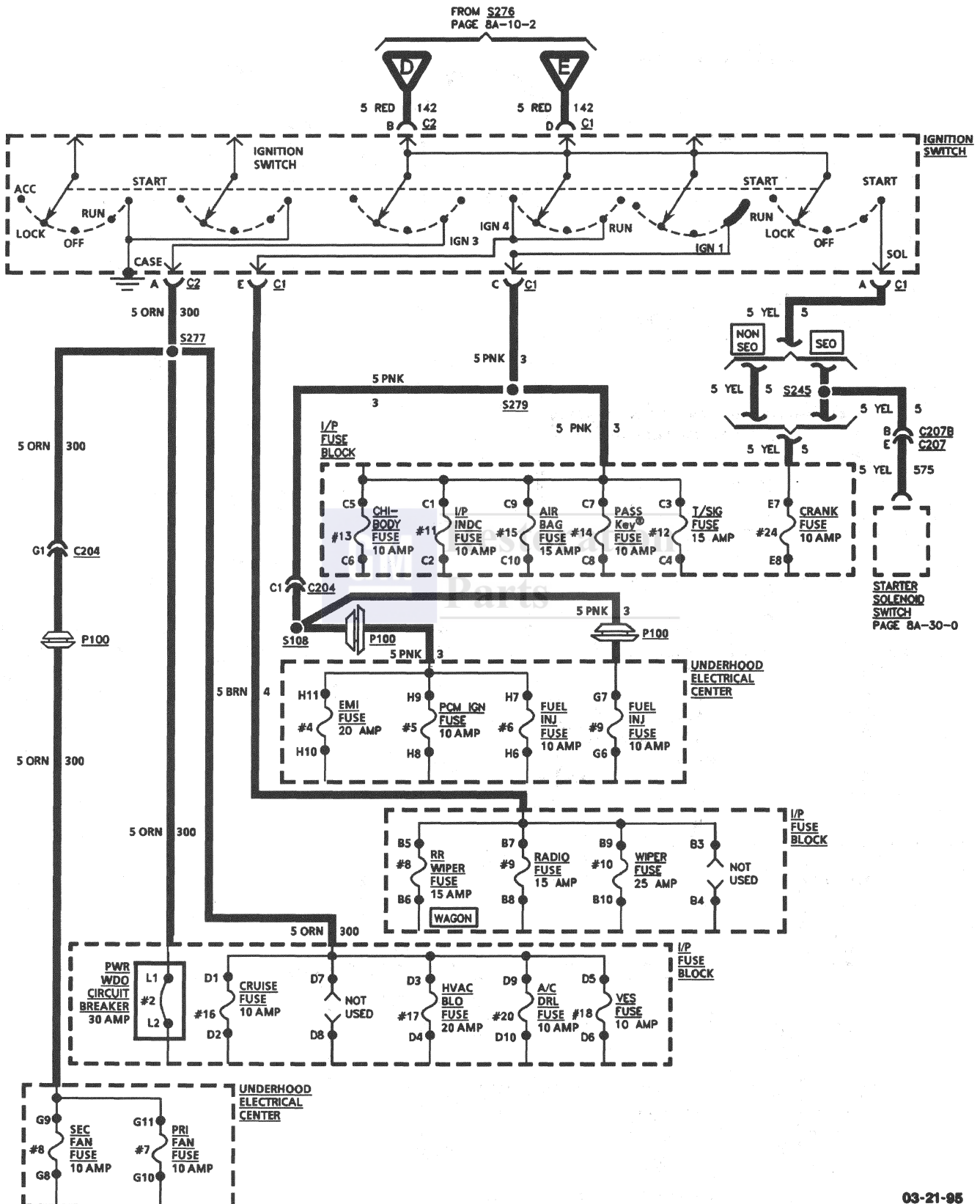
POWER DISTRIBUTION





POWER DISTRIBUTION



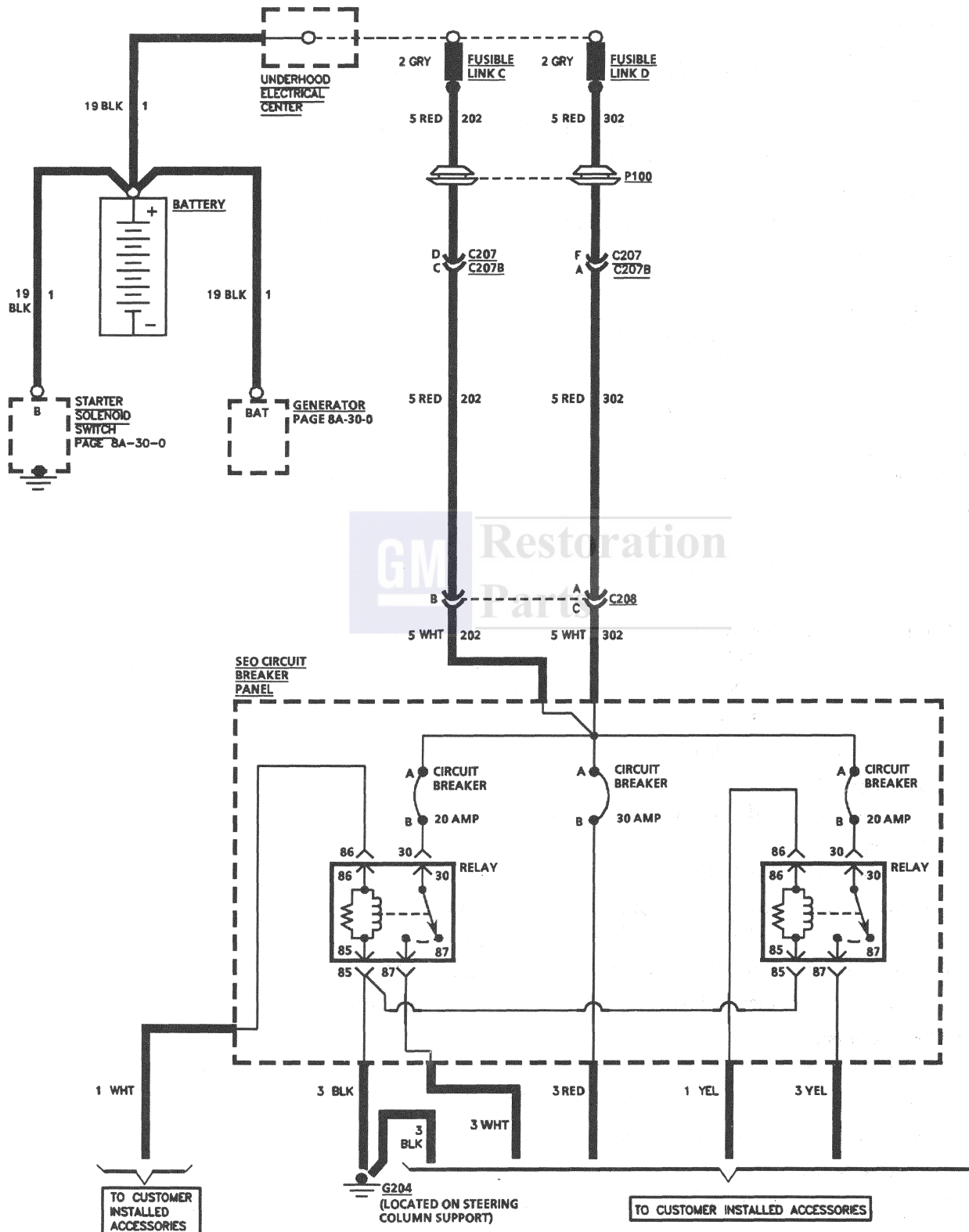


POWER DISTRIBUTION SEO



POWER DISTRIBUTION

SEO (6J1)



8A - 10 - 6 ELECTRICAL DIAGNOSIS

POWER DISTRIBUTION

COMPONENT	LOCATION	201-PG	FIG.	CONN
Auxiliary Fuse Block (with 7Z5)	LH I/P left of Brake Pedal Bracket, attached to Convenience Center	11	19	
Auxiliary Junction Block (SEO)	RH side of Engine compartment beneath Overflow Reservoir	9	15	
Battery	RH Front Engine Compartment	9	15	
Blower Motor High Speed Relay	Under RH I/P, right of Blower Motor			
Brake Pressure Modulator Valve (BPMV) (with Electronic Brake Control Module) (EBCM)	LH Engine Compartment, part of Electronic Brake Control Module			
Circuit Breaker Panel (with 6J1)	Near base of Steering Column			
Daytime Running Lamps (DRL) Control Module	RH "A" Pillar, behind kickpad	18	29	202-10
Fusible Link A	RH Engine Compartment, bolted to Underhood Electrical Center			
Fusible Link B	RH Engine Compartment, bolted to Underhood Electrical Center			
Fusible Link C (SEO)	RH Engine Compartment, bolted to Auxiliary Junction Block			
Fusible Link D (SEO)	RH Engine Compartment, bolted to Auxiliary Junction Block			
Generator	RH side of Engine, forward of RH Valve Cover	7	12	
Headlamp Automatic Control Module	RH "A" Pillar, behind kickpad			
Headlamp and I/P Lamp Dimmer Switch	LH side of I/P			
Headlamp Switch	LH side of I/P, part of Headlamp and I/P Lamp Dimmer and Accessory Switch			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Ignition Switch	Mounted on upper RH side of Steering Column	13	21	
Starter Motor Theft Deterrent Relay	RH "A" Pillar, behind kickpad	11	19	
Starter Assembly	RH side of Engine, below Manifold			
Starter Solenoid Switch	Bottom of RH side of Engine, above Starter Motor			
Underhood Electrical Center	Engine Compartment, mounted to RH wheelhouse	9	15	
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities) (Base)	Body Harn to I/P Harn, at RH side of Steering Column, above C200	14	22	202-5

COMPONENT	LOCATION	201-PG	FIG.	CONN
C201 (6 cavities) (w/T61)	Body Harn to Daytime Running Lamps (DRL) Wiring Harn, at RH side of Steering Column, above C200	11	19.....	202-5
C201 (6 cavities) (w/T82)	Body Harn to Twilight Sentinel Wiring Harn, at RH side of Steering Column, above C200.....	11	19.....	202-5
C202 (6 cavities) (w/T61)	I/P Harn to Daytime Running (DRL) Lamps Wiring Harn, RH side of Steering Column, above C200.....	11	19.....	202-5
C202 (6 cavities) (w/T82)	I/P Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column, above C200.....	11	19.....	202-5
C203 (10 cavities) (Base).....	Body Harn to I/P Harn, at RH side of Steering Column.....	11	19.....	202-5
C203 (10 cavities) (w/T61)	Body Harn to Daytime Running Lamps (DRL) Wiring Harn, RH side of Steering Column	11	19.....	202-5
C203 (10 cavities) (w/T82)	Body Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column	11	19.....	202-5
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	18	29.....	202-3
C207 (6 cavities).....	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad	18	29	
C207A (3 cavities).....	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad	18	29	
C207B (3 cavities)	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad	18	29	
C208 (6 cavities) (w/6J1).....	Body Harn to Accessory Wiring Harn, LH side of Convenience Center			
C208 (6 cavities) (w/7Z5)	Body Harn to Accessory Wiring Harn, LH side of Convenience Center			
C220 (10 cavities) (w/T61)	I/P Harn to Daytime Running Lamps (DRL) Wiring Harn, at RH side of Steering Column.....	11	19.....	202-5
C220 (10 cavities) (w/T82)	I/P Harn to Twilight Sentinel Wiring Harn, at RH side of Steering Column	11	19.....	202-5
C250 (w/6J1)	Accessory Harn to Body Harn, RH side of Steering Column			
G204 (w/6J1).....	Located on Steering Column Support			
P100	RH I/P, forward of Blower Motor	18	29	
S108	Engine Harn, approx 19 cm from Underhood Electrical Center			
S110.....	Engine Harn, left side, approx 5 cm from G104 breakout, on Electronic Brake Control Module Conn branch			
S220 (w/T61).....	Daytime Running Lamp (DRL) Wiring Harn, approx 13 cm from Daytime Running Lamp Diode			
S220 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S226	Body Harn, approx 4 cm from Convenience Center branch breakout			

8A - 10 - 8 ELECTRICAL DIAGNOSIS

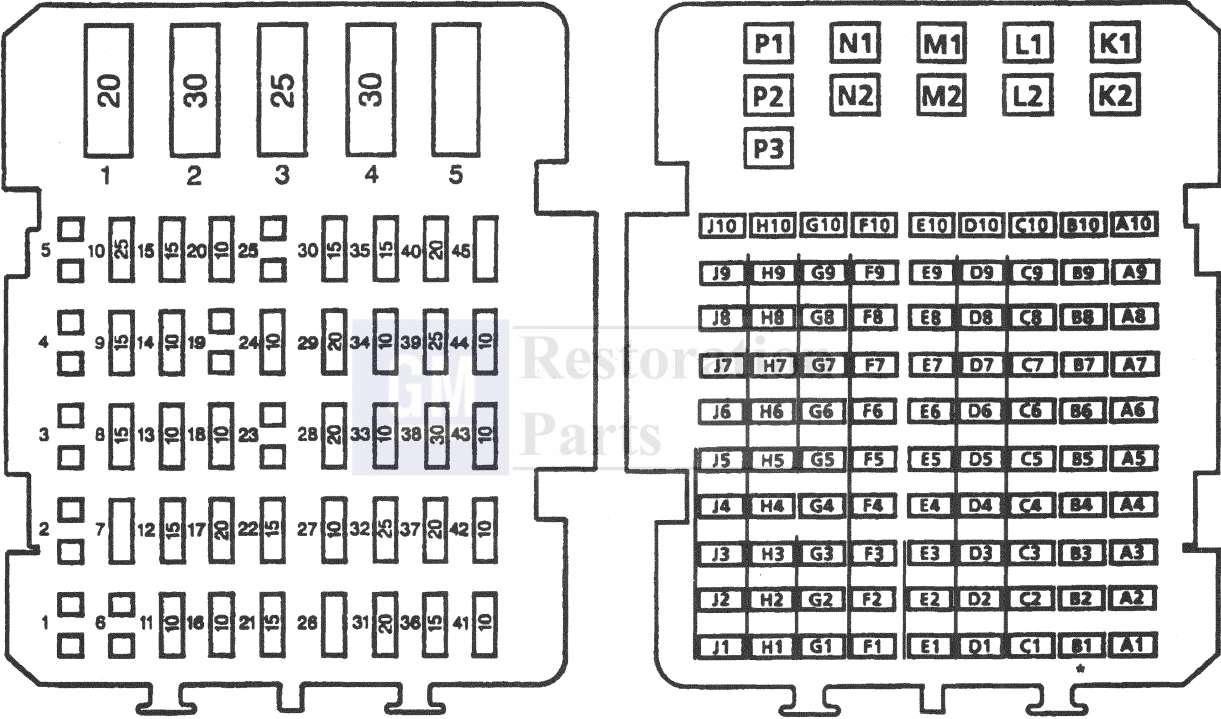
POWER DISTRIBUTION

COMPONENT	LOCATION	201-PG FIG.	CONN
S239 (w/T61).....	Daytime Running Lamp (DRL) Wiring Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout		
S239 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 8 cm from headlamp Automatic Control Ambient Light Sensor Conn branch breakout		
S241	Body Harn, approx 20 cm from SDM breakout		
S245 (Wagon).....	Body Harn, approx 4 cm from I/P Fuse Block breakout		
S276	Body Harn, approx 13 cm from SDM breakout		
S277	Body Harn, approx 18 cm from SDM breakout		
S279	Body Harn, approx 8 cm from Convenience Center branch breakout		





FUSE BLOCK DETAILS



* B5 B7 B9 WAGON

B3 B5 B7 B9 SEDAN WITH UV1/UV3

B7 B9 SEDAN WITHOUT UV1/UV3

FUSE	DESCRIPTION	PAGE
8	Rear Window Wiper and Washer and Multifunction Switch (Wagon)	8A-11-5
9	Radio	8A-11-5
10	Windshield Wiper and Windshield Washer Switch	8A-11-5
11	Rear Defog Relay, SDM, Rear Compartment Lid Release Switch, Headlamp Switch, I/P Cluster Rear Defog Switch	8A-11-6
12	Turn Signal Lamp Flasher, Backup Lamp/Transmission Position Sensor (PNP) Switch, BTSI	8A-11-6
13	Inside Rear View Mirror, Warning Alarm, Cruise Control Release Switch, Headlamp Auto Control Module, Daytime Running Lamp Control Module, Remote Control Door Lock Receiver, Automatic Level Control Sensor	8A-11-6
14	Theft Deterrent Module	8A-11-6
15	Inflatable Restraint Diagnostic, Energy Reserve (with sensor) Module (SDM)	8A-11-6
16	Cruise Control Module, Cruise Control Switch, Cruise Control Release Switch	8A-11-8
17	Heater and A/C Control, Low Blower Module Relay	8A-11-8
18	Power Steering Control Module, Heated Seats Control	8A-11-8
20	Electric Actuator, Vacuum and Electric Solenoid, Heater and A/C Control, Instrument Cluster, DRL	8A-11-8
21	SEO Fuse for RH Spot Lamp and SEO (6J6) Relay Panel	8A-11-9
22	SEO Fuse for LH Spot Lamp	8A-11-9
24	SDM, Theft Deterrent Relay	8A-11-10
27	Auto Level Control Sensor, Rear Compartment Courtesy Lamp, Mercury Switch (SEO)	8A-11-10
28	Cigar Lighter and DLC	8A-11-10
29	Remove Control Door Lock Receiver, Endgate Upper Latch Switch, Endgate Window Release Switch, Rear Compartment Lid Release Switch, Endgate Window Glass Release Relay, Rear Compartment Release Relay	8A-11-11
30	Radio	8A-11-11
31	Headlamp Switch, Headlamp Auto Control Module, Daytime Running Lamps Control Module	8A-11-12
32	Horn Relay	8A-11-12
33	Warning Alarm, I/P Compartment Lamp Switch, I/P Compartment Lamp, I/P Cluster, Heater and A/C Control	8A-11-12
34	Theft Deterrent Module	8A-11-12
35	Courtesy Lamp Relay, LH Front Door Lock Switch, RH Front Door Lock Switch, LH Front Door Courtesy Lamp, RH Front Door Courtesy Lamp, LH Rear Door Courtesy Lamp, RH Rear Door Courtesy Lamp, Outside Remove Control Rearview Mirror Switch, Dome Lamp, Inside Rearview Mirror, LH Sunshade Illuminated Mirror, RH Sunshade Illuminated Mirror, I/P Door Lamps, LH and RH Roof Rail Courtesy Lamps	8A-11-13
36	Rear Window Wiper Motor, Rear Compartment Lid Pulldown Actuator	8A-11-14
37	Stoplamp Switch, Hazard Lamp Flasher	8A-11-14
38	Blower Motor Control Module	8A-11-14
39	Power Door Lock Relay	8A-11-14
40	Seat Heat Control Module	8A-11-14
41	Turn Signal Switch, LH Front Side Marker Lamp, RH Front Side Marker Lamp, LH Park and Front Side Marker Lamp, RH Park and Front Side Marker Lamp	8A-11-15
42	Heater and A/C Control, Headlamp Switch, Instrument Cluster, Radio, Headlamp and Instrument Panel Lamp Dimmer Switch, Panel Lamps Dimming Module, Interior Lights Diode for SEO	8A-11-15

8A - 11 - 2 ELECTRICAL DIAGNOSIS

FUSE BLOCK DETAILS

FUSE	DESCRIPTION	PAGE
43	LH Opera Lamp, RH Opera Lamp, License Lamp, LH Marker Lamp, LH Inboard Taillamp, RH Inboard Taillamp, RH Marker Lamp, LH Outboard Tail/Turn Stoplamp, LH Inboard Tail/Turn Stoplamp, RH Inboard Tail/Turn Stoplamp, RH Outboard Tail/Turn Stoplamp	8A-11-16
44	Heated Power Mirrors	8A-11-18

T5718 (Continued)

FUSE	DESCRIPTION	PAGE
1	Radio Power Antenna Relay, Driver Seat Back Lumbar Support Switch, Driver Seat Recliner Switch, Passenger Seat Back Lumbar Support Switch, Passenger Seat Recliner Switch	8A-11-16
2	Master Power Side Window Switch, Power Side Window Lockout Switch, Power Window Control Module	8A-11-18
3	Driver Seat Adjuster Switch, Passenger Seat Adjuster Switch, Driver Seat Adjuster Memory Module	8A-11-18
4	Rear Window Defogger Switch, Rear Window Defogger Relay	8A-11-18

T5719

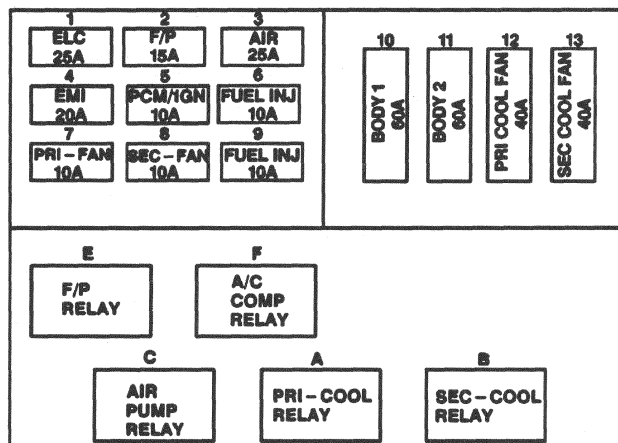


FUSE USAGE CHART										CIRCUIT BREAKERS	
1	X	2	X	3	X	4	X	5	X		
6	X	7	X	8	RR WPR 15A	9	RADIO 15A	10	WIPER 25A	1	PWR RECL 20A
11	I/P INDC 10A	12	T/SIG 15A	13	CHI BODY 10A *	14	PASS-KEY ^① 10A	15	AIR BAG 15A	2	PWR WDO 30A
16	CRUISE 10A	17	HVAC BLO 20A	18	VES 10A	19	X	20	A/C DRL 10A	3	PWR SEAT 25A
21	SEO 15A	22	SEO 15A	23	X	24	CRANK 10A	25	X	4	RR DEFG 30A
26	X	27	TRK LP 10A	28	CIG/DLC 20A	29	RR REL 20A	30	RADIO 15A	5	X
31	EXT LPS 20A	32	HORNS 25A	33	CLUS-CHI 10A	34	PASS-KEY ^① 10A	35	CTSY PWR LI 15A		
36	TRK PDWN 15A **	37	STOP/HZD 20A	38	HVAC MOD 30A	39	PWK/LK 25A	40	HTD SEAT 20A		
41	FWD LPS 10A	42	INT DIM 10A	43	RR T/LPS 10A	44	HTD MIR 10A	45	X		

FOR MORE INFORMATION, SEE OWNERS MANUAL

PRINTED IN U.S.A. * SEO ACSRY
** RR WIPER-WAGON

U/HOOD ELECTRICAL CENTER



8A - 11 - 4 ELECTRICAL DIAGNOSIS

FUSE BLOCK DETAILS

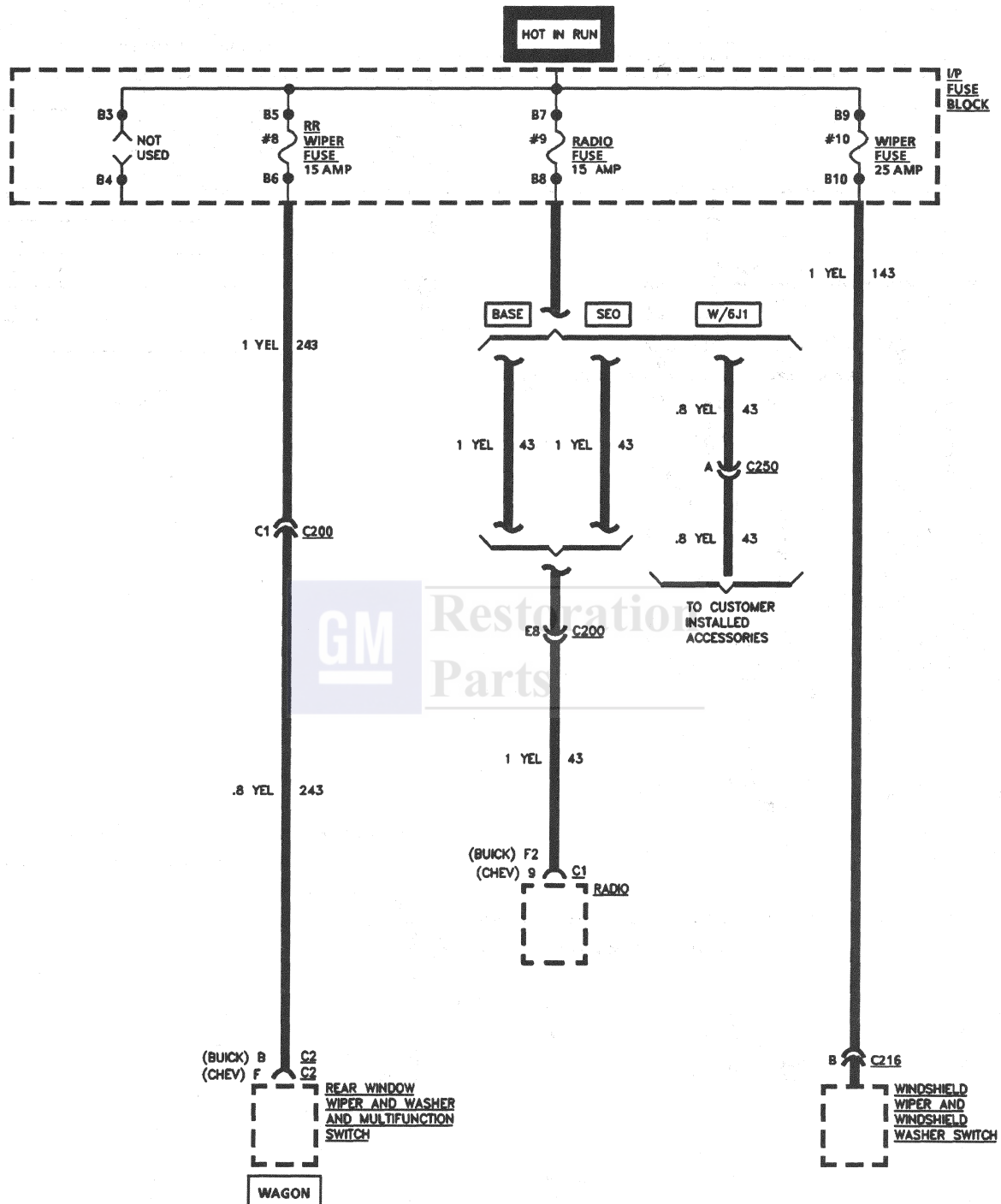
FUSE	DESCRIPTION	PAGE
1	Automatic Level Control Air Compressor	8A-11-19
2	Fuel Pump Relay, Fuel Pump and Engine Oil Pressure Switch, PCM	8A-11-19
3	Secondary Air Injection (AIR) Pump Relay, Underhood Lamp	8A-11-19
4	Mass Air Flow Sensor, Automatic Transmission, Secondary Air Pump Relay, EGR Control Valve Relay Solenoid, Evaporative Emission Solenoid, LH Oxygen Sensor, RH Oxygen Sensor	8A-11-20
5	PCM, Ignition Coil, Electronic Brake Control Module, Ignition Coil	8A-11-20
6	Fuel INJ #1, Fuel INJ #4, Fuel INJ #6, Fuel INJ #7	8A-11-20
7	Primary Engine Coolant Fan Relay, A/C Compressor Relay	8A-11-19
8	Generator, Secondary Engine Coolant Fan Relay	8A-11-19
9	Fuel INJ #2, Fuel INJ #3, Fuel INJ #5, Fuel INJ #8	8A-11-20

T5720



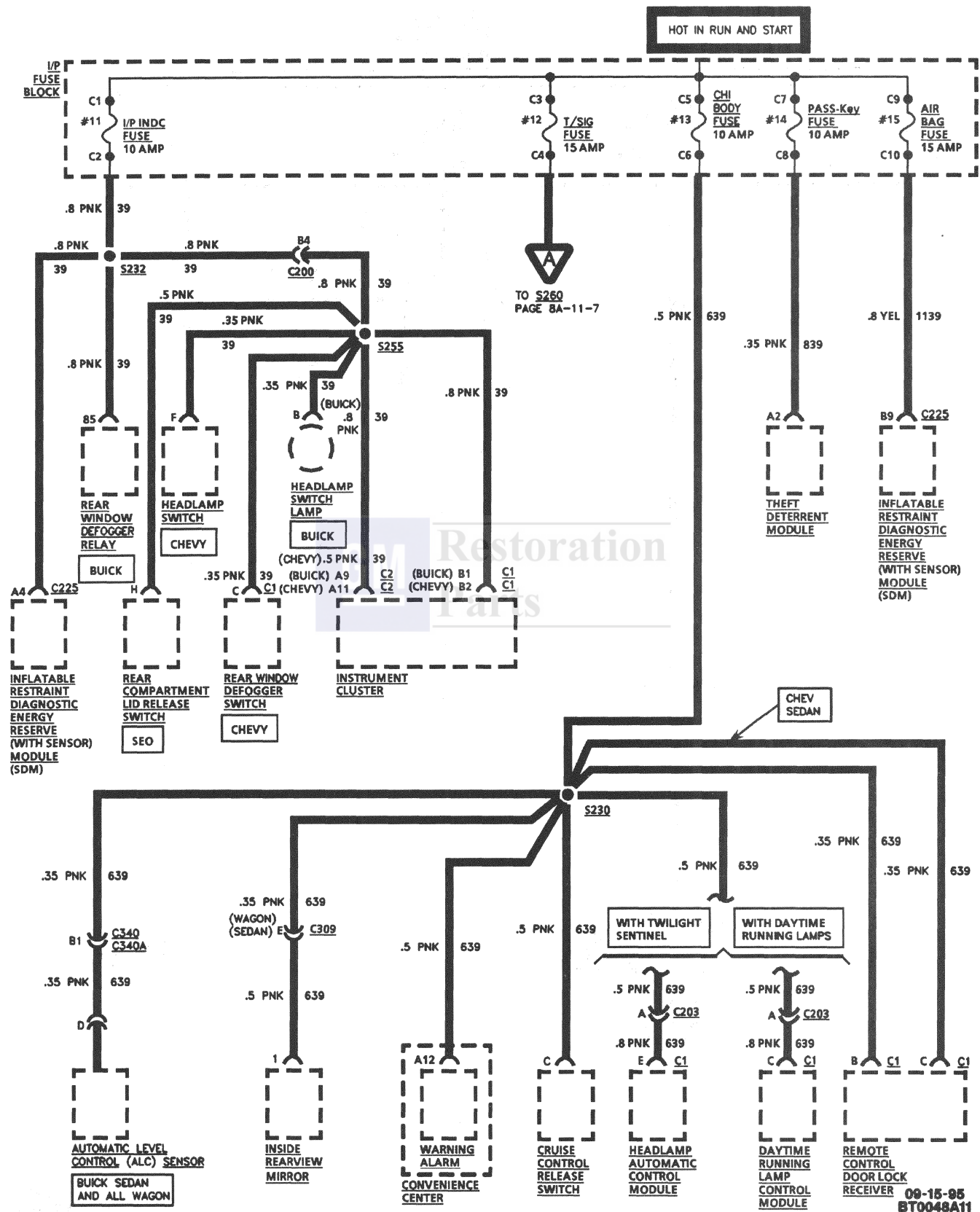
FUSE BLOCK DETAILS

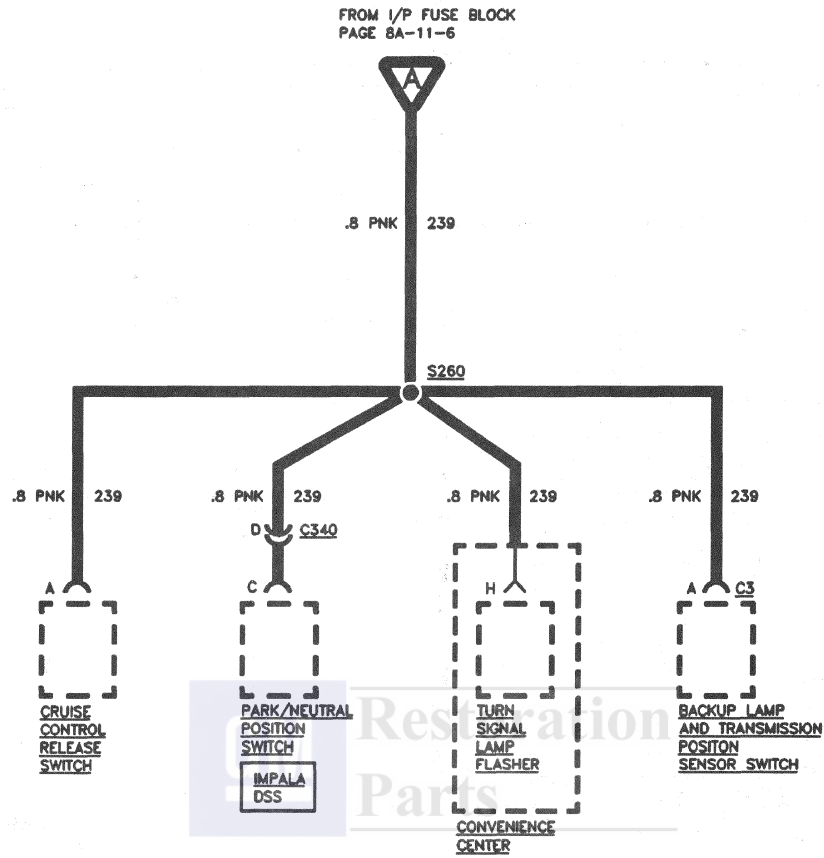
RR WIPER, RADIO AND WIPER FUSES



FUSE BLOCK DETAILS

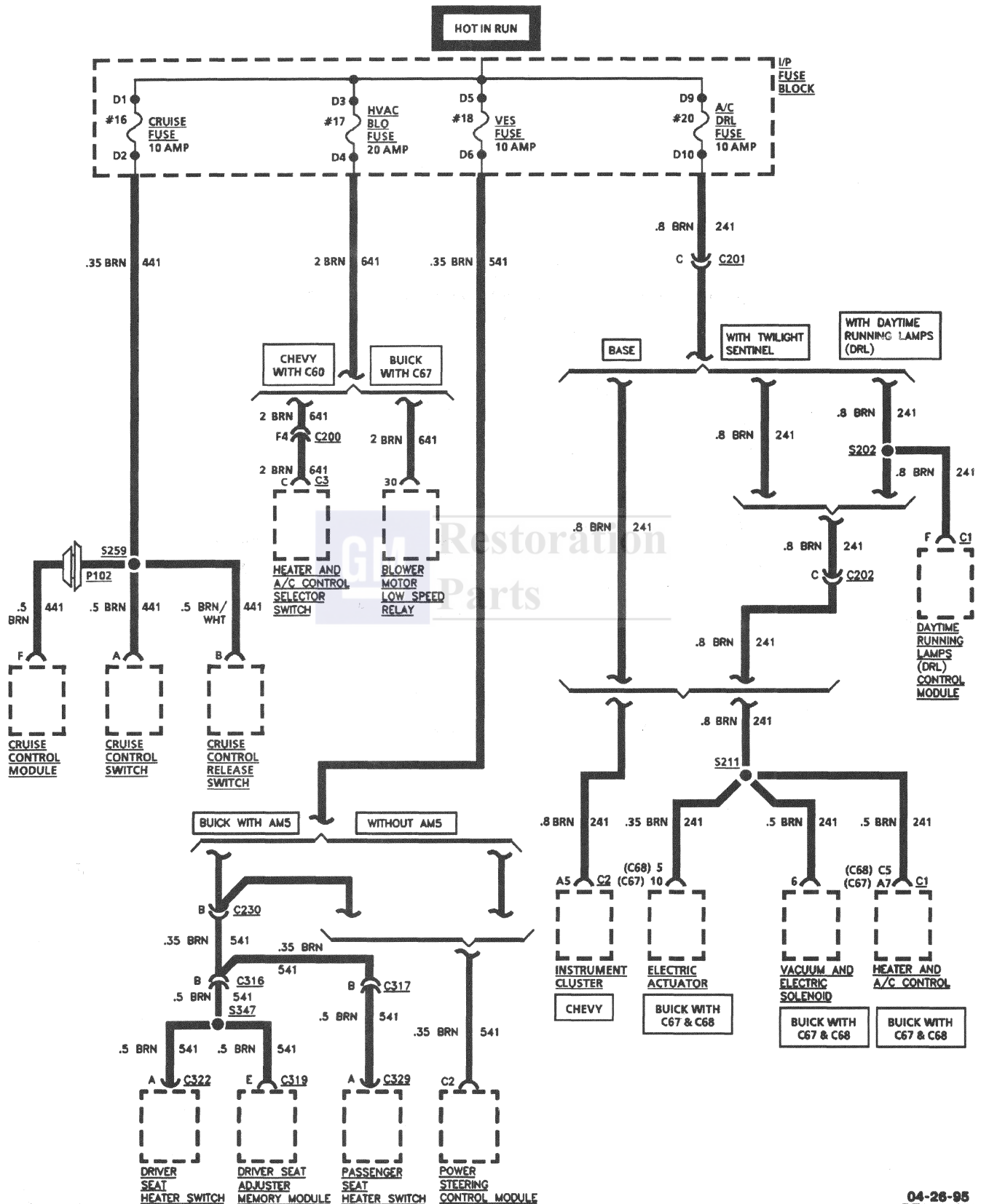
I/P INDC, T/SIG, CHI BODY, PASS-Key II® AND AIR BAG FUSES

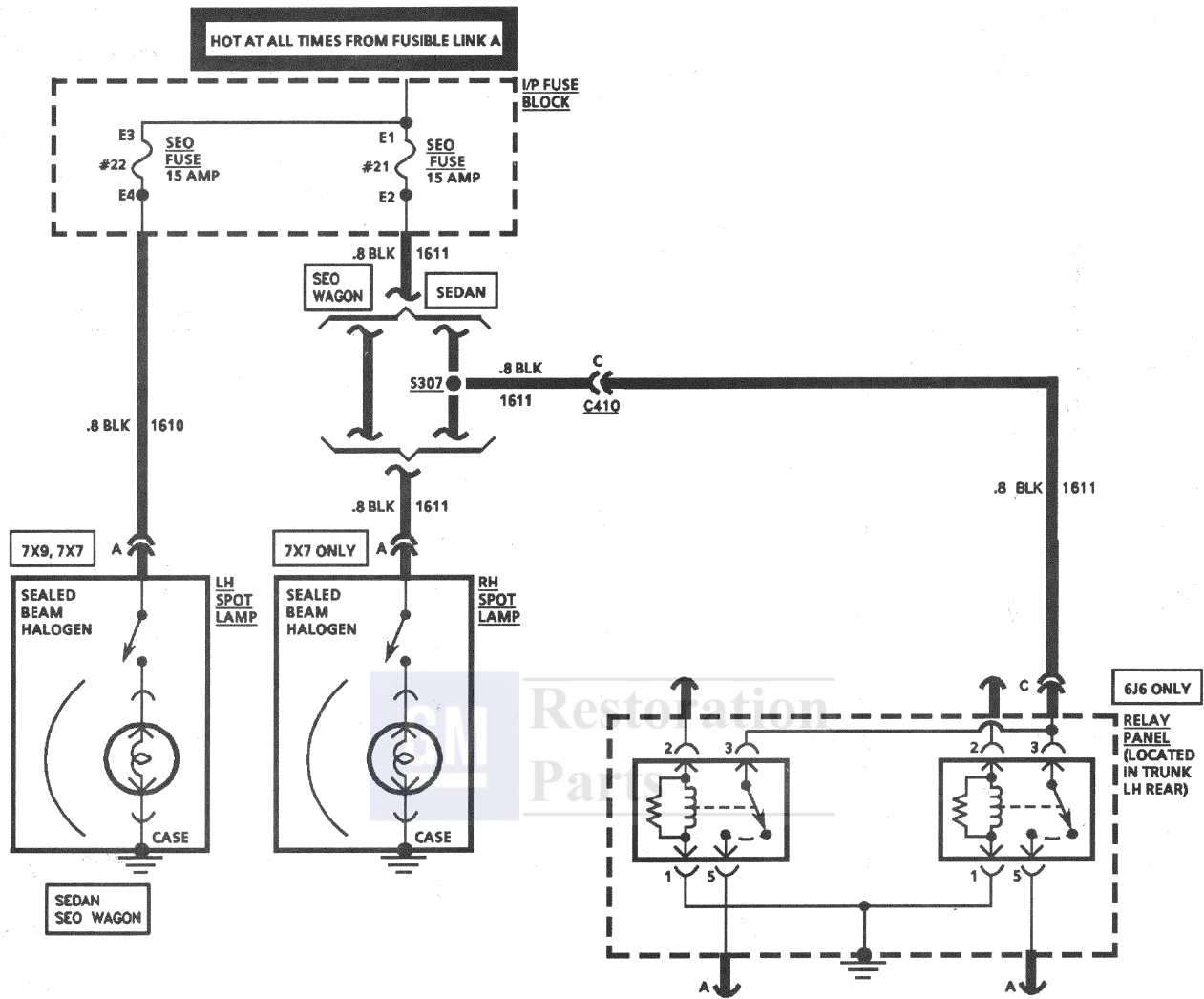




FUSE BLOCK DETAILS

CRUISE, HVAC BLO, VES AND A/C DRL FUSES

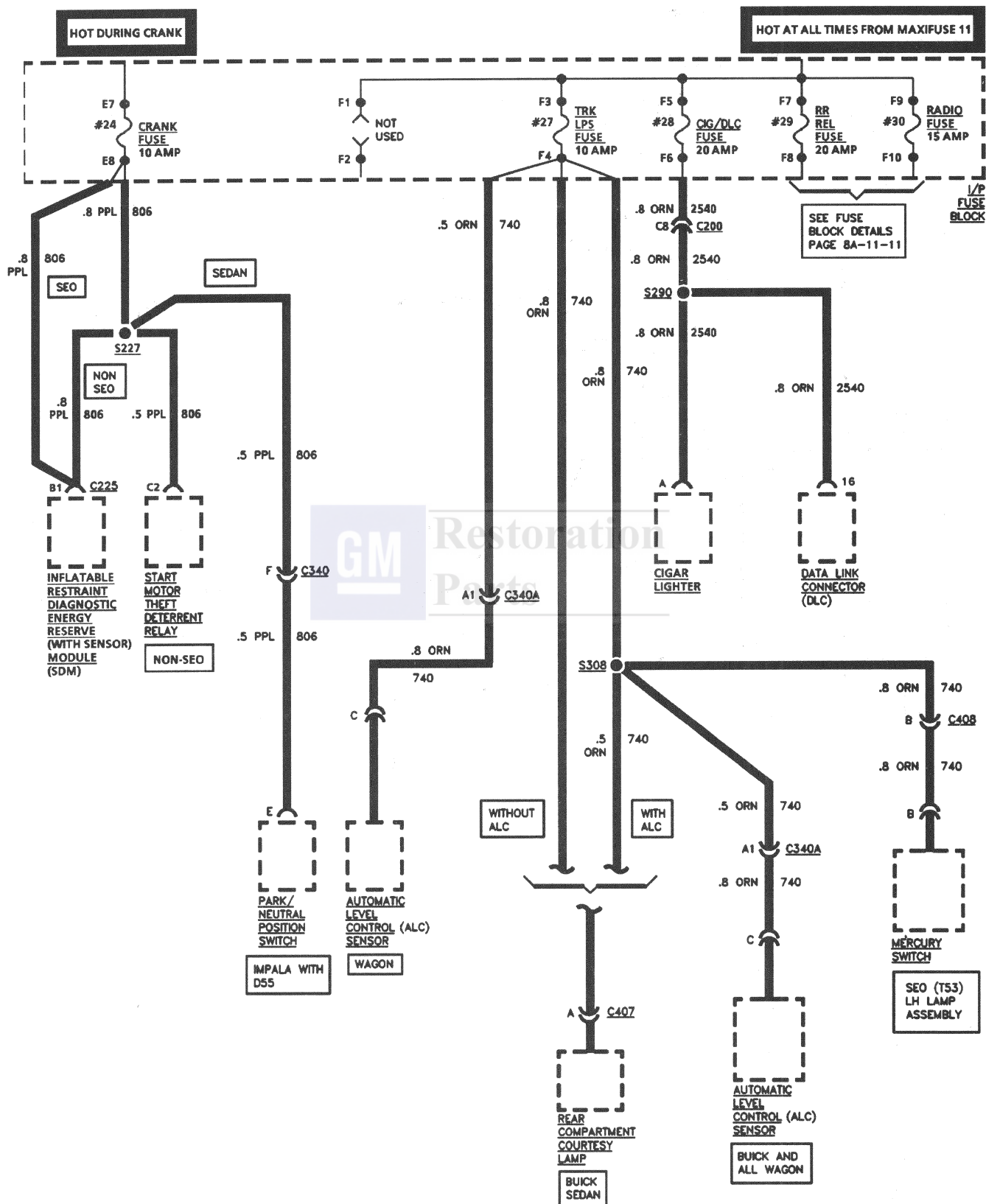


FUSE BLOCK DETAILS**SPOT LAMPS, REAR WINDOW PANEL LAMPS RELAYS (6J6, 7X9, 7X7) FUSES**

8A - 11 - 10 ELECTRICAL DIAGNOSIS

FUSE BLOCK DETAILS

CRANK, TRK LPS AND CIG / DLC FUSES

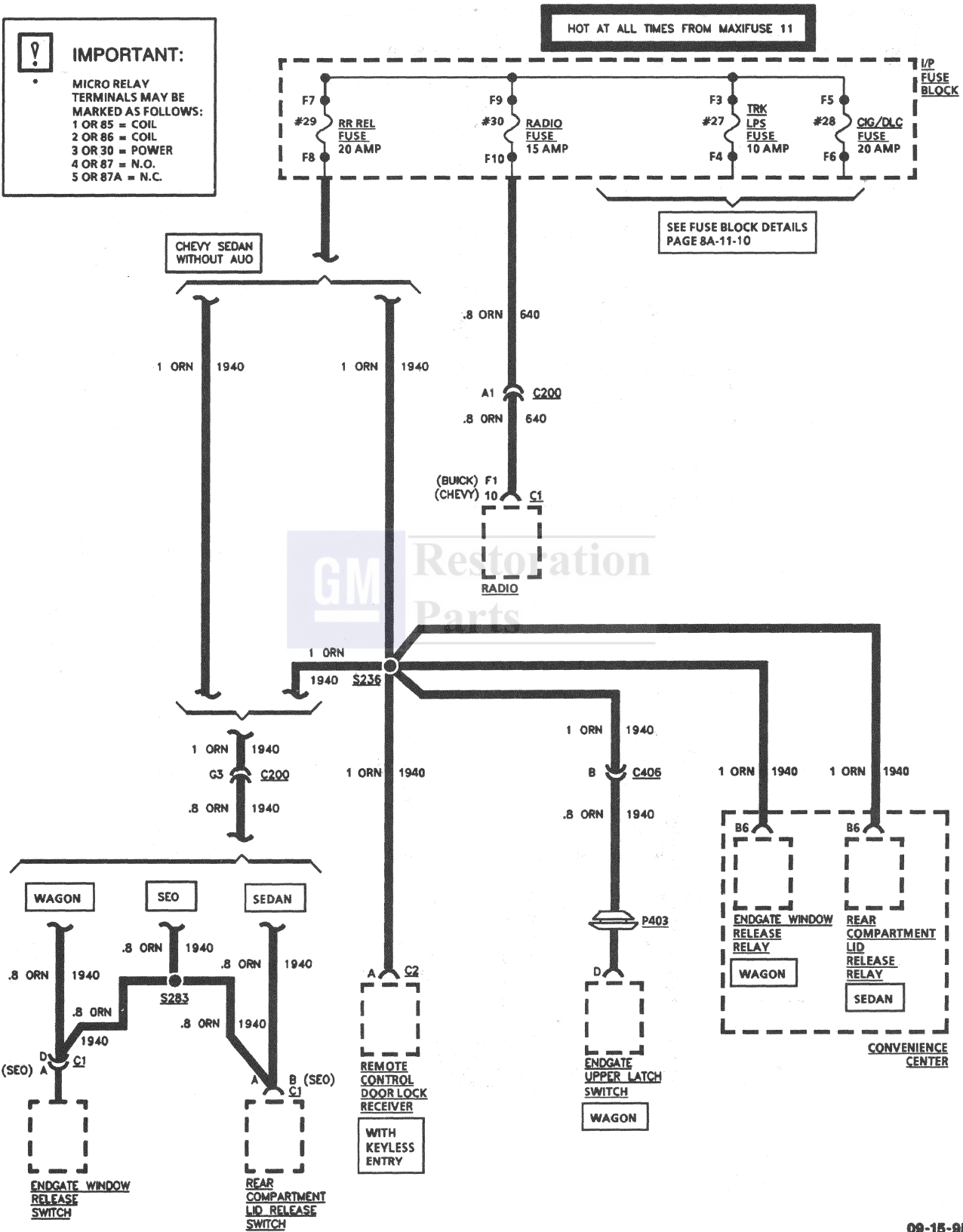


FUSE BLOCK DETAILS
RR REL AND RADIO FUSES

! IMPORTANT:

MICRO RELAY
TERMINALS MAY BE
MARKED AS FOLLOWS:

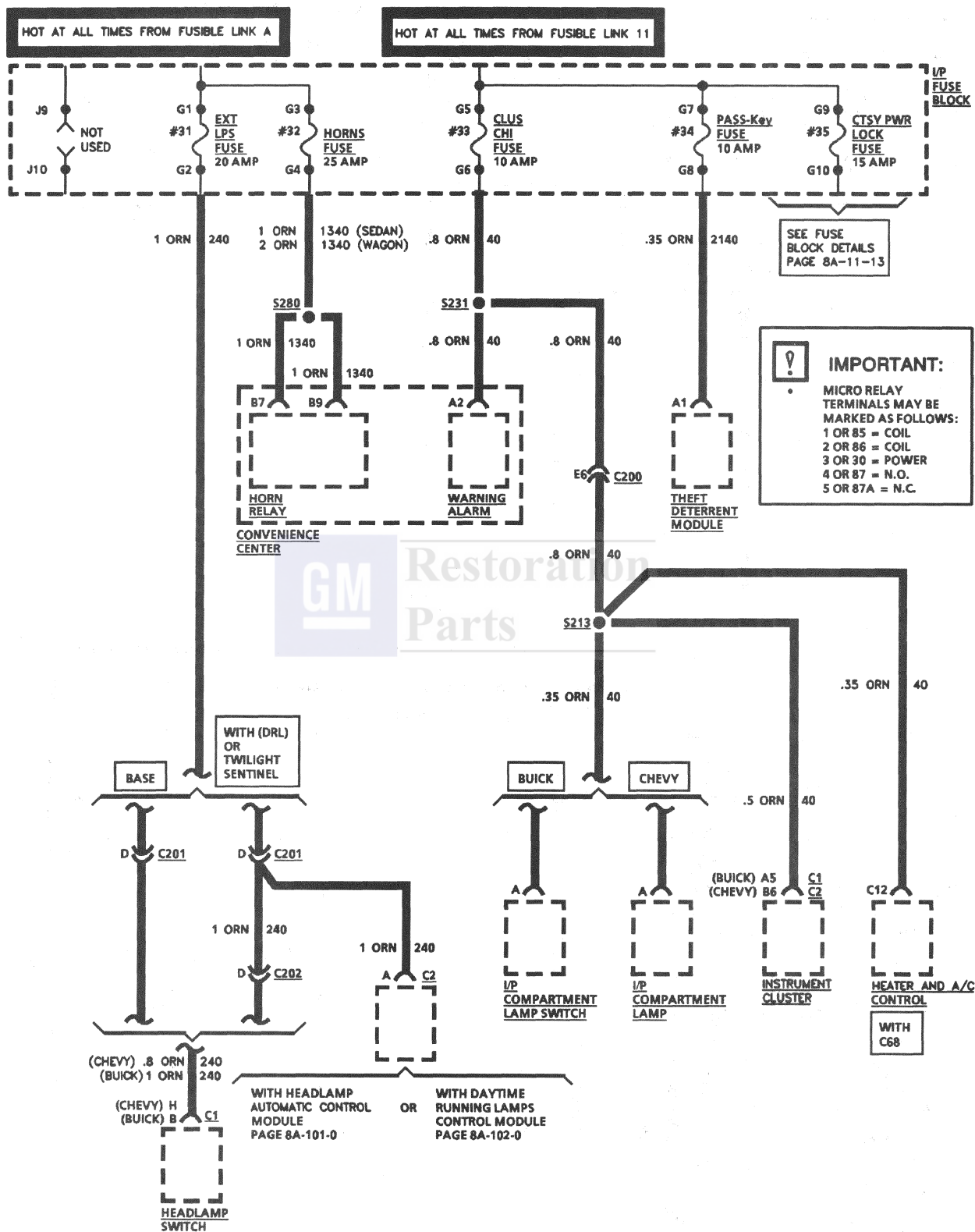
- 1 OR 85 = COIL
- 2 OR 86 = COIL
- 3 OR 30 = POWER
- 4 OR 87 = N.O.
- 5 OR 87A = N.C.



8A - 11 - 12 ELECTRICAL DIAGNOSIS

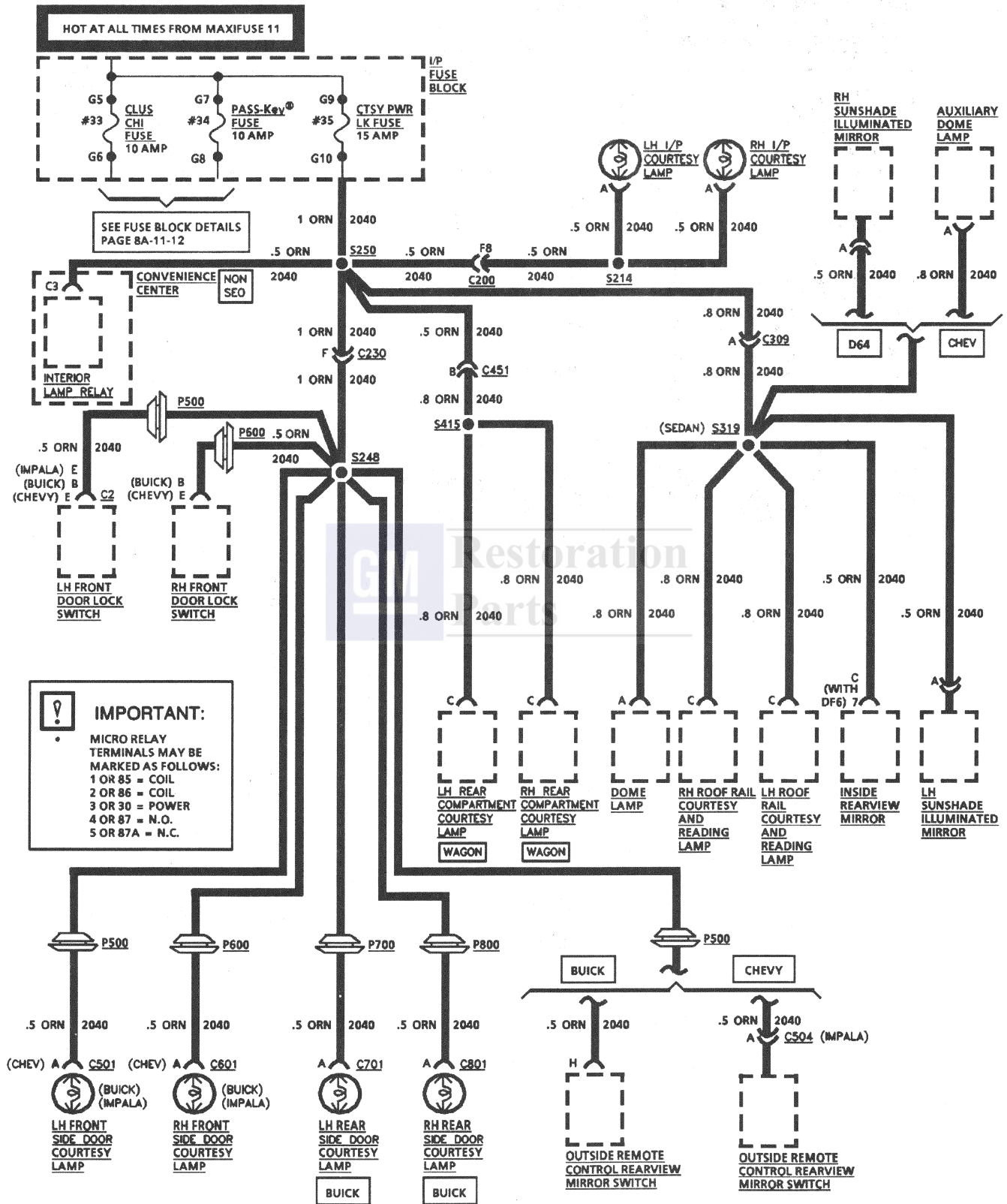
FUSE BLOCK DETAILS

EXT LPS, HORNS, CLUS CHI AND PASS-Key II® FUSES



FUSE BLOCK DETAILS

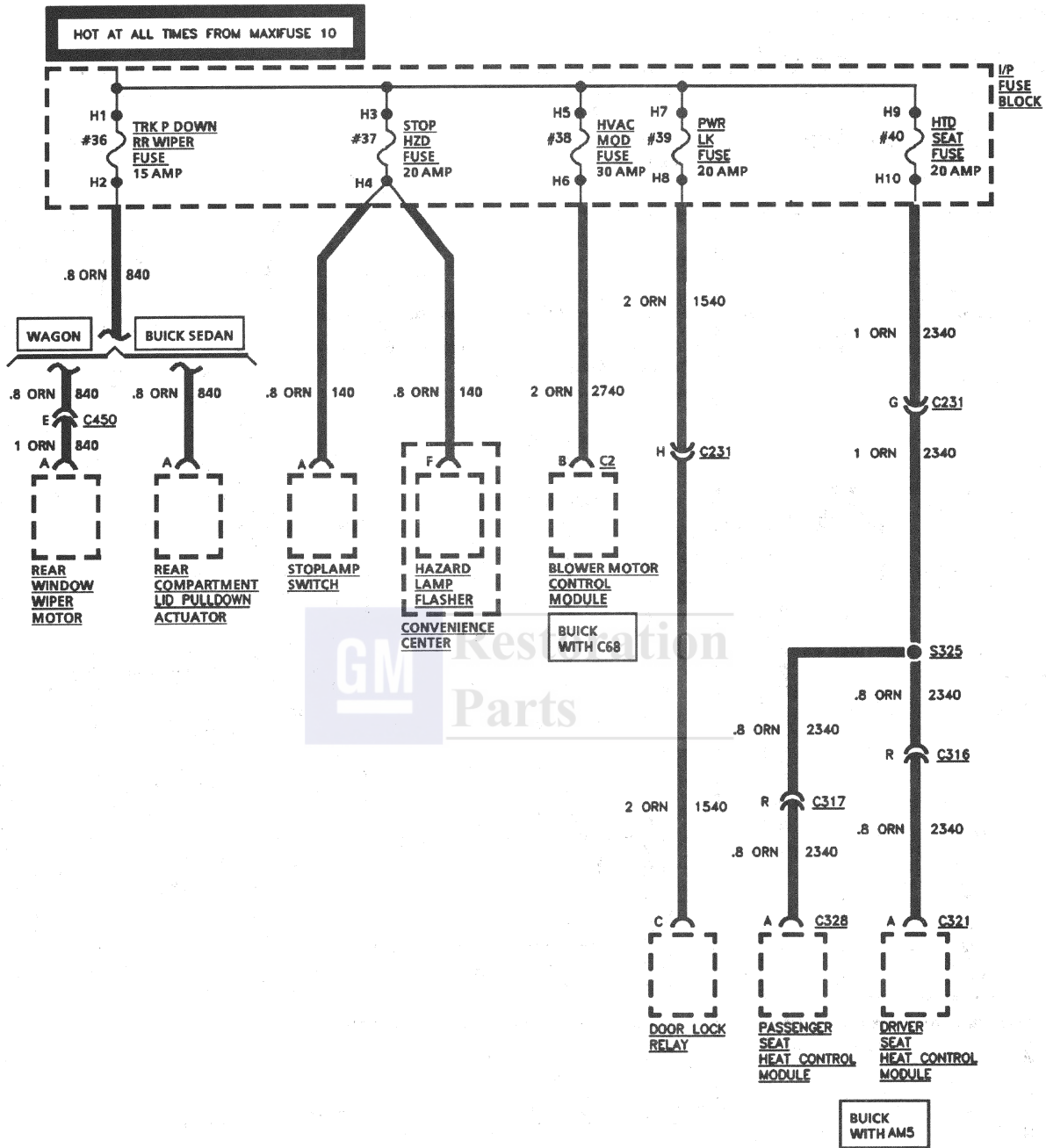
CTSY PWR LK FUSE



8A - 11 - 14 ELECTRICAL DIAGNOSIS

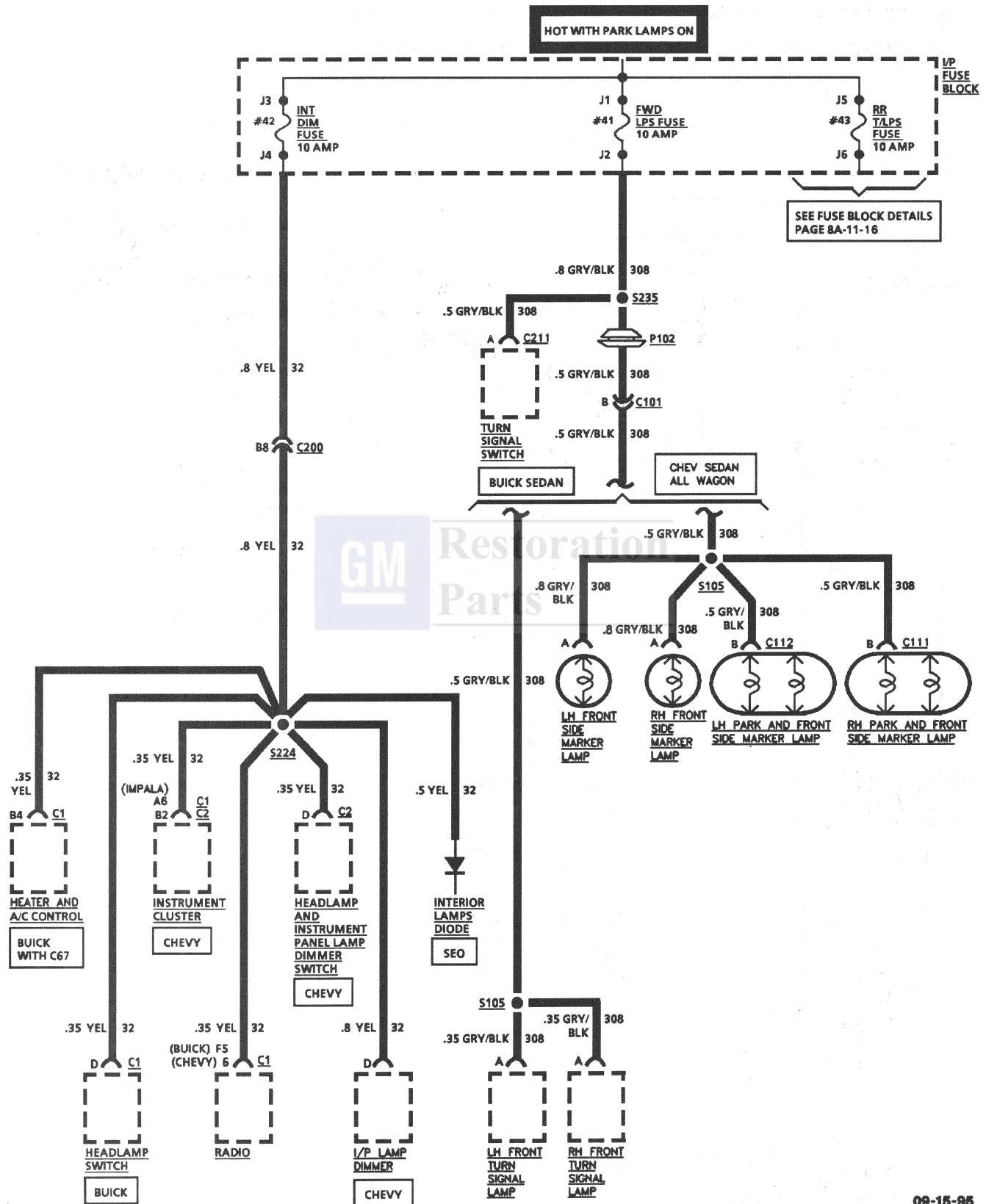
FUSE BLOCK DETAILS

TRK PDWN/RR WIPER, STOP HZD, HVAC MOD, PWR LK AND HTD SEAT FUSES



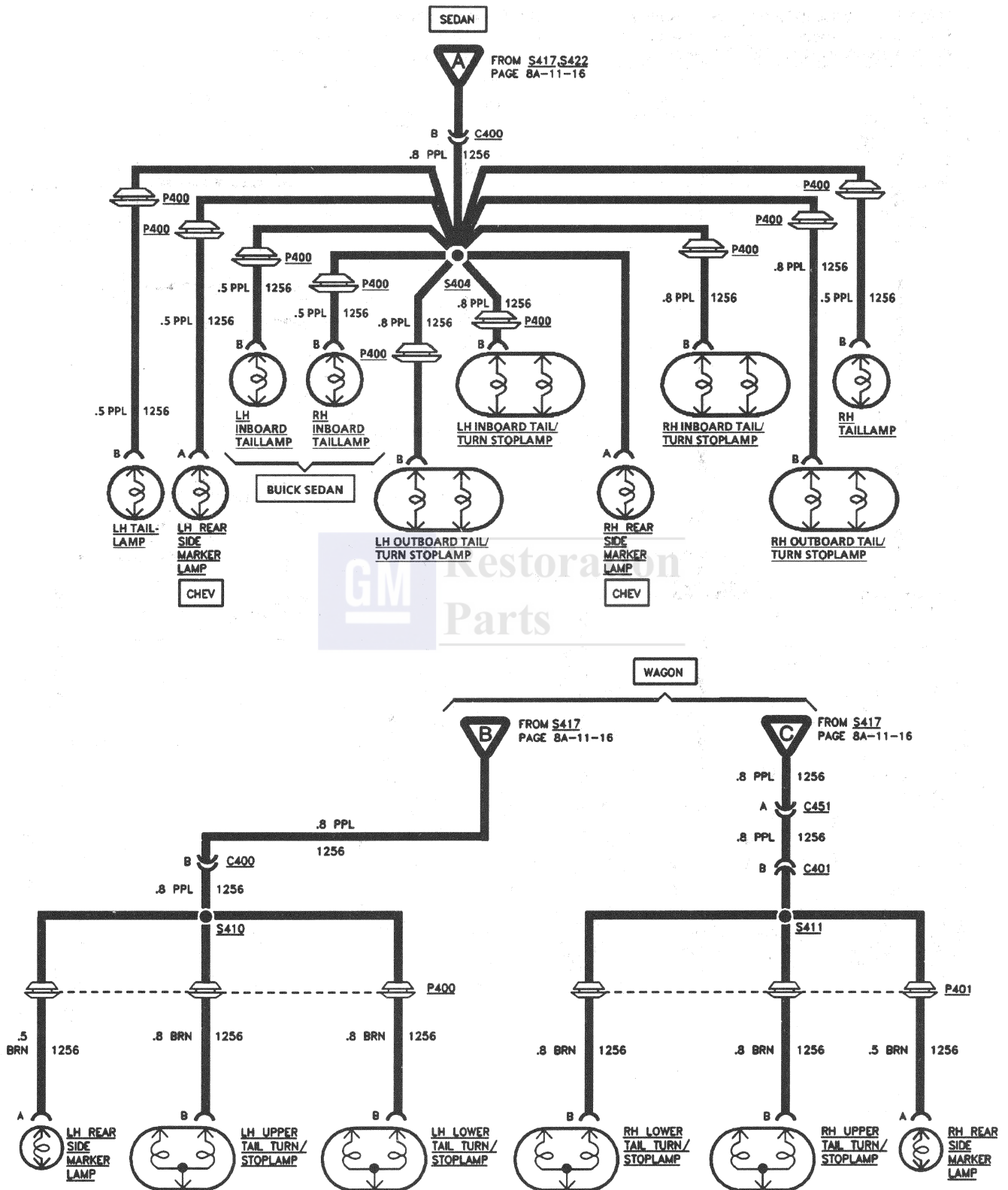
FUSE BLOCK DETAILS

INT DIM AND FWD LPS FUSES





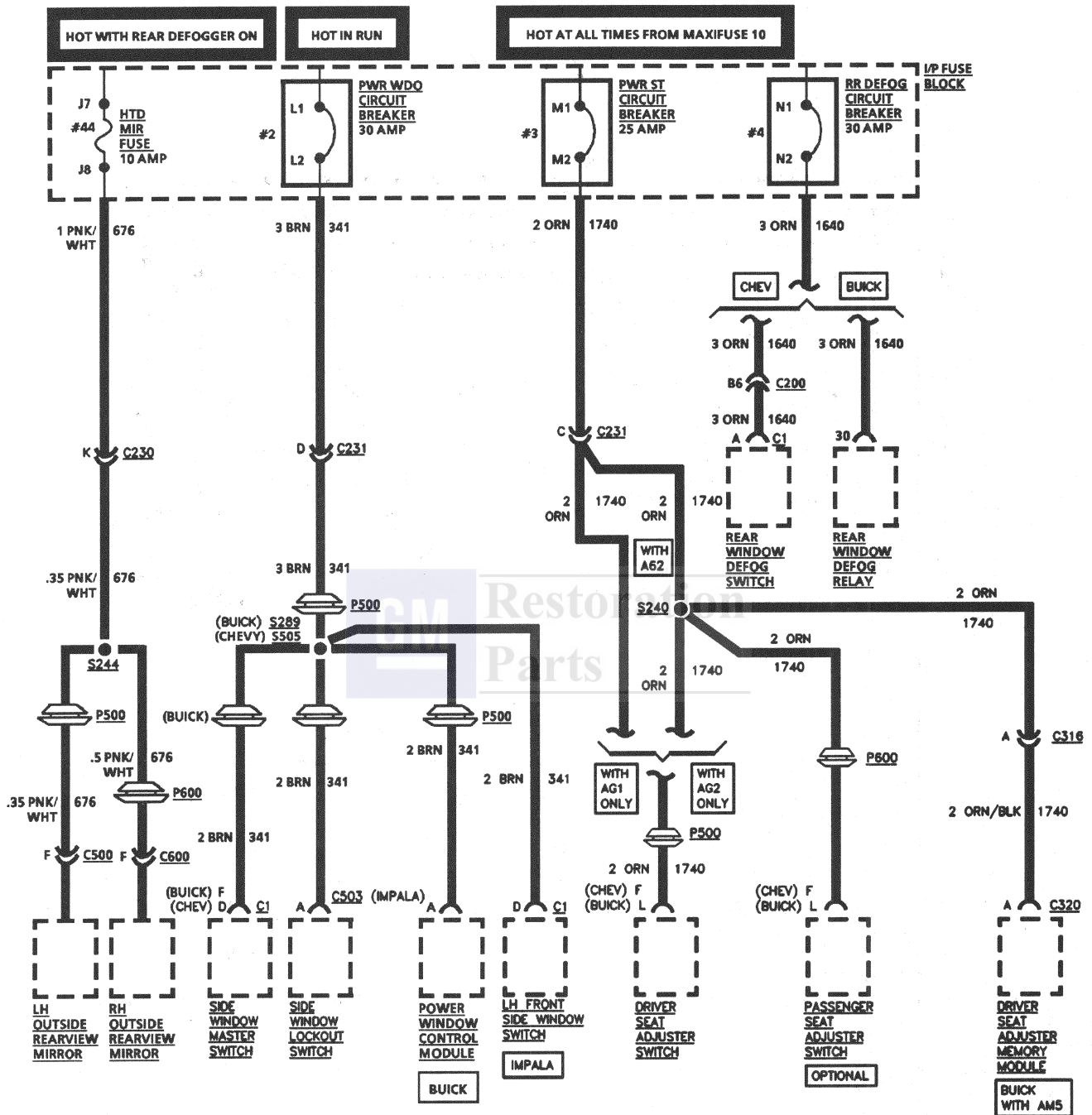
FUSE BLOCK DETAILS



8A - 11 - 18 ELECTRICAL DIAGNOSIS

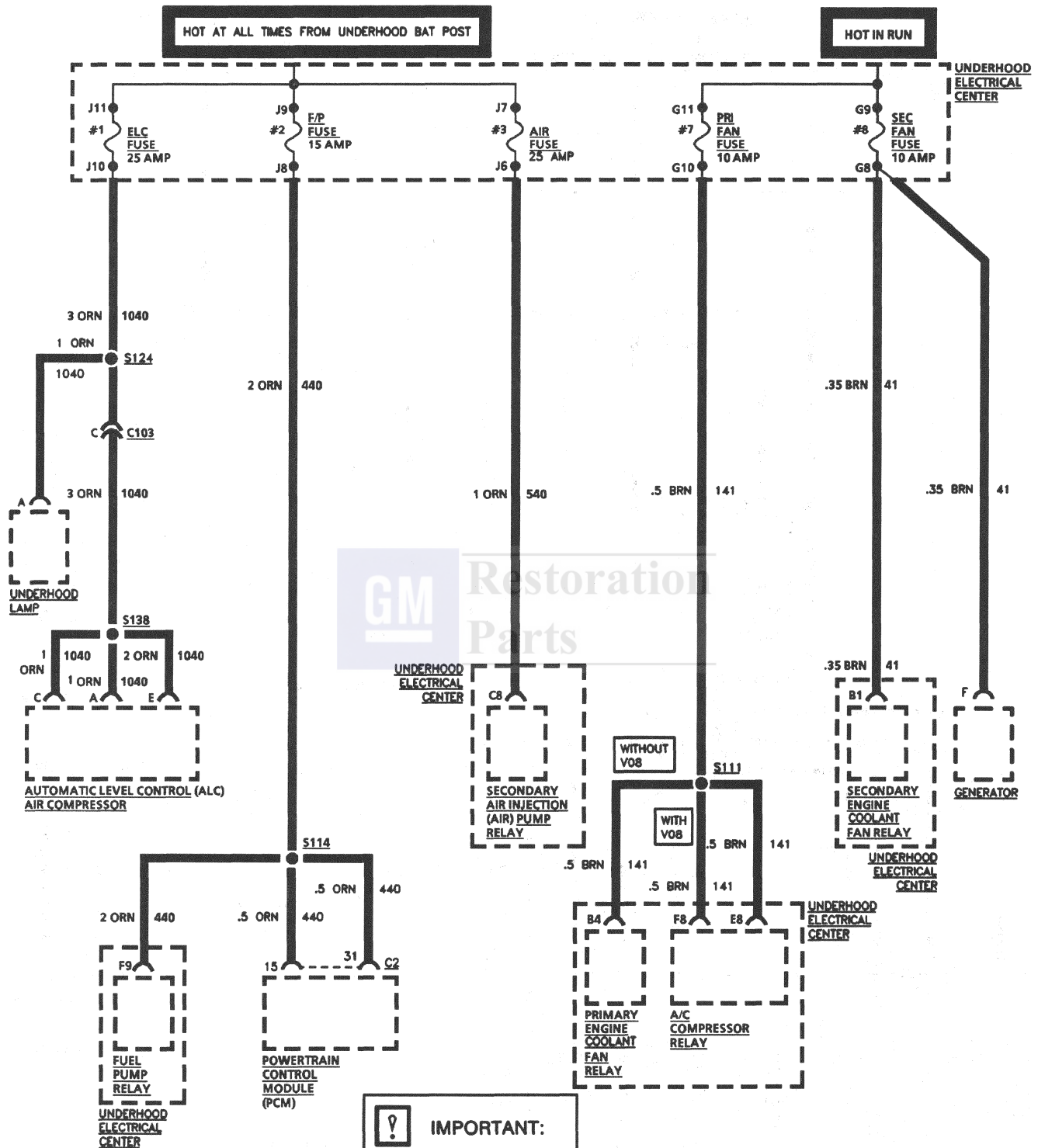
FUSE BLOCK DETAILS

HTD MIR FUSE, PWR WDO, PWR ST AND RR DEFOG CIRCUIT BREAKERS



FUSE BLOCK DETAILS

ELC, F/P, AIR, PRI FAN AND SEC FAN FUSES



FUSE BLOCK DETAILS

EMI, PCM/IGN AND FUEL INJ FUSES



FUSE BLOCK DETAILS

COMPONENT	LOCATION	201-PG	FIG.	CONN
A/C Compressor Relay	Located in Underhood Electrical Center			
Automatic Level Control (ALC) Air Compressor.....	Front Frame Rail, under LH Wheelhouse	2	.....	4
Automatic Level Control (ALC) Sensor.....	Bolted to Rear Crossmember, near center.....	29	.....	41
Automatic Transmission Control Module.....	Part of Transmission, LH rear			
Auxilliary Dome Lamp.....	Center Front of Vehicle			
Backup Lamp and Transmission Position Sensor Switch.....	Near base of Steering Column, on Column			
Blower Motor Control Module.....	RH I/P, near Blower Motor			
Blower Motor Low Speed Relay.....	Under RH I/P, right of Blower Motor.....	16	.....	26
Cigar Lighter	Center of I/P, to RH side of Radio	17	.....	28
Convenience Center	Left I/P, left of Steering Column.....	11	.....	19
Courtesy Lamp Relay	Located in Convenience Center	12	.....	20
Courtesy Lamp, LH	LH side of I/P	19	.....	30
Courtesy Lamp, RH.....	RH side of I/P	23	.....	34
Cruise Control Module	Fastened to LH Front Wheelhouse	5	.....	10
Cruise Control Release Switch.....	Attached to Brake Pedal Bracket (bottom switch)	11	.....	19
Cruise Control Switch.....	Attached to Brake Pedal Bracket.....	13	.....	21
Data Link Connector (DLC)	Attached to I/P Carrier, RH side of Steering Column.....	14	.....	22
Daytime Running Lamps (DRL) Control Module	RH "A" Pillar, behind RH kickpad.....	18	.....	29
Dome Lamp.....	Center Front of Vehicle			
Door Lock Relay.....	At base of LH "A" Pillar, behind kickpad.....	11	.....	19
Driver Seat Adjuster Memory Module.....	Below center of Driver Seat.....	22	.....	33
Driver Seat Adjuster Switch.....	LH Front Door Armrest			
Driver Seat Back Lumbar Support Switch.....	Part of Driver Seat bottom			
Driver Seat Heat Control Module.....	Attached to Seat Support, under LH Seat.....	22	.....	33
Driver Seat Recliner Switch.....	Part of Driver Seat bottom			
EGR Control Valve Relay Solenoid.....	Top of Engine, behind Fuel Injector #7.....	6	.....	11
Electronic Ignition Control Module.....	Front of Engine, in front of LH Cylinder Head.....	6	.....	11

8A - 11 - 22 ELECTRICAL DIAGNOSIS

FUSE BLOCK DETAILS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Electric Actuator	Behind center I/P, on HVAC Module.....	16.....	27	
Electronic Brake Control Module	LH Engine Compartment, part of Brake Pressure Modulator Valve			
Endgate Upper Latch Switch	Near center of Endgate	35.....	51	
Endgate Window Release Relay.....	Located in Convenience Center	12.....	20	
Endgate Window Release Switch.....	LH side of I/P, part of Accessory Switch Panel			
Evaporative Emission Canister Purge Solenoid Valve	Top of Engine, behind Fuel Injector #4.....	7.....	12	
Front Door Lock Switch, LH ...	LH Front Side Door, attached to Front Side Door Inside Handle Bezel.....	19.....	30	
Front Door Lock Switch, RH ...	RH Front Side Door, attached to Front Side Door Inside Handle Bezel.....	23.....	34	
Front Side Door Courtesy Lamp, LH.....	Lower left side of LH Front Side Door Trim.....	19.....	30	
Front Side Door Courtesy Lamp, RH	Lower right side of RH Front Side Door Trim	23.....	34	
Front Side Marker Lamp, LH...	LH Front of Vehicle.....	0.....	1	
Front Side Marker Lamp, RH...	RH Front of Vehicle	0.....	2	
Front Side Window Switch, LH.....	LH Front Side Door Armrest, attached to Accessory Switch Panel	19.....	30	
Fuel Injectors Left Bank	Top LH side of Engine.....	6.....	11	
Fuel Injectors Right Bank	Top RH side of Engine	7.....	12	
Fuel Pump Relay	In Underhood Electrical Center			
Generator.....	RH side of Engine, forward of RH Valve Cover.....	7.....	12	
Hazard Lamp Flasher.....	In Convenience Center, LH I/P.....	10.....	18	
Headlamp Automatic Control Module	RH "A" Pillar behind RH kickpad			
Headlamp Switch	LH side of I/P, part of Headlamp & I/P Lamp Dimmer & Accessory Switch			
Headlamp Switch Lamp	LH side of I/P			
Headlamp and Instrument Panel Lamp Dimmer Switch.....	LH side of I/P			
Heated Oxygen Sensor, LH Front	In LH Converter Pipe			
Heated Oxygen Sensor, RH Front	In RH Converter Pipe			
Heated Oxygen Sensor, LH Rear	In LH Converter Pipe			

COMPONENT	LOCATION	201-PG	FIG.	CONN
Heated Oxygen Sensor, RH Rear	In RH Converter Pipe			
Heater and A/C Control	Center of I/P	17	28	
Heater and A/C Control Selector Switch	Center of I/P, part of Heater and A/C Control	17	28	
Horn Relay	In Convenience Center	12	20	
I/P Compartment Lamp	Inside I/P Compartment, upper LH side			
I/P Compartment Lamp Switch	LH side of I/P Compartment, accessed with door open			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open			
I/P Lamp Dimmer	Attached to I/P Carrier lower reinforcement, to RH side of Steering Column			
Ignition Coil	Front of Engine, in front of LH Cylinder Head	6	11	
Ignition Switch	Mounted on Upper RH side of Steering Column	13	21	
Inboard Tail/Turn Stoplamp, LH	LH Rear of Vehicle	32	47	
Inboard Tail/Turn Stoplamp, RH	RH Rear of Vehicle	32	47	
Inboard Taillamp, LH	LH Rear of Vehicle	32	47	
Inboard Taillamp, RH	RH Rear of Vehicle	32	47	
Inflatable Restraint Diagnostic Energy Reserve (with Sensor) Module (SDM)	LH I/P, above Convenience Center	11	19	
Inside Rear View Mirror	Mounted on Windshield			
Instrument Cluster	LH side of I/P, centered above Steering Column	9	16	
Interior Lamps Diode	Approx 18 cm from Instrument Cluster Conn C2 breakout, behind Instrument Cluster			
License Lamp	Center Rear of Vehicle, in Trunk Lid	30	43	
Lower Tail Turn/ Stoplamp, LH	LH Rear of Vehicle	37	53	
Lower Tail Turn/ Stoplamp, RH	RH Rear of Vehicle	38	54	
Mass Air Flow (MAF) Sensor ..	Engine Compartment, in Air Intake Passage, between Air Cleaner and Intake Resonator			
Mercury Switch (SEO)	Rear of Trunk			
Opera Lamp, LH	Outside LH "C" Pillar			
Opera Lamp, RH	Outside RH "C" Pillar			
Outboard Tail/Turn Stoplamp, LH	LH Rear of Vehicle	32	47	
Outboard Tail/Turn Stoplamp, RH	RH Rear of Vehicle	32	47	

8A - 11 - 24 ELECTRICAL DIAGNOSIS

FUSE BLOCK DETAILS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Outside Rear View Mirror, LH.....	LH Front Side Door			
Outside Rear View Mirror, RH	RH Front Side Door			
Outside Remote Control Rear View Mirror Switch	LH Front Side Door, attached to Front Side Door Inside Handle Bezel.....	19.....	30	
Park and Front Side Marker Lamp, LH.....	LH Forward Lamp Wiring, near Headlamp.....	0.....	1	
Park and Front Side Marker Lamp, RH	RH Forward Engine Compartment, near Headlamp			
Park/Neutral Position Switch.....	Under Floor Console, attached to Automatic Transmission Control			
Passenger Seat Adjuster Switch.....	RH Front Door Armrest	23.....	34	
Passenger Seat Back Lumbar Support Switch	Part of Passenger Seat bottom			
Passenger Seat Heat Control Module	Attached to Seat Support, under RH Seat			
Passenger Seat Recliner Switch.....	Part of Passenger Seat bottom			
Powertrain Control Module (PCM).....	Engine Compartment, forward of LH Wheelhouse, under Air Cleaner.....	4.....	8	
Primary Engine Coolant Fan Relay.....	In Underhood Electrical Center, center of I/P			
Radio.....	Center of I/P.....	17.....	28	
Radio Power Antenna Relay	LH I/P, left of Convenience Center.....	15.....	25	
Rear Compartment Courtesy Lamp.....	Under Package Shelf.....	30.....	43	
Rear Compartment Lid Pulldown Actuator.....	Mounted in rear of Rear Compartment.....	31.....	45	
Rear Compartment Lid Release Relay.....	Located in Convenience Center	12.....	20	
Rear Compartment Lid Release Switch.....	LH I/P Carrier, left of Steering Column			
Rear Side Door Courtesy Lamp, LH.....	At back edge of LH Rear Door Trim			
Rear Side Door Courtesy Lamp, RH	At back edge of RH Rear Door Trim			
Rear Side Marker Lamp, LH....	LH Rear of Vehicle.....	37.....	53	
Rear Side Marker Lamp, RH....	RH Rear of Vehicle	38.....	54	
Rear Window Defogger Relay ..	RH I/P, next to Blower Motor.....	16.....	26	

COMPONENT	LOCATION	201-PG	FIG.	CONN
Rear Window Defogger Switch.....	Center of I/P, part of Heater and A/C Control.....	17	.....	28
Rear Window Wiper and Washer and Multifunction Switch.....	LH side of I/P	10	.....	17
Rear Window Wiper Motor.....	Attached to Rear Header	36	.....	52
Relay Panel.....	In RH Rear Trunk			
Remote Control Door Lock Receiver (Sedan).....	Near center of LH "D" Pillar	29	.....	42
Remote Control Door Lock Receiver (Wagon)	Mounted on bracket above LH Rear Wheelhouse, under Trim Panel			
Roof Rail and Courtesy Reading Lamp, LH.....	LH rear Roof Rail.....	26	.....	37
Roof Rail and Courtesy Reading Lamp, RH.....	RH rear Roof Rail.....	26	.....	38
Secondary Air Injection (AIR) Pump Relay.....	Located in Underhood Electrical Center			
Secondary Engine Coolant Fan Relay.....	In Underhood Electrical Center			
Side Window Lockout Switch...	LH Front Side Door, attached to Accessory Switch Panel.....	19	.....	30
Side Window Master Switch....	LH Front Door Armrest.....	19	.....	30
Spot Lamp, LH	At LH "A" Pillar			
Spot Lamp, RH	At RH "A" Pillar			
Starter Motor Theft Deterrent Relay.....	RH "A" Pillar, behind RH kickpad.....	11	.....	19
Stoplamp Switch.....	Attached to Brake Pedal Bracket (bottom switch)			
Sunshade Illuminated Mirror, LH.....	LH Visor	26	.....	37
Sunshade Illuminated Mirror, RH	RH Visor	26	.....	37
Taillamp, LH.....	LH Rear of Vehicle.....	34	.....	49
Taillamp, RH	RH Rear of Vehicle.....	36	.....	52
Theft Deterrent Module	Behind LH I/P left of Brake Pedal Bracket	11	.....	19
Turn Signal Lamp Flasher.....	In Convenience Center, LH I/P.....	12	.....	20
Turn Signal Switch	Mounted on upper LH side of Steering Column.....	13	.....	21
Underhood Electrical Center.....	Engine Compartment, attached to RH Wheelhouse			
Underhood Lamp.....	RH rear of Hood			
Upper Tail Turn/ Stoplamp, LH.....	LH Rear of Vehicle.....	37	.....	53

8A - 11 - 26 ELECTRICAL DIAGNOSIS**FUSE BLOCK DETAILS**

COMPONENT	LOCATION	201-PG	FIG.	CONN
Upper Tail Turn/ Stoplamp, RH	RH Rear of Vehicle	38	54	
Vacuum and Electric Solenoid.....	Near center I/P, next to HVAC Motor	16	27	
Warning Alarm	In Convenience Center, LH I/P.....	11	19	
Windshield Wiper and Windshield Washer Switch	Part of Rear Window Wiper and Washer and Multifunction Switch.....	10	17	
C101 (4 cavities).....	Forward Lamp Harn to Body Harn, LH front Engine Compartment, near PCM			
C103 (5 cavities).....	Engine Harn to Forward Lamp Harn, at RH Fender			
C111 (3 cavities).....	Forward Lamp Harn to RH Park And Front Side Marker Lamp			
C112 (3 cavities).....	Forward Lamp Harn to LH Park And Front Side Marker Lamp			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal			
C201 (6 cavities) Base	Body Harn to I/P Harn, at RH side of Steering Column, above C200			
C201 (6cavities) (w/T61).....	Body Harn to Daytime Running Lamps (DRL) Harn.at RH side of Steering Column above C200			
C201 (6cavities) (w/T82).....	Body Harn to Twilight Sentinel (TWS) Harn.at RH side of Steering Column above C200			
C202 (6 cavities) (w/T61).....	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, RH side of Steering Column, above C200			
C202 (6cavities) (w/T82).....	I/P Harn to Twilight Sentinel Harn, RH side of Steering Column, above C200			
C203 (10 cavities) (Base).....	Body Harn to I/P Harn, at RH of Steering Column			
C203 (10 cavities) (w/T61).....	Body Harn to Daytime Running Lamp Harn, lower RH side of Steering Column, next to C200			
C203 (10 cavities) (w/T82).....	Body Harn to Twilight Sentinel Harn, lower RH side of Steering Column, next to C200			
C211 (3 cavities).....	Body Harn to Turn Signal Switch			
C216 (7 cavities).....	Body Harn to Windshield Wiper and Windshield Washer Switch			
C225 (20 cavities).....	Body Harn to Inflatable Restraint Diagnostic Energy Reserve (With Sensor) Module (SDM)			
C230 (10 cavities).....	Crossbody & Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad			
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad			
C309 (6 cavities).....	Body Harn to Roof Harn, near Dome Lamp			
C316 (23 cavities).....	Driver Seat Harn, to Cross-Car Harn, under Driver Seat			

COMPONENT	LOCATION	201-PG FIG. CONN
C317 (23 cavities).....	Passenger Seat Harn, to Cross-Car Harn , under Passenger Seat	
C319 (6 cavities).....	Driver Seat Jumper Harn, to Driver Seat Adjuster Memory Module	
C320 (3 cavities).....	Driver Seat Jumper Harn, to Driver Seat Adjuster Memory Module	
C321 (2 cavities).....	Driver Seat Jumper Harn, to Heated Seat Module	
C322 (2 cavities).....	Driver Seat Jumper Harn, to Driver Seat Harn	
C328 (2 cavities).....	Passenger Seat Jumper to Heated Seat Module	
C329 (2 cavities).....	Passenger Seat Jumper to Passenger Seat Heater Switch	
C340 (4 cavities).....	Electronic Brake Control Harn to Body Harn, below LH Rear Floor Pan	
C400 (8 cavities) (Sedan).....	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender	
C400 (6 cavities) (Wagon)	LH Stoplamp Harn to Rear Body Harn, at LH "D" Pillar	
C401 (6 cavities).....	RH Stoplamp Harn to Rear Body Harn, at RH "D" Pillar	
C406 (8 cavities).....	Endgate Harness to Body Harness, near center of LH "D" Pillar	
C407 (2 cavities).....	Body Harness to Rear Compartment Courtesy Lamp	
C408 (4 cavities).....	Body Harn to Rear Compartment Courtesy Lamp Harn	
C410 (4 cavities).....	Body Harness to Shelf Lamps Harness	
C450 (6 cavities).....	Body Rear Harn to Body Harn, near center of LH "D" Pillar	
C451 (6 cavities).....	Body Rear Harn to Body Harn, near center of LH "D" Pillar	
C500 (8 cavities).....	Crossbody & Side Door Harn to LH Outside Rearview Mirror	
C501 (2 cavities).....	Crossbody & Side Door Harn to LH Front Side Door Courtesy Lamp Jumper, inside door	
C503 (2 cavities).....	Crossbody & Side Door Harn to Side Door Window Lockout Switch Jumper	
C504 (8 cavities).....	Crossbody & Side Door Harn to Outside Remote Control Rearview Mirror Switch Jumper.	
C600 (8 cavities).....	Crossbody & Side Door Harn to RH Outside Rearview Mirror	
C601 (2 cavities).....	Crossbody and Side Door Harn to RH Front Side Door Courtesy Lamp Jumper, inside door	
C701 (2 cavities).....	Crossbody & Side Door Harn to LH Rear Side Door Courtesy Lamp Jumper, inside door	
C801 (2 cavities).....	Crossbody & Side Door Harn to RH Rear Side Door Courtesy Lamp Jumper, inside door	
C903 (2 cavities).....	Endgate Harn to Rear License Lamp Jumper	

FUSE BLOCK DETAILS

201-PG FIG. CONN

COMPONENT	LOCATION
P102	Visible from Engine Compartment, behind LH Wheelhouse
P400	LH Rear of Vehicle, in Luggage Compartment (Sedan) or at Taillamps (Wagon)
P401	RH Rear of Vehicle, at Taillamps
P403	Between Endgate and LH "D" Pillar
P500	Between LH Front Door and "A" Pillar
P600	Between RH Front Door and "A" Pillar
P700	Between LH Rear Door and "B" Pillar
P800	Between RH Rear Door and "B" Pillar
S102	Engine Harn, center branch, approx 7 cm from Fuel Injector #8 Conn breakout
S103	Engine Harn, left side, approx 16 cm from Automatic Transmission Control Conn branch breakout
S105	Forward Lamp Harn, approx 11 cm from C100 branch breakout
S111	Engine Harn, approx 15 cm from Underhood Electrical Center
S114	Engine Harn, approx 14 cm from Underhood Lamp Conn branch breakout
S116	Engine Harn, left side, approx 8 cm from G104 breakout
S124	Engine Harn, approx 7 cm from Underhood Electrical Center branch breakout, in underhood branch
S132	Engine Harn, approx 18 cm from Fuel Injector #7
S202	Daytime Running Lamp Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout
S211	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel
S213	I/P Harn, approx 12 cm from Heater and A/C Control Conn branch breakout (Chev) or approx 4 cm from I/P Cluster C2 Conn breakout, in spiral taping (Buick)
S214	I/P Harn, approx 7 cm from Cigar Lighter Conn branch breakout (Chev) or approx 8 cm from C200 branch breakout, in spiral taping (Buick)
S216	I/P Harn, approx 8 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel
S224	I/P Harn, behind Instrument Cluster, approx 26 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping (Chev) or approx 27 cm from C200, on branch (Buick)
S227	Body Harn, approx 8 cm from Convenience Center breakout
S230	Body Harn, approx 4 cm from BTSI Conn breakout

COMPONENT	LOCATION	201-PG	FIG.	CONN
S231	Body Harn, approx 16 cm from Convenience Center breakout			
S232	Body Harn, approx 10 cm from SDM breakout			
S235	Body Harn, approx 16 cm from P102			
S236	Body Harn, approx 4 cm from Starter Motor Theft Deterrent Relay breakout			
S240	Crossbody Harn, approx 8 cm from Door Lock Relay branch breakout			
S244	Crossbody Harn, on C230 branch, approx 4 cm from breakout			
S248	Crossbody Harn, approx 8 cm from C231 branch breakout			
S250	Body Harn, approx 20 cm from Convenience Center breakout			
S255	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping (Chev) or behind Instrument Cluster, 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping (Buick)			
S259	Body Harn, approx 12 cm from Convenience Center breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S280	Body Harn, approx 8 cm from BTSI Solenoid Conn breakout			
S282	Body Harn, approx 7 cm from channel opening at LH "B" Pillar			
S283	I/P Harn, behind Instrument Cluster, approx 30 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S289	Crossbody Harn, at C230 branch breakout			
S307	Body Harn, approx 17 cm from C309 breakout			
S308	Body Harn, approx 11 cm from C309 breakout			
S318	Roof Harn, in C309 branch, approx 40 cm from breakout			
S319	Roof Harn, approx 40 cm from Dome Lamp breakout			
S346	Driver Seat Harn, approx 2 cm			
S347	Driver Seat Harn, approx 6 cm from Memory Module breakout			
S404	Body Rear Harn, approx 21 cm (Buick Sedan) or 31 cm (Chev Sedan) from C400			
S409	Body Rear Harn, approx 15 cm from C400			
S410	LH Stoplamp Harn, approx 5 cm from C400			
S411.....	RH Stoplamp Harn, approx 5 cm from C401			
S415	Body Rear Harn, approx 40 cm from C450 branch breakout			

FUSE BLOCK DETAILS

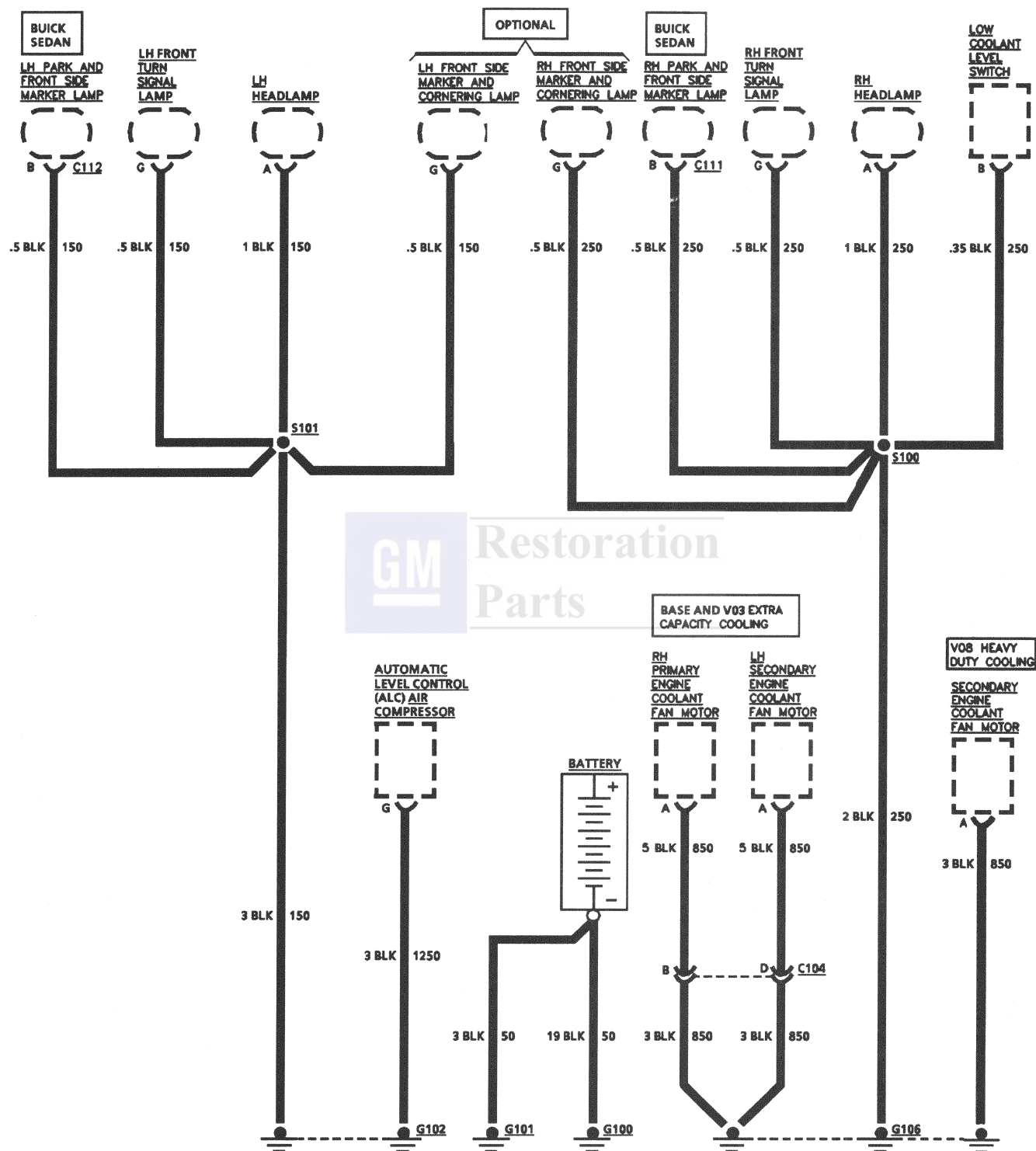
COMPONENT	LOCATION	201-PG FIG. CONN
S417	Body Harn, approx 12 cm from Remote Control Door Lock Module breakout	
S505	Crossbody Harn, approx 34 cm from P500, inside LH Front Door	





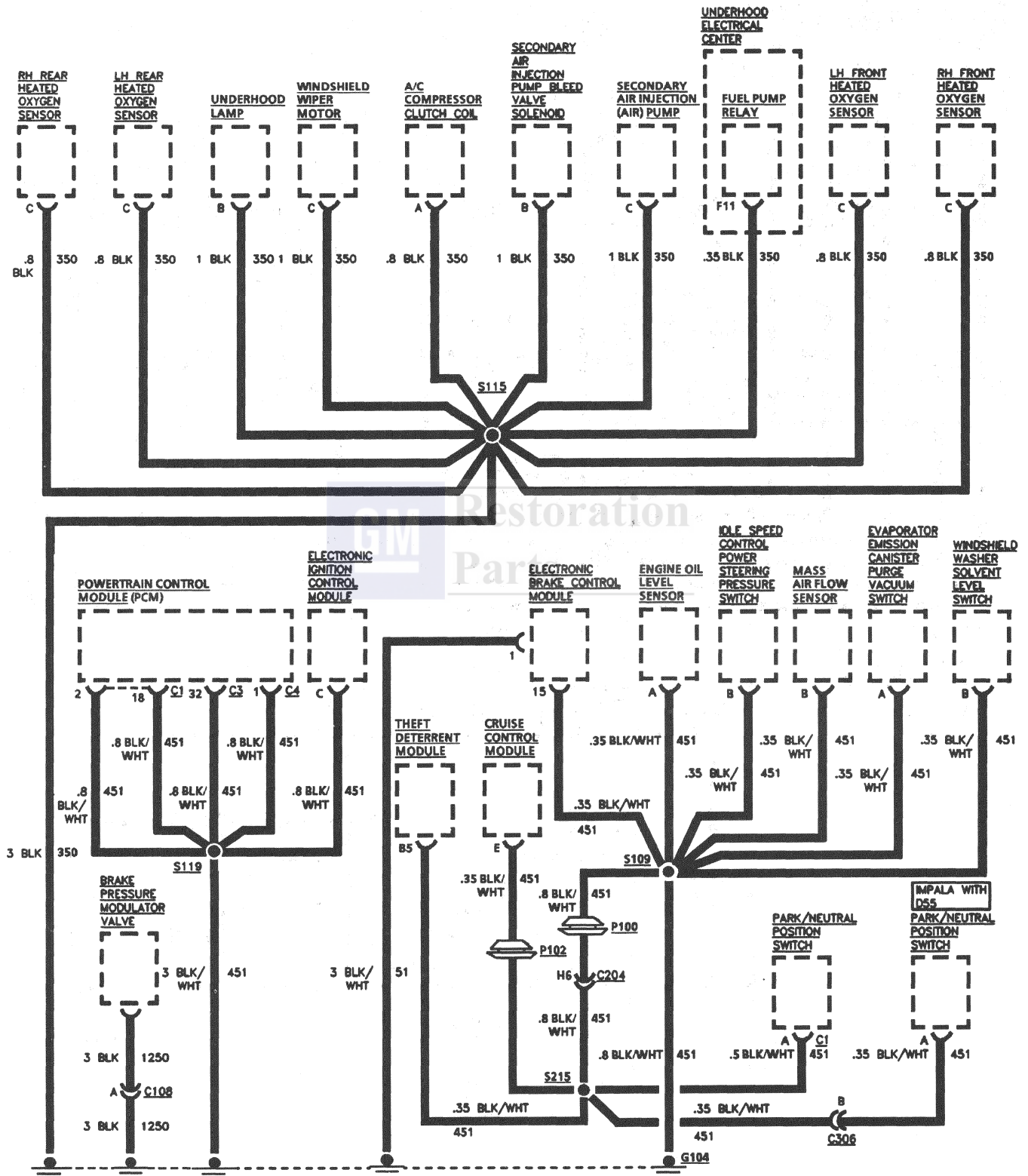
GROUND DISTRIBUTION

G100, G101, G102 AND G106 (BATTERY, FRONT LAMPS, AUTOMATIC LEVEL CONTROL AIR COMPRESSOR AND ENGINE COOLANT FANS)



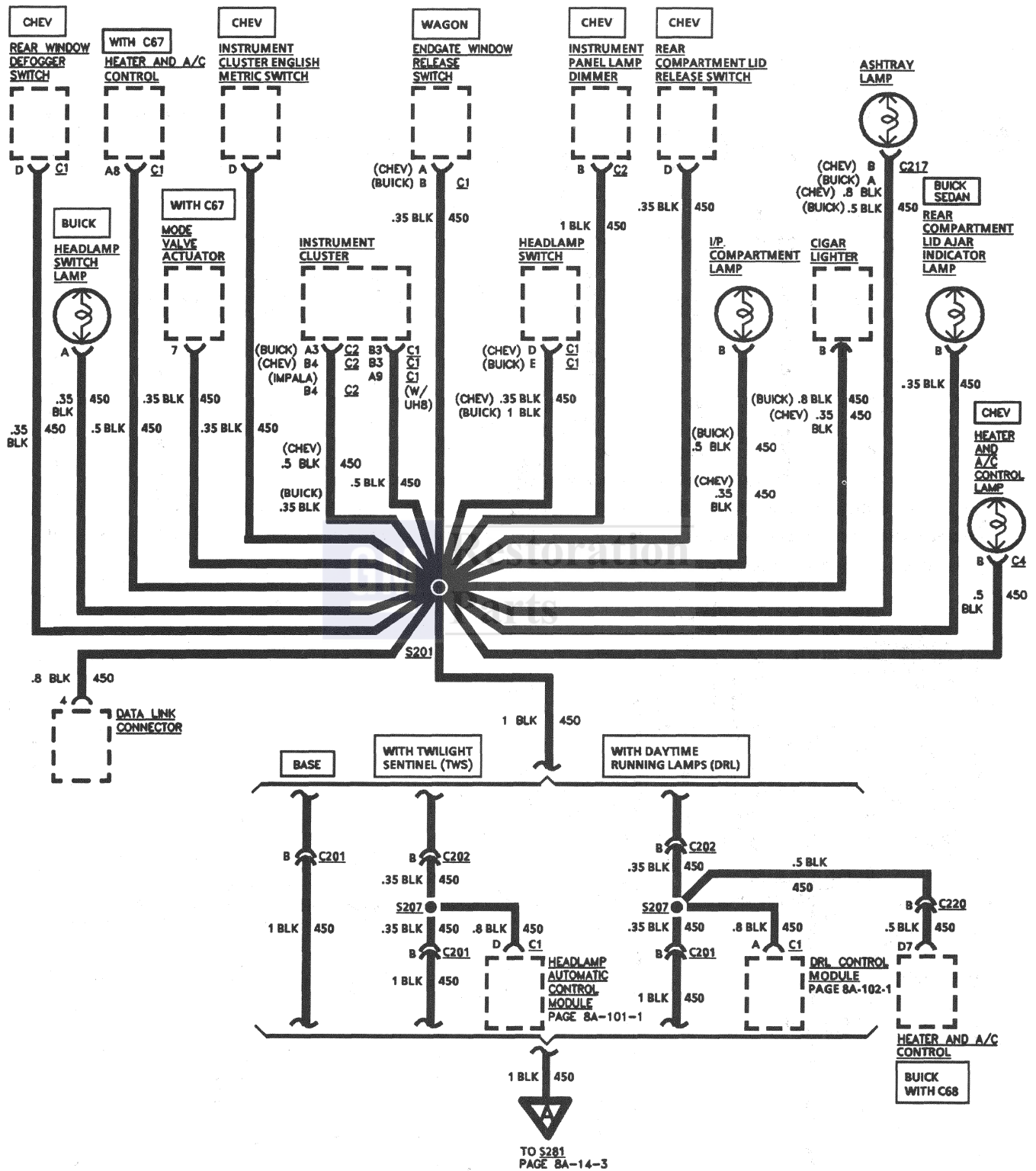
GROUND DISTRIBUTION

G104 (PCM, BRAKE PRESSURE MODULATOR VALVE, ELECTRONIC BRAKE CONTROL MODULE, AND VEHICLE GROUND)

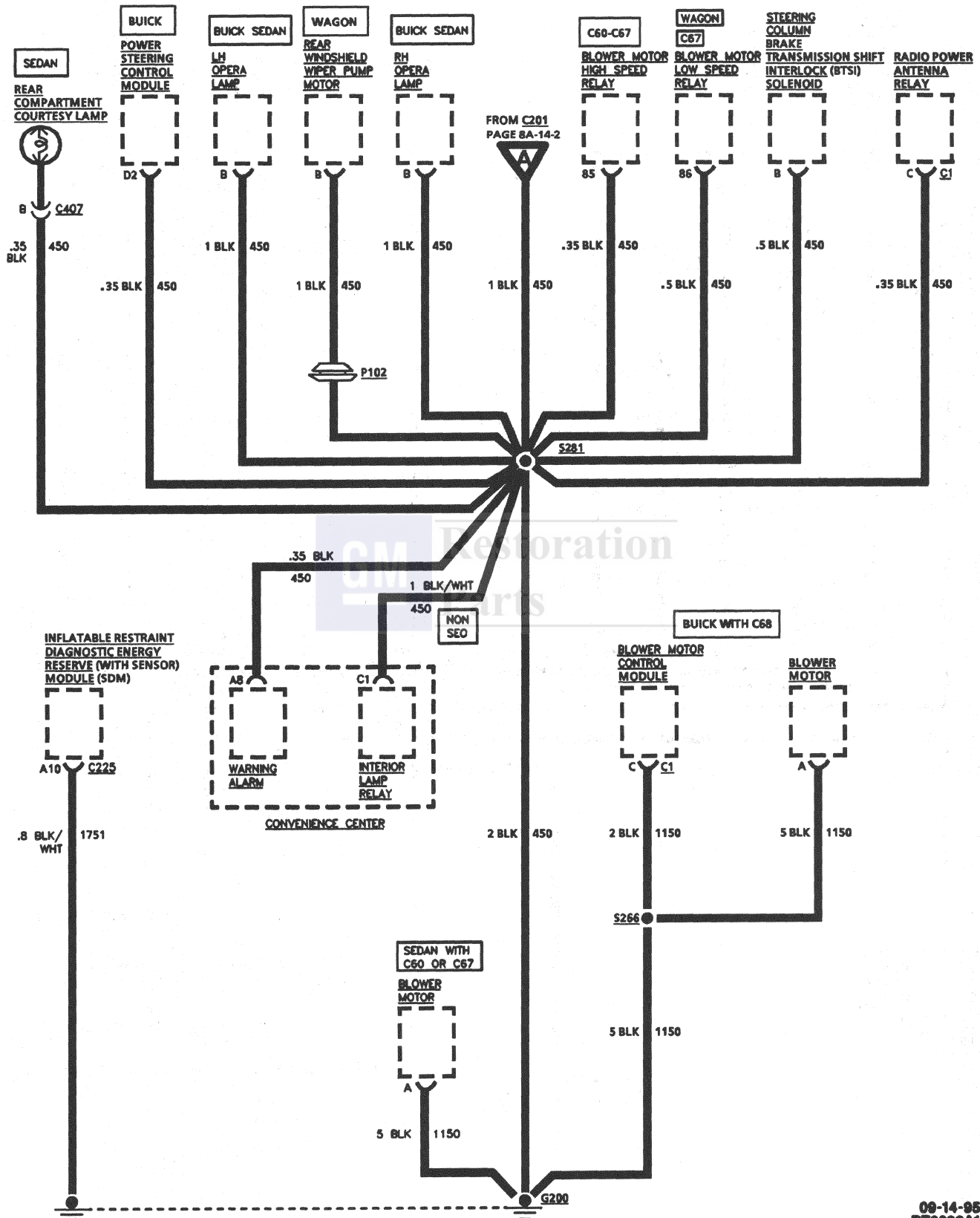


8A - 14 - 2 ELECTRICAL DIAGNOSIS

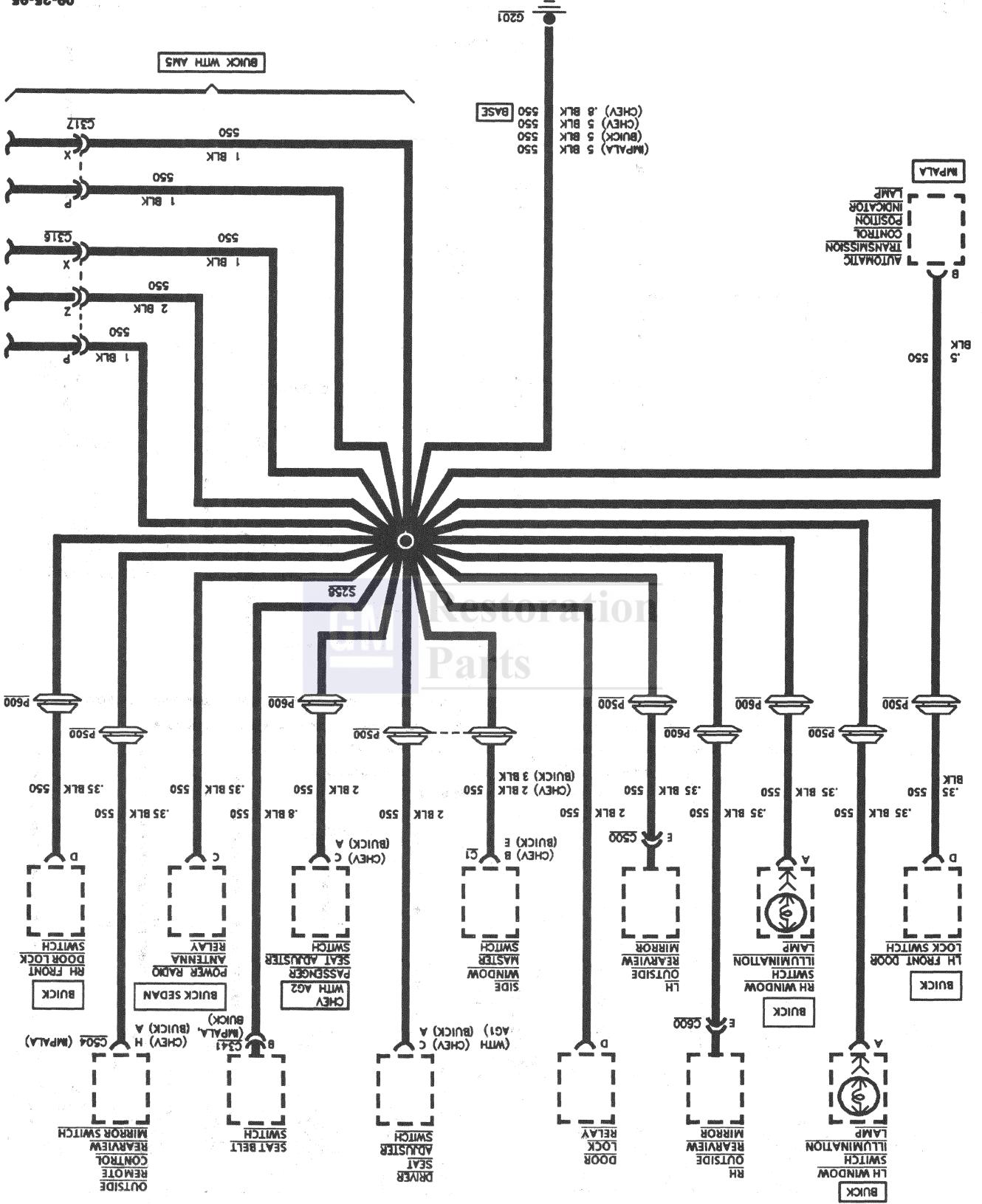
GROUND DISTRIBUTION G200 (INTERIOR BODY GROUND)

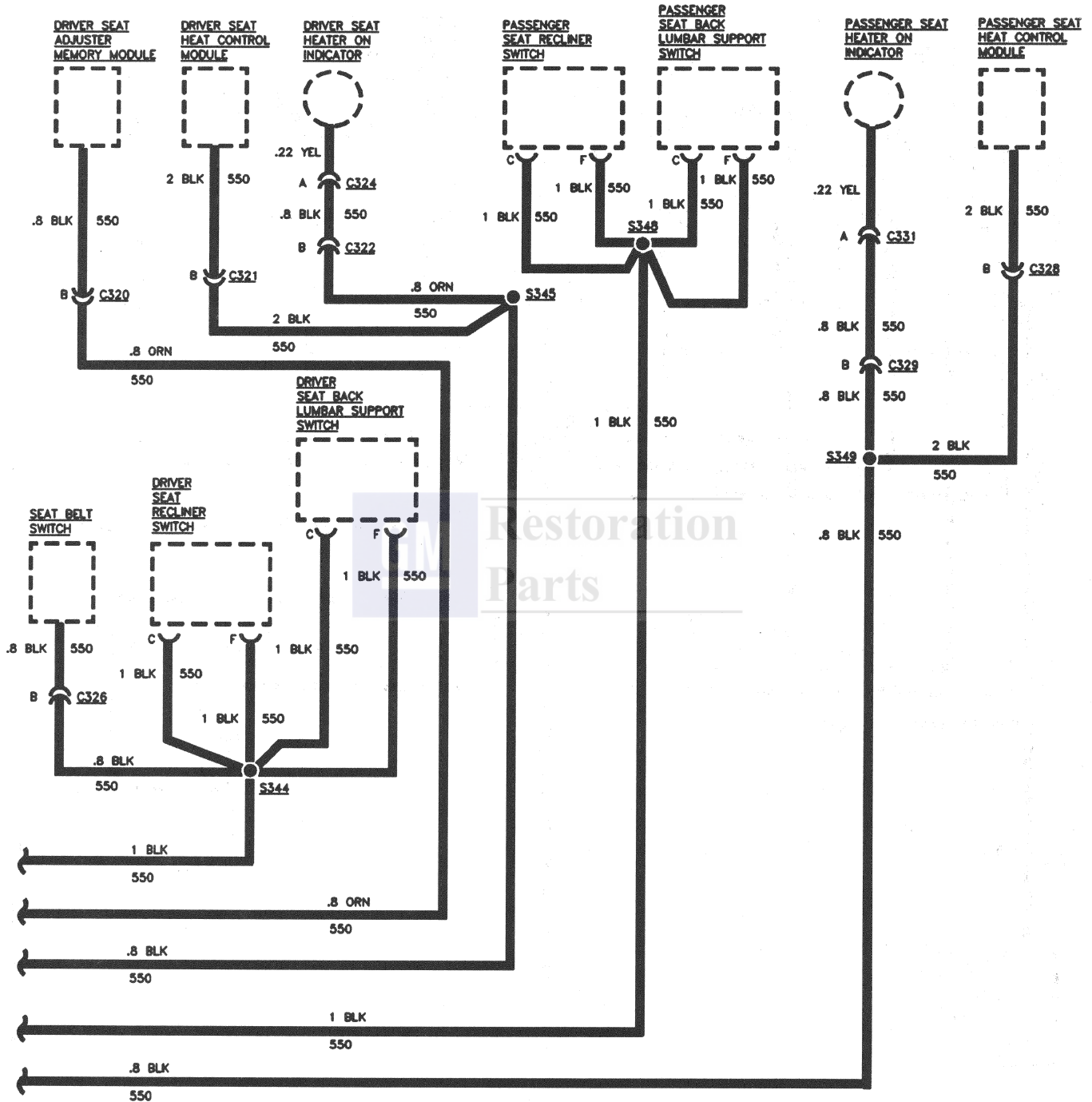


GROUND DISTRIBUTION INTERIOR BODY GROUND AND SDM



GROUND DISTRIBUTION G201 (POWER DOOR LOCKS, POWER MIRRORS AND POWER SEATS)

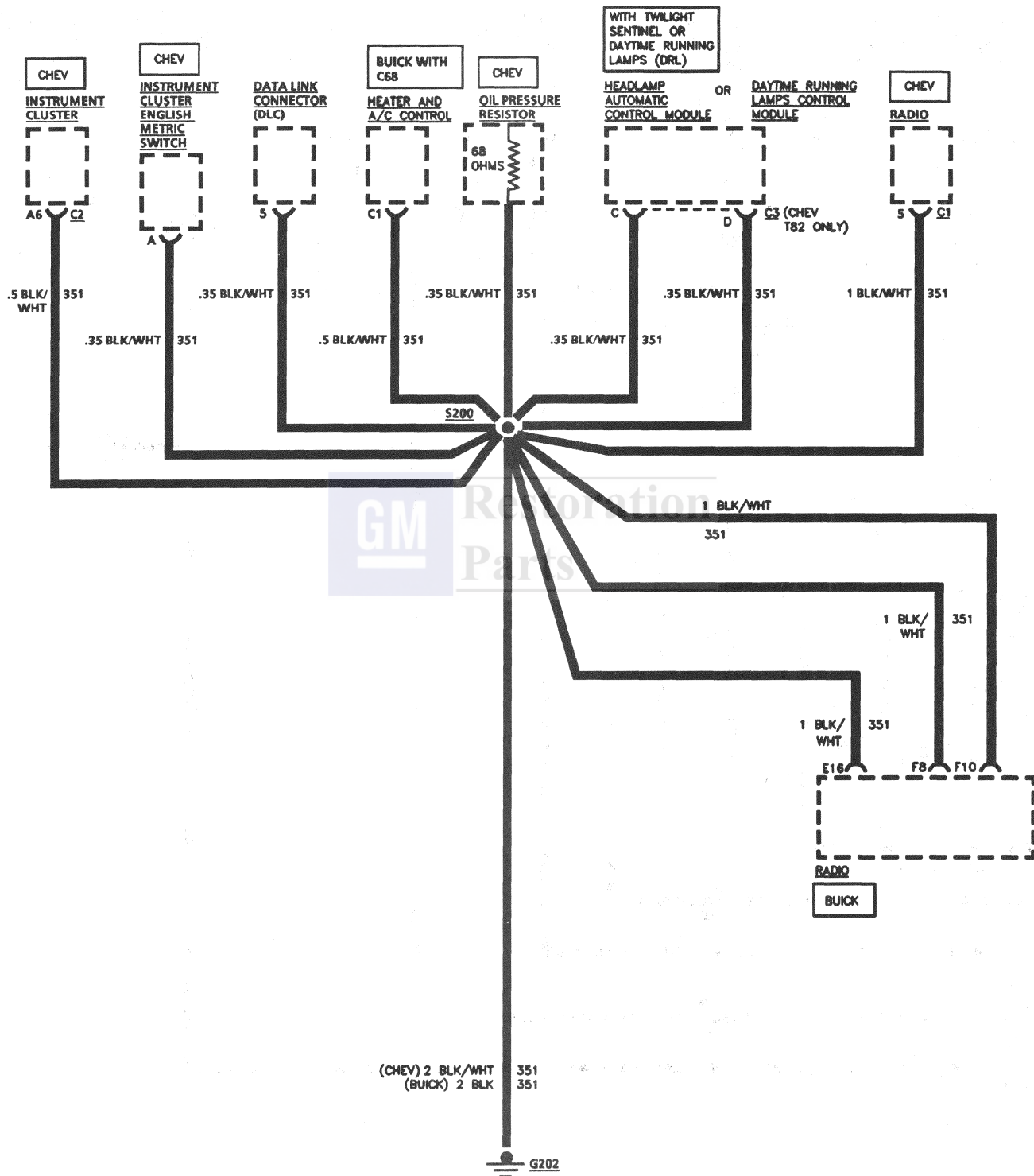


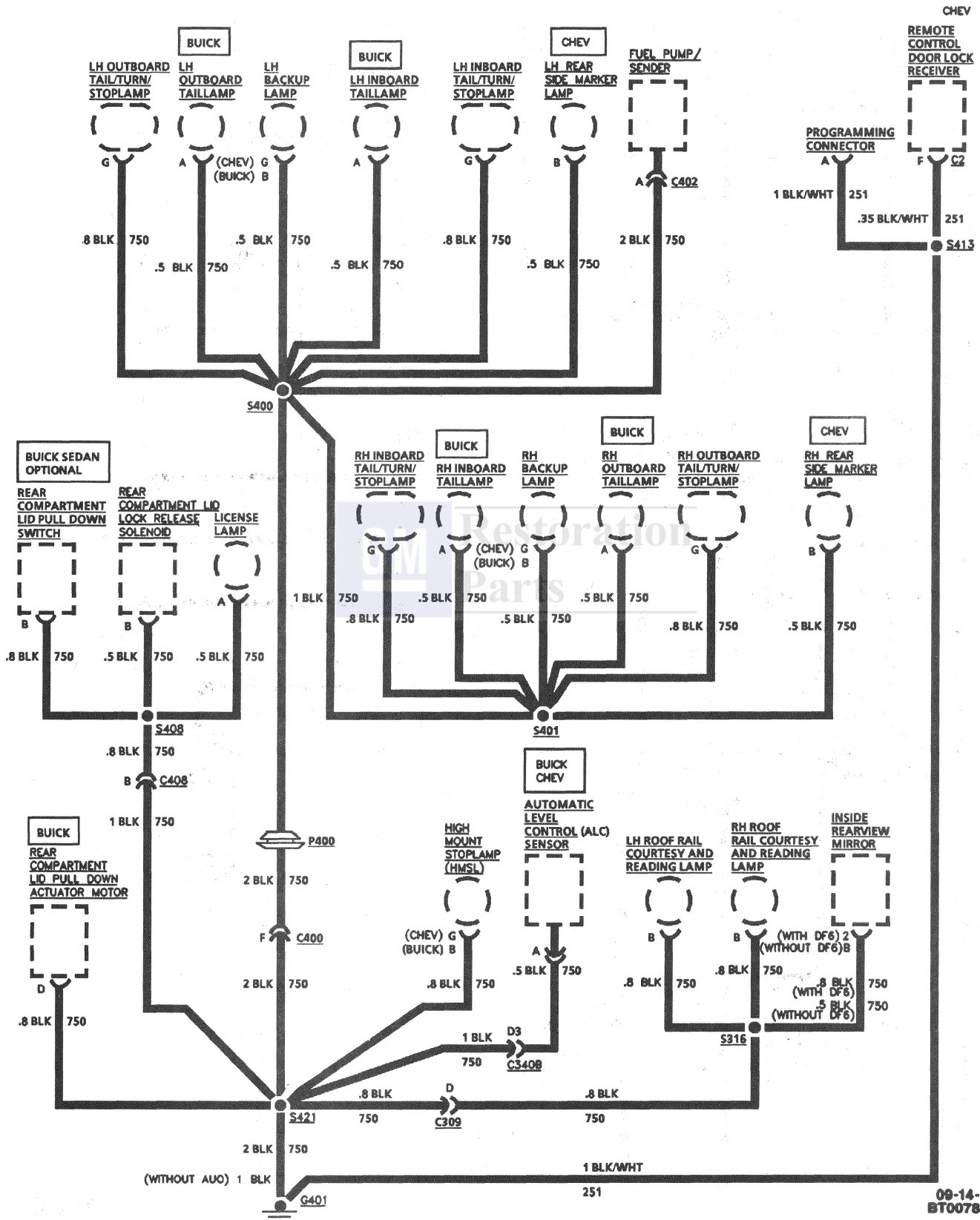


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GROUND DISTRIBUTION

G202 (INTERIOR BODY GROUND)



GROUND DISTRIBUTION**G401 (SEDAN) (REAR LAMPS, TRUNK LID, KEYLESS ENTRY, FUEL SENDER AND AUTOMATIC LEVEL CONTROL)**

GROUND DISTRIBUTION

COMPONENT	LOCATION	201-PG	FIG.	CONN
G100.....	Engine Compartment, Front of RH Cylinder Head			
G101.....	RH Front Fender near Battery			
G102.....	Behind LH Headlamp Support, forward of Air Cleaner.....	5.....	9	
G104.....	Engine Compartment on front of LH Cylinder Head.....	6.....	11	
G106.....	RH Headlamp Support, forward of Battery.....	0.....	2	
G200.....	Base of LH "A" Pillar, behind kickpad.....	11.....	19	
G201.....	Base of LH "A" Pillar, behind kickpad.....	11.....	19	
G202.....	Base of RH "A" Pillar, behind kickpad.....	18.....	29	
G400.....	Near center of RH "D" Pillar.....	36.....	52	
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment			
G401 (Wagon).....	Near center of LH "D" Pillar.....	31.....	46	
P100.....	RH I/P, forward of Blower Motor.....	18.....	29	
P102.....	Visible from Engine Compartment, behind LH Wheelhouse...	5.....	10	
P400 (Sedan).....	LH Rear of Vehicle, in Luggage Compartment.....	32.....	47	
P400 (Wagon).....	LH Rear of Vehicle, at Taillamps.....	37.....	53	
P401 (Wagon).....	RH Rear of Vehicle, at Taillamps.....	38.....	54	
P403 (Wagon).....	Between Endgate and LH "D" Pillar			
P500.....	Between LH Front Door and "A" Pillar.....	19.....	30	
P600.....	Between RH Front Door and "A" Pillar.....	23.....	34	
S100.....	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn branch breakout			
S101.....	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout			
S109.....	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S115.....	Engine Harn, approx 4 cm from Fuel Injector #3			
S119.....	Engine Harn, left side, approx 8 cm from G104 breakout			
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S201 (Buick).....	I/P Harn, behind I/P Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout			
S207 (w/T61).....	Daytime Running Lamps (DRL) Wiring Harn, approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn breakout			

GROUND DISTRIBUTION

COMPONENT	LOCATION	201-PG FIG. CONN
S207 (w/T82).....	Twilight Sentinel Wiring Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn breakout	
S215	Body Harn, approx 4 cm from SDM Conn breakout	
S258	Crossbody and Side Door Harn, approx 12 cm from C231 branch breakout	
S266 (Buick Sedan)	Body Harn, approx 32 cm from Rear Window Defogger Relay	
S266 (Buick Wagon).....	Body Harn, approx 38 cm from Rear Window Defogger Relay	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	
S316	Roof Harn, in C309 branch, approx 32 cm from breakout	
S344 (Buick)	Driver Seat Harness, approx 40 cm from C316	
S345 (Buick)	Driver Seat Harness, approx 36 cm from C316	
S348 (Buick)	Passenger Seat Harness, approx 16 cm from C317	
S349 (Buick)	Passenger Seat Harness, approx 23 cm from C317	
S400 (Buick Sedan)	Body Rear Wiring Harn, approx 4 cm from C416 branch breakout	
S400 (Chev Sedan).....	Body Rear Wiring Harn, approx 4 cm from C402 branch breakout	
S400 (Wagon).....	LH Stoplamp Wiring Harn, approx 12 cm from LH Lower Tail/Turn/Stoplamp Conn branch breakout	
S401 (Buick Sedan)	Body Rear Wiring Harn, approx 4 cm from C417 branch breakout	
S401 (Chev Sedan)	Body Rear Wiring Harn, approx 4 cm from RH Backup Lamp Conn branch breakout	
S401 (Wagon).....	RH Stoplamp Wiring Harn, approx 12 cm from RH Lower Tail/Turn/Stoplamp Conn branch breakout	
S402 (Wagon/SEO Wagon)	Rear Compartment Wiring Harn, approx 5 cm from High Mount Stoplamp Conn breakout	
S406 (Wagon).....	Rear Body Harn, approx 17 cm from C412 branch breakout	
S408 (Sedan)	Deck Lid Harn, approx 4 cm from Rear License Lamp breakout	
S413	Body Harn, approx 7 cm from G401 breakout	
S414 (Wagon).....	Body Harness, approx 26 cm from Remote Control Door Lock Module breakout	
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp breakout	



8A - 20 - 0 ELECTRICAL DIAGNOSIS

SEQUENTIAL MULTIPORT FUEL INJECTION: V8 VIN P AND VIN W

- For Schematics, Circuit Operation and System Diagnosis regarding the Powertrain Control System, refer to Engine Controls.

COMPONENT	LOCATION	201-PG	FIG.	CONN
C120 (4 cavities).....	Engine Harness to Distributor			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	26	202-3
C205 (10 cavities).....	Engine Harn to I/P Harn, right of I/P Compartment.....	18	29	202-4
C400 (8 cavities)(Sedan)	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender	32	47	202-6
C400 (6 cavities)(Wagon).....	Body Harn to LH Taillamp Harn, forward of Taillamps.....	34	49	
C402.....	Rear Lamp Harn to Fuel Pump/Level Sender	37	53	
G104.....	Front of LH Cylinder Head	6	11	
G202.....	Base of RH "A" Pillar behind kickpad			
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment.....	31	46	
G401 (Wagon)	Near center of LH "D" Pillar	34	49	
P100	RH I/P, forward of Blower Motor	16	26	
P102	Visible from Engine Compartment behind LH Wheelhouse			
P400	LH rear of Vehicle near Taillamps	32	47	
S102	Engine Harn, center branch, approx 7 cm from Fuel Injector #8 Conn branch breakout			
S103	Engine Harn, left side, approx 16 cm from Automatic Transmission Control Conn branch breakout			
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S111.....	Engine Harn, approx 15 cm from Underhood Electrical Center			
S113	Engine Harn, center branch, approx 14 cm from Fuel Injector #6 Conn branch breakout			
S114	Engine Harn, approx 14 cm from Underhood Lamp branch breakout			
S115	Engine Harn, approx 4 cm from Fuel Injector #3			
S116	Engine Harn, left side, approx 8 cm from G104 breakout			
S117	Engine Harn, center branch, approx 5 cm from Fuel Injector #6 Conn branch breakout			
S119	Engine Harn, left side, approx 8 cm from G104 breakout			
S120	Engine Harn, right side, approx 7 cm from center branch breakout			
S122	Engine Harn, left side, approx 17 cm from G104 breakout			
S132	Engine Harn, approx 13 cm from Underhood Electrical Center branch breakout			

COMPONENT	LOCATION	201-PG FIG. CONN
S150	Engine Harness, approx 19 cm from Underhood Electrical Center	
S151	Engine Harn, left side, approx 19 cm from Fuel Injector #5 Conn branch breakout	
S152	Engine Harn, left side, approx 15 cm from Fuel Injector #5 Conn branch breakout	
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping	
S200 (Chev).....	I/P Harn, approx 8 cm from Heater and A/C Control Conn branch breakout	
S215	Body Harn, approx 4 cm from SDM Conn breakout	
S223 (Buick).....	I/P Harn, approx 23 cm from C200, on branch	
S230	Body Harn, approx 4 cm from BTSI Connector breakout	
S232	Body Harn, approx 10 cm from SDM Conn branch breakout, behind Instrument Cluster	
S234	Body Harn, approx 4 cm from C201 branch breakout	
S251	Body Harn, approx 7 cm from SDM Conn branch breakout	
S252	Body Harn, approx 15 cm from Inflatable Restraint I/P Inflator Module Conn branch breakout	
S255 (Buick).....	I/P Harn, approx 24 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping	
S400 (Buick Sedan).....	Body Rear Wiring Harn, approx 4 cm from C416 branch breakout	
S400 (Chev Sedan).....	Body Rear Wiring Harn, approx 4 cm from C402 branch breakout	
S400 (Wagon).....	LH Stoplamp Wiring Harn, approx 12 cm from LH Lower Tail/Turn/Stoplamp Conn branch breakout	
S414 (Wagon).....	Body Harn, approx 26 cm from Remote Control Door Lock Module	
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp	



COMPONENT	LOCATION	201-PG	FIG.	CONN
Battery	RH front of Engine Compartment	9	15	
Generator	RH side of Engine, forward of RH Valve Cover	7	12	
I/P Fuse Block	Mounted to LH I/P, accessible with LH front door open	11	19	
Ignition Switch	Mounted on upper RH side of Steering Column	13	21	202-12
Inflatable Restraint Diagnostic Energy Reserve (with sensor) Module (SDM)	Upper LH I/P, above Convenience Center	11	19	47-2
Instrument Cluster	LH side of I/P, centered above Steering Column	9	16	
Starter Motor Theft Deterrent Relay	RH "A" Pillar, behind RH kickpad	11	19	202-15
Starter Solenoid Switch	Bottom of RH side of Engine, above Starter Motor			
Theft Deterrent Module	behind LH I/P, Left of Brake Pedal Bracket	11	19	
Underhood Electrical Center	Engine Compartment, on RH Wheelhouse	9	15	
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C205 (10 cavities)	I/P Harn to Engine Harn, right of I/P Compartment	18	29	202-4
C207	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad	18	29	
C207A	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad	18	29	
C207B	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad	18	29	
G100	Engine Compartment, front of RH Cylinder Head			
G101	RH Front Fender, near Battery			
P100	RH I/P, forward of Blower Motor	16	26	
S227	Body Harn, approx 8 cm from Convenience Center branch breakout, behind Instrument Cluster			
S232	Body Harn, approx 10 cm from SDM breakout			
S245	Body Harn, approx 4 cm from I/P Fuse Block breakout			
S255 (Buick)	I/P Harn, approx 24 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S255 (Chev)	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping			
S276	Body Harn, approx 13 cm from SDM breakout			

STARTER AND CHARGING TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

Starter

1. Visually inspect the hydrometer (built into Battery).
 - Green dot—Battery is charged.
 - Dark dot—Charge and load test Battery, refer to SECTION 6D1. If Battery passes load test, refer to System Diagnosis, page 8A-30-2.
 - Clear or light yellow dot—Battery electrolyte is low. Replace Battery.
2. Check that Starter Solenoid Switch terminals "S" and "B" and Battery connections are clean and tight.
3. Check that Maxifuse #11 and I/P Fuse #24 are OK. If these fuses are open, check for a short to ground in CKT 5, CKT 142 or CKT 806.
4. Check that G100 and G101 are clean and tight.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

Charging System

1. Visually inspect the hydrometer (built into Battery).
 - Green dot—Battery is charged.
 - Dark dot—Charge and load test Battery, refer to SECTION 6D1. If Battery passes load test, refer to System Diagnosis, page 8A-30-2.
 - Clear or light yellow dot—Battery electrolyte is low. Replace Battery.
2. Check U/Hood Fuse #8 and I/P Fuse #11. Check Maxifuse #11.
3. Check that the Generator Connector and Generator "BAT" terminal are both clean and tight.
4. Check that the Battery connections are clean and tight.
5. Check Generator belt.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity/voltage check (see "Troubleshooting Procedures," page 8A-4-0).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

SYSTEM DIAGNOSIS

! Important:

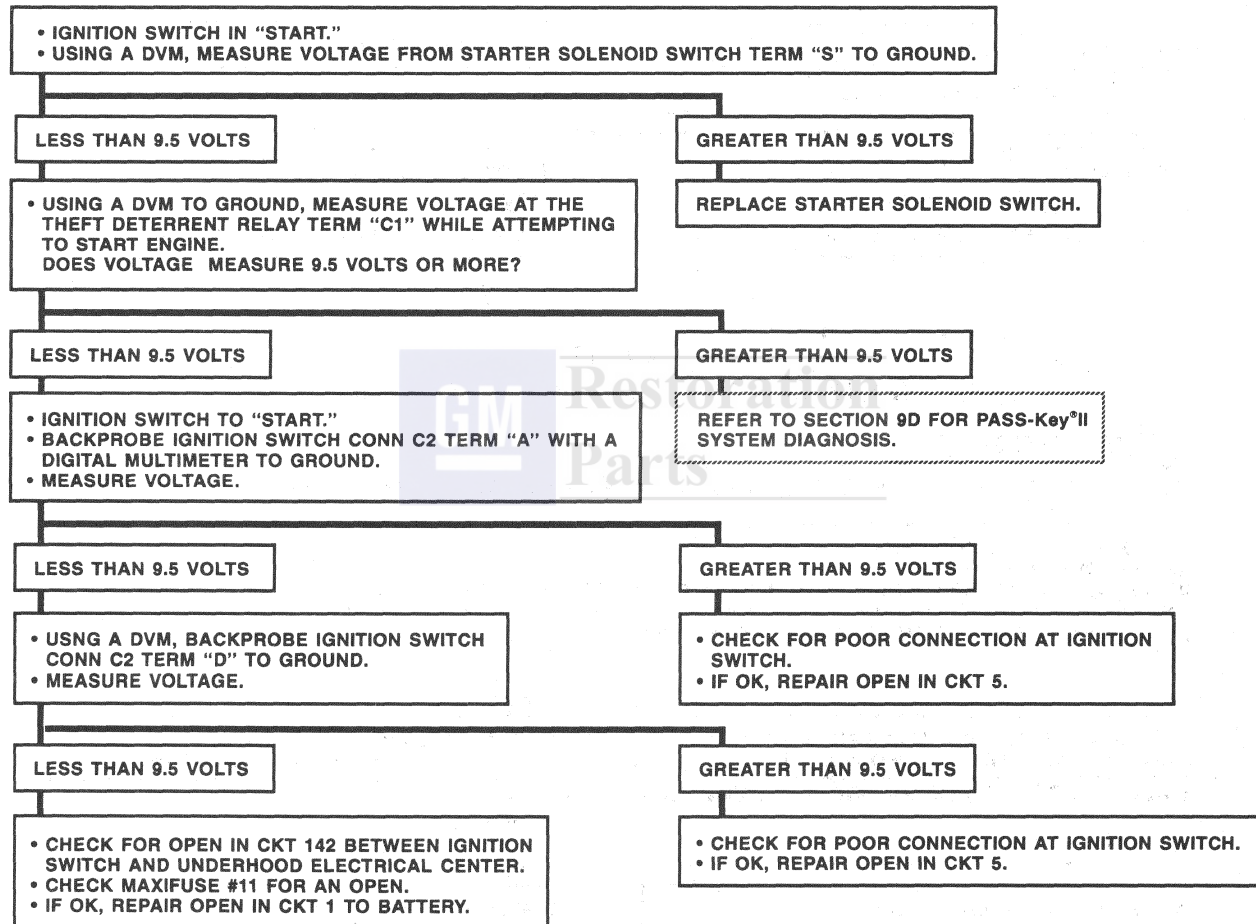
- If the Starter or Charging System continues to malfunction after the following diagnostic procedures are performed, refer to SECTIONS 6D2 and 6D3.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Engine does not crank, Starter Solenoid Switch does not click.	Chart #1	8A-30-3
Starter Solenoid Switch clicks, Engine does not crank.	Chart #2	8A-30-4
Engine cranks/cranks slowly but does not start.	Refer to Engine Controls.	
Battery is undercharged or overcharged.	Chart #3	8A-30-4
"CHARGE" Warning Indicator on at all times.	Chart #4	8A-30-5
"CHARGE" Warning Indicator inoperative.	Chart #5	8A-30-6

CHART #1**ENGINE DOES NOT CRANK, STARTER SOLENOID SWITCH DOES NOT CLICK****IMPORTANT:**

- BATTERY MUST BE IN A CHARGED STATE TO AVOID MISDIAGNOSIS. REFER TO SECTION 6D1.



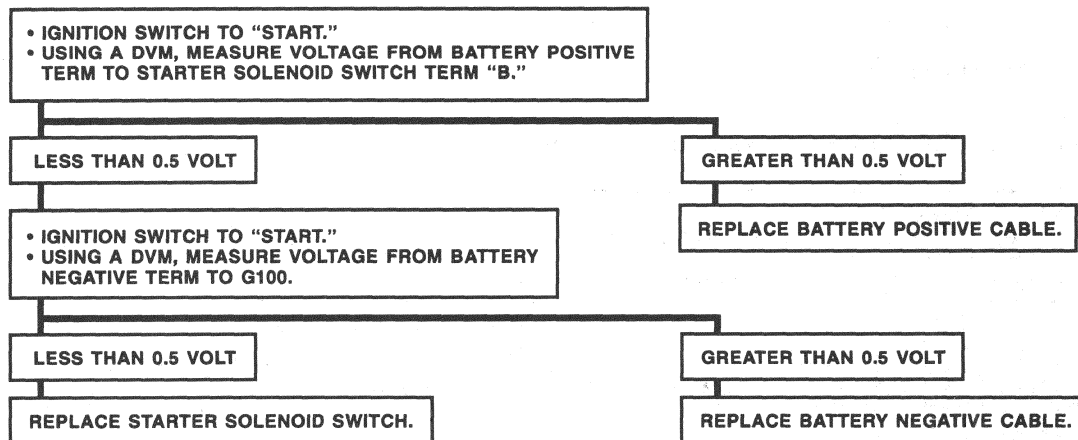
STARTER AND CHARGING

CHART #2

STARTER SOLENOID SWITCH CLICKS, ENGINE DOES NOT CRANK

**IMPORTANT:**

- BATTERY MUST BE IN A CHARGED STATE TO AVOID MISDIAGNOSIS. REFER TO SECTION 6D1.



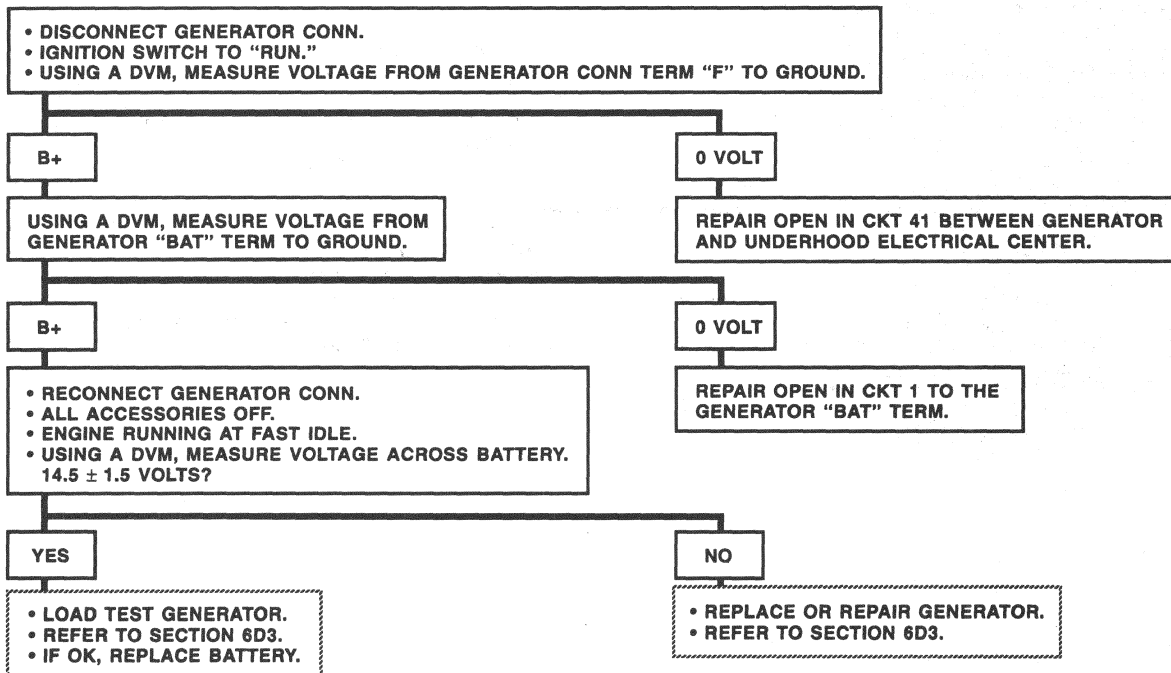
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CHART #3

BATTERY IS UNDERCHARGED OR OVERCHARGED

**IMPORTANT:**

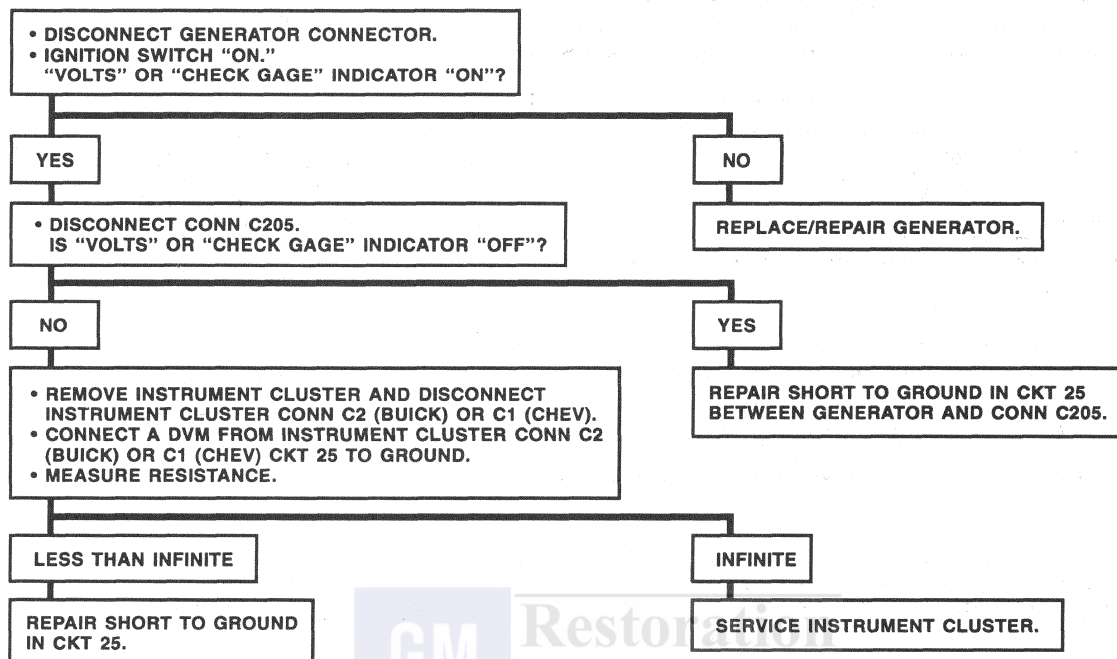
- BATTERY MUST BE IN A CHARGED STATE TO AVOID MISDIAGNOSIS. REFER TO SECTION 6D1.



C8132

CHART #4**"VOLTS" OR "CHECK GAGE" INDICATOR ON AT ALL TIMES****IMPORTANT:**

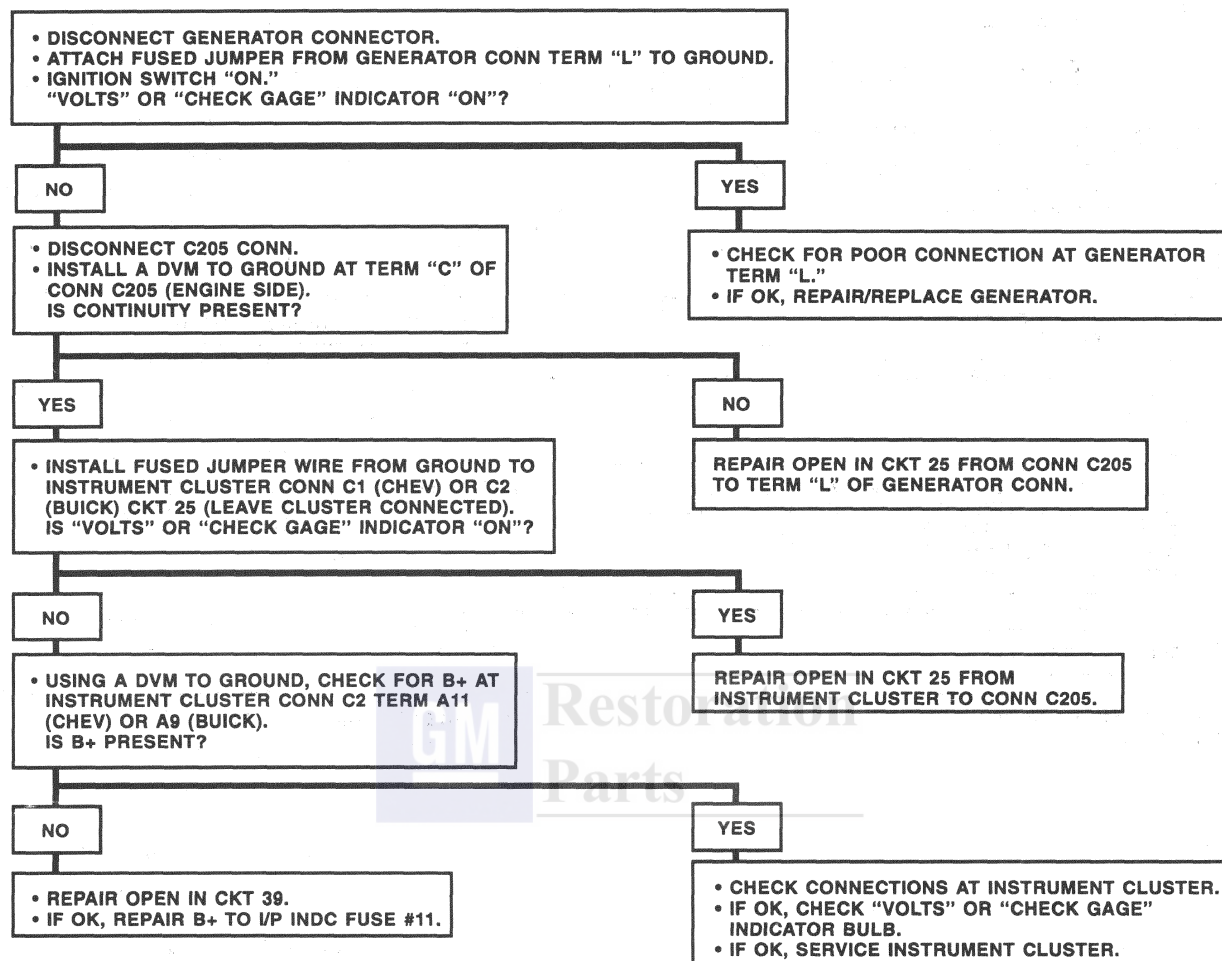
- CHECK GENERATOR ROTOR SHAFT DRIVE END NUT. IF LOOSE, TIGHTEN NUT TO 100 N M/75 LB FT. INSPECT GENERATOR PULLEY FOR DAMAGE. REFER TO SECTION 6D3.



C8133

STARTER AND CHARGING

CHART #5
"VOLTS" OR "CHECK GAGE" INDICATOR INOPERATIVE



CIRCUIT OPERATION

Starter

Battery voltage is applied to the Ignition Switch at all times through Maxifuse #11. When the Ignition Switch is turned to "START," battery voltage is applied through the closed contacts of the Ignition Switch, (through the contacts of the Theft Deterrent Relay). This relay is controlled by the Theft Deterrent Module, (NON SEO). Then it goes to the Starter Solenoid Switch at terminal "S." When battery voltage is applied to terminal "S" of the Starter Solenoid Switch, the Hold-In Coil and Pull-In Coil of the Starter Solenoid Switch are energized with the Pull-In Coil grounded through the Starter Motor. The coils, when energized, work together to pull in and hold the Plunger of the Starter Solenoid Switch. As the Plunger is pulled in, it closes the Starter Solenoid Switch contacts and causes the Shift Lever to rotate, engaging the Drive Assembly to the Flywheel. With battery voltage applied directly to the Starter Motor, through the closed Solenoid Contacts, the Starter Motor begins to rotate the Drive Assembly as the Drive Assembly comes in contact with the Flywheel. The Pull-In Coil is de-energized by having battery voltage at both ends of the coil. The Starter Motor continues to rotate to crank the Engine through the Drive Assembly-Flywheel gear combination.

Battery voltage is removed from the Starter Solenoid Switch terminal "S" when the Ignition Switch is released from the "START" position. The Hold-In Coil is de-energized and the return spring in the Starter Solenoid Switch causes the Plunger to disengage the Drive Assembly from the Flywheel. As the Plunger returns, the Plunger opens the Solenoid Contacts removing battery voltage from the Starter Motor.

Charging

The Generator provides voltage to operate the vehicle's electrical system and charge the Battery. The Regulator supplies current to the field coil of the Rotor. When current flows through the field coil, a magnetic field is created.

This field rotates as the Rotor is driven by the Engine, creating an AC voltage and current in the Stator windings. This AC signal is converted to DC by the rectifier bridge and available to the vehicle's electrical system at the "BAT" terminal.

The Generator must supply sufficient current to all vehicle electrical loads especially for charging the vehicle's Battery. Since the Rotor speed varies with Engine speed, the Generator must also maintain the output voltage at a constant value. The Generator's Regulator switches current to the field coil of the Rotor on or off controlling the output voltage of the Generator. When the Ignition Switch is turned to "RUN," battery voltage is supplied from U/Hood Fuse #8 to the Generator at terminal "F," turning on the Regulator. If for any reason terminal "F" did not supply any current to the connection inside the Generator, the Regulator could still turn on because CKT 25 would function as a backup source of "TURN ON" current.

The Regulator switches on the field current by connecting the field coil of the Rotor to battery voltage available at the "BAT" terminal.

The field current creates a weak magnetic field in the field coil when the Engine is being started. The Regulator senses Generator rotation by detecting an AC voltage at the Stator through an internal wire. Once the Engine is running, the Regulator can monitor the internal AC voltage and DC output at the "BAT" terminal. The Regulator will then vary the current in the field coil of the Rotor, as needed, to provide a constant output voltage and adequate current to the electrical system of the vehicle.

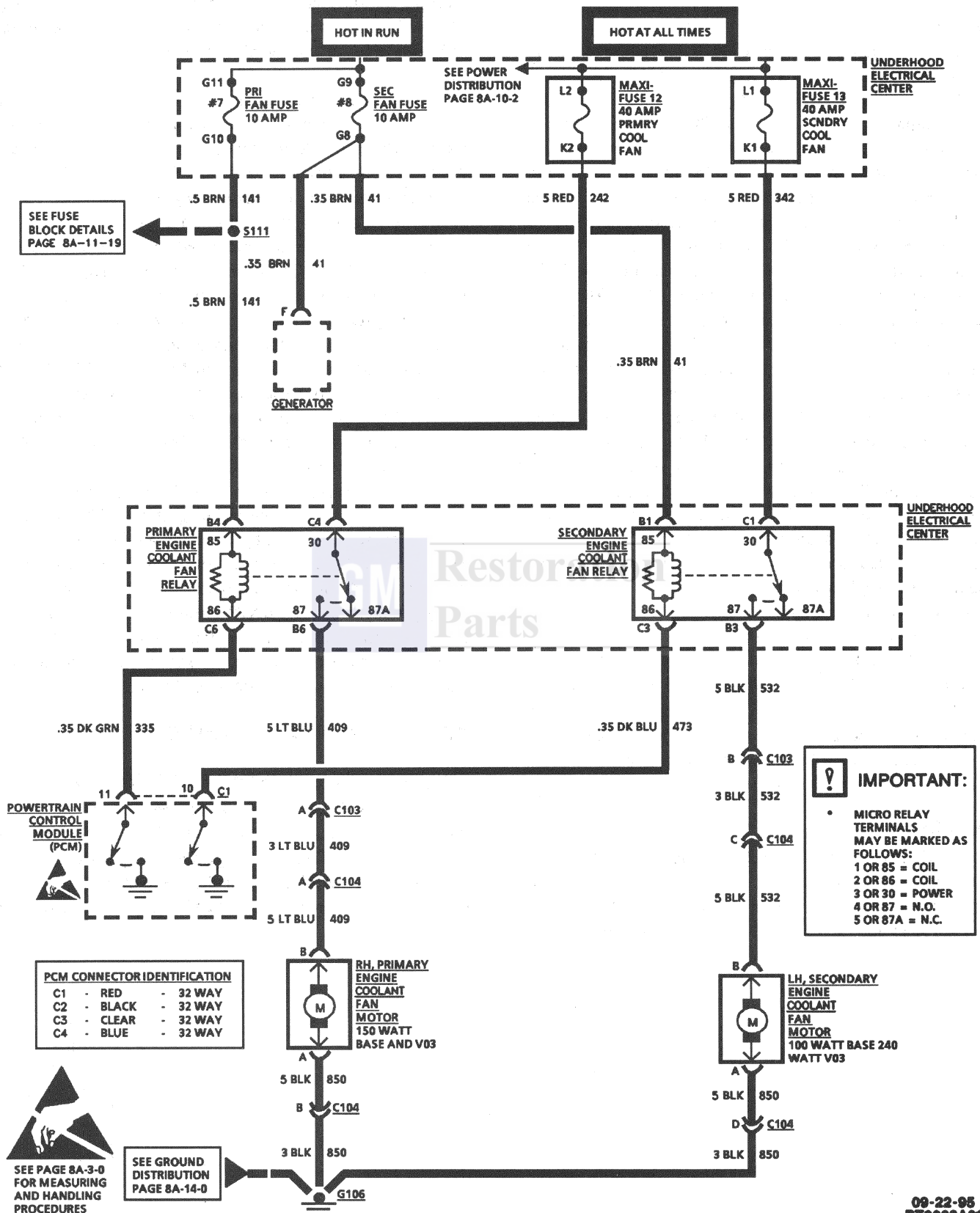
"VOLTS" INDICATOR (BUICK)

"CHECK GAGE" INDICATOR (CHEV)

Battery voltage is applied to the Instrument Cluster through I/P Fuse #11 whenever the Ignition Switch is in "RUN," or "START." A ground is provided at the Generator "L" terminal when the Regulator senses a high or low voltage condition or when the Rotor stops turning.

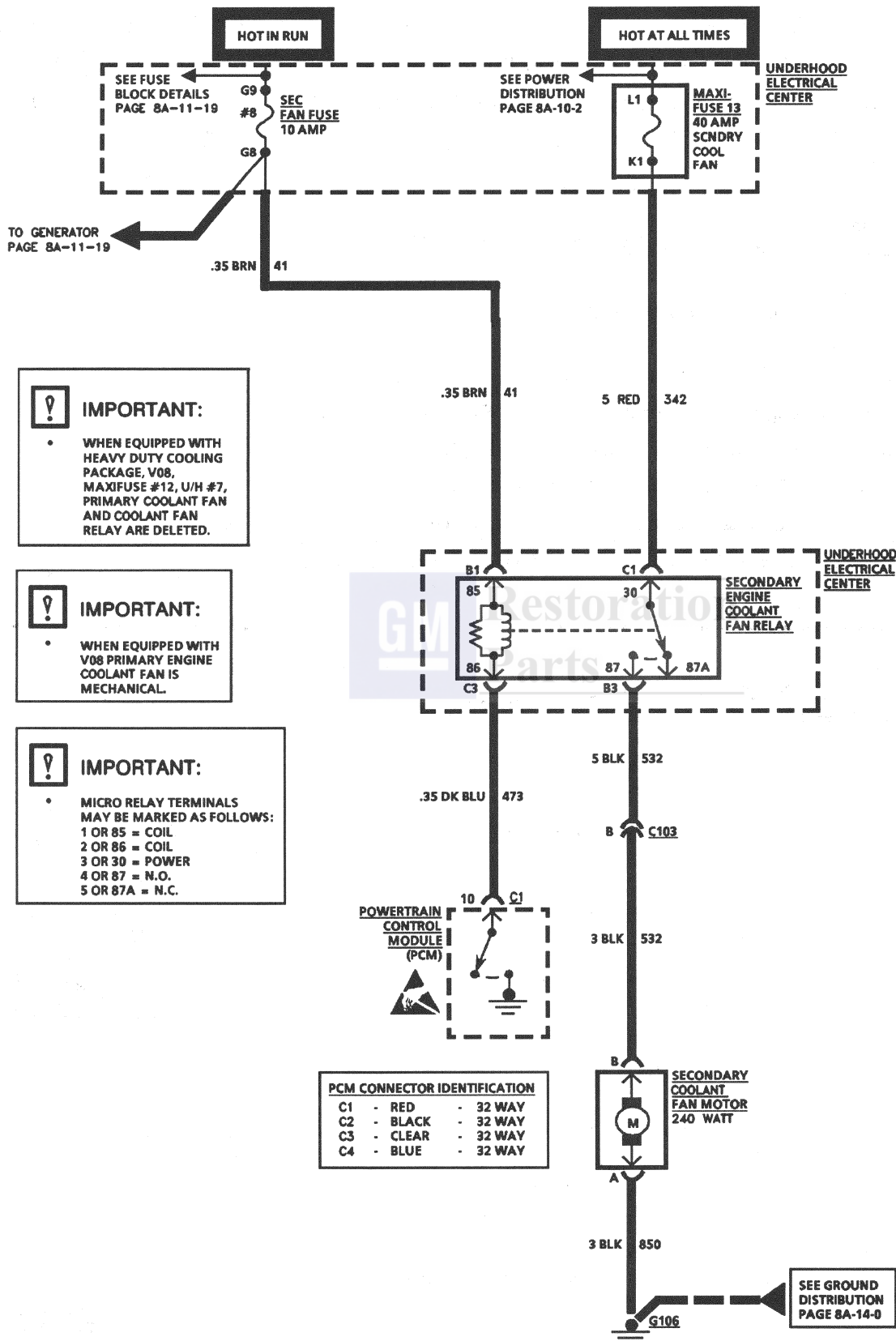
COOLANT FANS

BASE AND V03 EXTRA CAPACITY COOLING ONLY



COOLANT FANS

V08 HEAVY DUTY COOLING ONLY



8A - 31 - 2 ELECTRICAL DIAGNOSIS

COOLANT FANS

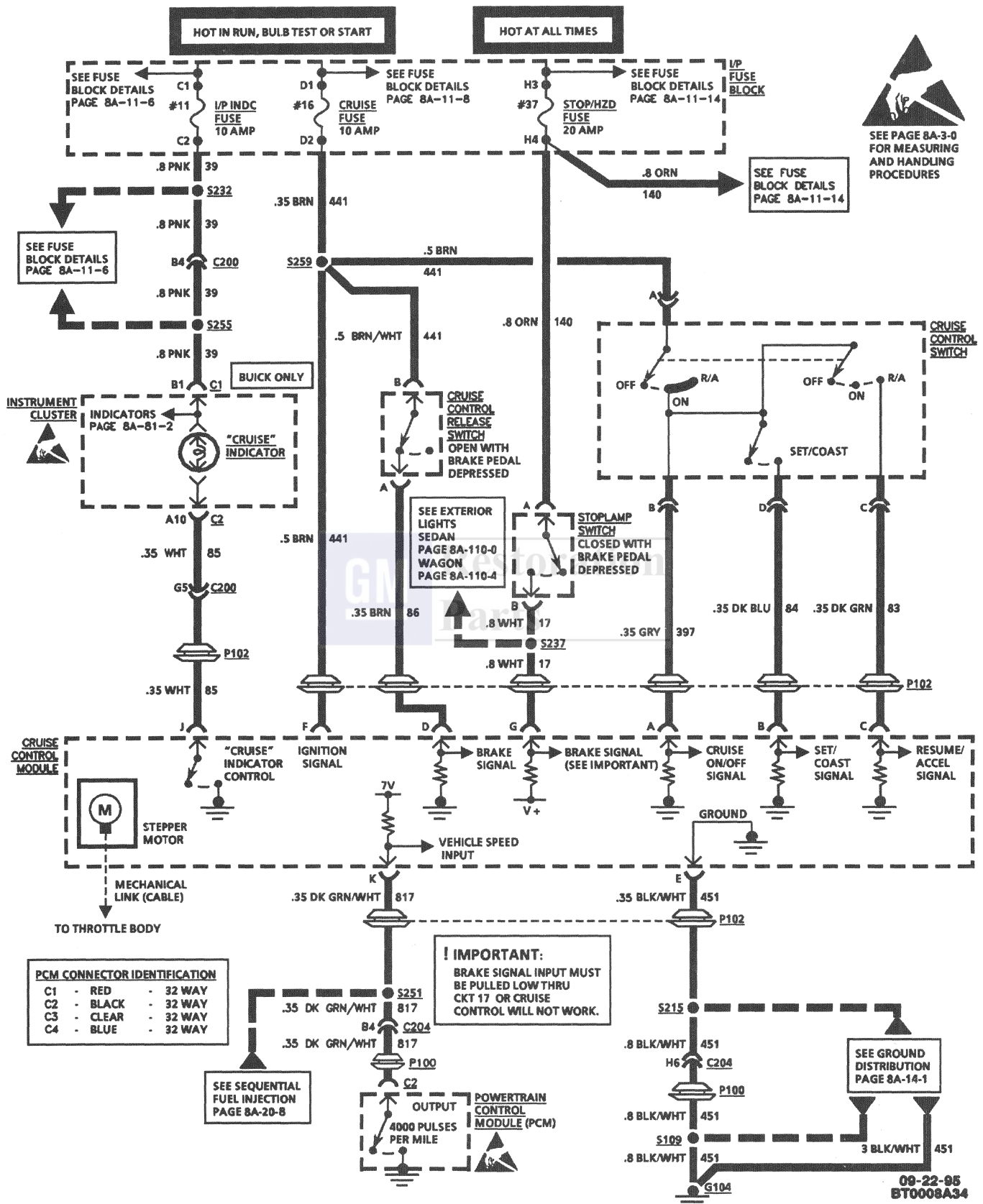
COMPONENT	LOCATION	201-PG	FIG.	CONN
Generator.....	RH side of Engine, forward of RH Valve Cover.....	7.....	12	
Powertrain Control Module (PCM).....	Engine Compartment, forward of LH Wheelhouse under Air Cleaner.....	4.....	8.....	20-10 to 13
Primary Engine Coolant Fan Motor.....	Behind RH side of Radiator			
Primary Engine Coolant Fan Relay.....	In Underhood Electrical Center			
Secondary Engine Coolant Fan Motor.....	Behind LH side of Radiator			
Secondary Engine Coolant Fan Relay.....	In Underhood Electrical Center			
Underhood Electrical Center	Engine Compartment, attached to RH Wheelhouse.....	9.....	15	
C103 (5 cavities).....	F/L Harn to Engine Harn, at RH Fender			
C104 (4 cavities).....	F/L Harn to Coolant Fans Jumper, near Battery			
G106.....	RH Headlamp Support, forward of Battery	0.....	2	
S111.....	Engine Harn, approx 15 cm from Underhood Electrical Center			

SYSTEM DIAGNOSIS

- Refer to "Electric Cooling Fans," Engine Controls
Table of Contents for diagnosis.



CRUISE CONTROL



COMPONENT	LOCATION	201-PG	FIG.	CONN
Cruise Control Module	Fastened to LH Front Wheelhouse	5	10	
Cruise Control Release Switch..	Attached to Brake Pedal Bracket (bottom switch)	11	19	
Cruise Control Switch.....	Attached to Brake Pedal Bracket.....	13	21	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH front door open.....	11	19	
Instrument Cluster	LH side of I/P, centered above Steering Column.....	9	16	
Powertrain Control Module (PCM).....	Engine Compartment forward of LH Wheelhouse, under Air Cleaner.....	4	8	
Stoplamp Switch.....	Attached to Brake Pedal Bracket (top switch).....	11	19	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	26.....	202-3
G104.....	Engine Compartment, on front of LH Cylinder Head			
P100	RH I/P, forward of Blower Motor	16	26	
P102	Visible from Engine Compartment behind LH Wheelhouse....	5	10	
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S215	Body Harn, approx 4 cm from SDM Conn breakout			
S232	Body Harn, approx 10 cm from SDM breakout			
S237	Body Harn, approx 11 cm from Starter Motor Theft Deterrent Relay breakout			
S251	Body Harn, approx 7 cm from SDM breakout			
S255 (Buick).....	I/P Harn, behind Instrument Cluster, 16 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 breakout, before spiral taping			
S259	Body Harn, approx 12 cm from Convenience Center breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

! Important:

- The "Set To Get Cruise" feature requires the operator to set the initial set speed by using the Set/Coast button before the R/A (Resume/Accel) slider switch input will be recognized. The "Set To Get Cruise" feature must be applied whenever cruise is turned "OFF" or the Ignition Switch is cycled.

! Important:

- The "Brake Before Cruise" feature requires the cruise module to see terminal "D" change states, once each

Ignition Cycle before allowing Cruise Control. (Some Cruise Modules will use either terminal "D" or "G".)

1. Check that Cruise Control Module Linkage is connected and moving freely.
2. Check Cruise Cable Adjustment. See SECTION 9B.
 - Cruise will not function with Hazard Lamps "ON."
 - Make sure that CKT 17 and the Stoplamps are working properly. If inoperative, Cruise Module will be disabled.
 - Cruise performance can be affected by trailer towing and steep grades.

CRUISE CONTROL

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).
- If speedometer is inoperative, refer to "Vehicle Speed Sensor," page 8A-81-20.

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Drive vehicle above 25 mph. • Cruise Switch to "ON." • Depress Set Switch once and release. • Remove foot from accelerator pedal.	Vehicle maintains set speed at time of release.
[2] • Depress and hold Set Switch until vehicle speed decreases by 4 to 5 mph. • Release Set Switch.	Vehicle decelerates and maintains a new lower set speed, if speed is above 25 mph.
[3] • Depress and hold R/A Switch until vehicle speed increases by 4 to 5 mph. • Release R/A Switch.	Vehicle accelerates and maintains a new higher set speed.
[4] • Depress brake pedal slightly.	Cruise Control disengages. Memory unchanged.
[5] • Depress R/A Switch once (less than 3/4 seconds) and release.	Vehicle accelerates to and maintains previous set speed.
[6] • Depress R/A Switch once and release (less than 1/2 of a second).	Vehicle speed increases by 1 mph and maintains new set speed.
[7] • Depress Set Switch once and release (less than 1/2 of a second).	Vehicle speed decreases by 1 mph and maintains new set speed.
[8] • Depress Set and R/A Switches simultaneously.	Vehicle put in Non-Cruise mode with memory unchanged.
[9] • Depress R/A Switch once (less than 3/4 seconds) and release.	Vehicle accelerates to and maintains previous set speed.
[10] • Cruise Switch to "OFF."	Cruise Control disengages. Memory lost.

ADDITIONAL SYSTEM CHECK

The following procedure may be used as a System Check to verify operation of the Cruise Control System after repairs.

- Set Park Brake.
- Start Engine.
- Move Cruise Control Switch to "OFF."
- Move Cruise Control Switch to "ON" and then

wait at least 3 seconds before doing next step.

- Push Cruise Set Switch in and hold.
- Hold Cruise Slider Switch in "R/A" position.
- Fully depress and hold brake pedal.
- After 10 seconds, release brake pedal while still holding R/A and Set Switches.
- Engine rpm should increase momentarily then return to normal.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Cruise Control will not engage.	Chart #1	8A-34-4
Cruise Control will not resume, accelerate or tap-up.	Chart #2	8A-34-7
"CRUISE" Indicator inoperative (Buick).	Chart #3	8A-34-7
"CRUISE" Indicator on at all times (Buick).	Chart #4	8A-34-8



Restoration
Parts

CRUISE CONTROL

CHART #1
CRUISE CONTROL WILL NOT ENGAGE

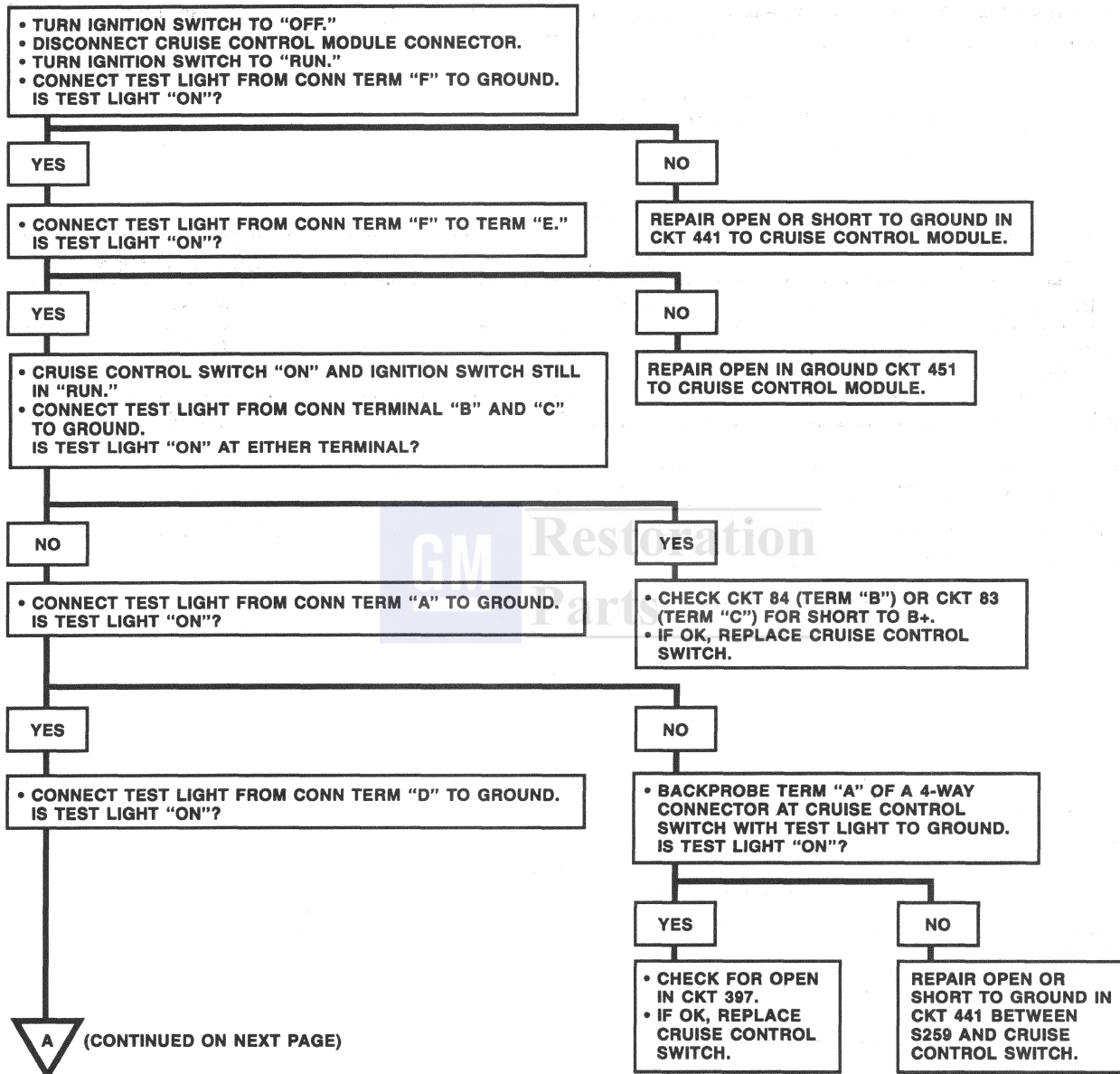
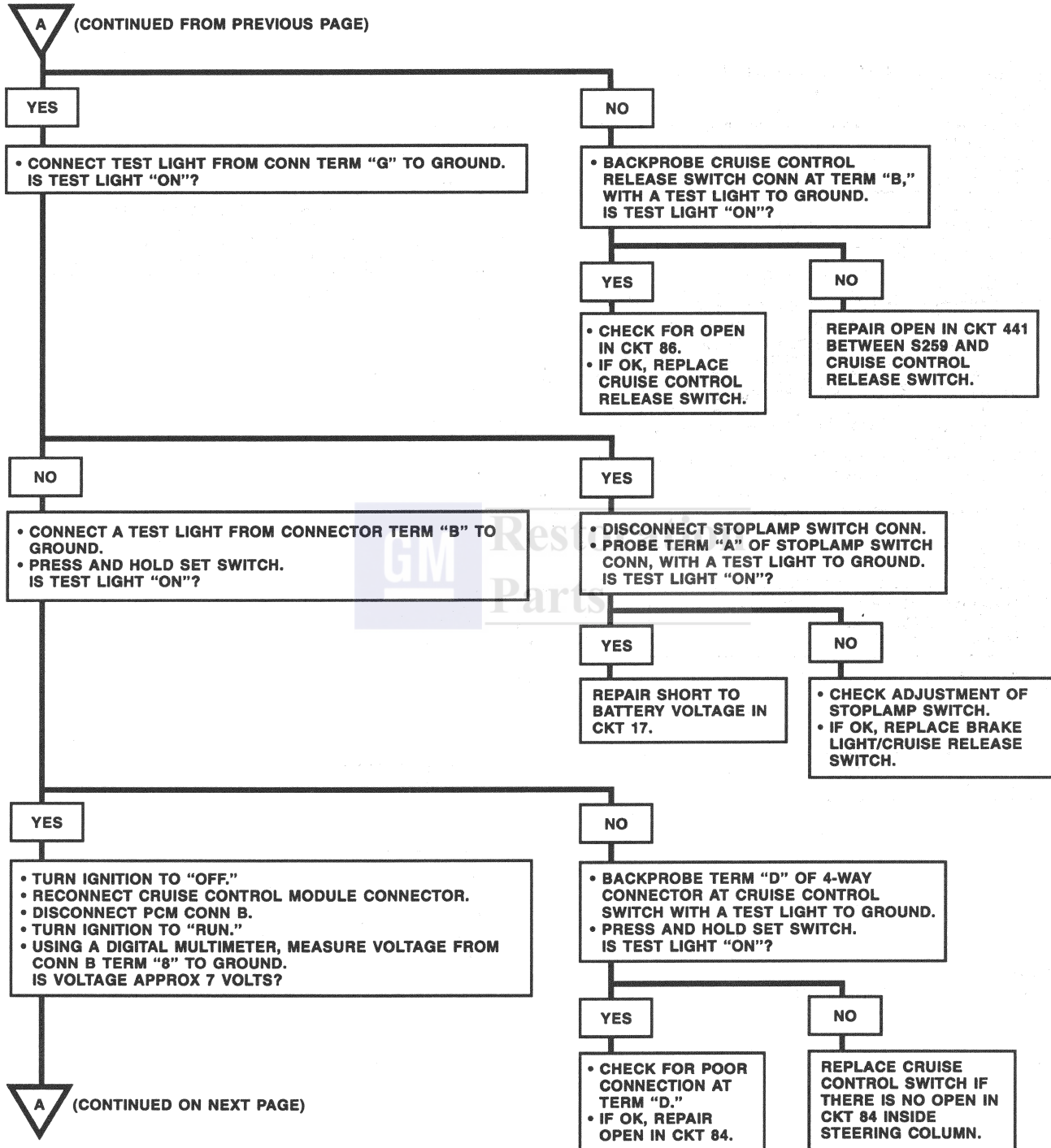


CHART #1 (continued) CRUISE CONTROL WILL NOT ENGAGE



CRUISE CONTROL

CHART #1 (continued)
CRUISE CONTROL WILL NOT ENGAGE

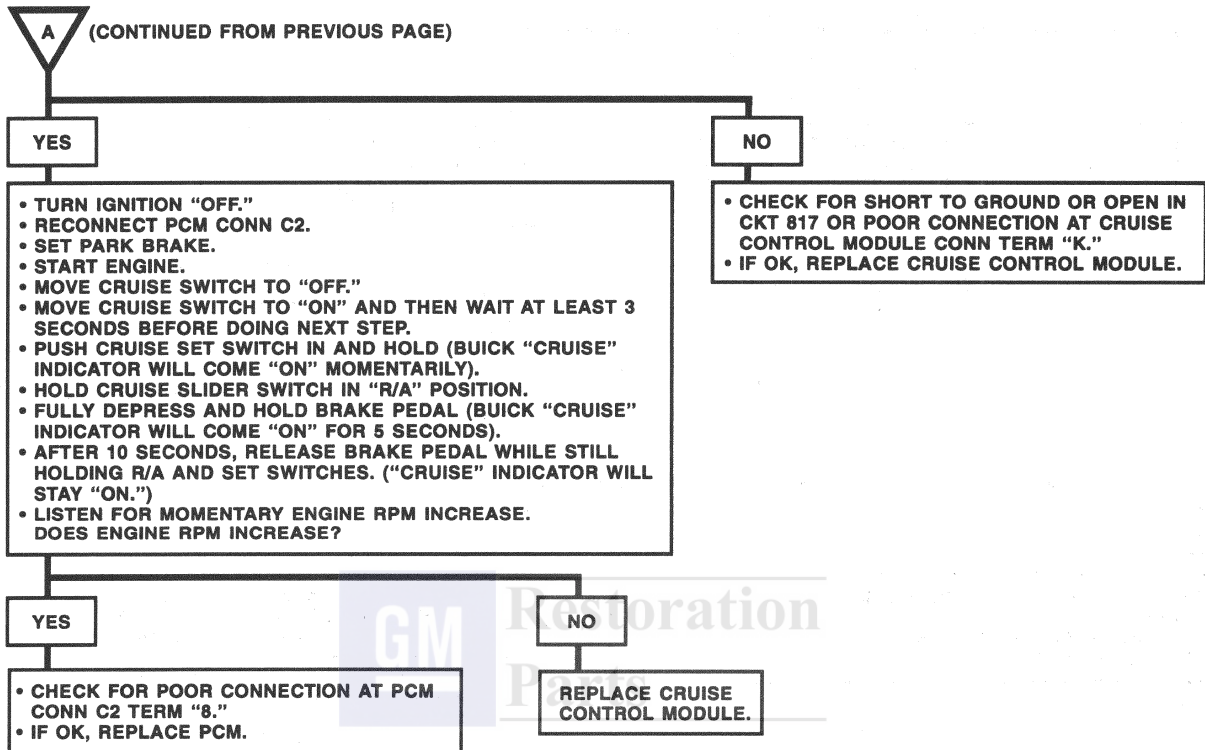
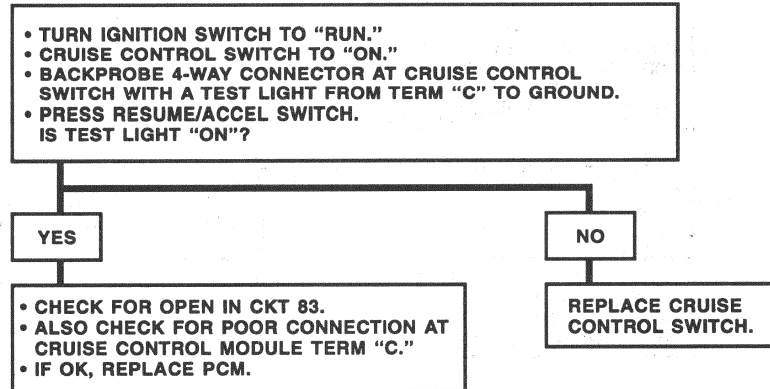


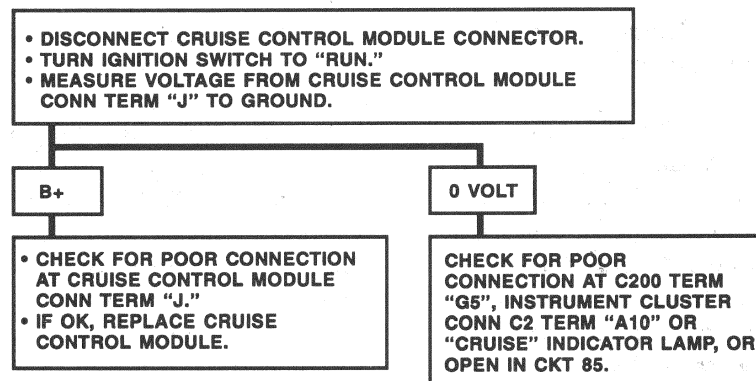
CHART #2
CRUISE CONTROL WILL NOT RESUME, ACCELERATE OR TAP-UP,
TAP-UP OR TAP-DOWN



C9179



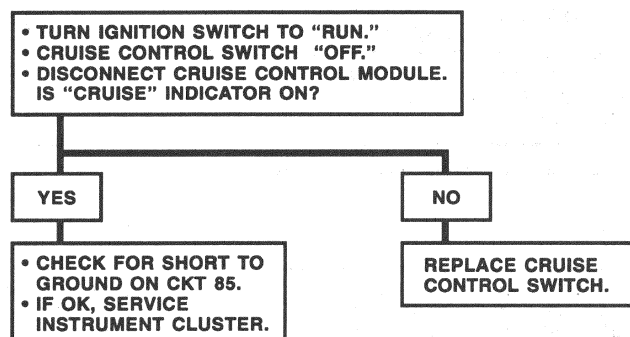
CHART #3
"CRUISE" INDICATOR INOPERATIVE (BUICK)



C9180

CRUISE CONTROL

CHART #4
"CRUISE" INDICATOR ON AT ALL TIMES (BUICK)



CIRCUIT OPERATION

The Electro-Motor Cruise Control is a speed control system which maintains a desired vehicle speed under normal driving conditions. The system has the capability to CRUISE, COAST, RESUME SPEED, ACCELERATE, TAP-UP and TAP-DOWN.

Depressing the Set and R/A Switches simultaneously will suspend cruise control operation without removing memory speed.

An Electronic Controller and Electric Motor are contained in the Cruise Control Module. The Controller monitors vehicle speed and operates the Electric Motor. In response to the Controller, the motor moves a connecting strap that is attached to the Cruise Control Cable. The Cable moves the Throttle Linkage to vary throttle position in order to maintain the desired cruise speed. The Cruise Control Module contains a low speed limit which will prevent system engagement below a minimum speed, about 25 mph. The module is controlled by mode control switches located on the LH Steering Column, part of the Turn Signal/Headlamp Dimmer Switch/Cruise Control Actuator/Windshield Wiper/Windshield Washer Lever.

With the Ignition Switch in "RUN," battery voltage is applied to terminal "F" of the Cruise Control Module. When the Slider Switch is moved to the "ON" position, battery voltage is applied to terminal "A" of the Cruise Control Module Connector. If the brake pedal is not depressed, battery voltage is present at module terminal "D." If the brake pedal is depressed, battery voltage is present at module terminal "G." The module must see terminal "D" change state once each Ignition cycle. (The brake pedal must be depressed once each Ignition cycle for cruise operation to occur). (Some Cruise Modules will use either terminal "D" or "G"). With the brake pedal not depressed, terminal "G" must see current flow through CKT 17 for cruise to operate properly. When the Slider Switch is moved to the "R/A" position, battery voltage is applied to terminal "C" of the module. With the Set Switch depressed, battery voltage is present at module terminal "B." Cruise Control Module Connector terminal "K" is the speed signal terminal. In operation, voltage will oscillate between a high of 4 to 5 volts and a low of near ground. Cruise Module terminal "H" is not used. Ground is at module terminal "E."

C9182

BLANK

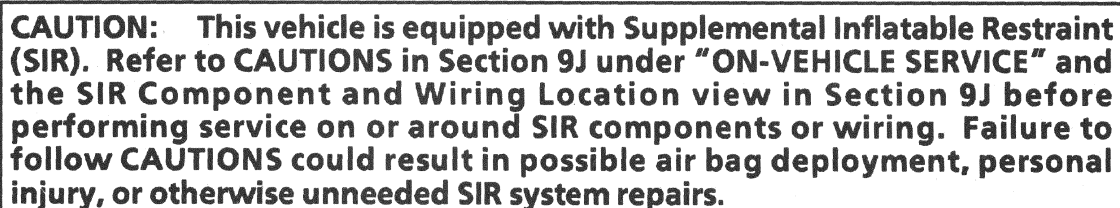


AUTOMATIC TRANSMISSION CONTROLS

- For Schematics, Circuit Operation, and System Diagnosis regarding the Automatic Transmission, refer to Transmission/Transaxle Diagnosis.









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HORNS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Convenience Center	LH side of I/P, left of Steering Column	9	15	
Horn Brush Slip Ring.....	Top of Steering Column, behind Steering Wheel			
Horn Relay	In Convenience Center.....	12	20	
Low "D" Note Horn	Forward of LH Wheelhouse, on Fender			
High "A" Note Horn.....	Forward of LH Wheelhouse, on Fender			
Low "F" Note Horn.....	Forward of RH Wheelhouse, on Fender			
High "C" Note Horn	Forward of RH Wheelhouse, on Fender			
I/P Fuse Block	Mounted to LH side of I/P, accessible with LH Front Door open	11	19	
Steering Wheel Horn Contact Plate	Part of Inflatable Restraint Steering Wheel Inflator Module...	14	23	
C101 (4 cavities).....	Forward Lamp Harn to Body Harn, LH Front Engine Compartment, near PCM.....	5	9.....	202-5
C210 (11 cavities).....	Body Harn to Turn/Hazard Switch Conn, under Steering Column			
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5	10	
S107	Forward Lamp Harn, approx 4 cm from BTSI Solenoid Conn breakout			
S280	Body Harn, approx 8 cm from BTSI Solenoid Conn breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

- Check I/P Fuse #32. If I/P Fuse #32 is open, check for a short to ground in CKT 1340 or CKT 29.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible,

should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

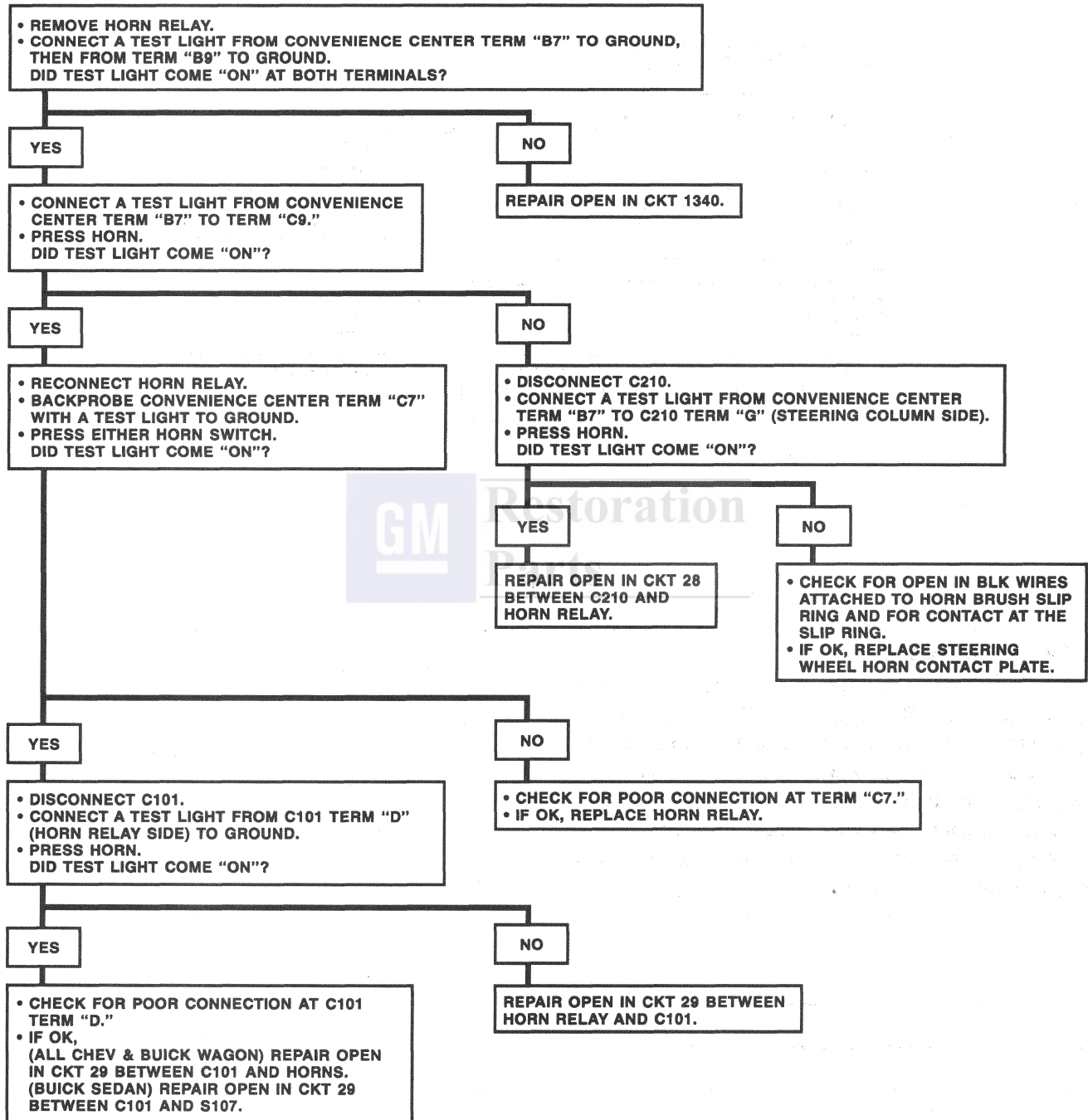
SYSTEM DIAGNOSIS

- See Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

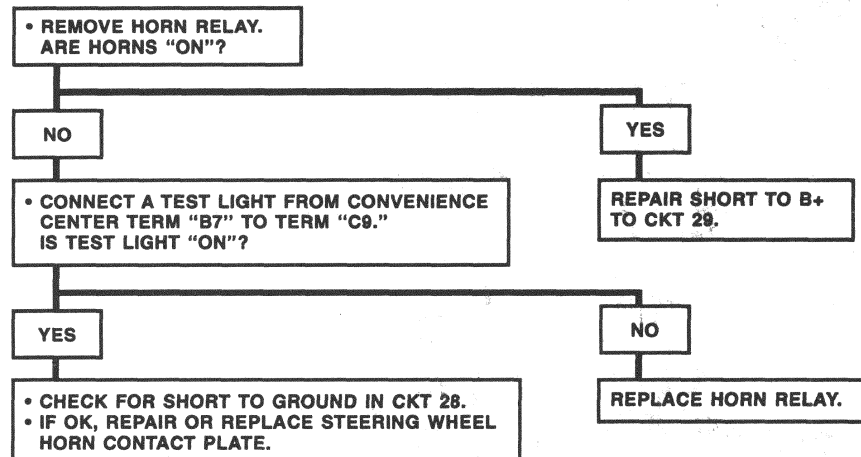
SYMPTOM	PROCEDURE	PAGE NUMBER
Horns inoperative.	Chart #1	8A-40-3
One Horn inoperative.	Remove connector from inoperative Horn. Attach one end of a fused jumper to B+. Momentarily touch the other end to the Horn. If the Horn sounds, repair open in CKT 29. If the Horn does not sound, check the Horn for a clean and tight ground at its case. If OK, replace Horn.	
Horns "ON" at all times.	Chart #2	8A-40-4
RH Horns inoperative, LH Horns operate normally.	Check for poor connection at C101 terminal "D" or open in CKT 29 between C101 and Low Note Horn (RH).	

CHART #1 HORNS INOPERATIVE



HORNS

CHART #2
HORNS "ON" AT ALL TIMES



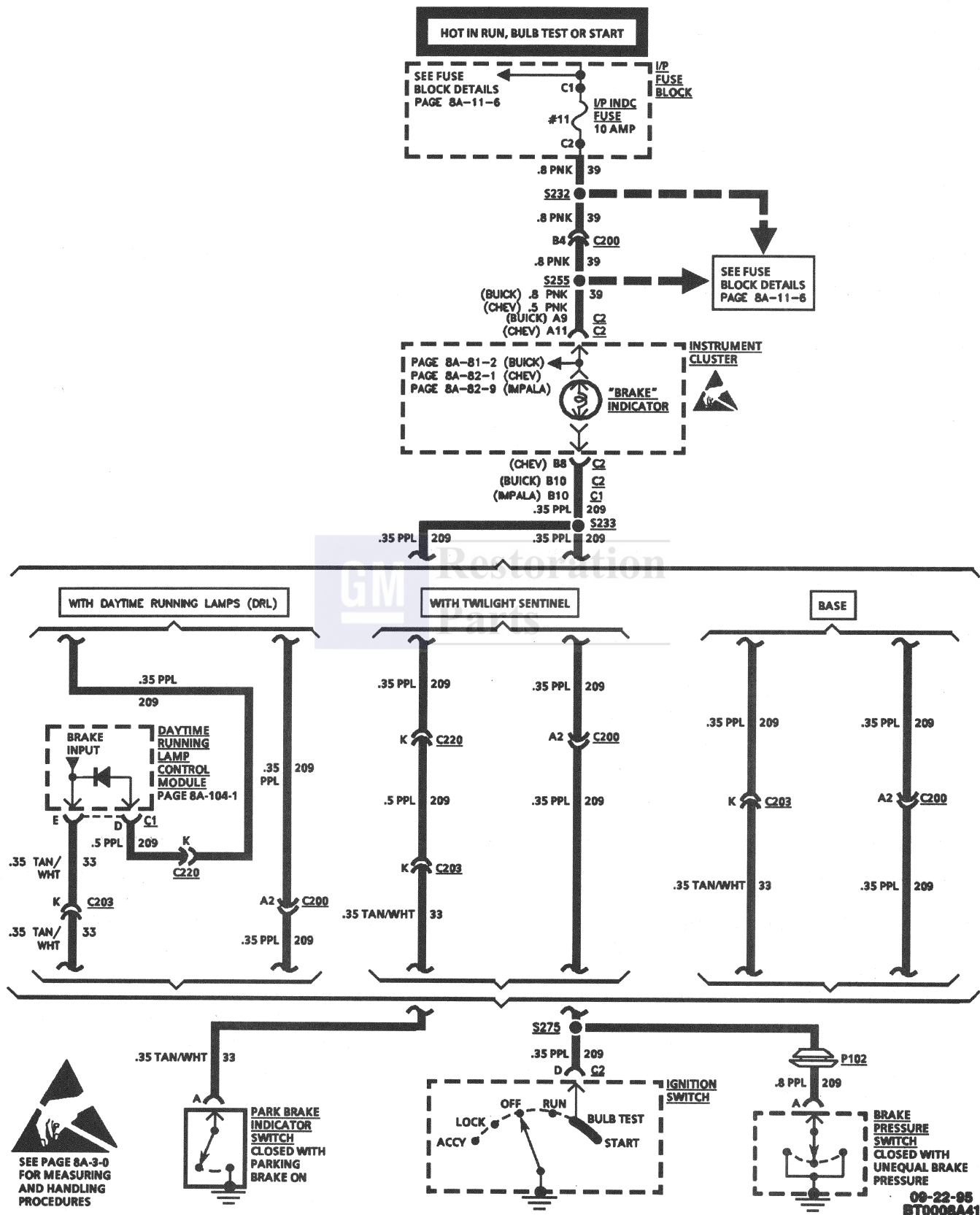
C9190

CIRCUIT OPERATION

Battery voltage is applied at all times to the Horn Relay at terminals "B7" and "B9." When the Steering Wheel Center is pressed, the contacts in the Steering Wheel Inflator Module close providing a ground to the Horn Relay. The Horn Relay contacts close, applying battery voltage to the horns (two with wagon, four with sedan). The horns continue to sound until the Steering Wheel Center is released.



BRAKE WARNING SYSTEM



COMPONENT	LOCATION	201-PG	FIG.	CONN
Brake Pressure Switch	Attached to Master Cylinder	5	10	
Daytime Running Lamp Control (DRL) Module	At RH "A" Pillar, behind kickpad	18	29	202-10
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Ignition Switch	Mounted on upper RH side of Steering Column	13	21	202-12
Instrument Cluster	LH side of I/P, centered above Steering Column			
Park Brake Indicator Switch	Mounted on Park Brake, forward of LH kickpad			
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C203 (10 cavities)(Base)	Body Harn to I/P Harn, right of Steering Column	14	22	202-5
C203 (10 cavities)(with Daytime Running Lamps or Twilight Sentinel)	Body Harn to Daytime Running Lamps or Twilight Sentinel Harn, lower RH side of Steering Column	14	22	202-5
C220 (10 cavities)	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column	14	22	202-5
P102	Visible from Engine Compartment, behind LH Wheelhouse	5	10	
S232	Body Harn, approx 10 cm from SDM breakout			
S233 (Chev)	I/P Harn, approx 25 cm from C200, on branch			
S233 (Buick)	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 breakout, on branch			
S236	Body Harn, approx 4 cm from Start Motor Theft Deterrent Relay breakout			
S255 (Buick)	I/P Harn, behind Instrument Cluster 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S255 (Chev)	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping			
S275	Body Harn, approx 4 cm from C200 breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse Block Fuse #11. If Fuse #11 is open check for a short to ground in CKT 39.
2. Check brake fluid level. If low, refer to SECTION 5.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system

disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

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BRAKE WARNING SYSTEM

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Turn Ignition Switch to "BULB TEST" (just past the "RUN" position). • Turn Ignition Switch to "OFF."	"BRAKE" Indicator is on only when Ignition Switch is in "BULB TEST."
[2] • Turn Ignition Switch to "RUN." • Set Park Brake. • Release Park Brake.	"BRAKE" Indicator is on only when Park Brake is set.

SYSTEM DIAGNOSIS

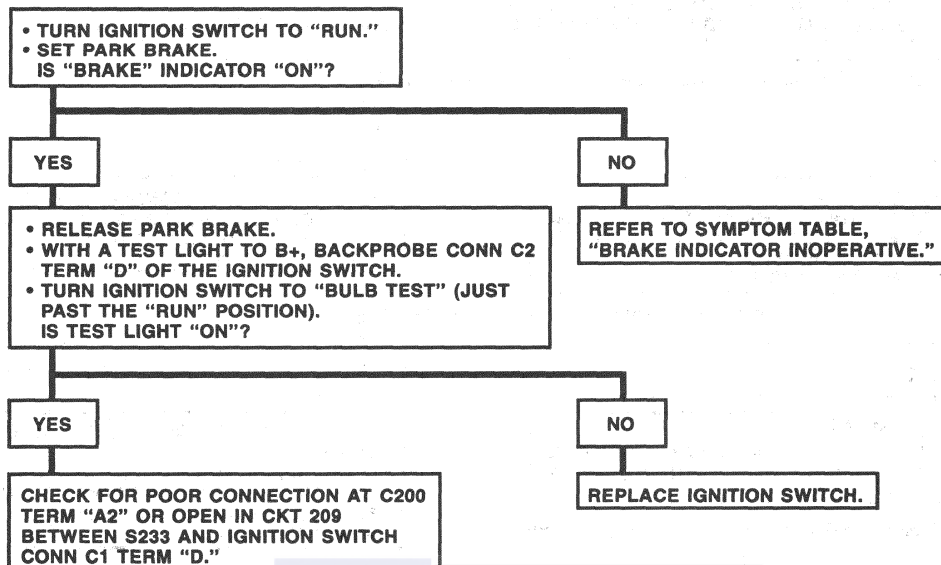
- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
"BRAKE" indicator inoperative.	Check for poor connection at Instrument Cluster Connectors or open in printed circuit. Check for open in CKT 209, CKT 39 and in indicator Lamp.	
Ignition Switch does not activate the "BRAKE" Indicator.	Chart #1	8A-41-3
Park Brake does not activate the "BRAKE" Indicator.	Chart #2 (Base or Twilight Sentinel) Chart #3 (With Daytime Running Lamps)	8A-41-3 8A-41-4
"BRAKE" Indicator stays on with Ignition Switch in "RUN" and Park Brake released.	Chart #4 (Base or Twilight Sentinel) Chart #5 (With Daytime Running Lamps)	8A-41-5 8A-41-6

CHART #1

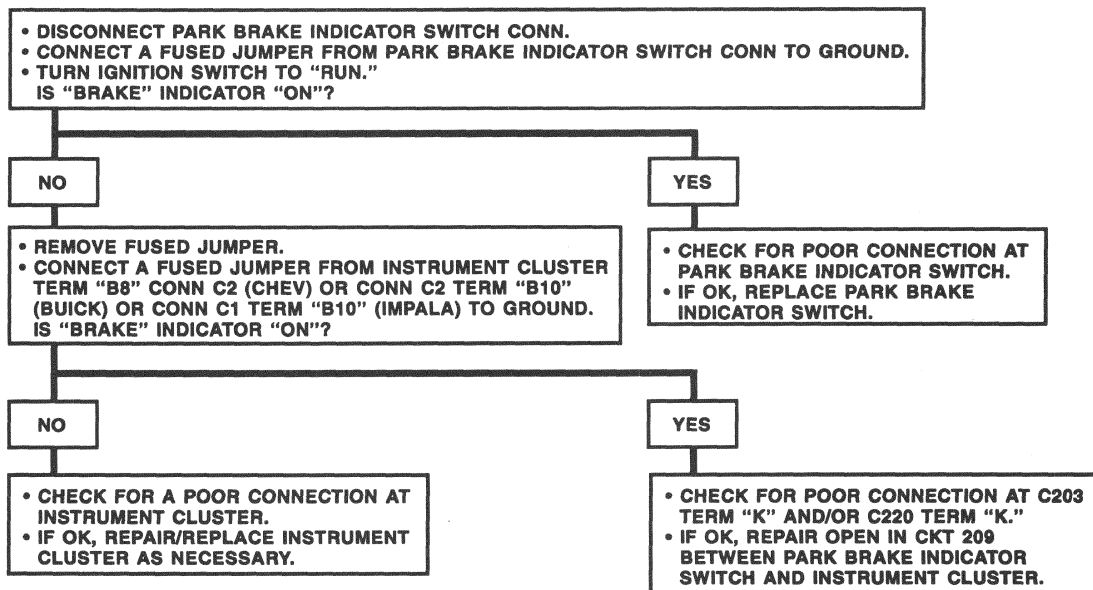
IGNITION SWITCH DOES NOT ACTIVATE THE "BRAKE" INDICATOR



C9184

CHART #2

PARK BRAKE DOES NOT ACTIVATE THE "BRAKE" INDICATOR (BASE OR TWILIGHT SENTINEL)



C9185

BRAKE WARNING SYSTEM

CHART #3
PARK BRAKE DOES NOT ACTIVATE THE "BRAKE" INDICATOR
(WITH DAYTIME RUNNING LAMPS)

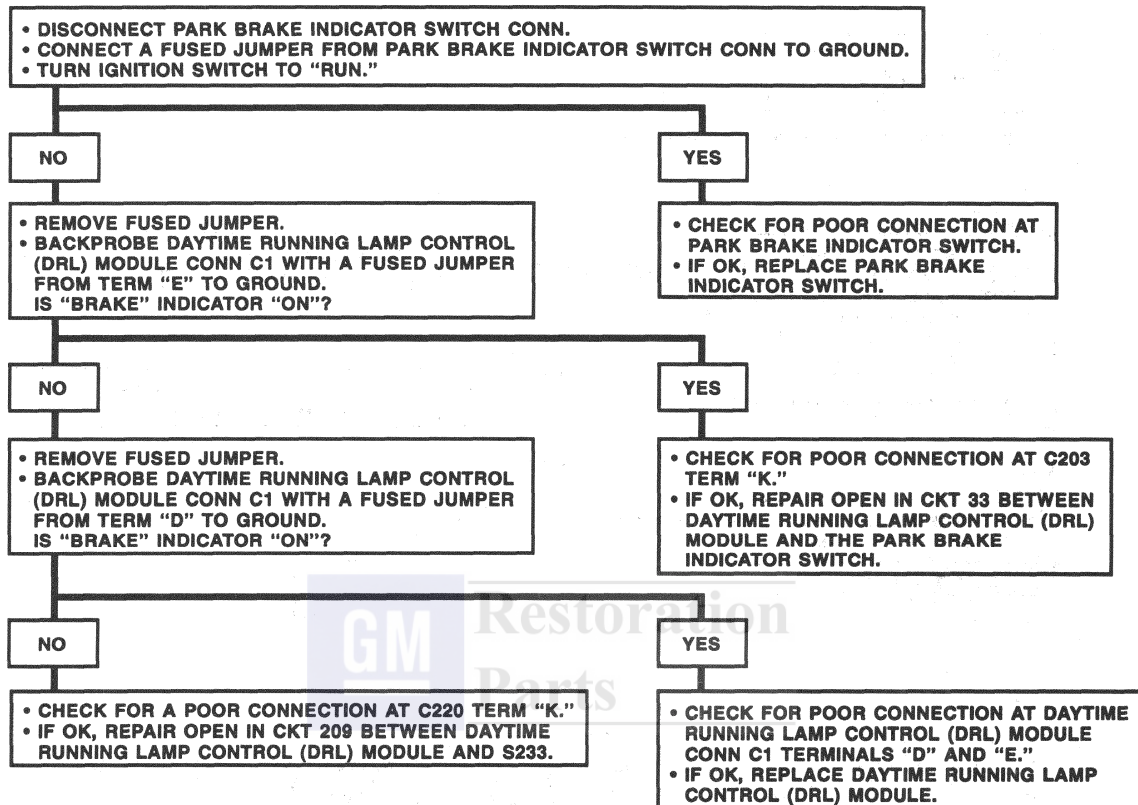
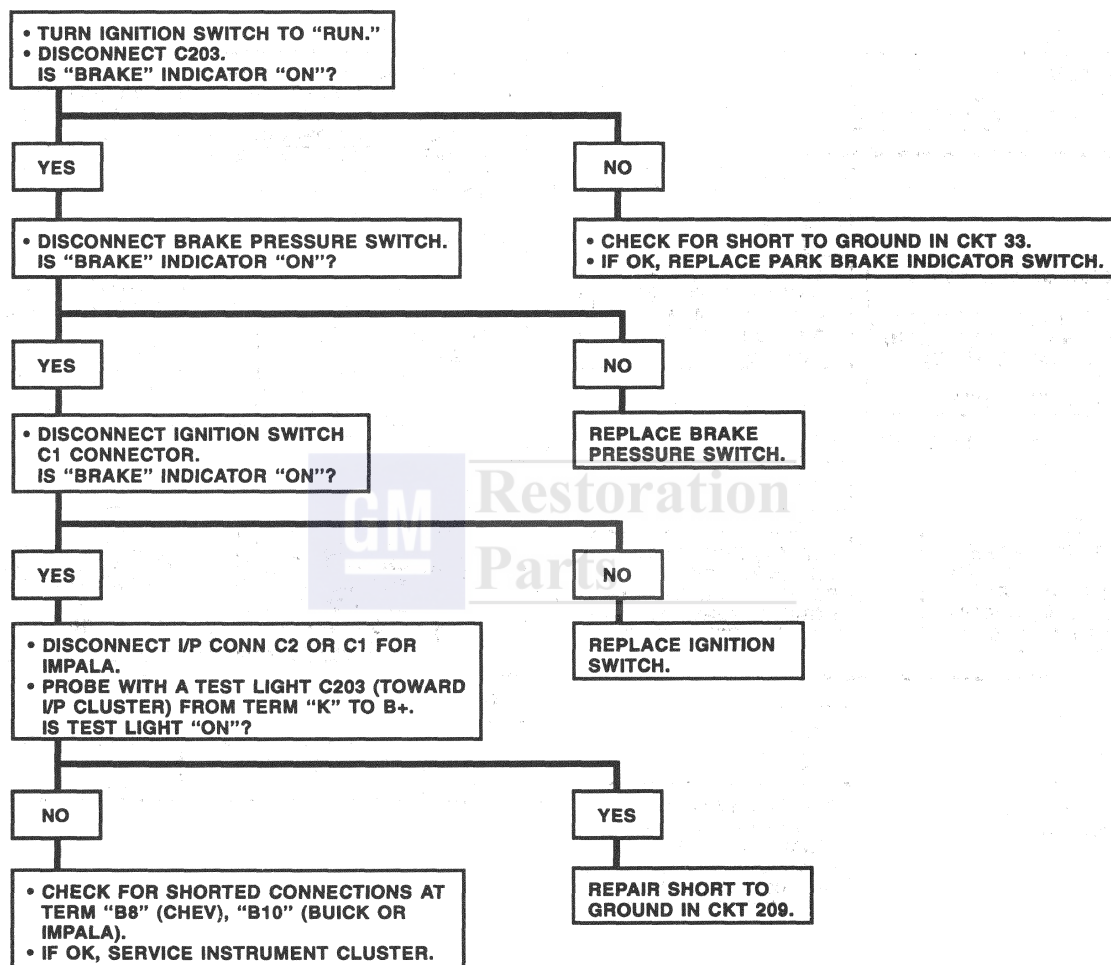


CHART #4

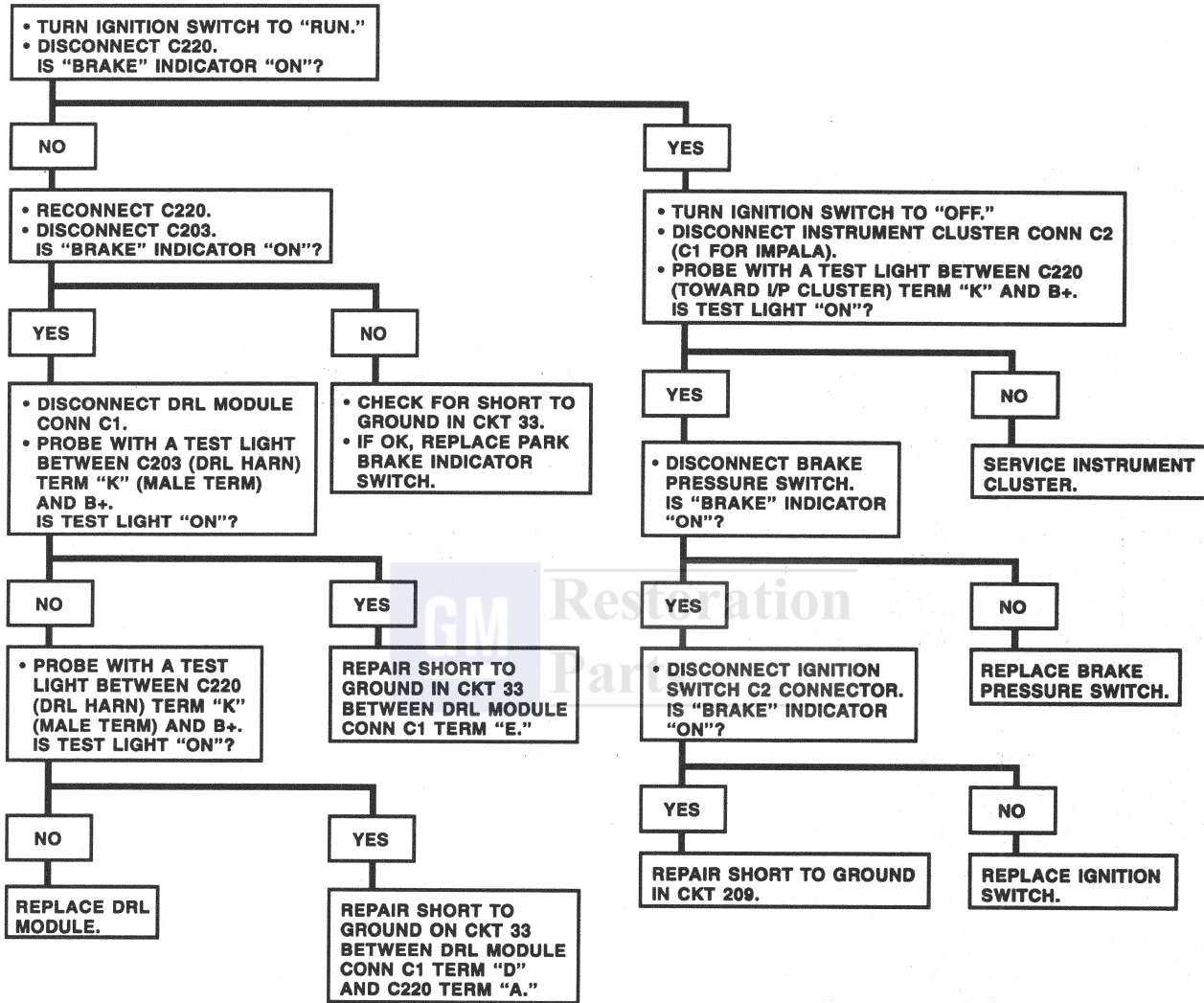
"BRAKE" INDICATOR STAYS ON WITH IGNITION SWITCH IN "RUN" AND PARK BRAKE RELEASED (BASE OR TWILIGHT SENTINEL)



BRAKE WARNING SYSTEM

CHART #5

"BRAKE" INDICATOR STAYS ON WITH IGNITION SWITCH IN "RUN" AND PARK BRAKE RELEASED (WITH DAYTIME RUNNING LAMPS)



CIRCUIT OPERATION

Voltage is applied to the "BRAKE" Indicator from I/P Fuse #11 when the Ignition Switch is turned to "RUN," "BULB TEST" or "START." The "BRAKE" Indicator is controlled by any one of three switches: the Brake Pressure Switch, Ignition Switch or Park Brake Indicator Switch.

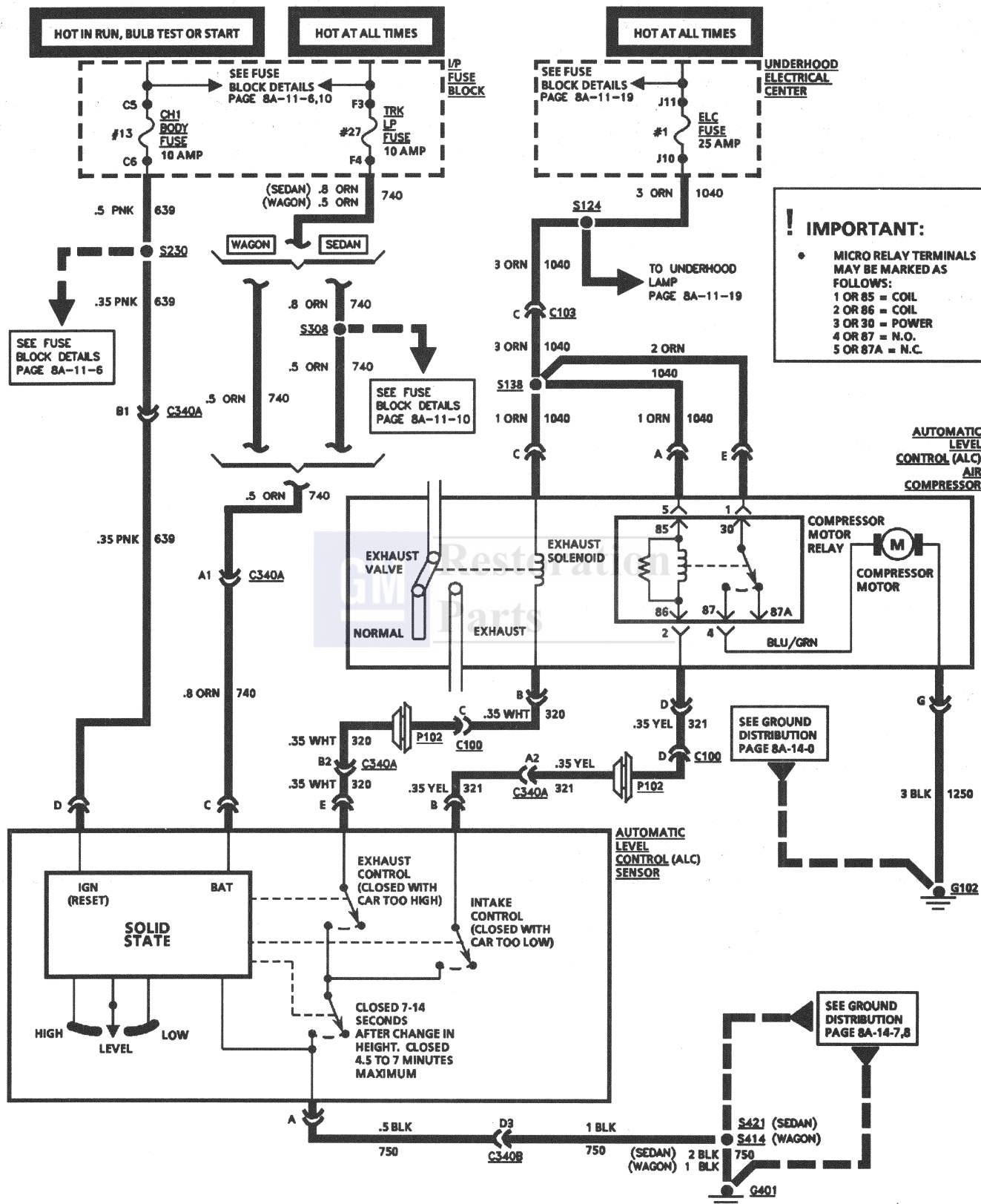
When the Ignition Switch is turned to "BULB TEST" or "START," CKT 209 is grounded through the Ignition Switch to activate the "BRAKE" Indicator. When the

Brake Pressure Switch is closed, CKT 209 is grounded through the contacts of the Brake Pressure Switch to activate the "BRAKE" Indicator. CKT 33 is grounded through the Park Brake Switch when the Park Brake is set, to activate the "BRAKE" Indicator.

With the Daytime Running Lamps (DRL) Control Module grounded through CKT 33, the module provides ground to CKT 209, lighting the "BRAKE" Indicator.



AUTOMATIC LEVEL CONTROL (ALC) (CHEV WAGON, ALL BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Automatic Level Control (ALC) Air Compressor.....	Front Frame Rail, under LH Wheelhouse	2	4	
Automatic Level Control (ALC) Sensor.....	Bolted to Rear Crossmember, near center.....	29	41	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Underhood Electrical Center.....	Engine Compartment, mounted to RH Wheelhouse.....	9	15	
C100 (10 cavities).....	Forward Lamp Harn to Body Harn, forward of Windshield Washer Solvent Container	5	9.....	202-0
C103 (5 cavities).....	Forward Lamp Harn to Engine Harn, at RH Fender			
C340 (10 cavities).....	Body Harn to Electronic Brake Control Harn, below LH Rear Floor Pan.....	27	39.....	202-7
C340A (4 cavities).....	Body Harn to EBCM Wiring Harn, below LH Rear Floor Pan	27	39.....	202-7
C340B (5 cavities)	Body Harn to EBCM Wiring Harn, below LH Rear Floor Pan	27	39.....	202-7
G102.....	Behind LH Headlamp, forward of Air Cleaner	5	9	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5	10	
G401 (Sedan).....	LH Rear Wheelhouse in Rear Compartment			
G401 (Wagon)	Near center of LH "D" Pillar	34.....	49	
S138	Forward Lamp Harn, approx 39 cm from ALC Air Compressor Motor Conn			
S230	Body Harn, approx 4 cm from BTSI Conn breakout			
S308 (Sedan)	Body Harn, approx 11 cm from C309 breakout			
S414 (Wagon).....	Body Harn, approx 26 cm from Remote Control Door Lock Module			
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp breakout			

AUTOMATIC LEVEL CONTROL (ALC)**TROUBLESHOOTING HINTS****(Perform before beginning System Diagnosis)**

1. Check Underhood Electrical Center Fuse #1. If Fuse #1 is open, check for a short to ground in CKT 1040.
2. Check I/P Fuse Block Fuse #12. If Fuse #12 is open, check for a short to ground in CKT 639.
3. Check I/P Fuse Block Fuse #27. If Fuse #27 is open, check for a short to ground in CKT 740.
4. Check that G102 and G300 are clean and tight.
5. If ALC Air Compressor runs continuously for approximately 7 minutes, check system air hoses for cracks or leaks.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a

continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

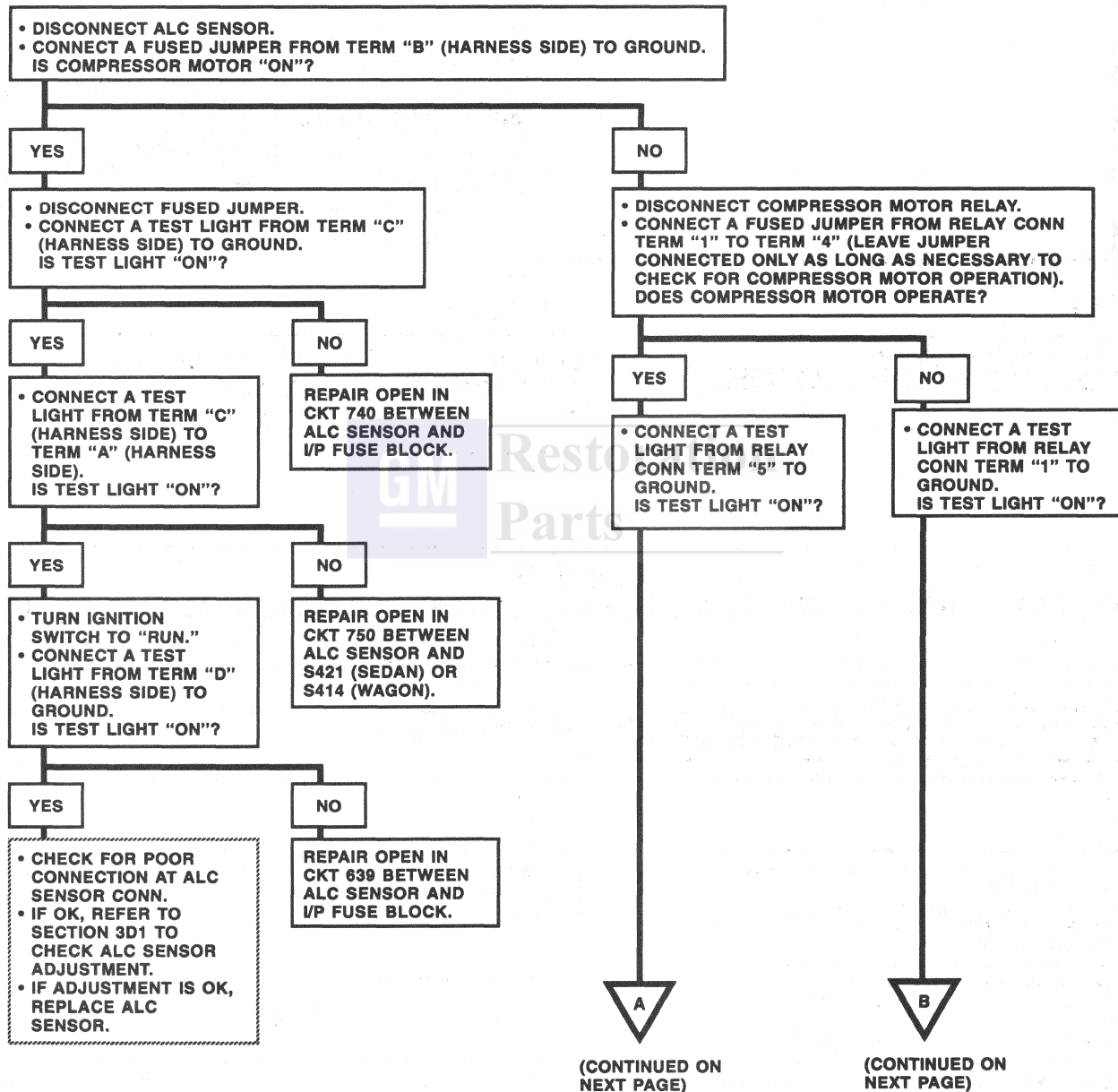
SYSTEM DIAGNOSIS

- Refer to Section 3D1 to perform the ALC System Operational Check.
- Refer to Symptom Table for the appropriate diagnostic procedure(s).

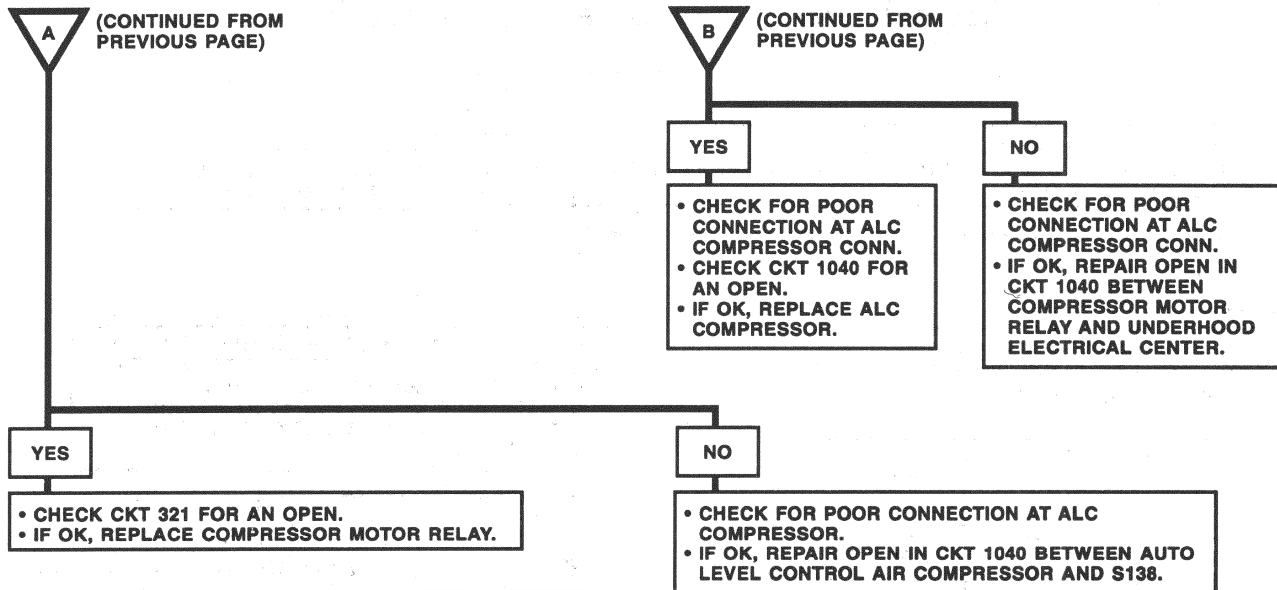
SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Compressor Motor does not turn "ON" to raise rear of vehicle.	Chart #1	8A-42-3
ALC System does not vent to lower rear of vehicle (checks Exhaust Solenoid).	Chart #2	8A-42-4
Compressor Motor runs continuously (longer than 7 minutes).	Chart #3	8A-42-5
Compressor Motor runs for maximum run time (approximately 4.5 to 7 minutes) then stops.	Refer to Section 3D1. Check for air leaks in the ALC System and for proper adjustment of the ALC Sensor. If OK, replace ALC Sensor.	
ALC System continuously re-levels vehicle with no change in load.	Refer to Section 3D1. Check for air leaks in the ALC System.	

CHART #1
AUTOMATIC LEVEL CONTROL (ALC) COMPRESSOR MOTOR
DOES NOT TURN "ON" TO RAISE REAR OF VEHICLE



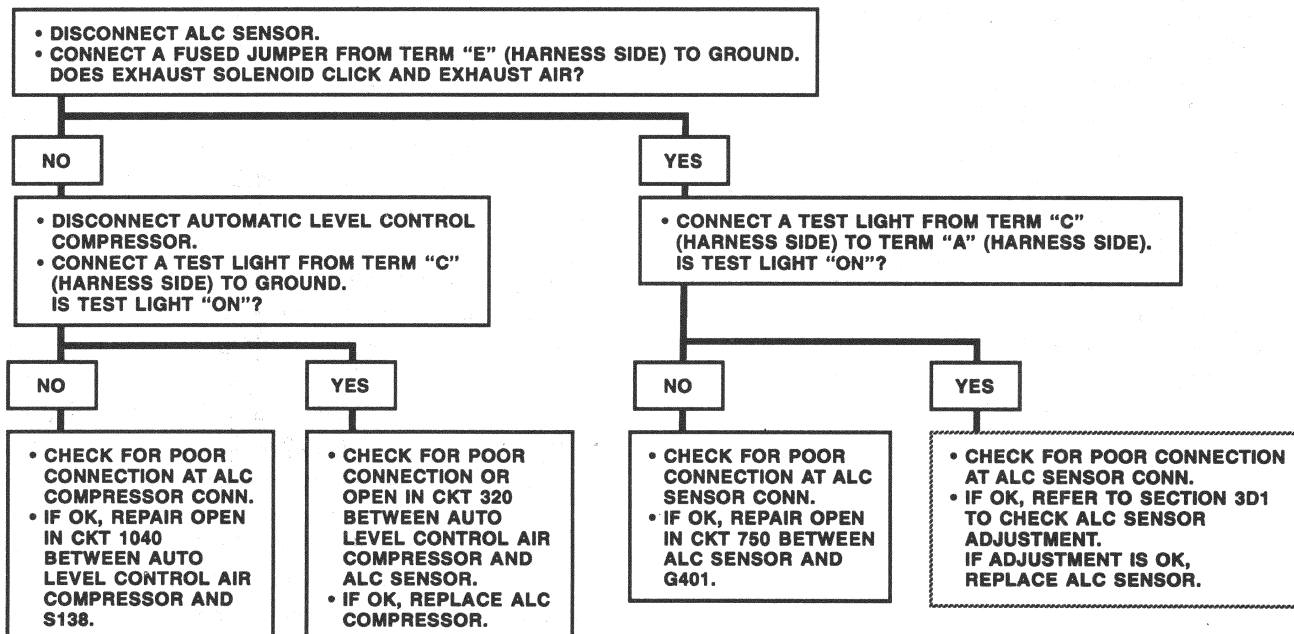
AUTOMATIC LEVEL CONTROL (ALC)



C9544

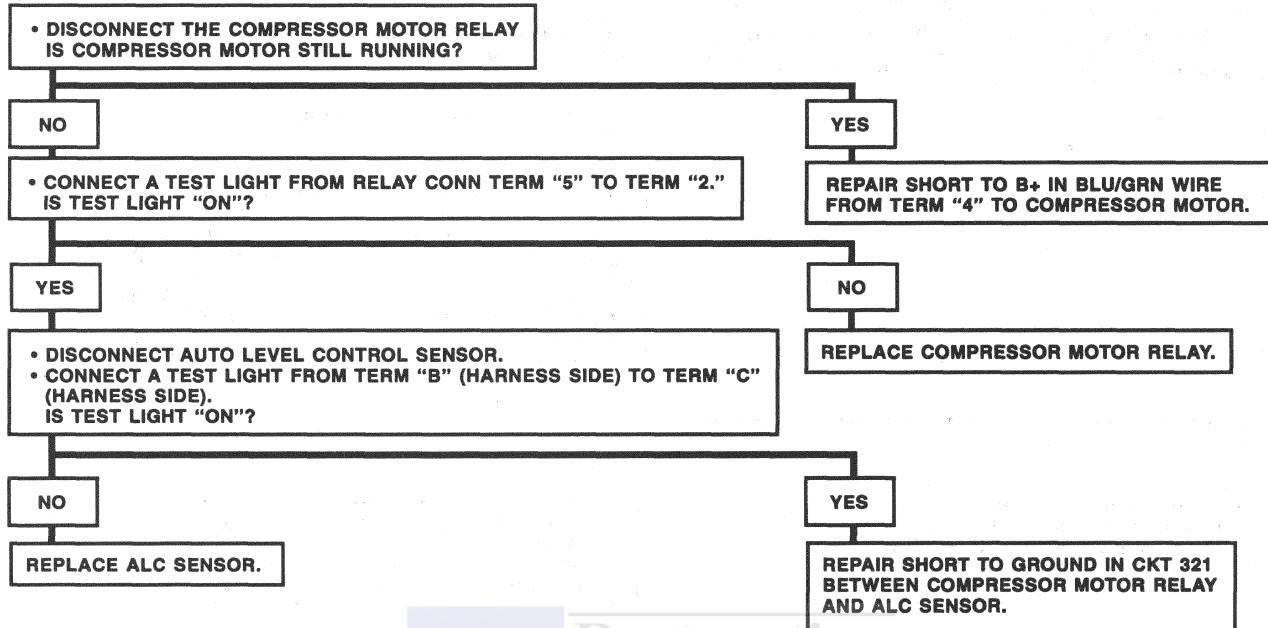
CHART #2

ALC SYSTEM DOES NOT VENT TO LOWER REAR OF VEHICLE (CHECKS EXHAUST SOLENOID)



C8135

CHART #3
COMPRESSOR MOTOR RUNS CONTINUOUSLY (LONGER THAN 7 MINUTES)



C8136

CIRCUIT OPERATION

Automatic Level Control (ALC)

The Automatic Level Control keeps the rear of the vehicle at a constant height. If weight is added to the vehicle, the ALC Sensor turns on the ALC Air Compressor. Air is pumped into the shock absorbers until the ALC Sensor senses that the vehicle is level. An Actuator Arm is linked between the upper RH Control Arm and the Sensor, which is mounted to the rear crossmember of the frame. It turns as the vehicle height changes. The Sensor detects this motion and operates switches to control the air flow into and out of the shock absorbers.

Voltage is applied, at all times, to the Compressor by Underhood Electrical Center Fuse #1 and to the Sensor by I/P Fuse Block fuse #27. This allows the ALC System to vent after a load is removed. Voltage is also applied to the Sensor by I/P Fuse Block Fuse #12, with the Ignition Switch in "RUN," "BULB TEST" or "START."

To ensure that the shock absorbers are filled with adequate residual pressure, the Compressor Motor will run for 3 to 5 seconds, approximately 35 to 50 seconds after the Ignition Switch is turned to "RUN."

The Sensor must detect a "Car-Low" or "Car-High" state for 7-14 seconds before activating the intake or exhaust outputs. This prevents system operation during normal ride motions. In addition, the Sensor limits Compressor Motor run time or Exhaust Solenoid energized time to a maximum of 4.5 to 7 minutes.

This time limit is necessary to prevent continuous Compressor Motor operation in case of a severe system leak or continuous vent. Cycling the Ignition Switch to "OFF" and back to "RUN" resets the 4.5 to 7 minute maximum run timer.

Raising the Vehicle

When a load is added to the vehicle, the vehicle body is moved downward. When the ALC Sensor has detected a "Car-Low" state for 7-14 seconds, the Intake Control Switch is closed to ground. With CKT 321 grounded, the coil in the Compressor Motor Relay is energized and the relay contacts close. Battery voltage is applied to the Compressor Motor, which operates the Compressor and pumps air into the adjustable shock absorbers. As the shocks extend, the rear of the vehicle rises. When the vehicle body reaches its original height of +25 mm (+1 inch), the ALC Sensor opens the Intake Control Switch, de-energizing the Relay coil and the Compressor Motor stops.

AUTOMATIC LEVEL CONTROL (ALC)

Lowering the Vehicle

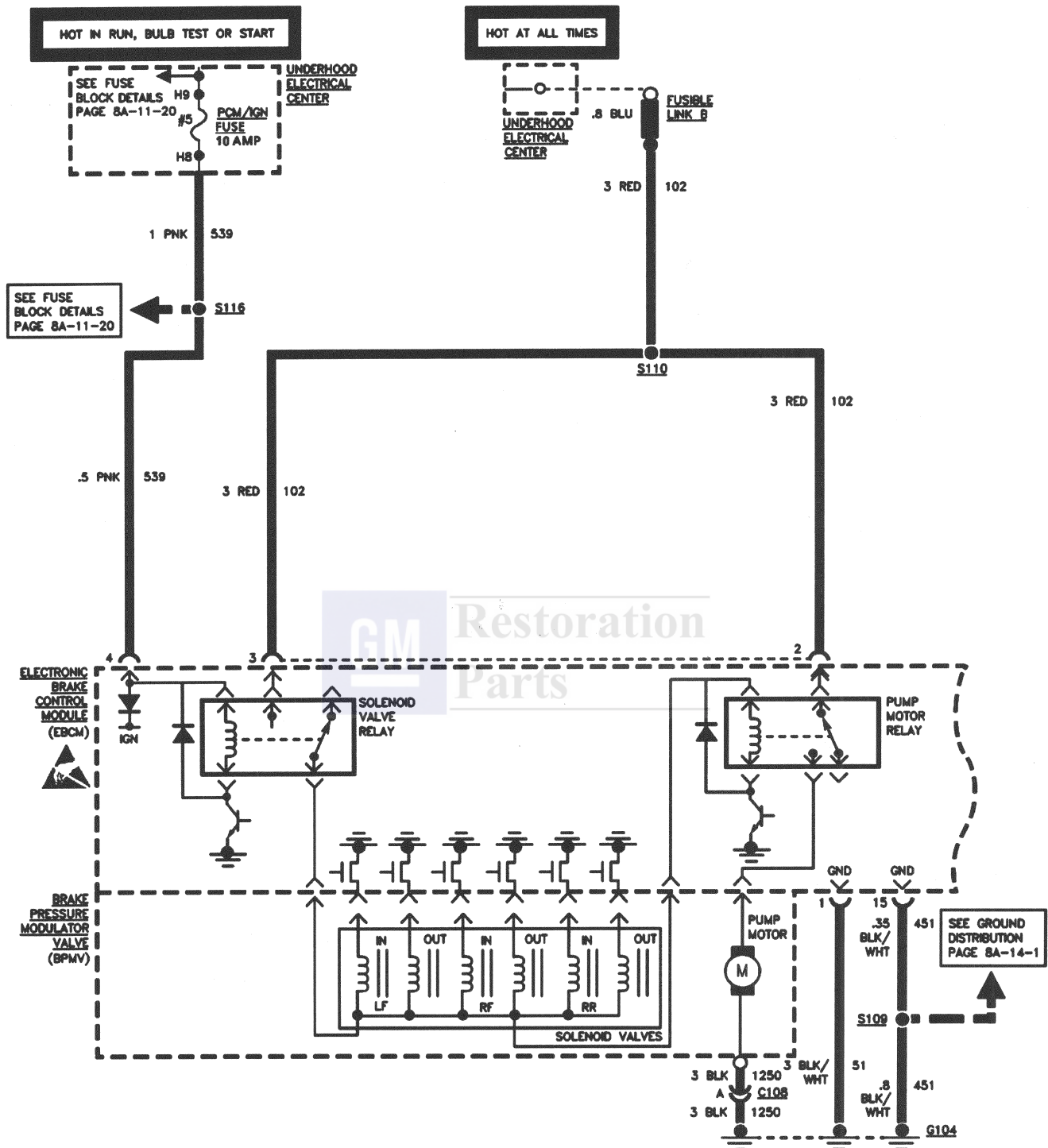
When a load is removed from the vehicle, the vehicle body is moved upward. When the ALC Sensor has detected a "Car-High" state for 7-14 seconds, the Exhaust Control Switch is closed to ground. With CKT 320 grounded, the Exhaust Solenoid is energized allowing the Exhaust Valve

to open. The ALC System vents into the atmosphere, lowering the rear of the vehicle. When the vehicle body reaches its original height of +25 mm (+1 inch), the Sensor opens the Exhaust Control Switch, de-energizing the Solenoid and closing the Exhaust Valve.

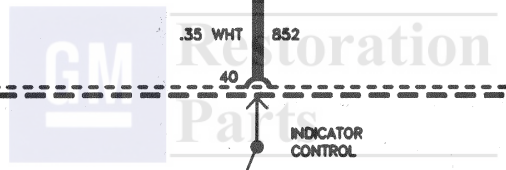




ANTILOCK BRAKE SYSTEM

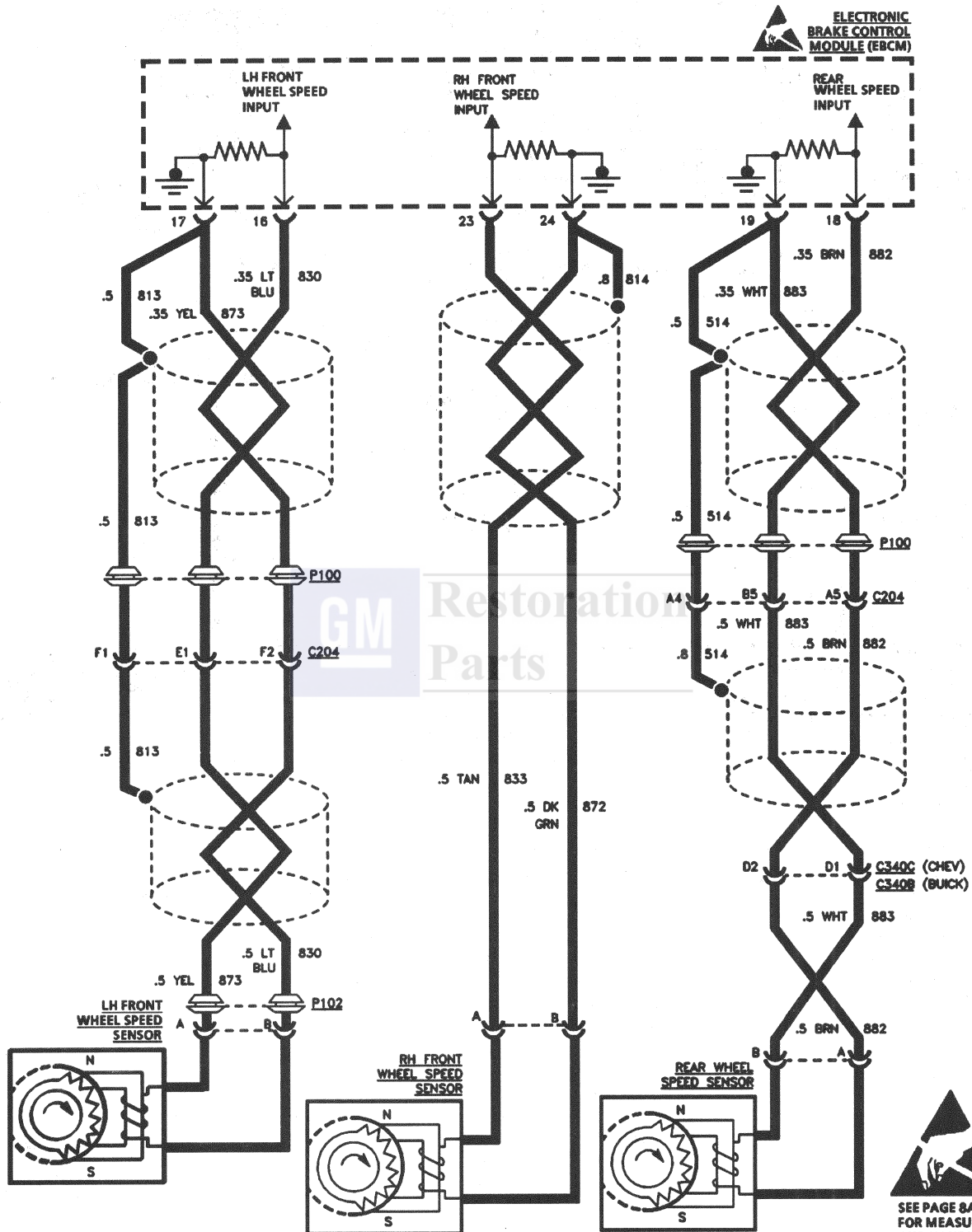


CAUTION: Certain components in the Antilock Brake System are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures in Section 5E1 should be serviced.

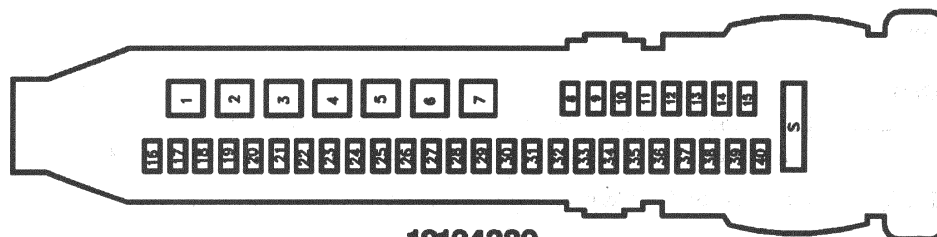


8A - 44 - 2 ELECTRICAL DIAGNOSIS

ANTILOCK BRAKE SYSTEM



SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES



12124389

40 - WAY F

NAT

**BRAKE PRESSURE MODULATOR VALVE (BPMV)
(WITH ELECTRONIC BRAKE CONTROL MODULE (EBCM))**

5-31-94
BS0038A44

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
1	BLK/WHT	51	EBCM GROUND TO G104	8A-44-0
2	RED	102	BATTERY FEED TO BPMV PUMP MOTOR RELAY	8A-44-0
3	RED	102	BATTERY FEED TO BPMV SOLENOID VALVE RELAY FROM FUSIBLE LINK B	8A-44-0
4	PNK	539	IGNITION FEED FROM PCM/IGN FUSE	8A-44-0
15	BLK/WHT	451	EBCM GROUND TO G104	8A-44-0
16	LT BLU	830	LH FRONT WHEEL SPEED SENSOR INPUT	8A-44-2
17	YEL	873	LH FRONT WHEEL SPEED SENSOR INPUT GROUND	8A-44-2
17	BARE	813	DRAIN WIRE RETURN	8A-44-2
18	BRN	882	REAR WHEEL SPEED SENSOR INPUT	8A-44-2
19	WHT	883	REAR WHEEL SPEED SENSOR INPUT GROUND	8A-44-2
19	BARE	514	DRAIN WIRE RETURN	8A-44-2
23	DK GRN	872	RH FRONT WHEEL SPEED SENSOR INPUT	8A-44-2
24	TAN	833	RH FRONT WHEEL SPEED SENSOR INPUT GROUND	8A-44-2
24	BARE	814	DRAIN WIRE RETURN	8A-44-2
28	WHT	17	BRAKE APPLIED SIGNAL FROM STOPLAMP SWITCH	8A-44-1
29	TAN	800	SERIAL DATA LINE TO DLC	8A-44-1
40	WHT	852	INSTRUMENT CLUSTER ABS INDICATOR CONTROL	8A-44-1

8A - 44 - 4 ELECTRICAL DIAGNOSIS**ANTILOCK BRAKE SYSTEM**

COMPONENT	LOCATION	201-PG	FIG.	CONN
Brake Pressure Modulator Valve (BPMV) (with Electronic Brake Control Module (EBCM).....	LH Engine Compartment, part of Electronic Brake Control Module.....	45.....	73	
Data Link Connector (DLC)	Attached to I/P Carrier, right of Steering Column.....	14.....	22	
Electronic Brake Control Module (EBCM).....	LH Engine Compartment, part of BPMV			
Front Wheel Speed Sensor, LH.....	Mounted on LH Front Knuckle	3.....	6	
Front Wheel Speed Sensor, RH	Mounted on RH Front Knuckle.....	3.....	7	
Fusible Link B	RH Engine Compartment, bolted to Underhood Electrical Center			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Instrument Cluster.....	LH side of I/P, centered above Steering Column.....	9.....	16	
Rear Wheel Speed Sensor.....	Mounted on Rear Axle Housing.....	28.....	40	
Stoplamp Switch	Attached to Brake Pedal Bracket (bottom switch)			
Underhood Electrical Center	Engine Compartment, mounted to RH Wheelhouse.....	9.....	15	
C108.....	BPMV Ground Wire to Engine Harn, to left of EBCM			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14.....	22.....	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16.....	26.....	202-3
C205 (10 cavities).....	Engine Harn to I/P Harn, right of I/P Compartment			
C340 (4 cavities).....	Electronic Brake Control Harn to Body Harn, below LH Rear Floor Pan			
G104.....	Engine Compartment, front of LH Cylinder Head.....	6.....	11	
P100	RH I/P, forward of Blower Motor	16.....	26	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5.....	10	
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S110	Engine Harn, left side, approx 5 cm from G104 breakout, on Electronic Brake Control Module Conn branch			
S116	Engine Harn, left side, approx 8 cm from G104 breakout			
S223 (Buick)	I/P Harn, approx 23 cm from C200, on branch			
S232	Body Harn, approx 10 cm from SDM Conn branch breakout, behind Instrument Cluster			
S237	Body Harn, approx 11 cm from Starter Motor Theft Deterrent Relay breakout			
S252	Body Harn, approx 15 cm from SDM breakout			

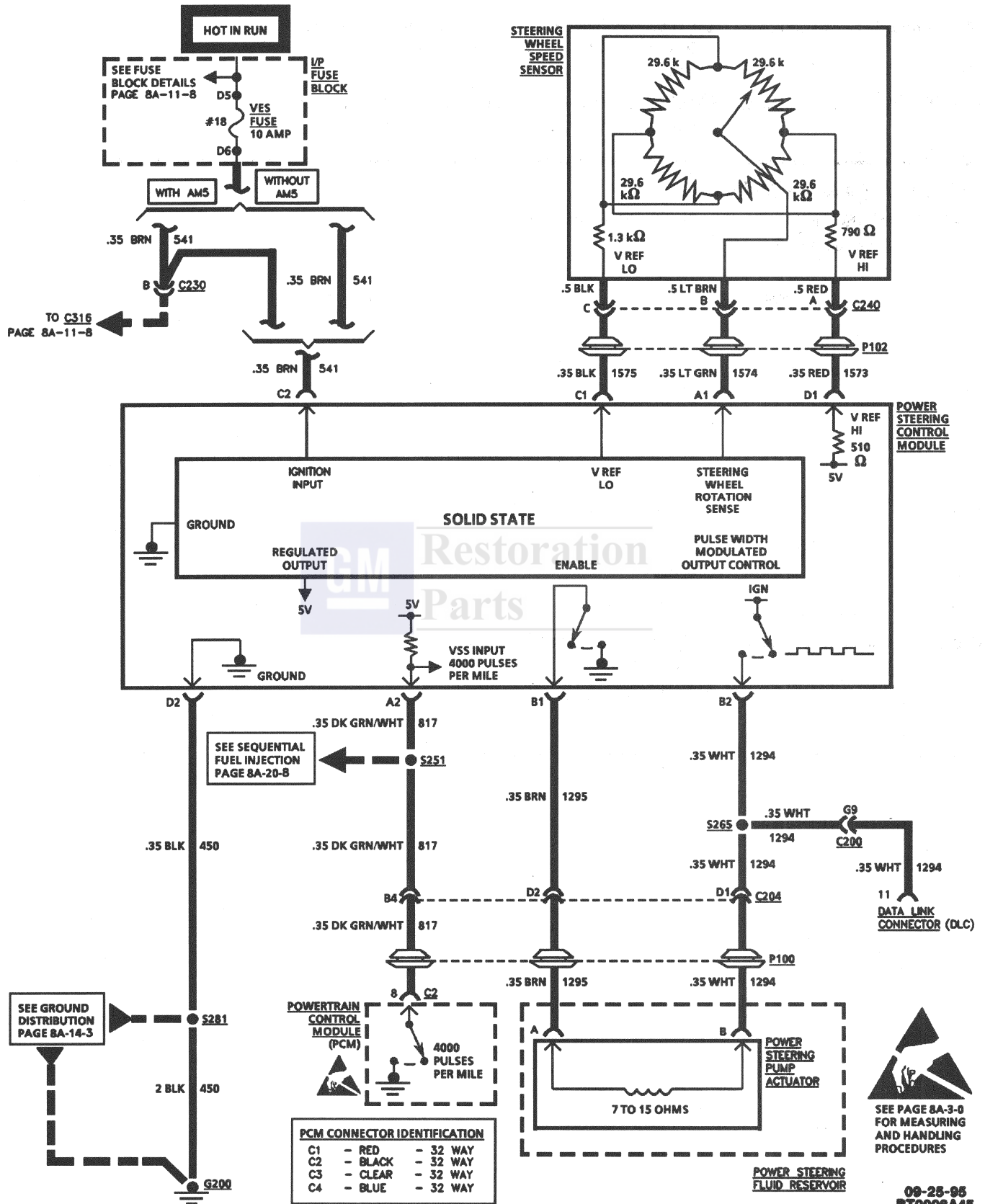
COMPONENT	LOCATION	201-PG FIG. CONN
S255 (Buick).....	I/P Harn, behind Instrument Cluster, approx 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping	

SYSTEM DIAGNOSIS

- Refer to SECTION 5E1 for System Diagnosis and service procedures.



VARIABLE EFFORT STEERING (BUICK)

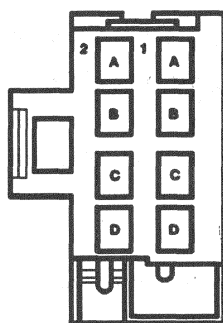


VARIABLE EFFORT STEERING

COMPONENT	LOCATION	201-PG	FIG.	CONN
Data Link Connector (DLC)	Attached to I/P Carrier, Right of Steering Column.....	14	22.....	
I/P Fuse Block.....	Mounted to LH side of I/P, accessible with LH Front Door open	11	19	
Power Steering Control Module	Bolted to bracket above and left of Steering Column, near I/P Fuse Block	11	19.....	202-5
Power Steering Fluid Reservoir	LH front of Engine			
Powertrain Control Module (PCM)	Engine Compartment, forward of LH Wheelhouse under Air Cleaner.....	4	8.....	20-10 to 13
Steering Wheel Speed Sensor ...	On Steering Column Shaft, forward of Dash Panel			
C200 (56 cavities).....	Body Harn to I/P Harn, above Accelerator Pedal			
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	17	28.....	202-3
C230 (10 cavities).....	Crossbody & Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad			
C240 (3 cavities).....	Body Harn to Steering Wheel Speed Sensor			
G200.....	Base of LH "A" Pillar, behind kickpad	24	37	
P100	RH I/P, forward of Blower Motor	17	28	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	34	54	
S251	Body Harn, approx 7 cm from SDM Conn branch breakout			
S265	Body Harn, approx 26 cm from SDM Conn branch breakout, inside channel			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			

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VARIABLE EFFORT STEERING



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8 - WAY F METRI - PACK 630 SERIES
BLK

03-29-95
BT0003B5

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A1	LT GRN	1574	STEERING WHEEL ROTATION SENSE	8A-45-0
A2	DK GRN/WHT	817	VEHICLE SPEED SIGNAL	8A-45-0
B1	BRN	1295	ENABLE	8A-45-0
B2	WHT	1294	PULSE WIDTH MODULATED OUTPUT CONTROL	8A-45-0
C1	BLK	1575	STEERING WHEEL SPEED SENSOR VOLTAGE REFERENCE LO	8A-45-0
C2	BRN	541	IGNITION INPUT	8A-45-0
D1	RED	1573	STEERING WHEEL SPEED SENSOR VOLTAGE REFERENCE HI	8A-45-0
D2	BLK	450	G200 GROUND	8A-45-0

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

- If scan tool displays "Pin D Always Low" for approximately 3 seconds, then starts displaying a rapidly changing Duty cycle of approximately 25 to 80 %, check for an open in CKT 1294 or a poor connection at terminal "B" of the Power Steering Control Module Connector. To verify this condition, cycle the Ignition "OFF" then "ON" with the Signal Generator connected at set to 60 Hz. Refer to "System Check" for connection of Signal Generator.

- A short to B+ on CKT 1294 will not drive the actuator pintle out to cause a decrease in assist. The fault is detected by the Power Steering Control Module which enables CKT 1294, and the scan tool will read "No Duty Cycle Present."
- Resistance of the Steering Wheel Speed Sensor from terminal "A" to terminal "C" should be between 8 k Ω and 15 k Ω , from terminal "A" to terminal "B" should be 500 Ω to 16 k Ω and from terminal "B" to terminal "C" should be 500 Ω to 16 k Ω . If not, replace the Steering Wheel Speed Sensor.
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

USING SIGNAL GENERATOR J 38522

! Important:

- Assume Power Steering Components are operating normally. If Power Steering Pump, Gear, or any other basic Power Steering Components are suspect, refer to "Mechanical/Hydraulic Diagnosis" in SECTION 3B5.

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Disconnect Power Steering Control Module Connector. • Back-out terminal "A2" (DK GRN/WHT wire) from the connector. Use a jumper made from a 1 foot piece of 16 or 18 gage (1 or .8 mm) wire and a female Metri-Pack 630 terminal #12015870. Insert the terminal into cavity "A2" of the Power Steering Control Module Connector. Strip the end of the wire and clip it to the RED lead of J 38522. Clip the BLACK lead of J 38522 to a good ground. • Reconnect the Power Steering Control Module Connector. • Connect the scan tool with an ABS cartridge and select the VES Duty Cycle Test. • J 38522 not plugged in. • Start the Engine.	Duty Cycle is approximately 20 to 30%.
[2] • Engine idling. • Rotate the Steering Wheel, in half turns, quickly to the left and then to the right, 2 or 3 times.	• No change in Duty Cycle. • Full power steering assist with no lag or decrease in assist.
[3] • Plug in J 38522 and set for a 5 V square wave at 30 Hz with a 50% Duty Cycle.	Duty Cycle increases to approximately 42 to 52%.
[4] • Increase frequency to 60 Hz.	Duty Cycle increases to approximately 57 to 67%.
[5] • Rotate the Steering Wheel, in half turns, quickly to the left and then to the right, 2 or 3 times.	• Duty Cycle decreases and returns to previous Duty Cycle (changing rapidly, reaching a low of approximately 35 to 45%). • A noticeable decrease in assist is felt, especially at the beginning of the turns.
[6] • Steps 7 and 8 are for further verification of system operation. Perform these steps only if dissatisfied with normal results of the previous steps.	

VARIABLE EFFORT STEERING

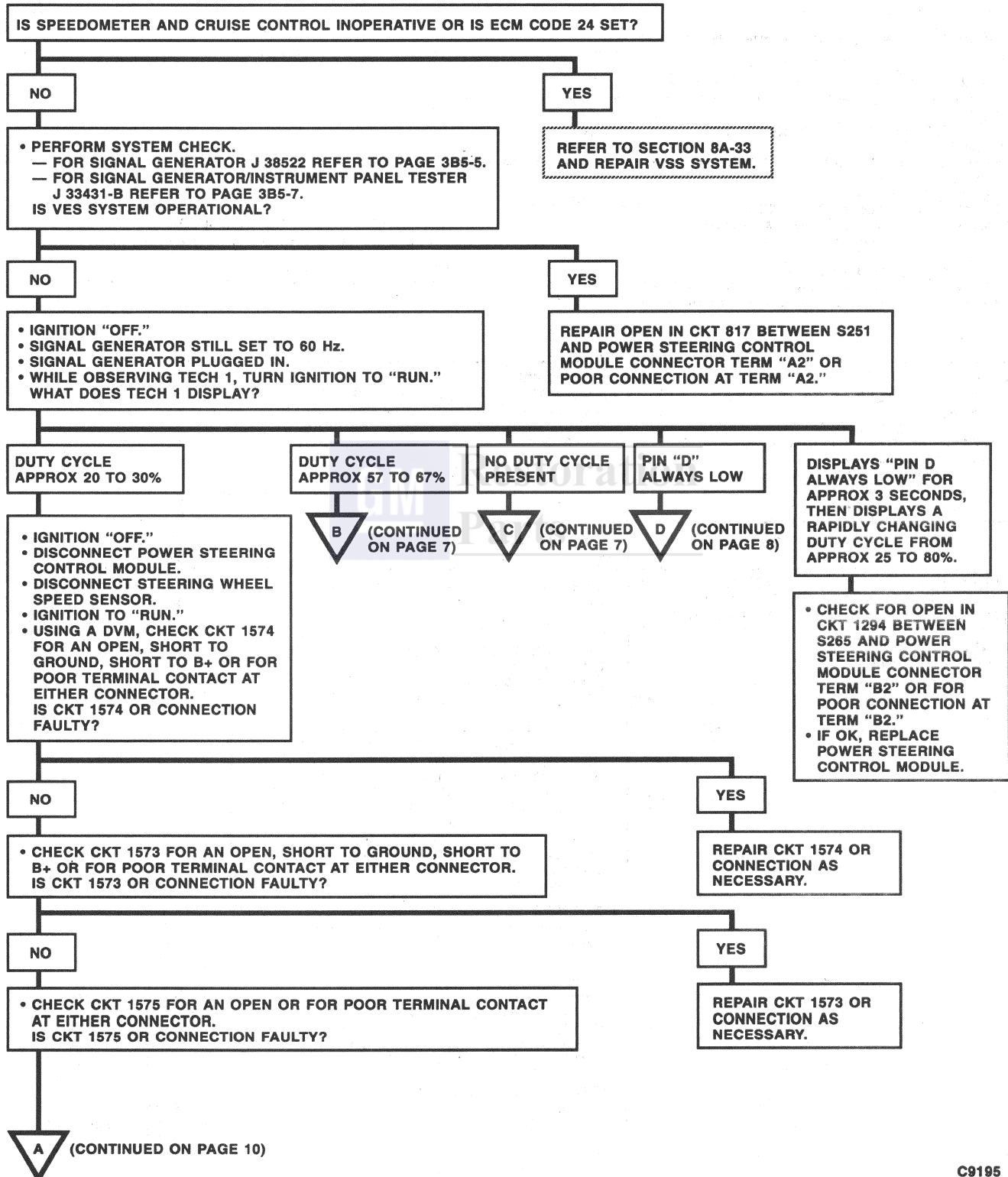
SYSTEM CHECK (Continued)

ACTION	NORMAL RESULTS
[7] • Engine "OFF." • J 38522 unplugged. • Install Power Steering Pressure Tester J 5176-D. (Refer to SECTION 3 for installation procedure.) • Start Engine, let Engine reach normal operating temperature. • Engine at idle.	• Duty Cycle is approximately 20 to 30%. • Power steering pressure is approximately 150 psi.
[8] • Plug in J 38522 and set for a 5 V square wave at 60 Hz with a 50% Duty Cycle.	• Duty Cycle increases to approximately 57 to 67%. • Power steering pressure drops significantly to approximately 50 psi.



CHART #1

POWER STEERING SYSTEM OPERATING WITH FULL ASSIST AT ALL TIMES, DECREASE IN ROAD FEEL AT HIGHWAY SPEEDS (VES SYSTEM INOPERATIVE)



VARIABLE EFFORT STEERING

CHART #1 (continued)

POWER STEERING SYSTEM OPERATING WITH FULL ASSIST AT ALL TIMES, DECREASE IN ROAD FEEL AT HIGHWAY SPEEDS (VES SYSTEM INOPERATIVE)

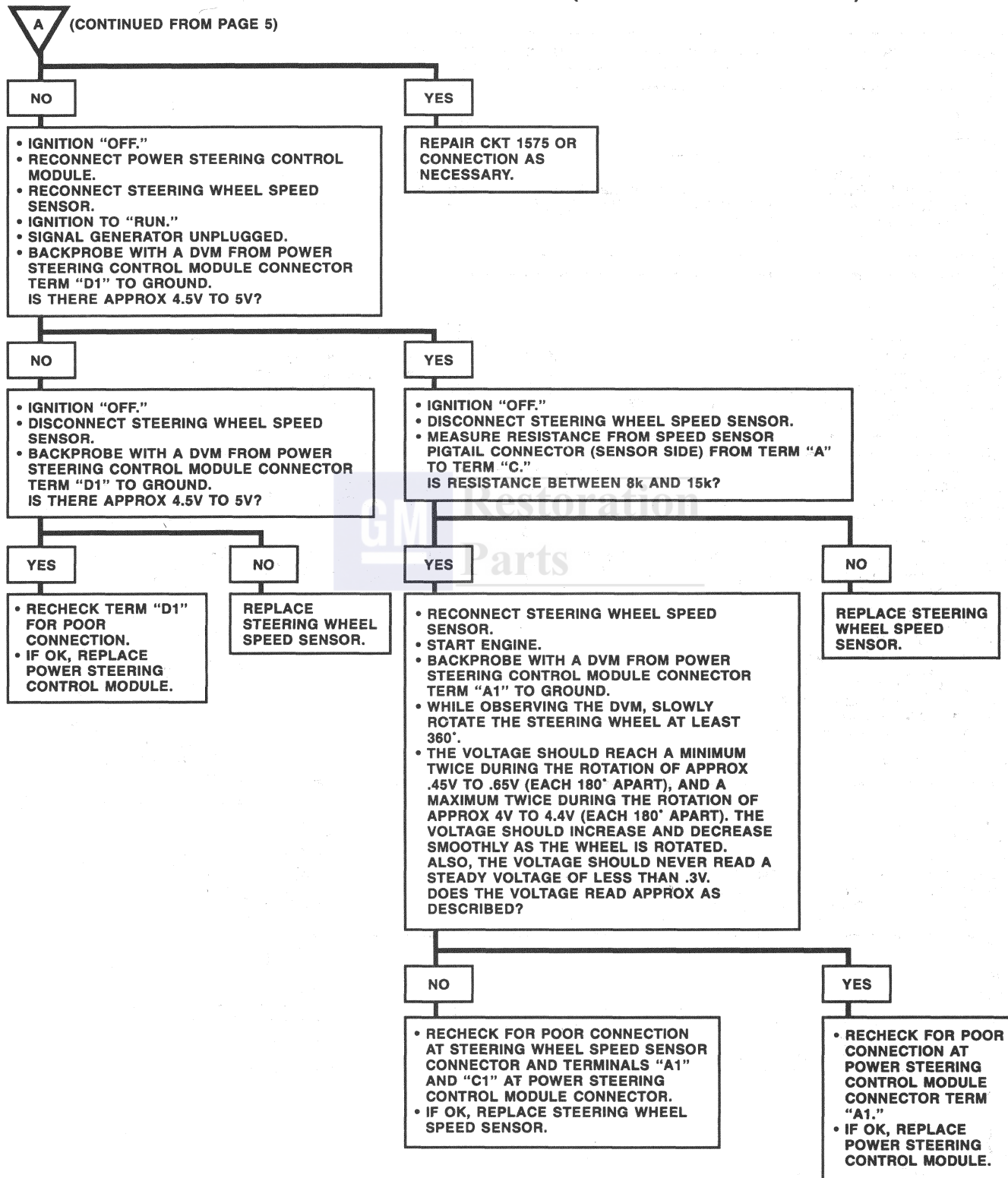
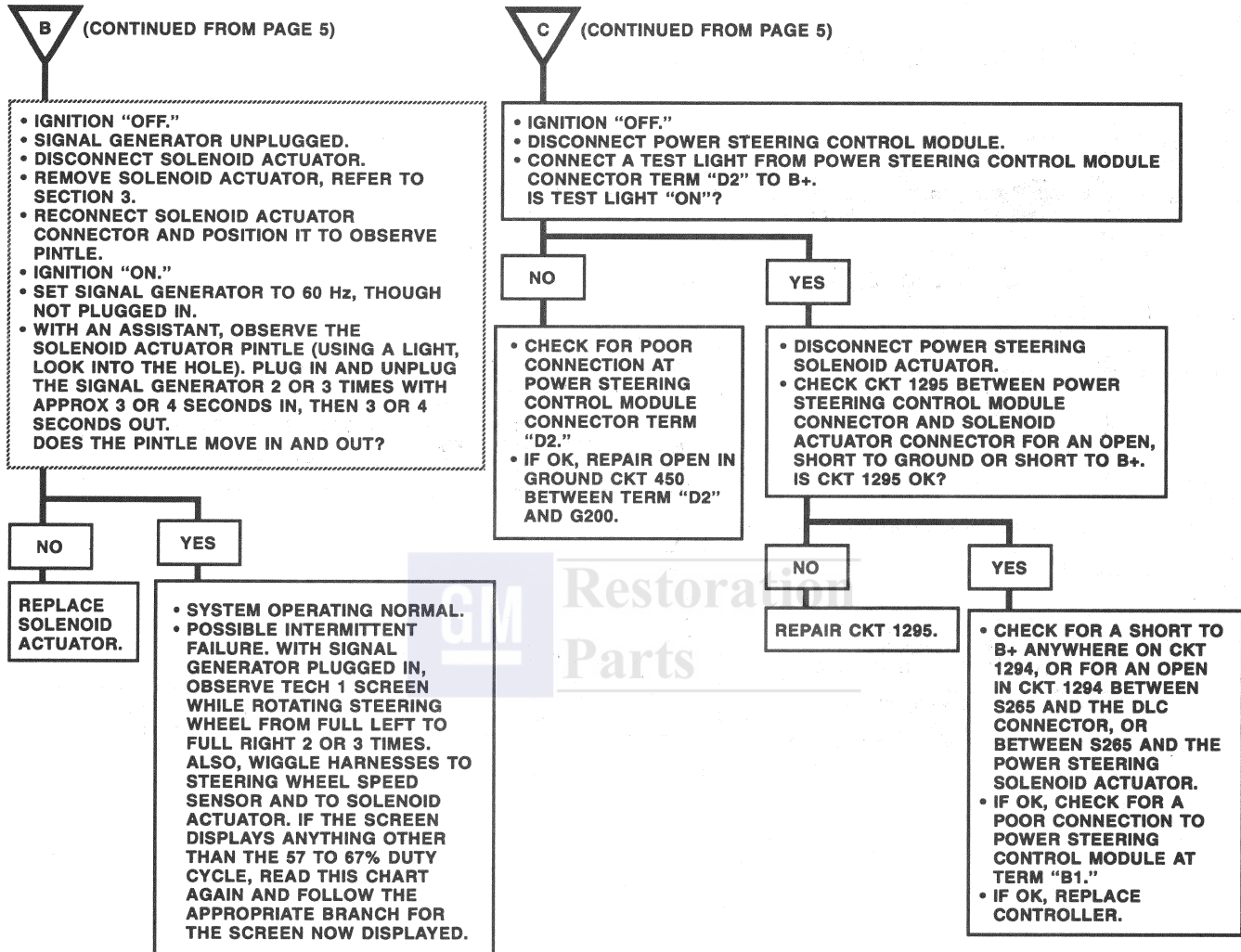


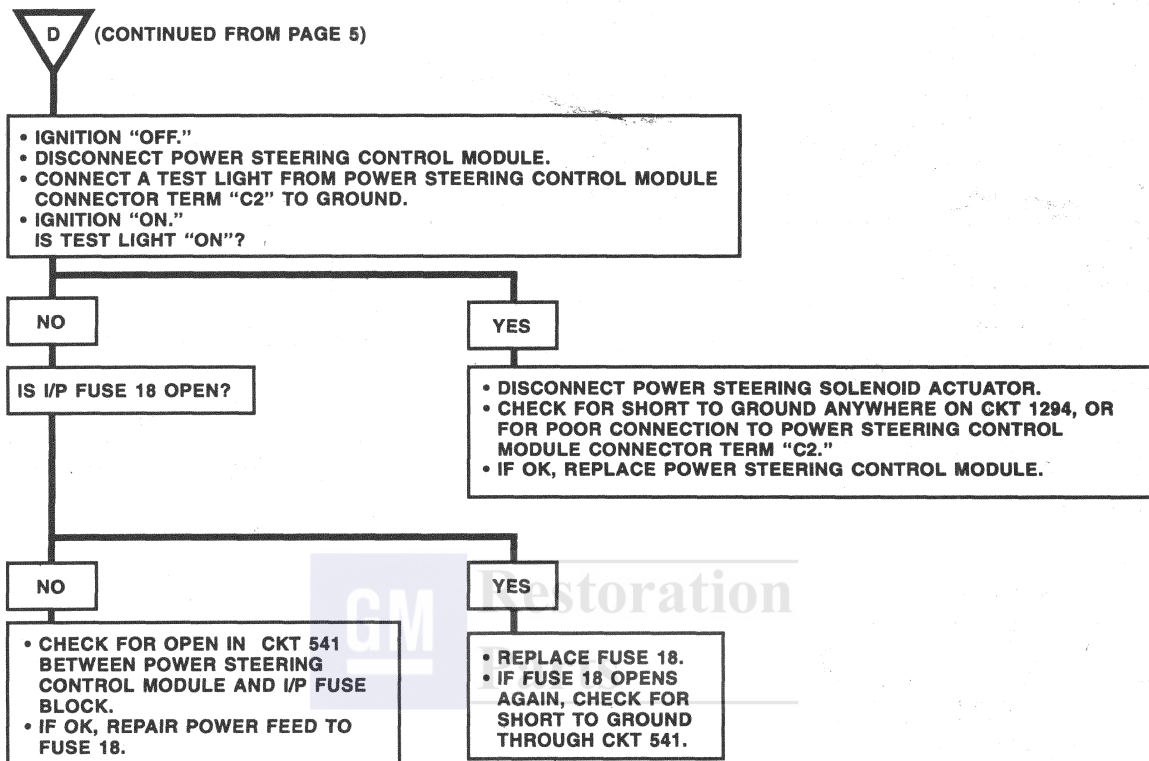
CHART #1 (continued)

POWER STEERING SYSTEM OPERATING WITH FULL ASSIST AT ALL TIMES, DECREASE IN ROAD FEEL AT HIGHWAY SPEEDS (VES SYSTEM INOPERATIVE)



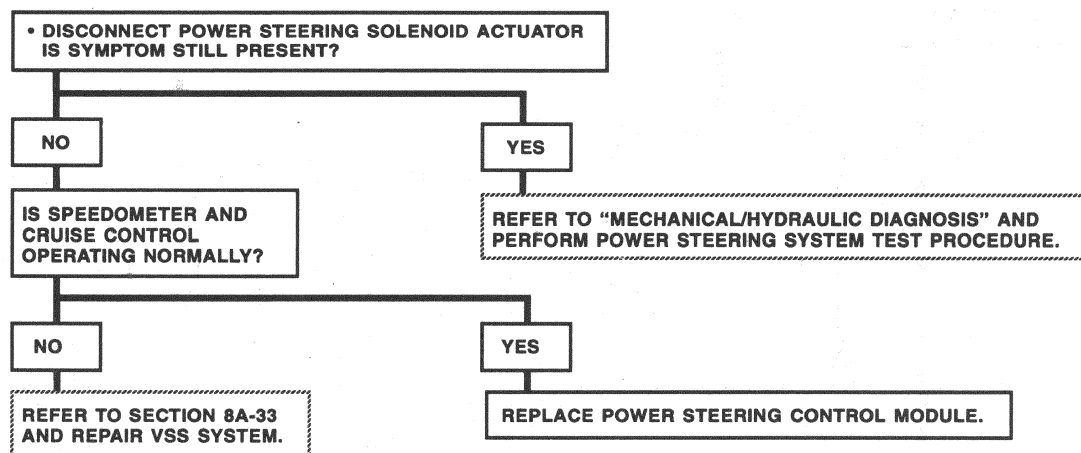
VARIABLE EFFORT STEERING

CHART #1 (continued)
POWER STEERING SYSTEM OPERATING WITH FULL ASSIST AT ALL TIMES, DECREASE
IN ROAD FEEL AT HIGHWAY SPEEDS (VES SYSTEM INOPERATIVE)



C9198

CHART #2 DECREASED POWER STEERING ASSIST AT ALL TIMES



C9199



CIRCUIT OPERATION

Variable Effort Steering

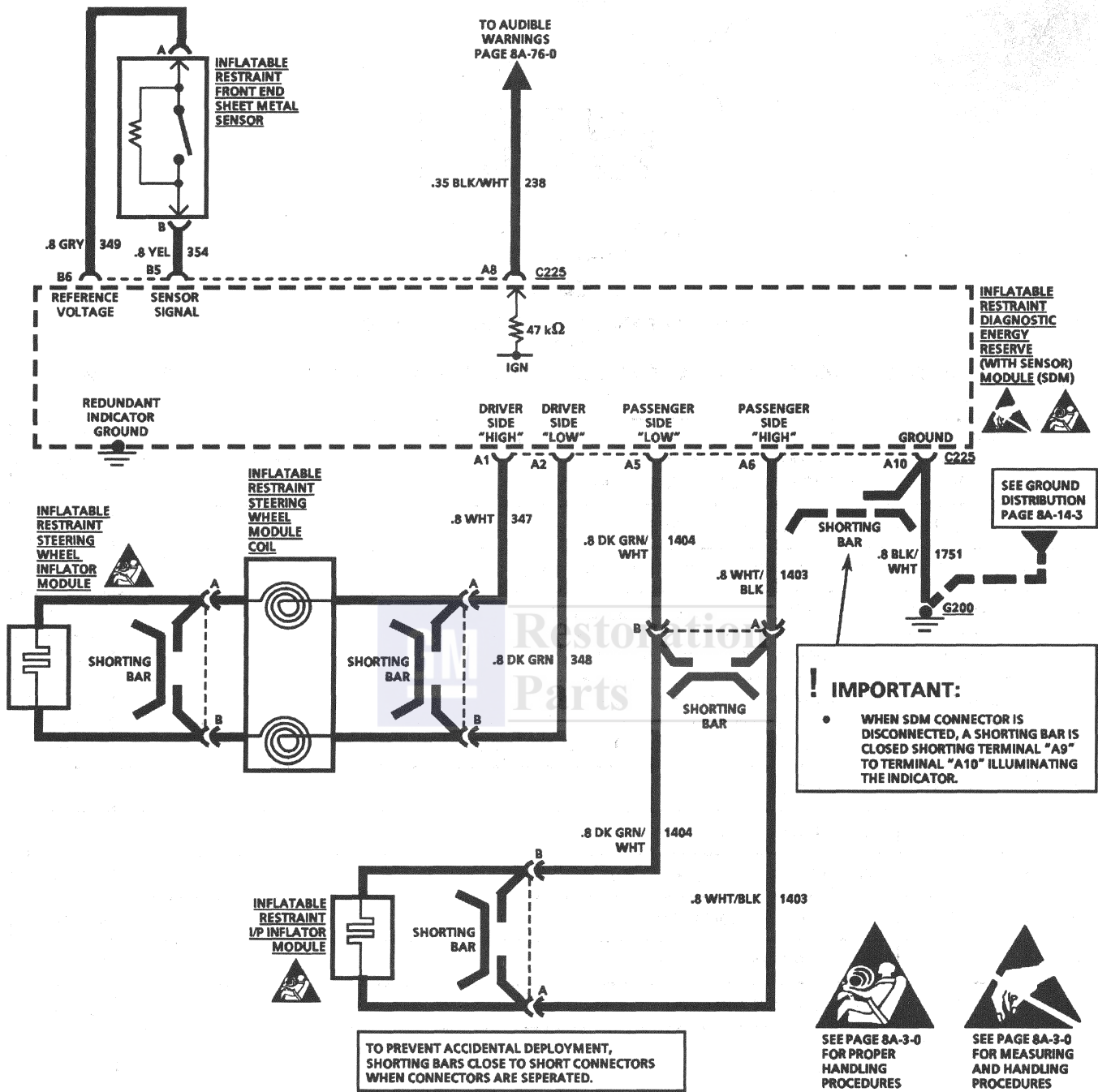
The Variable Effort Steering (VES) System uses inputs from the Vehicle Speed Sensor (VSS) and the Steering Wheel Speed Sensor to determine the desired amount of power steering assist. The power steering assist is controlled by the Power Steering Control Module (PSCM).

The PSCM constantly compares the amount of current actually flowing through the Power Steering Pump Actuator to the desired current it has calculated. The Actuator is an electromechanical current regulated device mounted to the Power Steering Pump. The Actuator has a pintle that moves in and out of an orifice, regulating power steering fluid pressure. The PSCM can change the amount of current flowing through the Actuator by varying the Output Duty Cycle. The current through the Actuator at 0 mph is approximately 230-250 mA, and with a 60 Hz signal on the VSS input of the PSCM approximately 600-650 mA. If the Actuator is disconnected, the pintle will be pulled out of the orifice for maximum power steering assist.

The PSCM has the ability to detect faults in the Steering Wheel Speed Sensor, the Actuator, or the circuitry to those components. Any fault detected will cause the power steering assist to remain at maximum with the pintle in its normally retracted position for all speeds. For example, a short to battery voltage on the high side (CKT 1294) of the Actuator will cause the PSCM to open the low side (CKT 1295) and the pintle will not extend to decrease power steering assist.

When the system is operating normally, increasing vehicle speed will decrease power steering assist, allowing the driver to have improved road feel and directional stability. When sudden steering wheel turns are made, as in evasive maneuvers, is detected by the PSCM through the Steering Wheel Speed Sensor. When detected, the PSCM reduces current to the Actuator, allowing greater power steering assist.



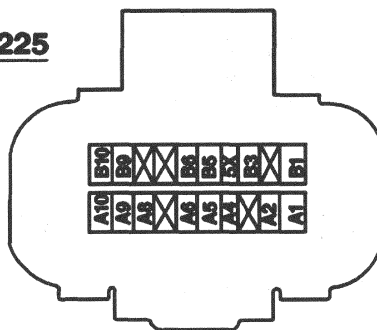


CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

8A - 47 - 2 ELECTRICAL DIAGNOSIS

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR)

C225



12160754

20 - WAY F MICRO - PACK 100 W SERIES

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INFLATABLE RESTRAINT DIAGNOSTIC ENERGY RESERVE (WITH SENSOR) MODULE (SDM)

**06-15-95
BT0028A47**

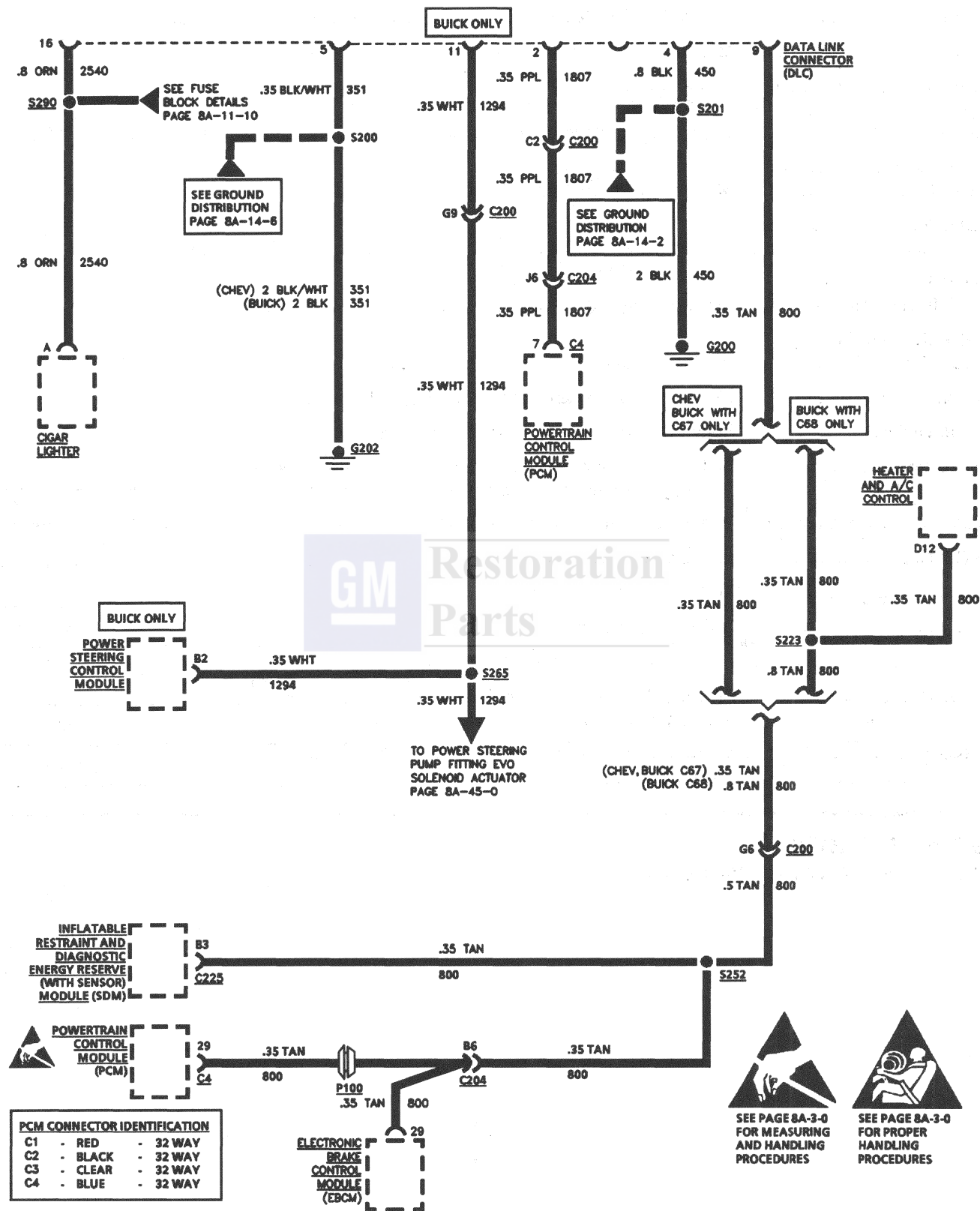
CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A1	WHT	347	DRIVER'S SIDE SENSE "HIGH"	8A-47-1
A2	DK GRN	348	DRIVER'S SIDE SENSE "LOW"	8A-47-1
A4	PINK	39	REDUNDANT INDICATOR IGNITION #1	8A-47-0
A5	DK GRN/WHT	1404	PASSENGER SIDE SENSE "LOW"	8A-47-1
A6	WHT/BLK	1403	PASSENGER SIDE SENSE "HIGH"	8A-47-1
A8	BLK/WHT	238	DRIVER'S SEAT BELT SIGNAL	8A-47-1
A9	BRN	358	REDUNDANT SIR INDICATOR CONTROLLED GROUND	8A-47-0
A10	BLK/WHT	1751	GROUND	8A-47-1
B1	PPL	806	CRANK INPUT	8A-47-0
B3	TAN	800	SERIAL DATA LINE TO DLC	8A-47-0
B5	YEL	354	SENSOR INDICATOR	8A-47-1
B6	GRY	349	REFERENCE VOLTAGE	8A-47-1
B9	YEL	1139	IGNITION #1	8A-47-0

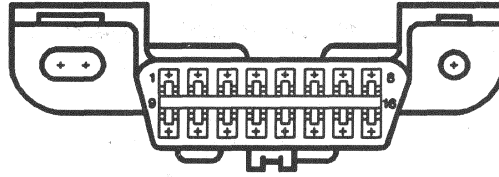
COMPONENT	LOCATION	201-PG	FIG.	CONN
Data Link Conn (DLC)	Attached to I/P Carrier, RH side of Steering Column.....	14.....	22	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Inflatable Restraint Diagnostic Energy Reserve (with sensor) Module (SDM).....	Upper LH I/P, above Convenience Center.....	11.....	19.....	47-2
Inflatable Restraint Front End Sheet Metal Sensor.....	Mounted on center Radiator Support.....	2.....	5	
Inflatable Restraint I/P Inflator Module.....	RH I/P, above I/P Compartment	15.....	24	
Inflatable Restraint Steering Wheel Inflator Module.....	Center of Steering Wheel	14.....	23	
Inflatable Restraint Steering Wheel Module Coil	Retained in top of Steering Column.....	14.....	23	
Instrument Cluster.....	LH side of I/P, centered above Steering Column.....	9.....	16	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14.....	22.....	202-1
C225 (20 cavities).....	Body Harn to Supplemental Inflatable Restraint Diagnostic Energy Reserve (with Sensor) Module (SDM)	11.....	19	
G200.....	Base of LH "A" Pillar, behind kickpad	11.....	19	
S223 (Buick).....	I/P Harn, approx 23 cm from C200			
S227	Body Harn, approx 8 cm from Convenience Center breakout			
S232	Body Harn, approx 10 cm from SDM breakout			
S252	Body Harn, approx 15 cm from SDM breakout			
S255 (Buick).....	I/P Harn, behind Instrument Cluster 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping			

SYSTEM DIAGNOSIS

- Refer to SECTION 9J and SECTION 9J-A.

DATA LINK CONNECTOR (DLC) PIN ASSIGNMENT



**12110250****16 - WAY F METRI - PACK 150 SERIES****BLK****DATA LINK CONNECTOR (DLC)**

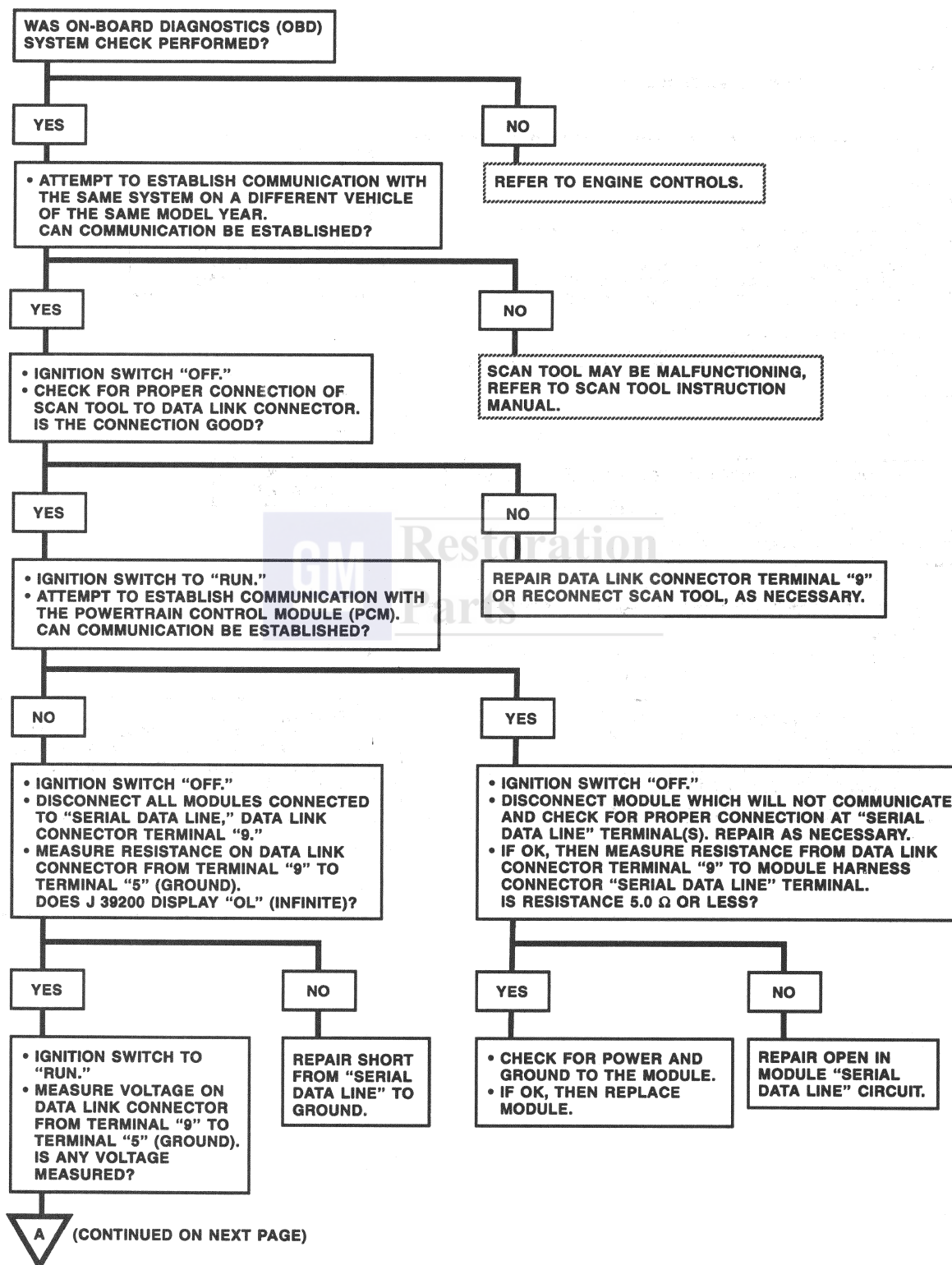
CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
2	PPL	1807	SERIAL DATA LINE	8A-50-0
4	BLK	450	GROUND	8A-50-0
5	BLK/WHT	351	GROUND	8A-50-0
9	TAN	800	SERIAL DATA LINE, SENSING AND DIAGNOSTIC MODULE (SDM), ELECTRONIC BRAKE CONTROL MODULE (EBCM) AND POWERTRAIN CONTROL MODULE (PCM)	8A-50-0
16	ORN	2540	DATA LINK TO C200 BODY HARNESS	8A-50-0
11	WHT	1294	VARIABLE EFFORT STEERING SYSTEM SIGNAL	8A-50-0

8A - 50 - 2 ELECTRICAL DIAGNOSIS

DATA LINK CONNECTOR (DLC)

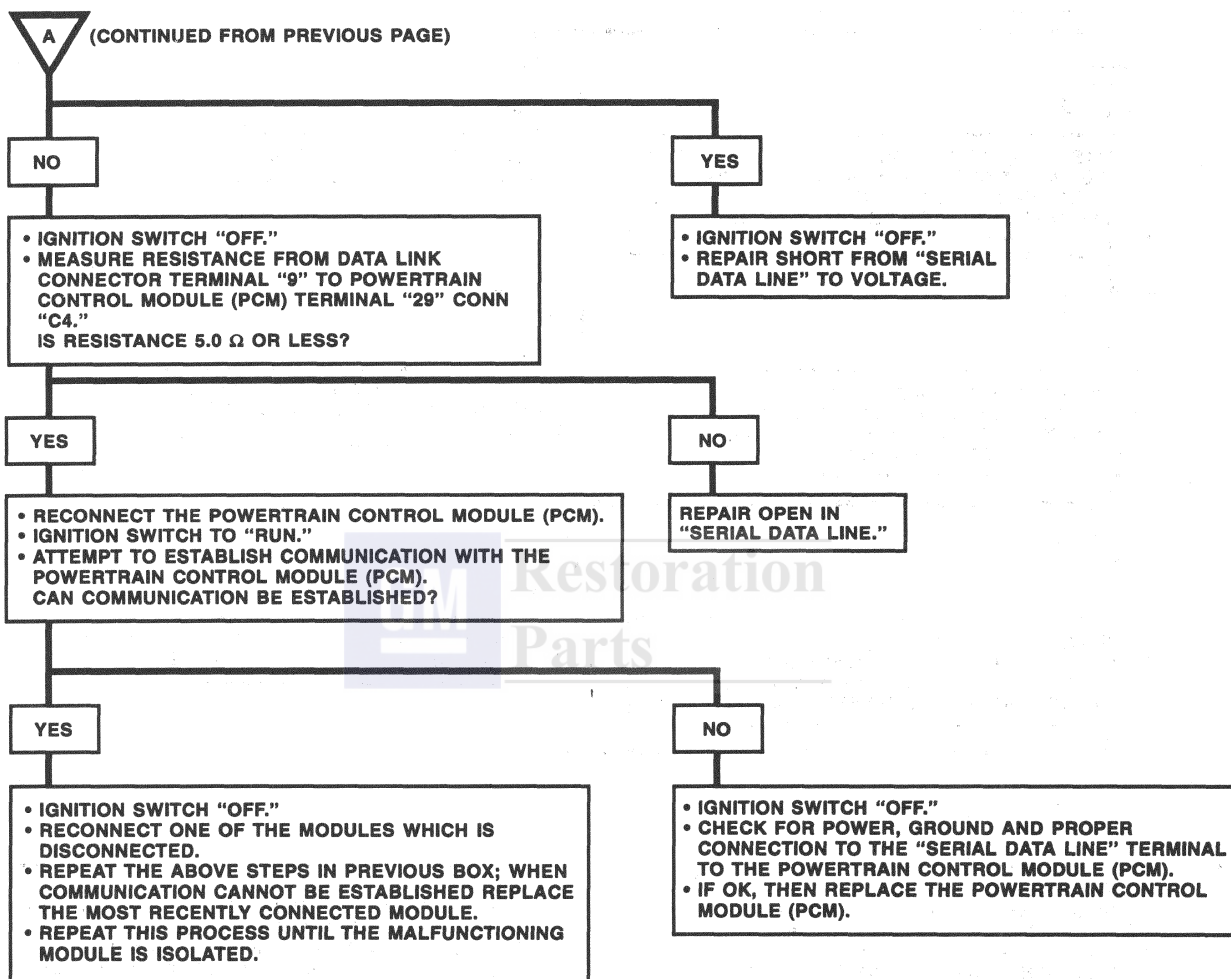
COMPONENT	LOCATION	201-PG	FIG.	CONN
Data Link Conn (DLC)	Attached to I/P Carrier, RH side of Steering Column.....	14.....	22.....	202-10
Electronic Brake Control Module (EBCM).....	LH Engine Compartment, part of Brake Pressure Modulator valve			
Heater and A/C Control (C68).....	Center of I/P	17	28.....	1C-38
Inflatable Restraint Diagnostic Energy Reserve (with sensor) Module (SDM).....	LH I/P, above Convenience Center.....	11	19	
Power Steering Control Module	Bolted to bracket above and left of Steering Column, near I/P Fuse Block	11	19	
Powertrain Control Module (PCM).....	Engine Compartment forward of LH Wheelhouse, under Air Cleaner.....	4.....	8	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14.....	22.....	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	26.....	202-3
C205 (10 cavities).....	Engine Harn to I/P Harn, right of I/P Compartment	18	29	
G202.....	Base of RH "A" Pillar, behind kickpad	16.....	26	
P100	RH I/P, forward of Blower Motor	16.....	26	
S200 (Buick)	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S223 (Buick)	I/P Harn, approx 23 cm from C200, on branch			
S252	Body Harn, approx 15 cm from SDM breakout			
S265 (Buick)	Body Harn, approx 26 cm from SDM breakout, inside channel			

SERIAL DATA LINE DIAGNOSIS (800 CKT)



DATA LINK CONNECTOR (DLC)

SERIAL DATA LINE DIAGNOSIS (800 CKT)

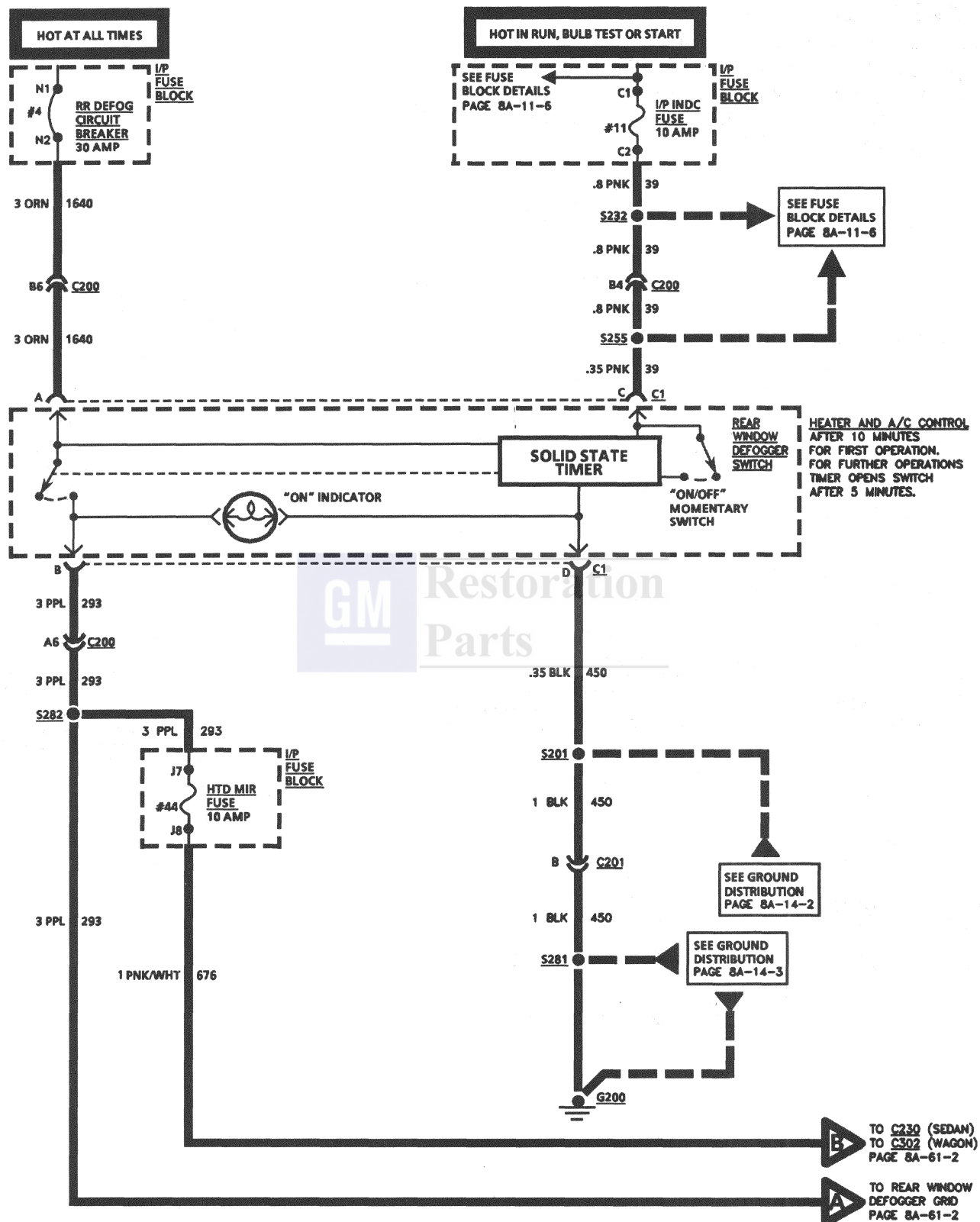


CIRCUIT OPERATION

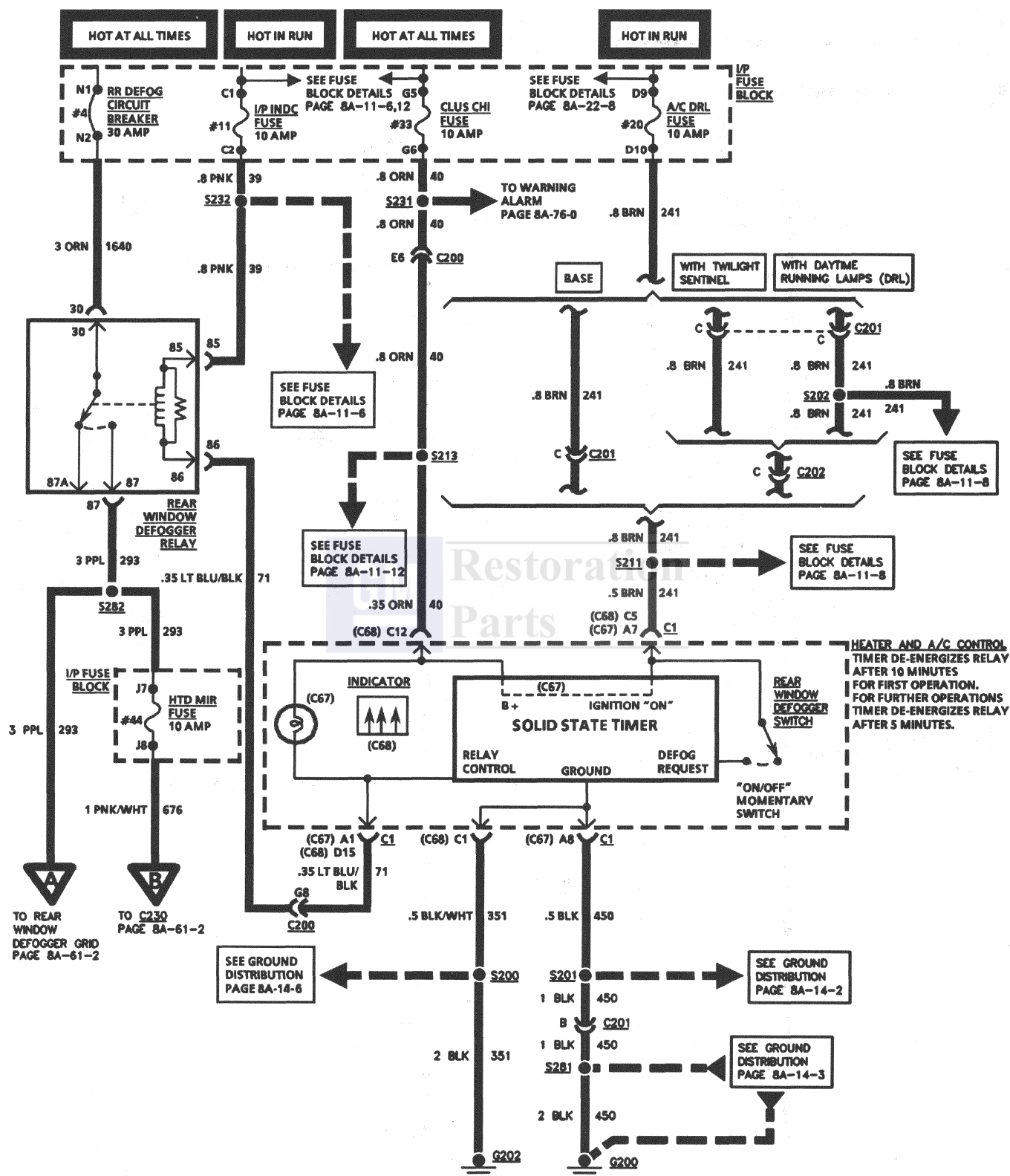
The Data Stream (on the 800 CKT) uses a 8192 Baud Rate. During normal vehicle operation, the PCM serves as the "Master" Module. When using the Tech-1, the Tech-1 will serve as the "Master" Module and interrogate any Module on the 800 CKT.



DEFOGGER AND HEATED MIRRORS **C60 (CHEV)**



DEFOGGER AND HEATED MIRRORS C67 AND C68 (BUICK)



DEFOGGER AND HEATED MIRRORS

C60, C67 AND C68 (CHEV AND BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Heater and A/C Control	Center of I/P	17	28	202-11
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Outside Rearview Mirror, RH ...	RH Front Door			
Outside Rearview Mirror, LH ...	LH Front Door			
Rear Window Defogger Switch	Center of I/P, part of Heater and A/C Control			
Rear Window Defogger Grid ...	Attached to Rear Window			
Rear Window Defogger Relay (C67 and C68)	RH I/P, next to Blower Motor	16	26	
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, lower RH side of Steering Column, next to C200	11	19	202-5
C201 (6 cavities)(w/T61)	Body Harn to Daytime Running Lamp Harn, at RH side of Steering Column, above C200	14	19	202-5
C201 (6 cavities)(w/T82)	Body Harn to Twilight Sentinel Harn, at RH side of Steering Column, above C200	11	19	202-5
C202 (6 cavities)	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column, next to C200	11	19	202-5
C230 (10 cavities)	Crosscar and Side Door Harn to Body Harn, at base of LH "A" Pillar behind kickpad	11	19	202-5
C450 (6 cavities)	Body Rear Harn to Body Harn, near center of LH "D" Pillar	34	49	202-5
C500 (8 cavities)	Crosscar and Side Door Harn to LH Outside Rearview Mirror	19	30	
C600 (8 cavities)	Crosscar and Side Door Harn to RH Outside Rearview Mirror	23	34	
G200	Base of LH "A" Pillar, behind kickpad	11	19	
G201	Base of LH "A" Pillar, behind LH kickpad	11	19	
G202	Base of RH "A" Pillar, behind RH kickpad	16	26	
G400	Near center of RH "D" Pillar	36	52	
G401	LH Rear Wheelhouse, in Luggage Compartment	31	46	
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	
S200 (Buick)	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S200 (Chev)	I/P Harn, approx 8 cm from Heater-A/C Control branch breakout			
S201 (Buick)	I/P Harn, behind I/P Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S201 (Chev)	I/P Harn, approx 12 cm from C200 breakout			

8A - 61 - 4 ELECTRICAL DIAGNOSIS

DEFOGGER AND HEATED MIRRORS

COMPONENT	LOCATION	201-PG FIG. CONN
S202	Daytime Running Lamps Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S211	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel	
S213 (Buick)	I/P Harn, approx 4 cm from I/P Cluster C2 Conn breakout, in spiral taping	
S213 (Chev).....	I/P Harn, approx 12 cm from Heater-A/C Control Conn branch breakout	
S231	Body Harn, approx 16 cm from Convenience Center breakout	
S232	Body Harn, approx 10 cm from SDM breakout	
S244	Crosscar Harn, on C230 branch, approx 4 cm from breakout	
S255 (Buick)	I/P Harn, behind Instrument Cluster, 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping	
S258	Crosscar Harn, approx 12 cm from C231 branch breakout	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	
S282	Body Harn, approx 7 cm from channel opening at LH "B" Pillar	
S406	Rear Body Harn, approx 17 cm from C412 breakout	

TROUBLESHOOTING HINTS (CHEV)

(Perform before beginning System Diagnosis)

1. Check Circuit Breaker #4. If open, check for short to ground in CKT 1640.
2. Check Fuse #11. If open, check for short to ground in CKT 39.
3. Check Rear Window Defogger Grid for opens, refer to SECTION 10-2.
4. Check that grounds G200, G201, G300 and G400 are clean and tight.
5. If both Mirror Defoggers are inoperative but Rear Window Defogger operates normally, check I/P Fuse #44. If Fuse #44 is open, check for a short to ground in CKT 676. If OK, perform Chart #3 on page 8A-61-8.
6. If Mirror Defoggers operate normally but Rear Window Defogger is inoperative, check that the Rear Window Defogger Grid connection is firmly mated and ground G300 (Sedan) or G400 (Wagon) is clean and tight. If OK, perform Chart #5 on page 8A-61-9.

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).
- For Diagnosis of the Buick Rear Defogger and Heated Mirrors Refer to SECTION 1C.

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Push Rear Window Defogger Control Switch to "ON" and release.	Switch returns to "REST" position. Rear Window Defogger Indicator is "ON" and Rear Window Defogger Grid becomes warm (also Heated Mirrors if equipped). Defogger Grid and Indicator turn "OFF" in approximately 10 minutes.
[2] • After first 10 minute time period, push Rear Window Defogger Control Switch to "ON" and release.	Switch returns to "REST" position. Indicator and Defogger Grid (also heated mirrors if equipped) remain "ON" for approximately 5 minutes and then turn "OFF."



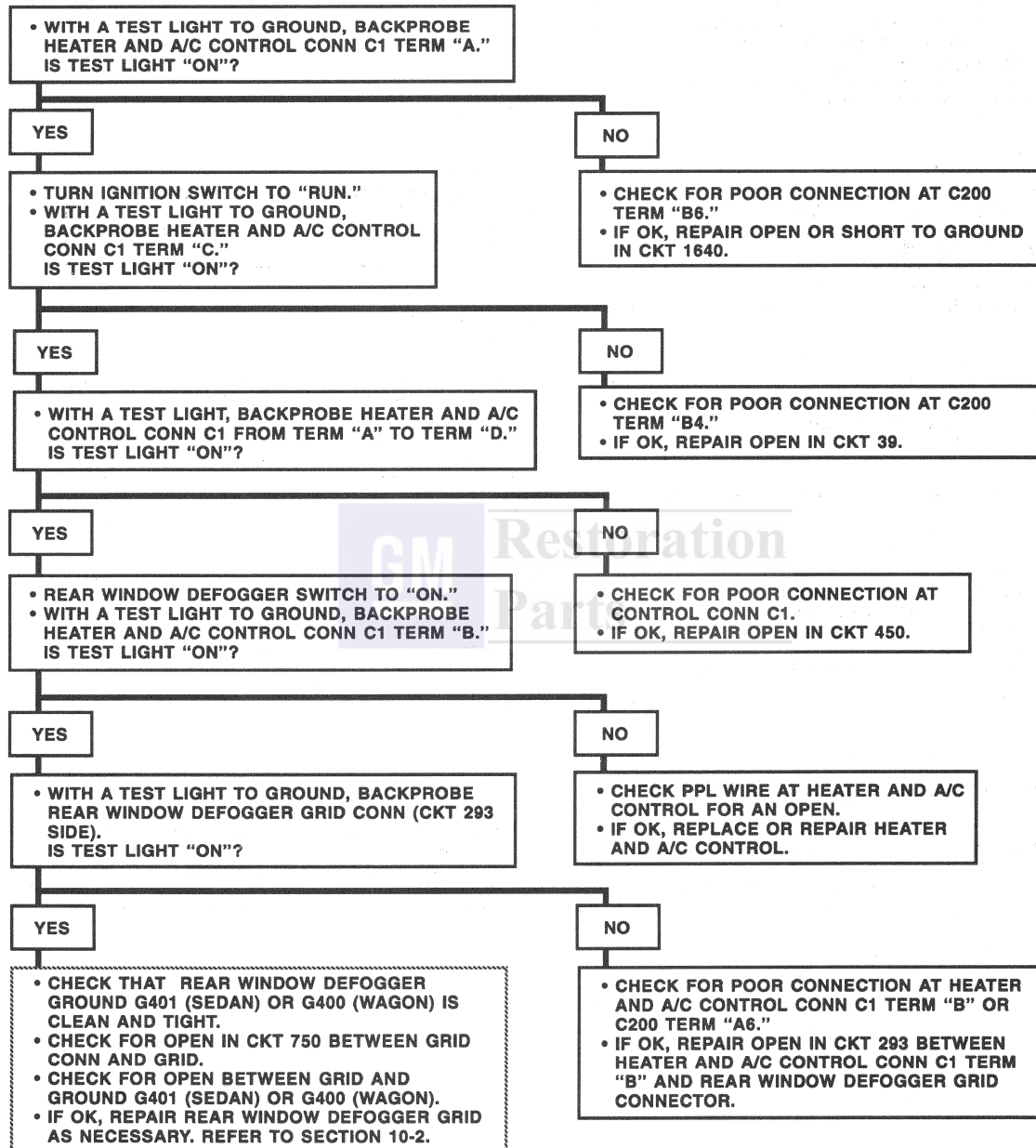
8A - 61 - 6 ELECTRICAL DIAGNOSIS**DEFOGGER AND HEATED MIRRORS****REAR DEFOGGER WITHOUT HEATED MIRRORS (C60)****SYMPTOM TABLE**

SYMPTOM	PROCEDURE	PAGE NUMBER
Rear Window Defogger Grid inoperative, Indicator may or may not light.	Chart #1	8A-61-7
Indicator inoperative, but Rear Window Defogger Grid operates normally.	Replace Heater and A/C Control.	
Rear Window Defogger Grid and Indicator will not cycle "ON/OFF" for 10 minutes or 5 minutes.	Replace Heater and A/C Control.	
Rear Window Defogger Control Switch does not return to "REST" position.	Replace Heater and A/C Control.	

REAR DEFOGGER WITH HEATED MIRRORS (C60)**SYMPTOM TABLE**

SYMPTOM	PROCEDURE	PAGE NUMBER
Rear Window Defogger and Mirror Defoggers are inoperative, Indicator may or may not light.	Chart #2	8A-61-8
Both Mirror Defoggers inoperative with Rear Window Defogger operating normally.	Chart #3	8A-61-9
One Mirror Defogger inoperative with the other Mirror Defogger operating normally.	Chart #4	8A-61-9
Rear Window Defogger inoperative with Mirror Defoggers operating normally.	Chart #5	8A-61-10
Indicator inoperative, but Rear Window Defogger Grid and Mirror Defoggers operate normally.	Replace Heater and A/C Control.	
Rear Window Defogger Grid and Indicator will not cycle "ON/OFF" for 10 minutes or 5 minutes.	Replace Heater and A/C Control.	
Rear Window Defogger Control Switch does not return to "REST" position.	Replace Heater and A/C Control.	

CHART #1
REAR WINDOW DEFOGGER GRID INOPERATIVE, INDICATOR MAY OR MAY NOT LIGHT
(REAR WINDOW DEFOGGER WITHOUT HEATED MIRRORS)



8A - 61 - 8 ELECTRICAL DIAGNOSIS

DEFOGGER AND HEATED MIRRORS

CHART #2
REAR WINDOW DEFOGGER AND MIRROR DEFOGGER
ARE INOPERATIVE, INDICATOR MAY OR MAY NOT LIGHT

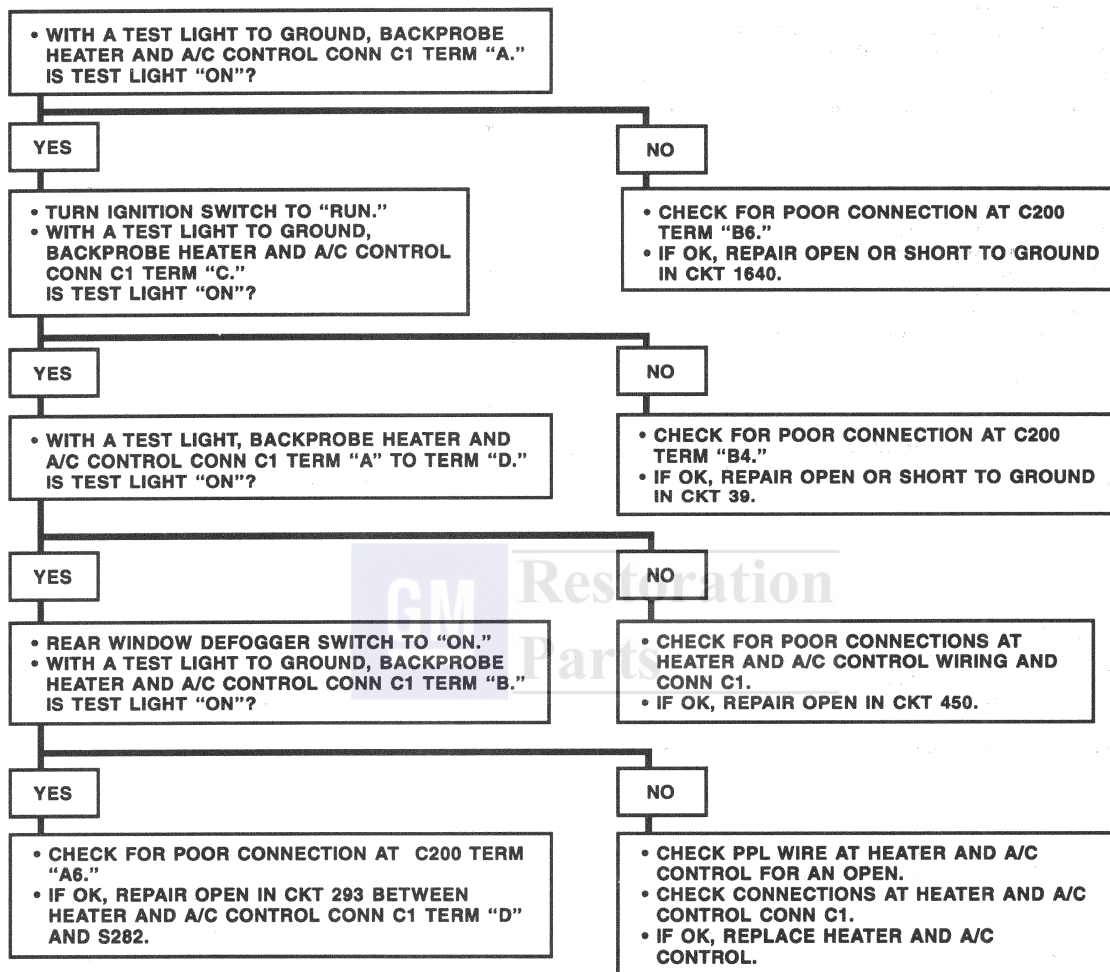
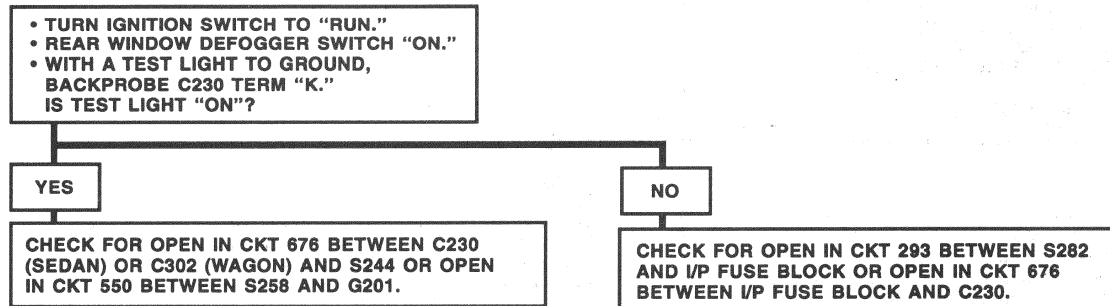


CHART #3

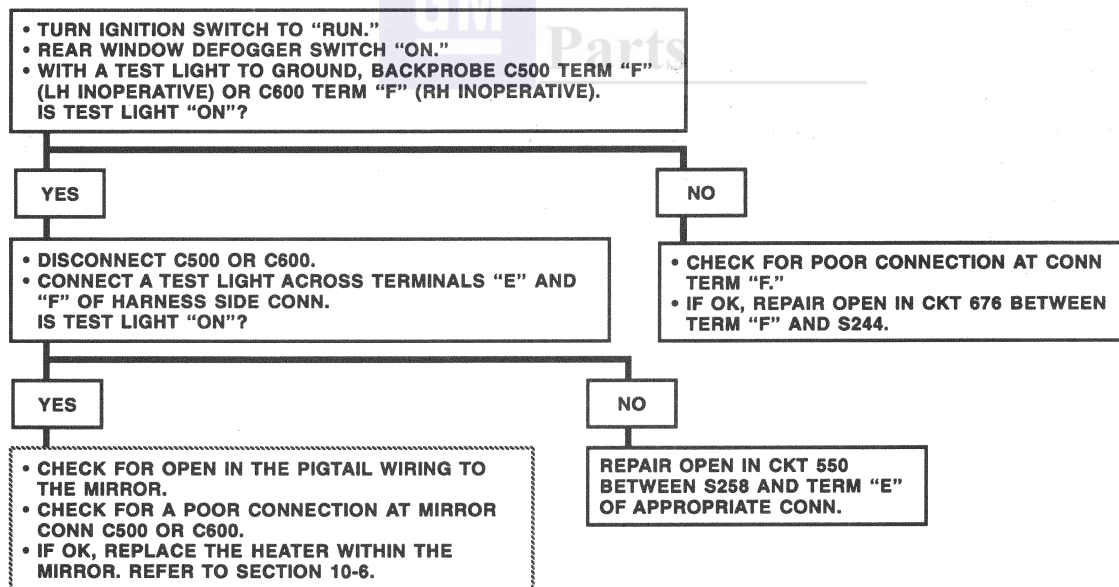
BOTH MIRROR DEFOGGER INOPERATIVE WITH REAR WINDOW DEFOGGER OPERATING NORMALLY



C9202

CHART #4

ONE MIRROR DEFOGGER INOPERATIVE WITH THE OTHER MIRROR DEFOGGER OPERATING NORMALLY

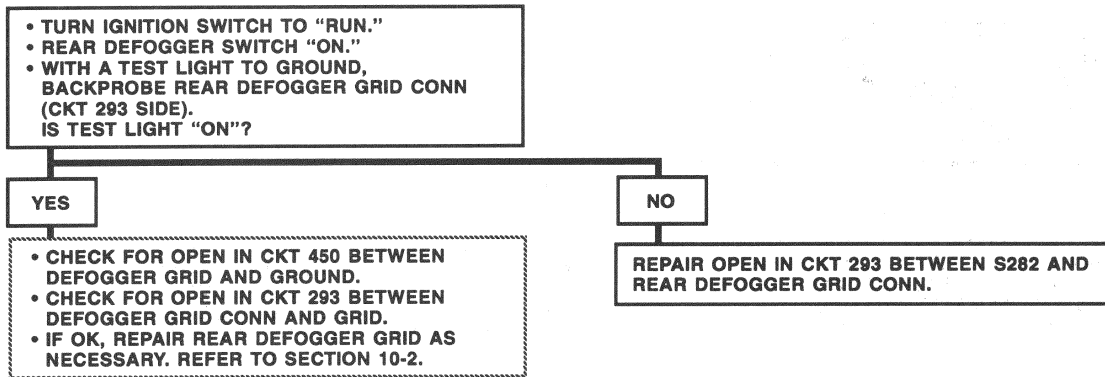


C9264

8A - 61 - 10 ELECTRICAL DIAGNOSIS

DEFOGGER AND HEATED MIRRORS

CHART #5
REAR WINDOW DEFOGGER INOPERATIVE WITH MIRROR
DEFOGGERS OPERATING NORMALLY



C9203

CIRCUIT OPERATION (CHEV)

When the Ignition Switch is turned to "RUN," voltage is applied from I/P Fuse #11 to the Heater and A/C Control. When the Rear Window Defogger Switch is pushed to "ON," voltage is momentarily applied to the Rear Window Defogger Solid State Timer through CKT 39. When voltage is applied to the Rear Window Defogger Timer, the Solid State Timer will close the internal contacts. The internal contacts remain closed until the defog cycle is complete or the Rear Window Defogger Switch is pushed "OFF."

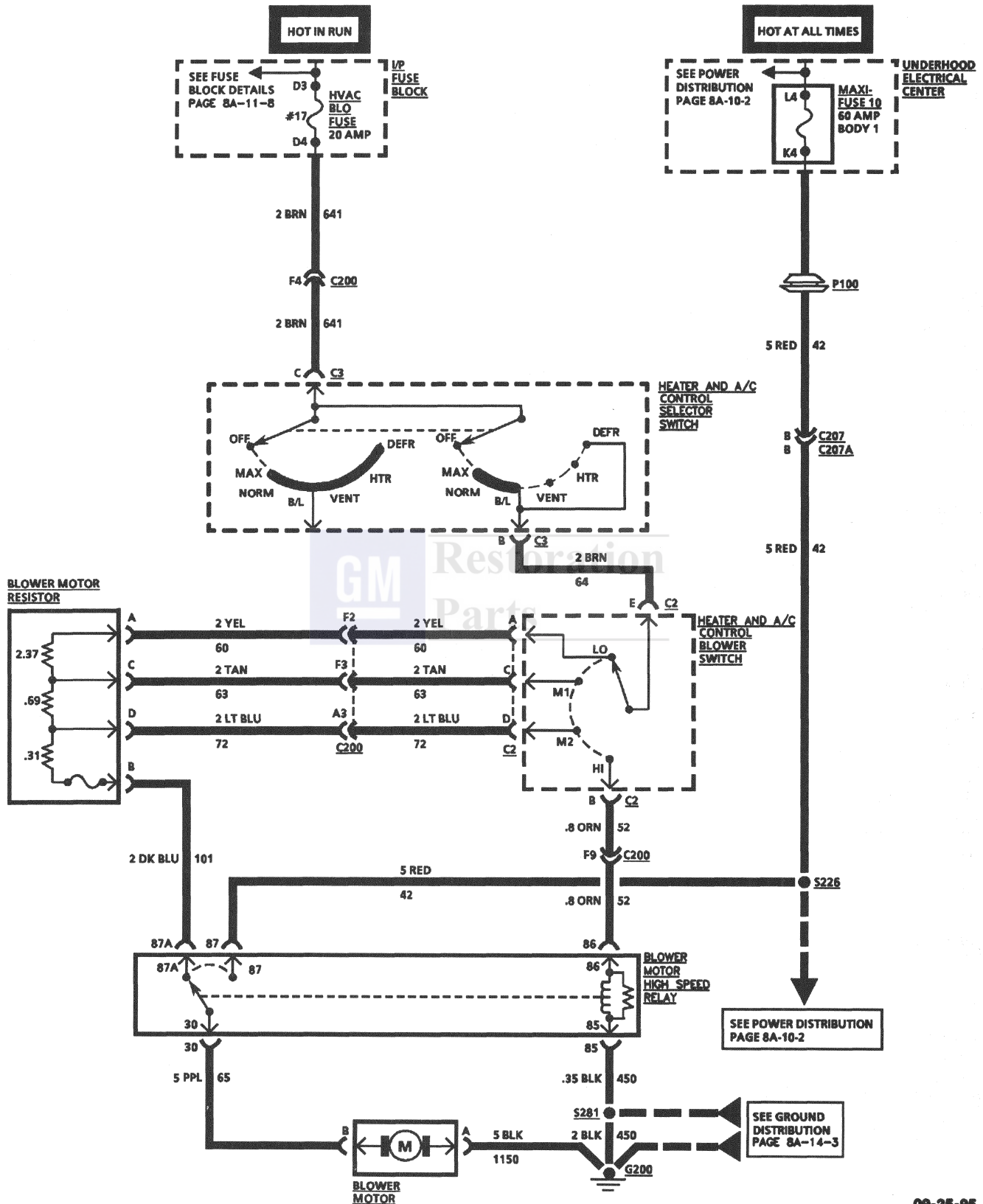
When the internal contacts of the Rear Window Defogger Switch are closed, voltage from I/P Circuit

Breaker #4 is applied to the indicator and to CKT 293, the Rear Window Defogger Grid and I/P Fuse #44 if equipped with Heated Mirrors.

The Heater and A/C Control contains an internal timer to control the time the internal contacts are closed. When the Ignition Switch is turned to "RUN" and the Rear Window Defogger Switch is pushed to "ON" for the first time, the defog cycle lasts 10 minutes. Further operation will result in 5 minute defog cycles. The defog cycle is reset to 10 minutes when the Ignition Switch is turned to "OFF" and back to "RUN."



HVAC BLOWER CONTROL MANUAL A/C (C60)(CHEV)





HVAC BLOWER CONTROL

COMPONENT	LOCATION	201-PG	FIG.	CONN
Blower Motor	Under RH I/P	16	26	
Blower Motor High Speed Relay (C60)	Under RH I/P, near RH kickpad	16	26	
Blower Motor High Speed Relay (C67)	Under RH I/P, right of Blower Motor	16	26	
Blower Motor Low Speed Relay (C67)	Under RH I/P, right of Blower Motor	16	26	
Blower Motor Resistor	Behind RH I/P	16	26	202-8
Heater and A/C Control	In Center I/P	17	28	202-6
Heater and A/C Control Blower Switch	Center I/P	17	28	
Heater and A/C Control Selector Switch	Center of I/P, part of Heater and A/C Control	17	28	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Underhood Electrical Center	Engine Compartment, mounted to RH Wheelhouse	9	15	
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, lower RH side of Steering Column, next to C200	11	19	202-5
C201 (6 cavities)(w/T61)	Body Harn to Daytime Running Lamp Harn, at RH side of Steering Column, above C200	11	19	202-5
C201 (6 cavities)(w/T82))	Body Harn to Twilight Sentinel Harn, at RH side of Steering Column, above C200	11	19	202-5
C202 (6 cavities)(w/T82)	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column, next to C200	11	19	202-5
C207A	Body Harn to Engine Harn, near base of RH "A" Pillar behind kickpad			
C207	Engine Harn to Body Harn, near base of RH "A" Pillar behind kickpad	18	29	
G200	Base of LH "A" Pillar, behind kickpad	11	19	
P100	RH I/P, forward of Blower Motor	16	26	
S202	Daytime Running Lamp Harness, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S211 (C67)	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel			
S226	Body Harn, 4 cm from Convenience Center branch breakout			
S264	Body Harn, approx 4 cm from Blower Motor High Speed Relay breakout			
S281	Body Harn, approx 24 cm from breakout in Convenience Center			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse # 17 for open. If open, check for short to ground through CKT 641.
2. Check U/Hood Maxifuse #10 for open. If open, check for short to ground through CKT 42.
3. Check G200 by noting normal operation of the Underhood Lamp or License Lamp.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or

resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the "System Check" and refer to the "Symptom Table" for the appropriate diagnostic procedures.

SYSTEM CHECK

ACTION	NORMAL RESULTS
• Ignition Switch in "RUN." • Heater Mode Selector in any mode except "OFF." • Move Heater and A/C Blower Switch from "LO" to "M1" to "M2" to "HI," then back to "LO."	Fan speed increases at each speed level selected, to "HI" then decreases back to "LO"

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Blower inoperative at any speed.	Chart #1	8A-63-4
Low speed inoperative, medium and high speeds operate normally.	Chart #2	8A-63-5
Medium speed inoperative, low and high speeds operate normally.	Chart #3	8A-63-6
High speed inoperative, low and medium speeds operate normally.	Chart #4	8A-63-7
Blower "ON" with Ignition Switch in "OFF."	Check for short to B+ on CKT 60, CKT 52, CKT 63, CKT 64, CKT 65, CKT 72 and CKT 101. If OK, replace High Blower Relay	
Blower "ON" at all times with Ignition Switch in "RUN" and Heater and A/C Selector Switch in "OFF."	Check for short to Ignition voltage on CKT 60, CKT 52, CKT 63, CKT 64, CKT 65, CKT 72 and CKT 101. If OK, replace Heater and A/C Selector Switch.	

- For Buick Diagnosis, refer to SECTION 1C.

HVAC BLOWER CONTROL

CHART #1
BLOWER INOPERATIVE AT ANY SPEED

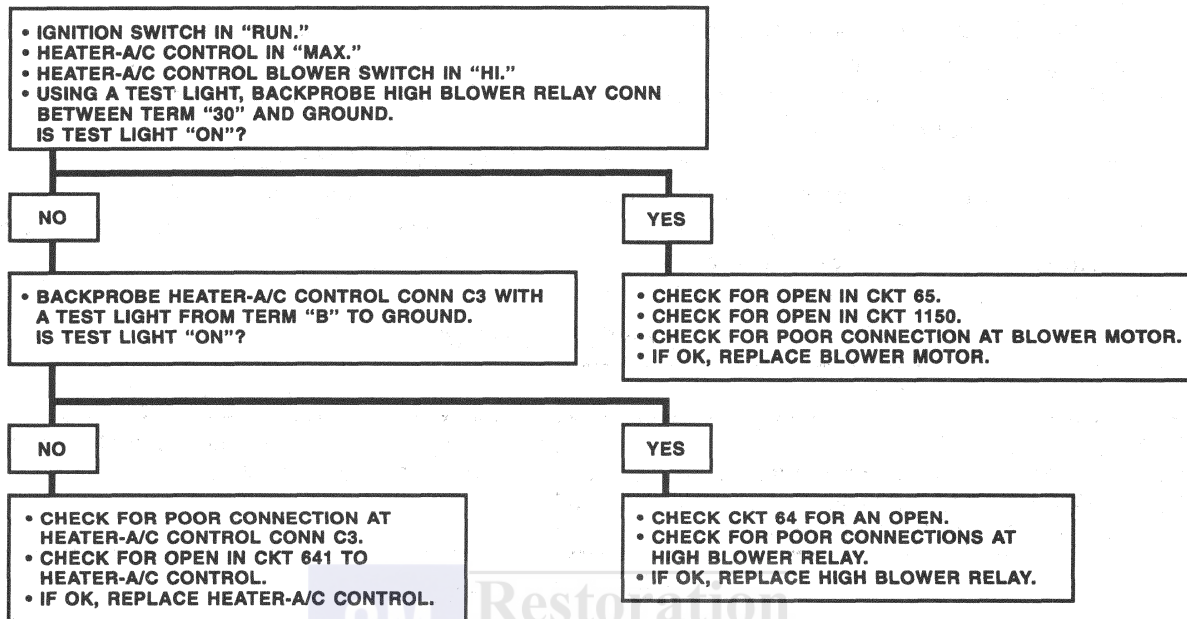
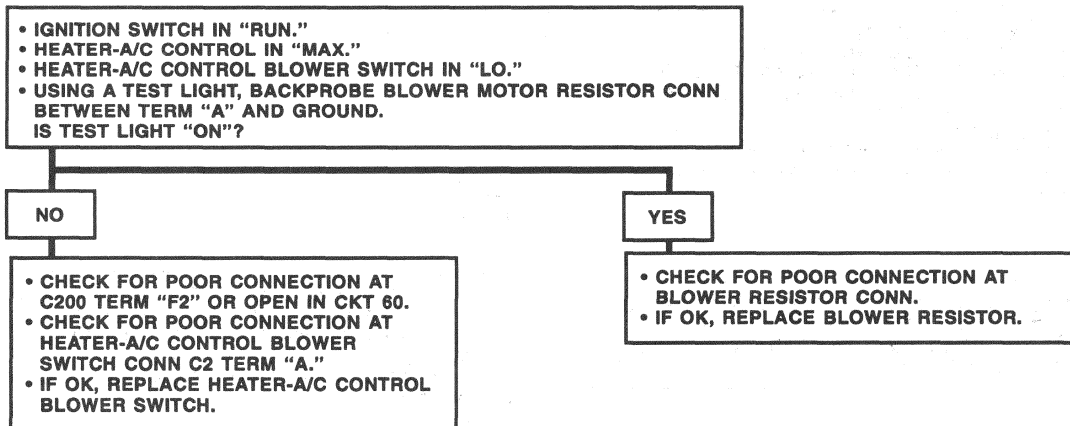


CHART #2
LOW SPEED INOPERATIVE, MEDIUM AND HIGH SPEEDS OPERATE NORMALLY



C9223



HVAC BLOWER CONTROL

CHART #3

MEDIUM SPEED(S) INOPERATIVE, LOW AND HIGH SPEEDS OPERATE NORMALLY

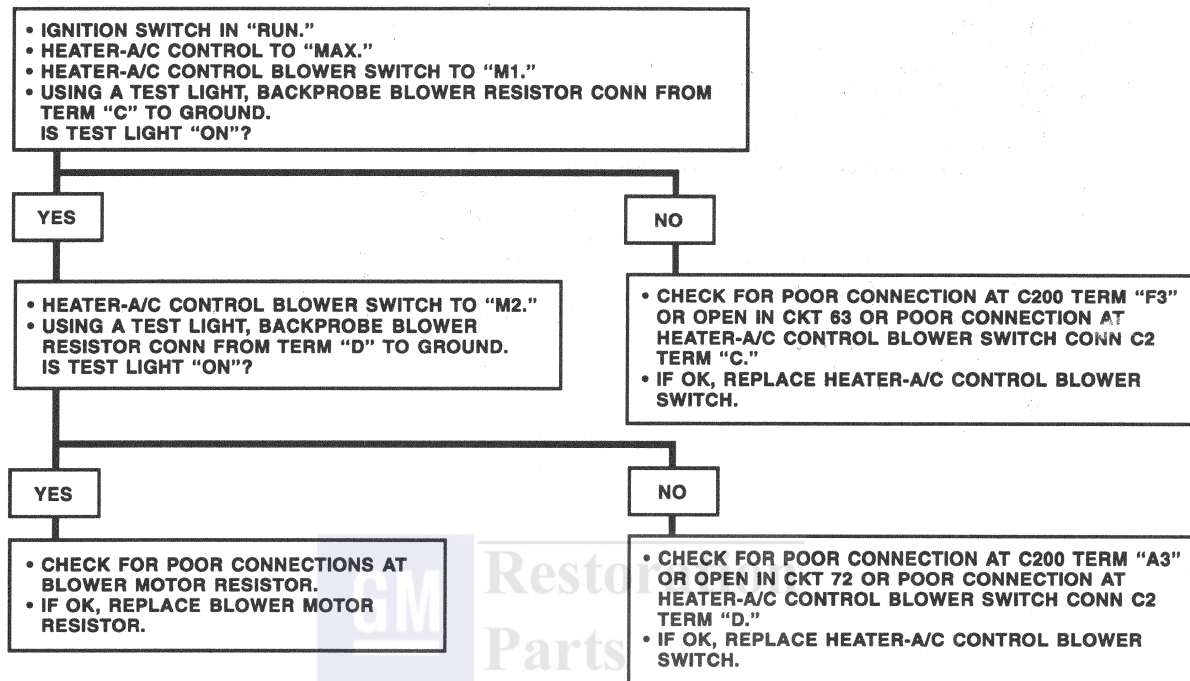
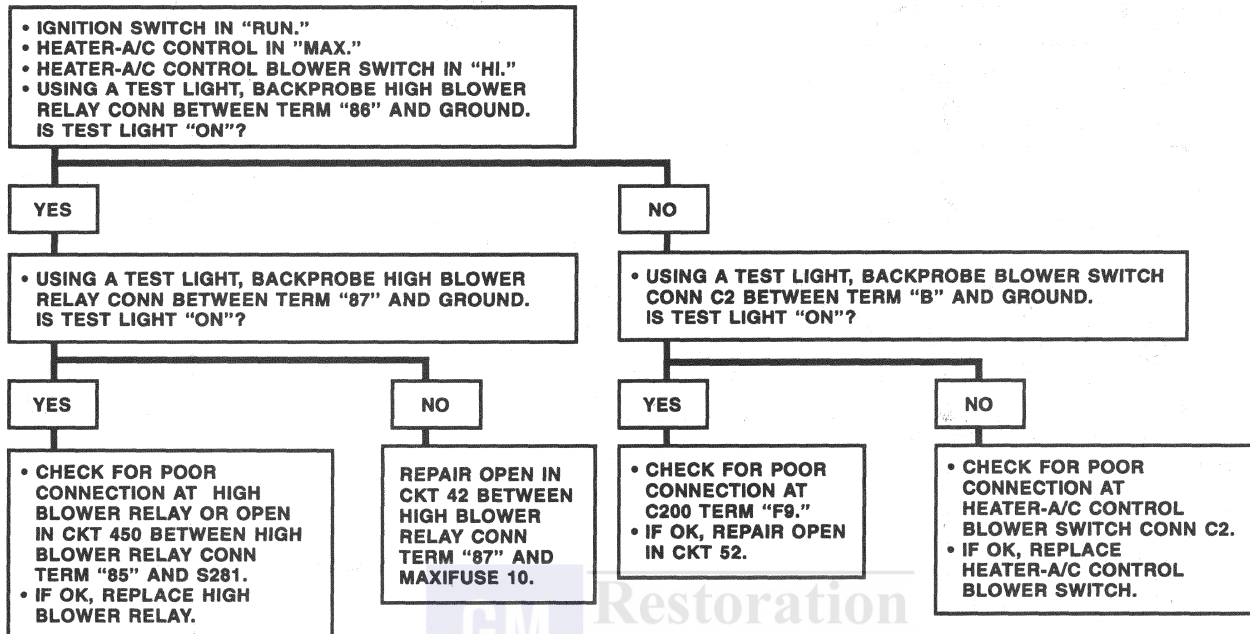


CHART #4

HIGH SPEED INOPERATIVE, LOW AND MEDIUM SPEEDS OPERATE NORMALLY



C9225

CIRCUIT OPERATION (CHEV)

The Blower Motor is a variable speed motor, which runs at a speed proportional to the applied voltage. The higher the voltage applied to the motor, the faster the speed.

While the Ignition Switch is in the "RUN" position, battery voltage is applied to the Heater and A/C Control through I/P Fuse #17. With the Heater and A/C Control Selector Switch in the "OFF" position, no voltage is supplied to the Blower Motor.

When any other mode position is selected, voltage is applied to the Heater and A/C Control Blower Switch, and Blower Motor Resistor if not in "HI."

With the Heater and A/C Control Blower Switch in the "LO" position, voltage is applied to CKT 60 from the Heater and A/C Control Blower Switch to terminal "A" of

the Blower Resistor, through the resistor to the relay contacts in the High Blower Relay, and the Blower Motor. The Blower Motor runs at low speed.

As the Heater and A/C Control Blower Switch is moved through positions "M1" and "M2," the switch bypasses part of the Blower Resistor allowing more voltage to be applied to the Blower Motor, which will increase its speed.

When the Heater and A/C Control Blower Switch is in the "HI" position, voltage is applied through CKT 52 to the coil of the High Blower Relay. The High Blower Relay energizes, removing the Blower Resistor from the circuit. Battery voltage is then applied directly to the Blower Motor through the High Blower Relay contacts. The motor runs at maximum speed.

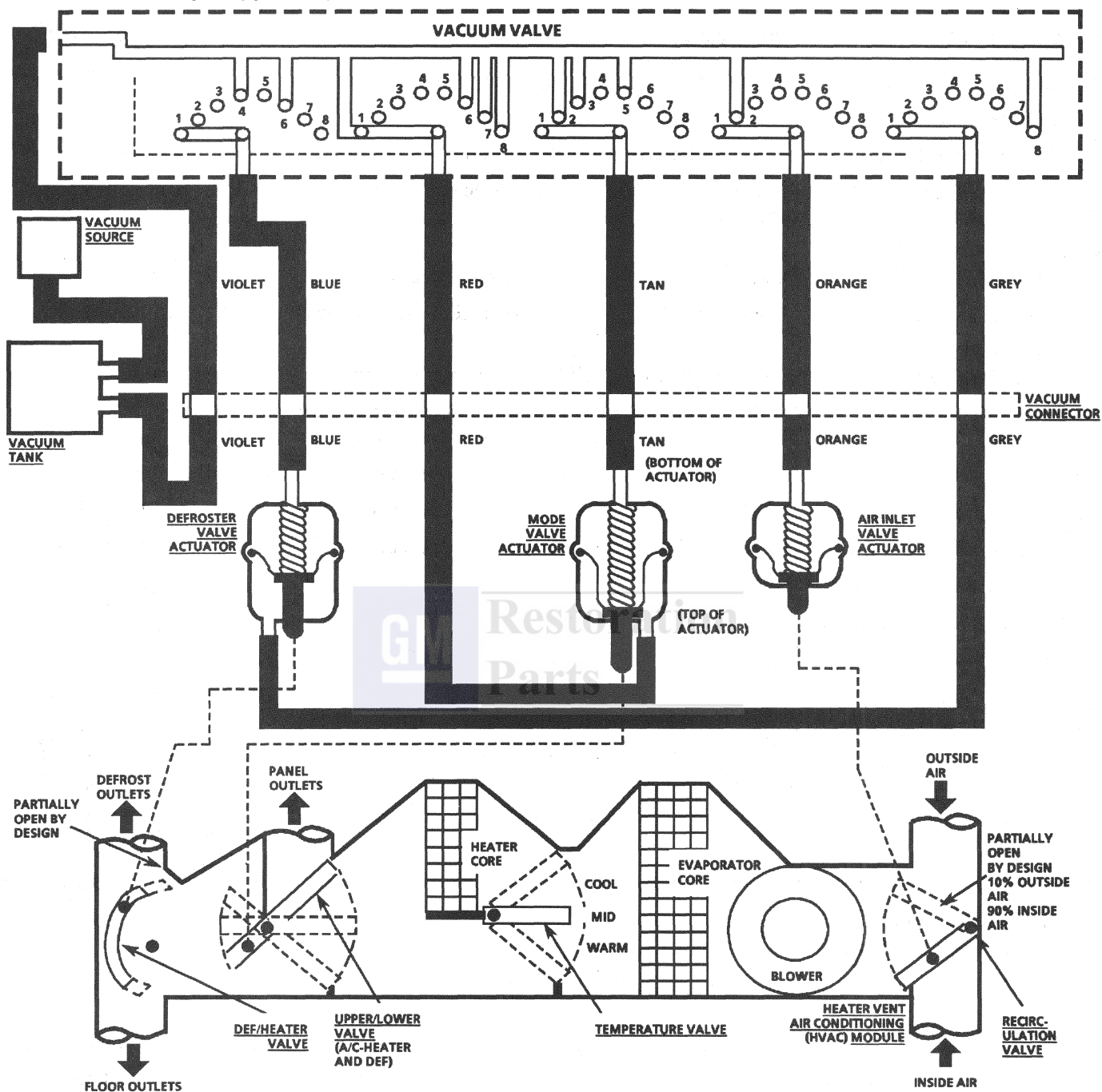


HVAC COMPRESSOR CONTROL MANUAL A/C (C60)

COMPONENT	LOCATION	201-PG	FIG.	CONN
A/C Clutch Diode	Engine Harn, near A/C Compressor Clutch Conn			
A/C Compressor Clutch Coil	RH side of Engine, part of A/C Compressor			
A/C Compressor Relay	Located in Underhood Electrical Center			
A/C Cycling Switch	RH Rear Engine Compartment, attached to A/C Accumulator			
Heater and A/C Control				
Selector Switch	Center of I/P, part of Heater and A/C Control	17	.....	28
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	.....	19
Idle Speed Control Power				
Steering Pressure Switch	In Power Steering Line, near Power Steering Unit			
Powertrain Control Module (PCM)	Engine Compartment, forward of LH Wheelhouse, under Air Cleaner	4	.....	8
Underhood Electrical Center	Engine Compartment mounted to RH Wheelhouse	9	.....	15
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	.....	22..... 202-1
C205 (10 cavities)	Engine Harn to I/P Harn, right of I/P Compartment	18	.....	29..... 202-4
G104	Front of LH Cylinder Head	6	.....	11
P100	RH I/P, forward of Blower Motor	16	.....	26
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S111	Engine Harn, approx 15 cm from Underhood Electrical Center			
S115	Engine Harn, approx 4 cm from Fuel Injector #3			
S120	Engine Harn, right side, approx 7 cm from center branch breakout			

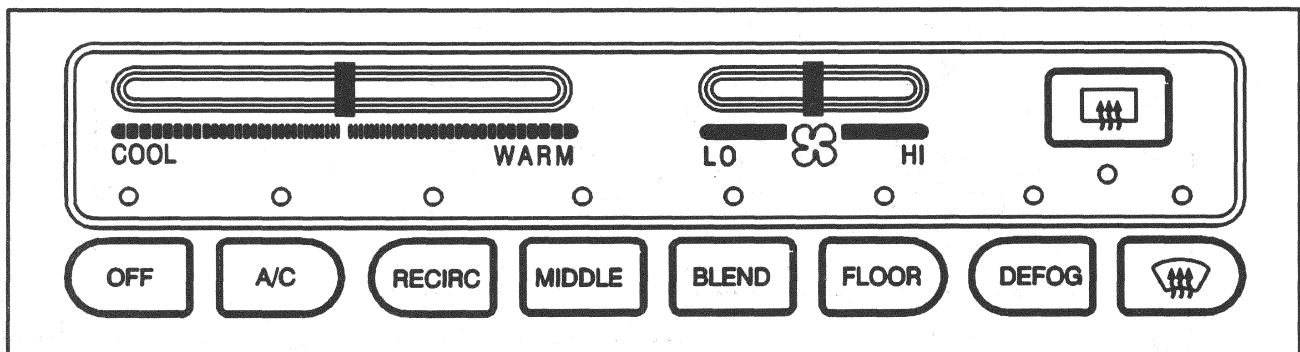
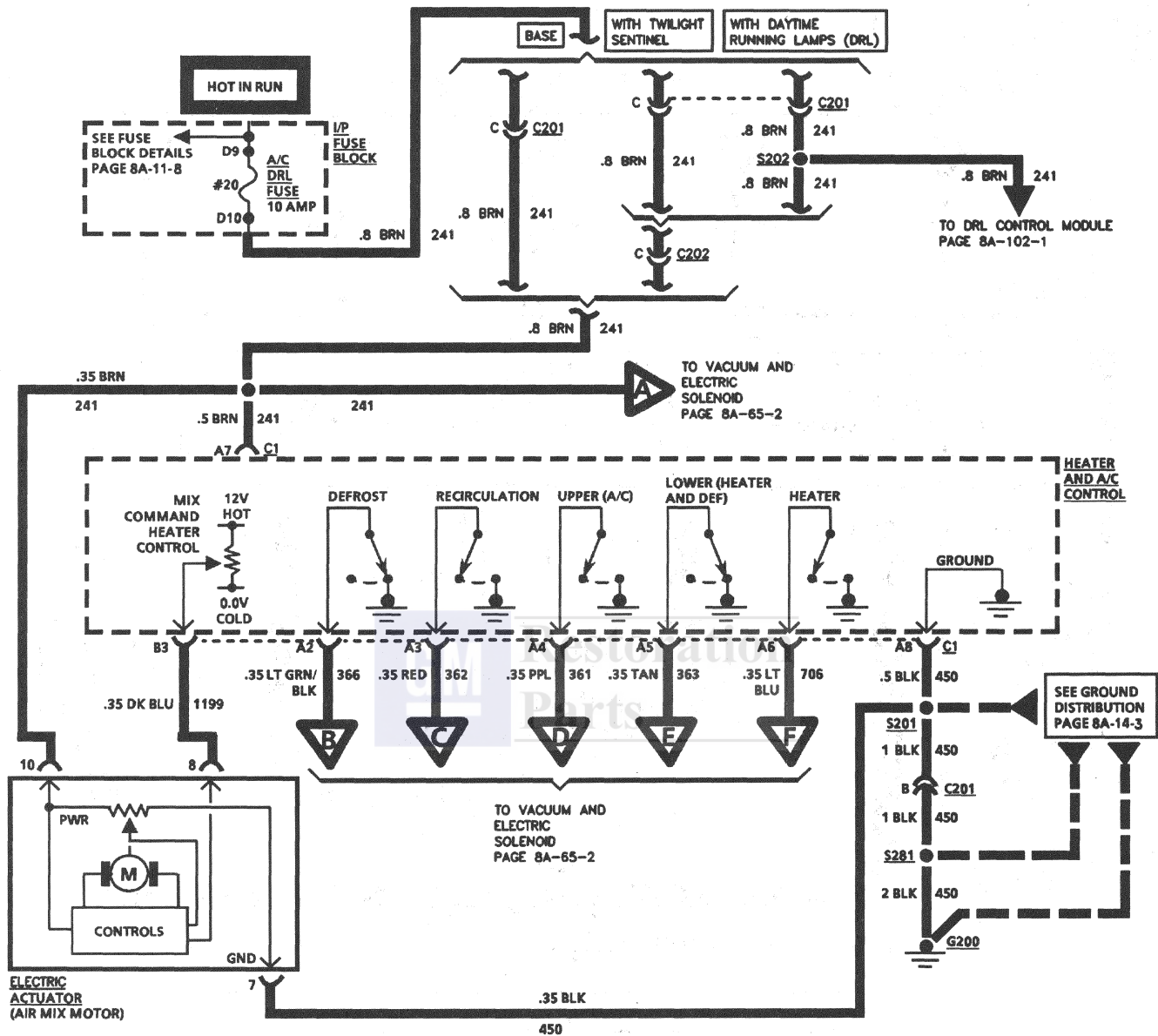
For Diagnosis, Refer to Engine Controls Table of Contents "A/C Clutch Circuit" Diagnosis.

HVAC AIR DELIVERY AND TEMPERATURE CONTROL MANUAL A/C (C60)(CHEV)



HVAC VACUUM VALVE SEQUENCE CHART			
1	OFF	4	B/L VENT
2	MAX	5	HTR
3	A/C	6	
		7	BLEND
		8	DEF

HVAC AIR DELIVERY AND TEMPERATURE CONTROL (C67)(BUICK)



HEATER AND A/C CONTROL SELECTOR SWITCH

8A - 65 - 2 ELECTRICAL DIAGNOSIS

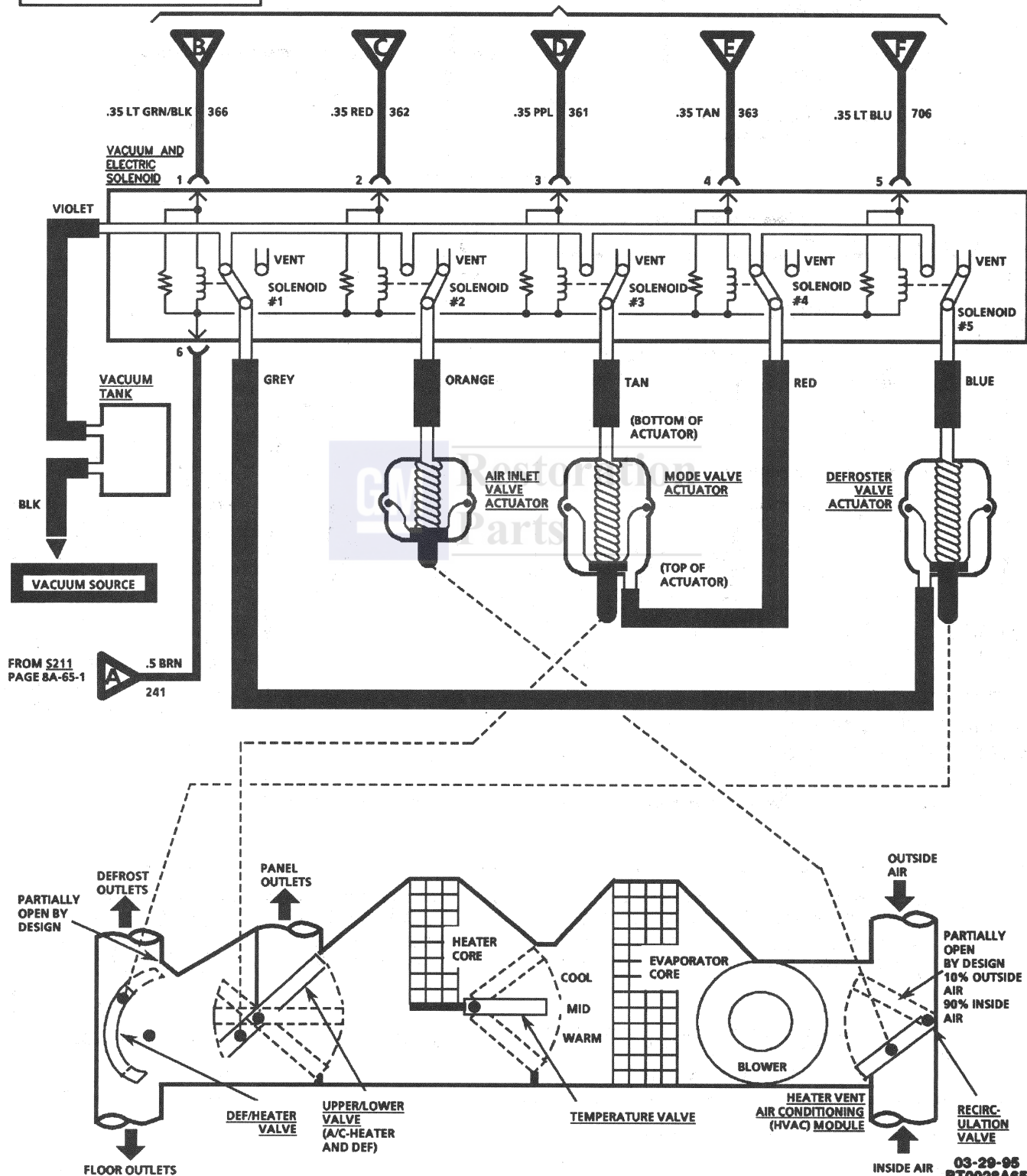
HVAC AIR DELIVERY AND TEMPERATURE CONTROL (C67)



IMPORTANT:

VACUUM SCHEMATIC SHOWN IN "DEFROST" MODE

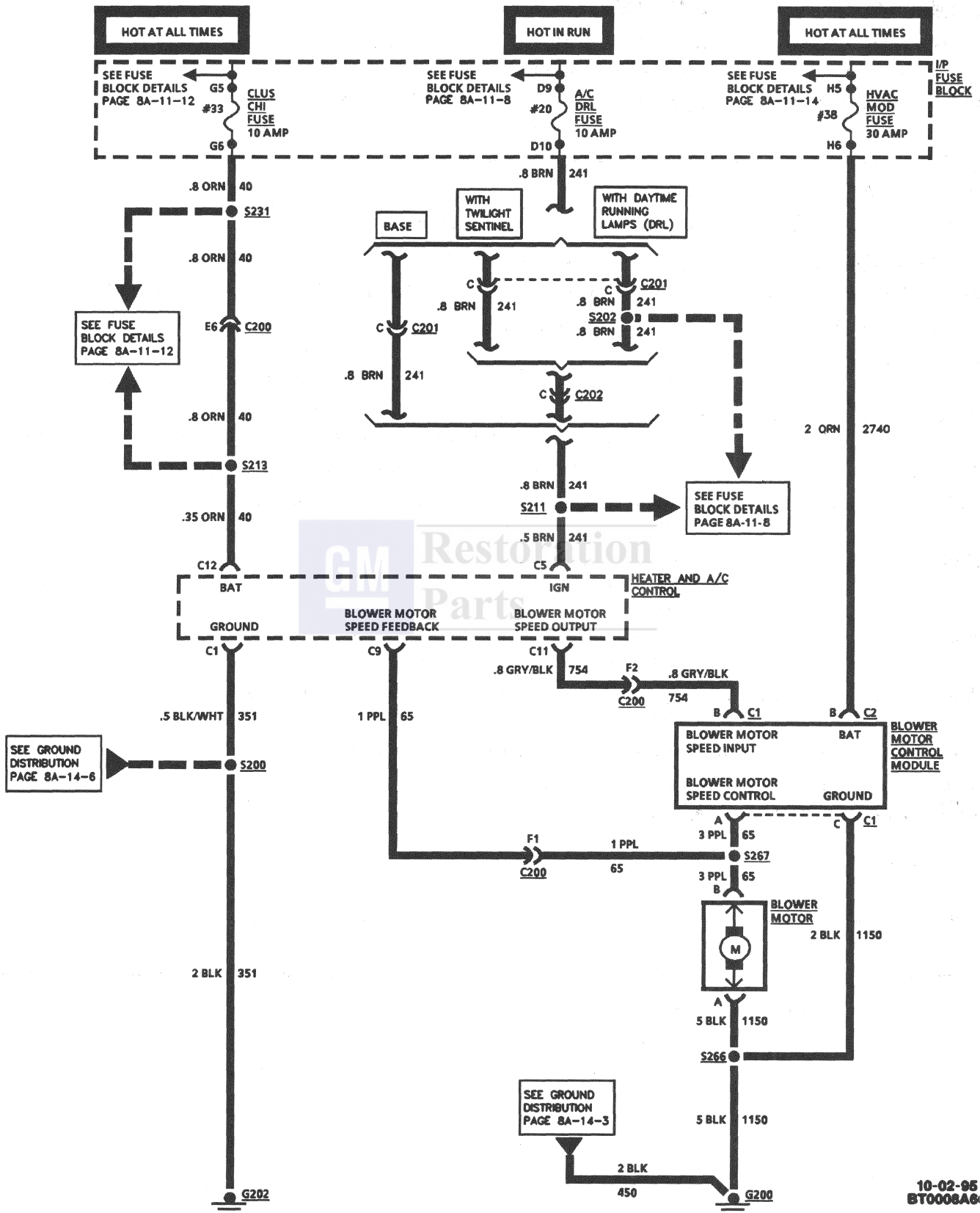
FROM HEATER AND A/C CONTROL PAGE 8A-65-1



COMPONENT	LOCATION	201-PG	FIG.	CONN
Air Inlet Valve Actuator	Attached to top RH side of HVAC Module forward of and above I/P Compartment.....	16	26	
Defroster Valve Actuator	Attached to lower LH side of HVAC Module left of Floor Ducts.....	14	22	
Electric Actuator.....	Behind center I/P on HVAC Module	16	27	
Heater and A/C Control	Center of I/P	17	28	
HVAC Module.....	Near center I/P, next to Vacuum/Electric Solenoid.....	16	27	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Mode Valve Actuator.....	Attached to LH front of HVAC Module above Floor Ducts ..	16	26	
Vacuum/Electric Solenoid	Near center I/P, next to HVAC Motor.....	16	27	
C201 (6 cavities).....	Body Harn to I/P Harn, at RH side of Steering Column, above C200	14	22.....	202-5
C202 (6 cavities).....	I/P Harn to Twilight Sentinel or Daytime Running Lights Harn, right of Steering Column, above C200	14	22.....	202-5
G200.....	Base of LH "A" Pillar behind LH kickpad	19	30	
S201	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S202	Daytime Running Lamps Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S211.....	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			

Refer to SECTION 1C for Buick Diagnosis. Refer to SECTION 1B1 for Chev Diagnosis.

HVAC BLOWER CONTROL ELECTRONIC A/C (C68)(BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Blower Motor	Under RH I/P	16	26	
Blower Motor Control Module .	RH I/P, near Blower Motor			
Heater and A/C Control	Center of I/P	17	28	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, lower RH side of Steering Column, next to C200	14	22	202-5
C201 (6 cavities)(w/T61)	Body Harn to Daytime Running Lamp Harn, at RH side of Steering Column, above C200	14	22	202-5
C201 (6 cavities)(w/T82)	Body Harn to Twilight Sentinel Harn, at RH side of Steering Column, above C200	14	22	202-5
C202 (6 cavities)	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column, above C200	14	22	202-5
G200	Base of LH "A" Pillar, behind kickpad	19	30	
G202	Base of RH "A" Pillar, behind kickpad	18	29	
S200	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S202	Daytime Running Lamp Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S211	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel			
S213	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S231	Body Harn, approx 16 cm from Convenience Center breakout			
S266 (Buick Sedan)	Body Harn, approx 32 cm from Rear Window Defogger Relay			
S266 (Buick Wagon)	Body Harn, approx 32 cm from Rear Window Defogger Relay			
S267	Body Harn, approx 21 cm from Rear Window Defogger Relay			

For Diagnosis, refer to SECTION 1C.



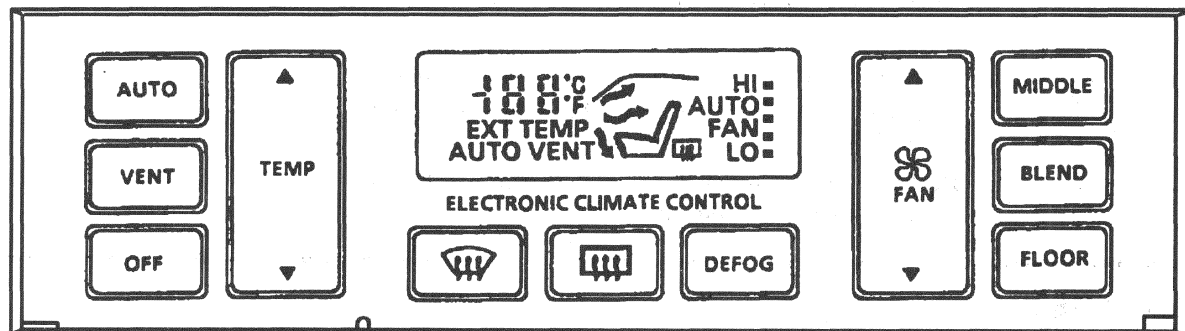
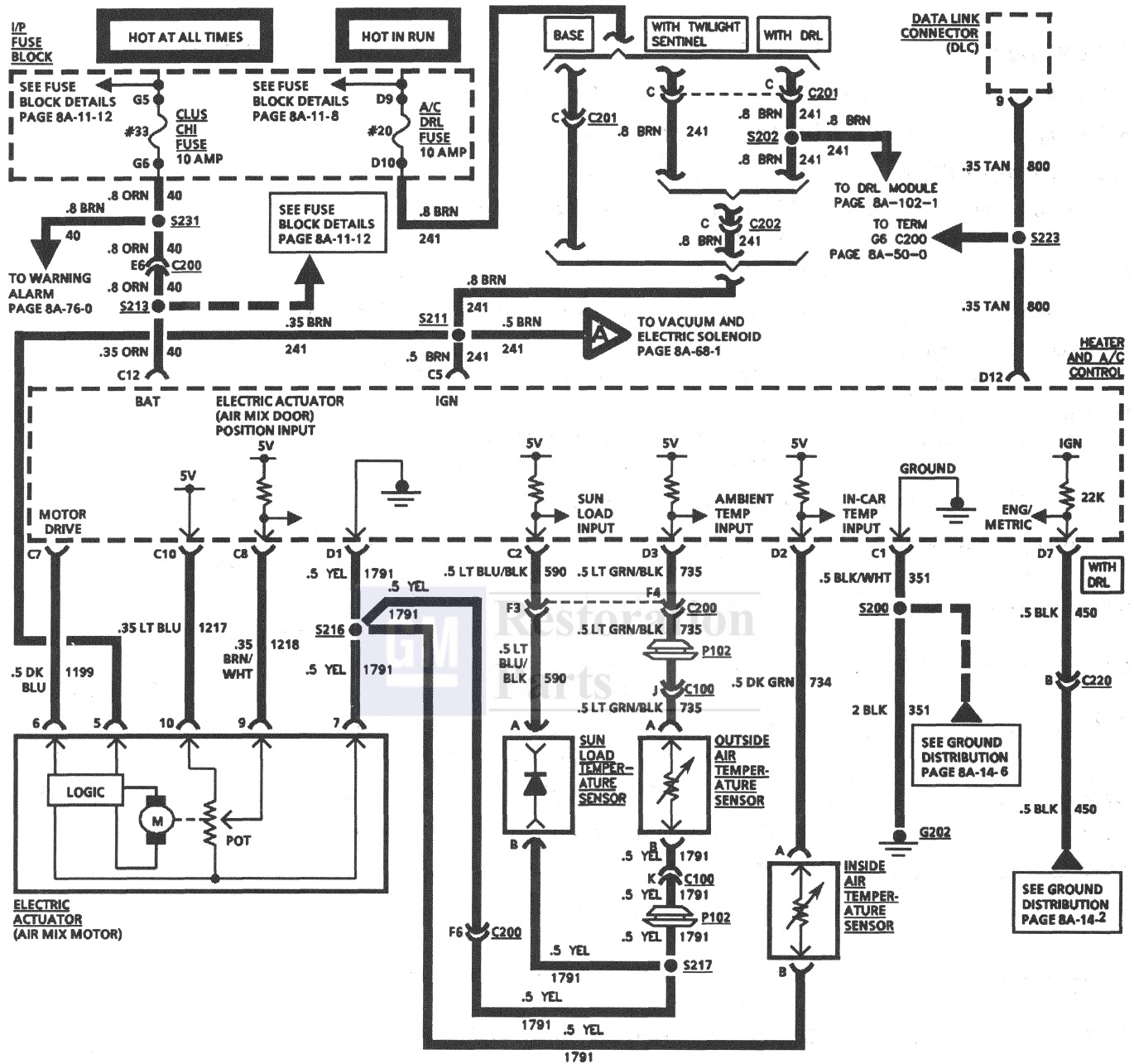
HVAC COMPRESSOR CONTROL ELECTRONIC A/C (C67 AND C68)

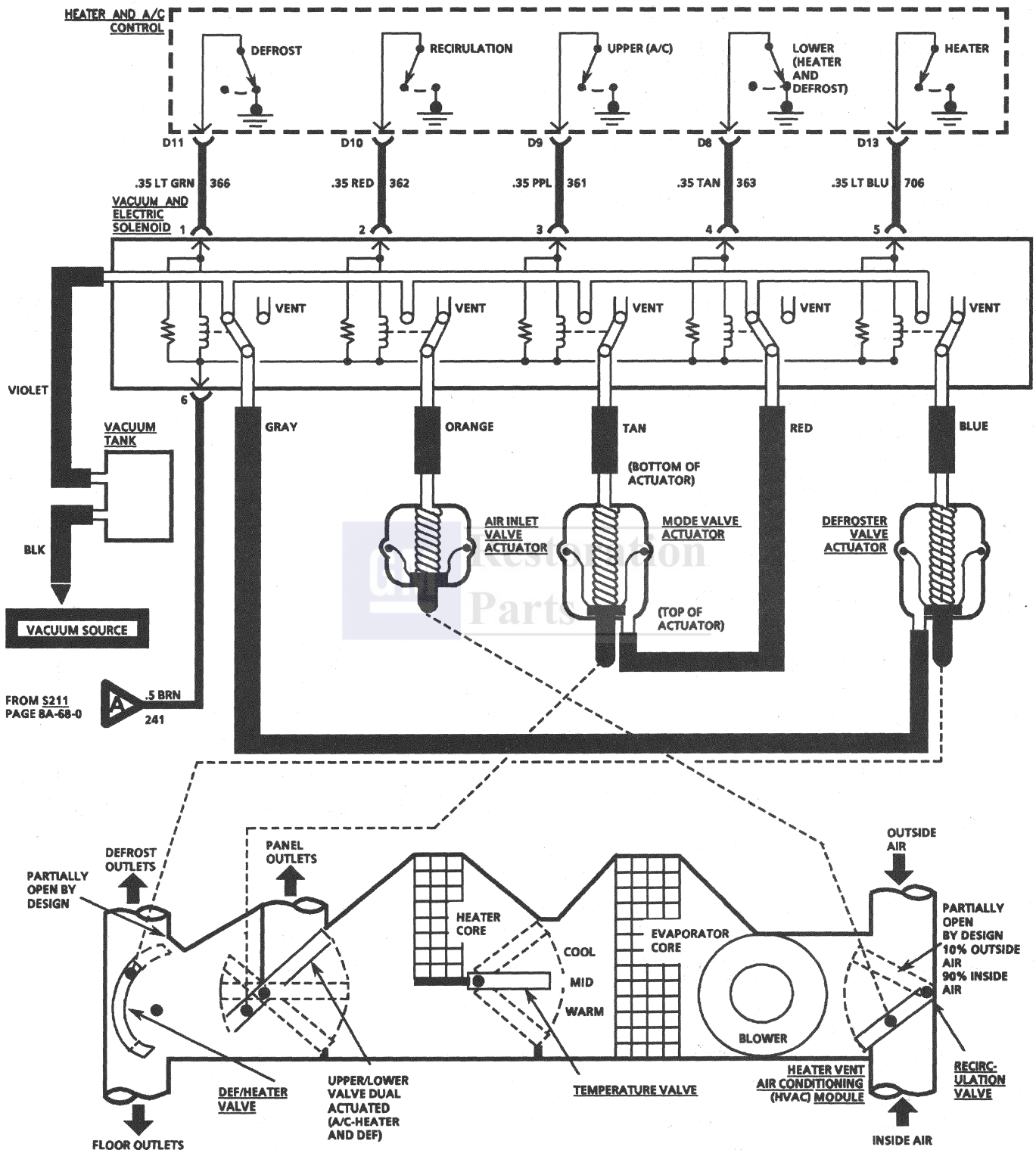
COMPONENT	LOCATION	201-PG	FIG.	CONN
A/C Clutch Diode	Engine Harn, near A/C Compressor Clutch Conn			
A/C Compressor Clutch Coil	RH side of Engine, part of A/C Compressor			
A/C Compressor Relay	Located in Underhood Electrical Center			
A/C Cycling Switch.....	RH Rear Engine Compartment, attached to A/C Accumulator			
Heater and A/C Control	Center I/P	17	28	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Idle Speed Control Power Steering Pressure Switch.....	In Power Steering Line, near Power Steering Unit			
Powertrain Control Module (PCM).....	Engine Compartment, forward of LH Wheelhouse, under Air Cleaner.....	4	8	
Underhood Electrical Center.....	Engine Compartment, mounted to RH Wheelhouse.....	9	15	
C201 (6 cavities)(Base)	Body Harn to I/P Harn, lower RH side of Steering Column, above C200	14	22.....	202-5
C201 (6 cavities)(w/T61).....	Body Harn to Daytime Running Lamp (DRL) Harn, at RH side of Steering Column, above C200.....	14	22.....	202-5
C201 (6 cavities)(w/T82))	Body Harn to Twilight Sentinel Harn, at RH side of Steering Column, above C200.....	14	22.....	202-5
C202 (6 cavities).....	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column, above C200	14	22.....	202-5
C205 (10 cavities).....	Engine Harn to I/P Harn, right of I/P Compartment.....	18	29.....	202-4
G104.....	Engine Compartment, on front of LH Cylinder Head	6	11	
P100	RH I/P, forward of Blower Motor	18	29	
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S111.....	Engine Harn, approx 15 cm from Underhood Electrical Center breakout			
S115.....	Engine Harn, approx 4 cm from Fuel Injector #3			
S120	Engine Harn, right side, approx 7 cm from center branch breakout			
S202	Daytime Running Lamps Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor breakout			
S211.....	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel			

SYSTEM DIAGNOSIS

- Refer to Engine Controls Table of Contents "A/C CLUTCH CIRCUIT."

HVAC AIR DELIVERY AND TEMPERATURE CONTROL AUTOMATIC CONTROL AIR CONDITIONING (C68)(BUICK)





! IMPORTANT:

- FOR SOLENOID/VACUUM CONTROL, REFER TO "AIR DELIVERY VACUUM DISTRIBUTION TABLE," IN SECTION 1C. VACUUM IS ROUTED TO THE CORRESPONDING ACTUATOR WHEN THE SOLENOID IS ENERGIZED. VACUUM IS SHOWN IN "DEFROST" MODE.

8A - 68 - 2 ELECTRICAL DIAGNOSIS

HVAC AIR DELIVERY AND TEMPERATURE CONTROL

COMPONENT	LOCATION	201-PG	FIG.	CONN
Air Inlet Valve Actuator.....	Attached to top RH side of HVAC Module, forward of and above I/P Compartment.....	16.....	26	
Data Link Conn (DLC).....	Attached to I/P Carrier, right of Steering Column.....	14.....	22	
Defroster Valve Actuator.....	Attached to lower LH side of HVAC Module, left of Floor Ducts.....	14.....	22	
Electric Actuator.....	Behind Center I/P, on HVAC Module.....	16.....	27	
HVAC Module.....	Near center I/P, next to Vacuum and Electric Solenoid			
Heater and A/C Control.....	Center I/P.....	17.....	28	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Inside Air Temperature Sensor.....	I/P Carrier, above Glove Compartment			
Mode Valve Actuator.....	Attached to LH Front of HVAC Module, above Floor Ducts	14.....	22	
Outside Air Temperature Sensor.....	Attached to Hood Latch Support			
Sun Load Temperature Sensor..	Near center of I/P Upper Trim Pad (in Defroster Grille)			
Vacuum and Electric Solenoid..	Near Center I/P, next to HVAC Module.....	16.....	27	
Vacuum Tank.....	Attached to Plenum, left of Evaporator Housing			
C100 (10 cavities).....	Forward Lamp Harn to Body Harn, forward of Windshield Washer Solvent Level Container.....	0.....	1.....	202-0
C200 (56 cavities).....	Body Harn to I/P Harn, bolted to bracket above Accelerator Pedal.....	14.....	22.....	202-1
C201 (6 cavities)(Base).....	Body Harn to I/P Harn, lower RH side of Steering Column, above C200.....	14.....	22.....	202-5
C201 (6 cavities)(with Daytime Running Lamps or Twilight Sentinel).....	Body Harn to Daytime Running Lamps Harn or Twilight Sentinel Harn, RH side of Steering Column, above C200..	14.....	22.....	202-5
C202 (6 cavities).....	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, right of Steering Column, above C200.....	14.....	22.....	202-5
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16.....	26.....	202-3
C220 (10 cavities)(w/T61).....	I/P Harn to Daytime Running Lamps (DRL) Wiring Harn, at RH side of Steering Column.....	14.....	22.....	202-5
C220 (10 cavities)(w/T82).....	I/P Harn to Twilight Sentinel Wiring Harn, at RH side of Steering Column.....	14.....	22.....	202-5
G202.....	Base of RH "A" Pillar, behind kickpad.....	18.....	29	
P102.....	Visible from Engine Compartment, behind LH Wheelhouse...	5.....	10	
S200.....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S202.....	Daytime Running Lamp (DRL) Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			

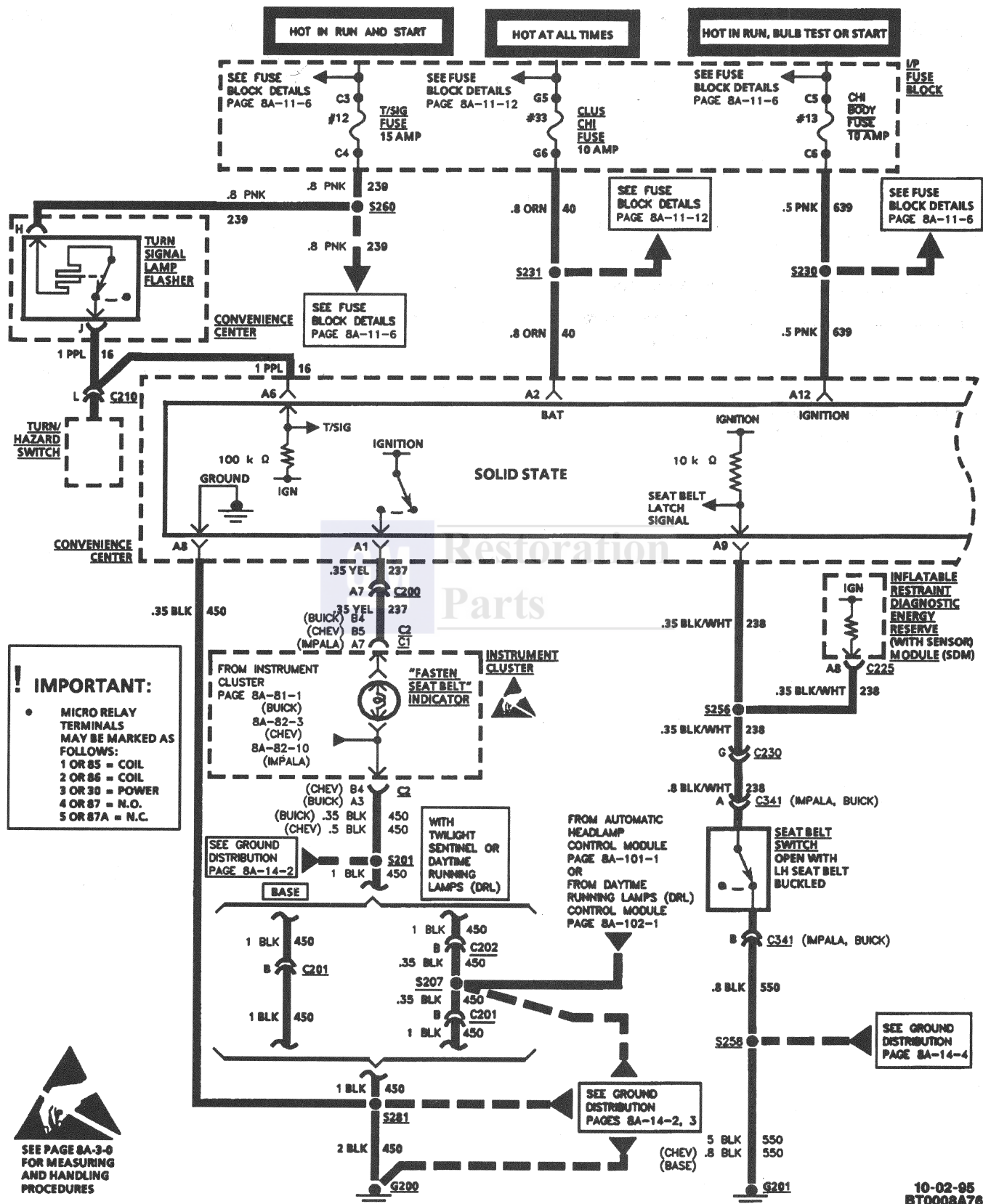
COMPONENT	LOCATION	201-PG FIG. CONN
S211.....	I/P Harn, approx 4 cm from I/P Compartment Lamp Switch Conn branch breakout, in channel	
S213	I/P Harn, approx 4 cm from I/P Cluster C2 Conn breakout, in spiral taping	
S216	I/P Harn, approx 8 cm from I/P Compartment Lamp Switch Conn breakout, in channel	
S217	Body Harn, in Sunload Temperature Sensor branch approx 4 cm from breakout	
S223	I/P Harn, approx 23 cm from C200, on branch	
S231	Body Harn, approx 16 cm from Convenience Center breakout	

SYSTEM DIAGNOSIS

- Refer to SECTION 1C.



AUDIBLE WARNINGS





AUDIBLE WARNINGS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Convenience Center	Left I/P, left of Steering Column.....	11	19	
Headlamp Automatic Control Module	Base of RH "A" Pillar, behind kickpad			
Headlamp Switch	LH side of I/P	9	16	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
I/P Lamp Dimmer.....	Attached to I/P Carrier lower reinforcement, to RH side of Steering Column	9	16	
Inflatable Restraint Diagnostic Energy Reserve (with Sensor) Module (SDM).....	Upper LH I/P, above Convenience Center.....	11	19	
Instrument Cluster.....	LH side of I/P, centered above Steering Column.....	9	16	
Interior Lamp Relay.....	In Convenience Center			
LH Front Door Jamb Switch	In LH Front Door Jamb	19	30	
LH Rear Door Jamb Switch	In LH Rear Door Jamb	25	36	
Powertrain Control Module (PCM).....	Engine Compartment, forward of LH Wheelhouse, under Air Cleaner.....	4	8	
Remote Control Door Lock Receiver.....	Near center of LH "D" Pillar	29	42	
RH Front Door Jamb Switch....	In RH Front Door Jamb	23	34	
RH Rear Door Jamb Switch	In RH Rear Door Jamb	24	35	
Seat Belt/Ignition Key/Lamps/Turn Signal Alarm.....	Part of Convenience Center.....	12	20	
Seat Belt Switch.....	LH Seat Belt Buckle			
Turn/Hazard Switch.....	Mounted on upper LH side of Steering Column	13	21	
Turn Signal Lamp Flasher.....	In Convenience Center, LH I/P.....	12	20	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, at RH side of Steering Column, above C200			
C201 (6 cavities)(w/T61).....	Body Harn to Daytime Running Lamps (DRL) Wiring Harn, at RH side of Steering Column, above C200	11	19	202-5
C201 (6 cavities)(w/T82).....	Body Harn to Twilight Sentinel Wiring Harn, at RH side of Steering Column, above C200.....	11	19	202-5
C202 (6 cavities)(w/T61).....	I/P Harn to Daytime Running (DRL) Lamps Wiring Harn, RH side of Steering Column, above C200.....	11	19	202-5
C202 (6 cavities)(w/T82).....	I/P Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column, above C200.....	11	19	202-5
C203 (10 cavities)(Base)	Body Harn to I/P Harn, at RH side of Steering Column.....	11	19	202-5
C203 (10 cavities)(w/T61).....	Body Harn to Daytime Running Lamps (DRL) Wiring Harn, RH side of Steering Column	11	19	202-5
C203 (10 cavities)(w/T82).....	Body Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column	11	19	202-5

COMPONENT	LOCATION	201-PG	FIG.	CONN
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	26.....	202-3
C210 (11 cavities).....	Body Harn to Turn/Hazard Switch connector, under Steering Column			
C230 (10 cavities).....	Crossbody Harn and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad	11	19.....	202-5
C341	Crossbody harn to Seat Belt Switch			
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G201.....	Base of LH "A" Pillar, behind kickpad	11	19	
S201 (Buick).....	I/P Harn, behind I/P Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout			
S207 (T61).....	Daytime Running Lamp (DRL) Wiring Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn			
S207 (T82).....	Headlamp Automatic Beam Control Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S209 (Buick).....	I/P Harn, behind Instrument Cluster, approx 12 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S209 (Chev).....	I/P Harn, behind Instrument Cluster, approx 22 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S230	Body Harn, approx 4 cm from BTSI Conn breakout			
S231	Body Harn, approx 16 cm from Convenience Center breakout			
S242 (Wagon).....	Body Harn, approx 4 cm from C302 breakout			
S250	Body Harn, approx 20 cm from Convenience Center breakout			
S251	Body Harn, approx 7 cm from SDM breakout			
S253	Body Harn, approx 4 cm from Convenience Center breakout			
S256	Body Harn, approx 12 cm from breakout on Convenience Center branch			
S257	Body Harn, approx 8 cm from breakout on Convenience Center branch			
S258	Crosscar Harn, approx 12 cm from C231 branch breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			
S306	Crosscar Harn, approx 8 cm forward of Power Seat crossover branch breakout			

AUDIBLE WARNINGS

COMPONENT	LOCATION	201-PG FIG. CONN
S341 (Buick)	Crosscar Harn, approx 24 cm from Power Seat crossover branch breakout	
S341 (Chev).....	Crosscar Harn, approx 16 cm from Power Seat crossover branch breakout	

TROUBLESHOOTING HINTS**(Perform before beginning System Diagnosis)**

1. Check I/P Fuse Block Fuse #33. If open, check for a short to ground in CKT
- 2.
3. Check I/P Fuse Block Fuse #13. If open, check for a short to ground in CKT 639.
4. Check I/P Fuse Block Fuse #12. If open, check for a short to ground in CKT 239.
5. Check that ground G200 is clean and tight.
6. If Speedometer or Cruise Control (if equipped) does not operate properly, refer to "Vehicle Speed Sensor," SECTION 8A-81,82.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

SYSTEM DIAGNOSIS

Perform the System Check in the order shown. When a fault is found, refer to the Symptom Table for the appropriate diagnostic procedure(s). If a normal result is found at each and every step of the System Check, the fault may be intermittent.

To help isolate an intermittent fault, first examine the mating terminals at each component and connector for a poor connection. Also check that each terminal of mating connectors is properly seated in the connector body. If the connections appear to be reliable, try the System Check again while moving the wiring harness from side to side at each component and in-line connector, to try and induce the intermittent fault.

Once a fault has been corrected, perform the System Check to verify the diagnosis.

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] LAMPS "ON" WARNING • Remove Ignition Key from Ignition Lock Cylinder. • Headlamp Switch to "HEAD." • Headlamp Switch To "OFF."	Lamps "ON" Warning (approximately one pulse per half second) sounds as long as the Headlamps are "ON."
[2] IGNITION KEY WARNING • Ignition Key in Ignition Lock Cylinder. • Ignition Switch to "OFF." • Open LH front door. • Close LH front door.	Ignition Key Warning (approximately one pulse per second) sounds when the key is in the Ignition Lock Cylinder and the LH front door is open.
[3] IGNITION KEY WARNING • Driver's seat belt latched. • Ignition Switch to "RUN." • Open LH front door. • Close LH front door.	No Alarm sounds.

SYSTEM CHECK (Continued)

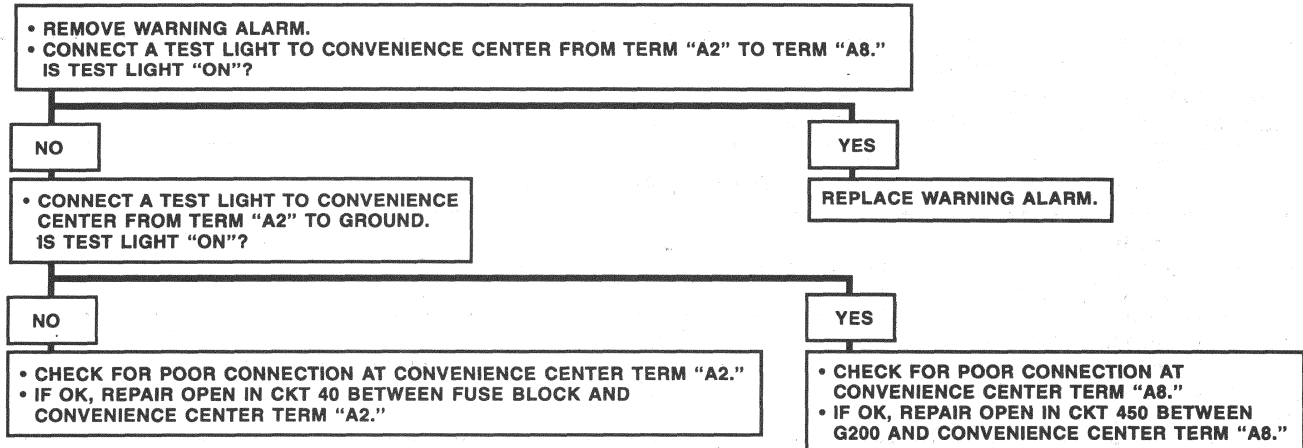
ACTION	NORMAL RESULTS
[4] FASTEN SEAT BELT WARNING • Driver's seat belt unlatched. • Ignition Switch to "RUN."	Fasten Seat Belt Warning (approximately one pulse every 1 1/2 seconds) sounds continuously and the "FASTEN SEAT BELT" Indicator goes out after 5-8 seconds.
[5] FASTEN SEAT BELT WARNING • Latch driver's seat belt. • Ignition Switch to "OFF" and back to "RUN."	None

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
All warning alarms inoperative.	Chart #1	8A-76-6
Ignition Key Warning inoperative.	Chart #2	8A-76-6
Fasten Seat Belt Warning inoperative.	Chart #3	8A-76-7
"FASTEN SEAT BELT" Indicator "ON" continuously.	Chart #4	8A-76-7
"FASTEN SEAT BELT" Indicator inoperative.	Chart #5	8A-76-8
Turn Signal "ON" Reminder inoperative.	Chart #6	8A-76-9
Turn Signal "ON" Reminder "ON" at all times.	Replace Alarm Module	
Lamps "ON" Warning inoperative.	Check for poor connection at Convenience Center terminal "A4" or open in CKT 8 to the Module. If OK, replace Module. (On non-T82 vehicles, make sure the Instrument Panel Dimmer Switch is NOT turned "ON").	
Ignition Key Warning sounds when LH front door is open and key is not in Ignition Switch.	Check Turn/Hazard Switch Pigtail for a short to ground. If OK, replace Ignition Key Alarm Switch.	
Ignition Key Warning continues to sound when LH front door is closed and Ignition Switch is in "RUN."	Repair short to ground in CKT 80.	
Ignition Key Warning sounds continuously with Ignition Switch in "OFF," "LOCK" or "ACC" position and LH front door is closed.	Repair short to ground in CKT 159.	
Fasten Seat Belt Warning sounds continuously.	Replace Alarm Module.	
Courtesy Lights are inoperative with "DOOR(S) OPEN" (Non-SEO).	Chart # 7	8A-76-10
Courtesy Lamps stay "ON" continuously (Non-SEO).	Chart # 8	8A-76-11
Courtesy Lamps stay "ON" or are inoperative (SEO).	Refer to SECTION 8A-114.	

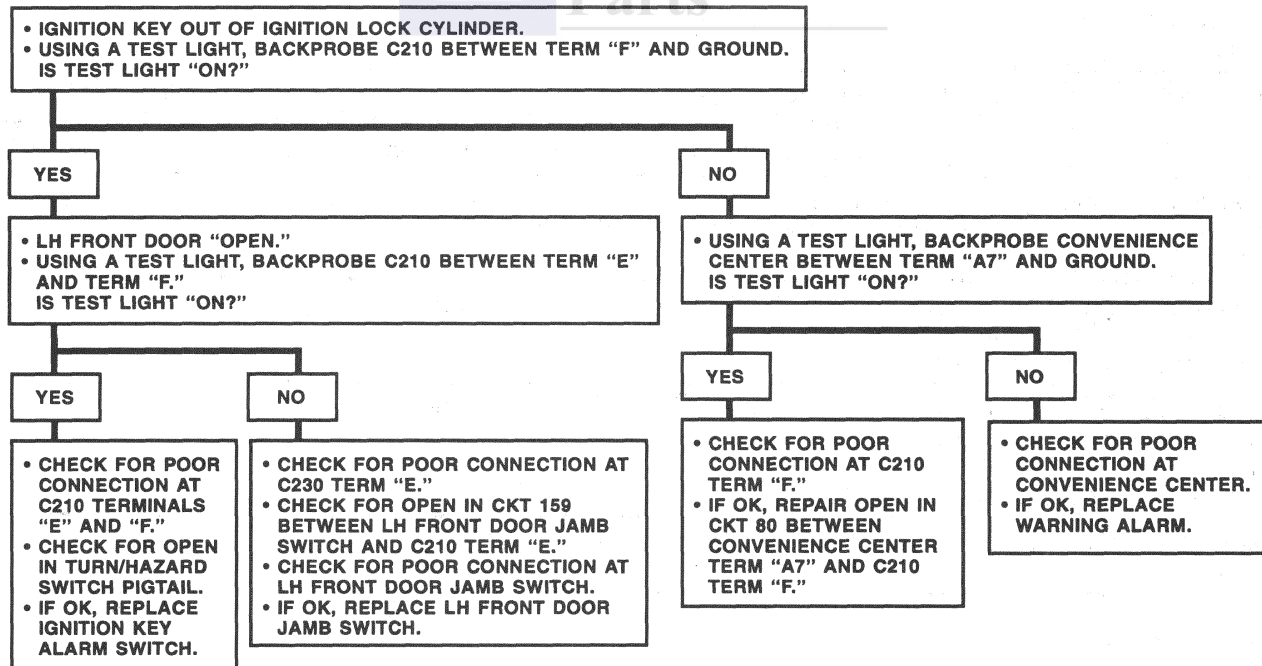
AUDIBLE WARNINGS

CHART #1
ALL WARNING ALARMS INOPERATIVE



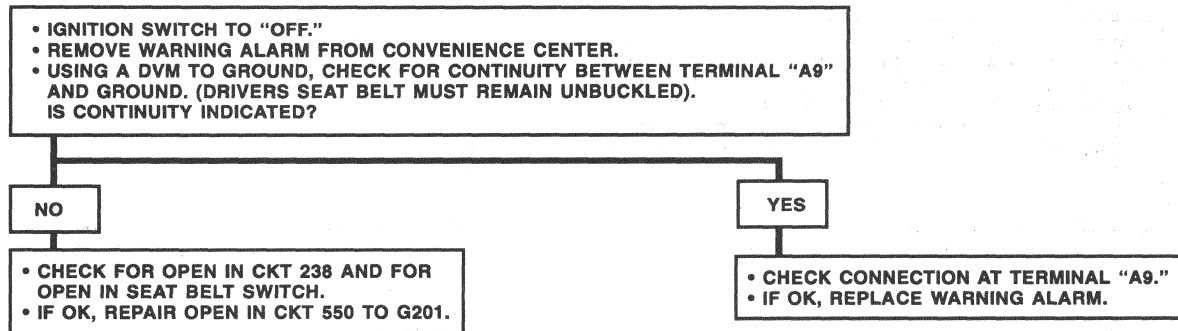
C9241

CHART #2
IGNITION KEY WARNING INOPERATIVE



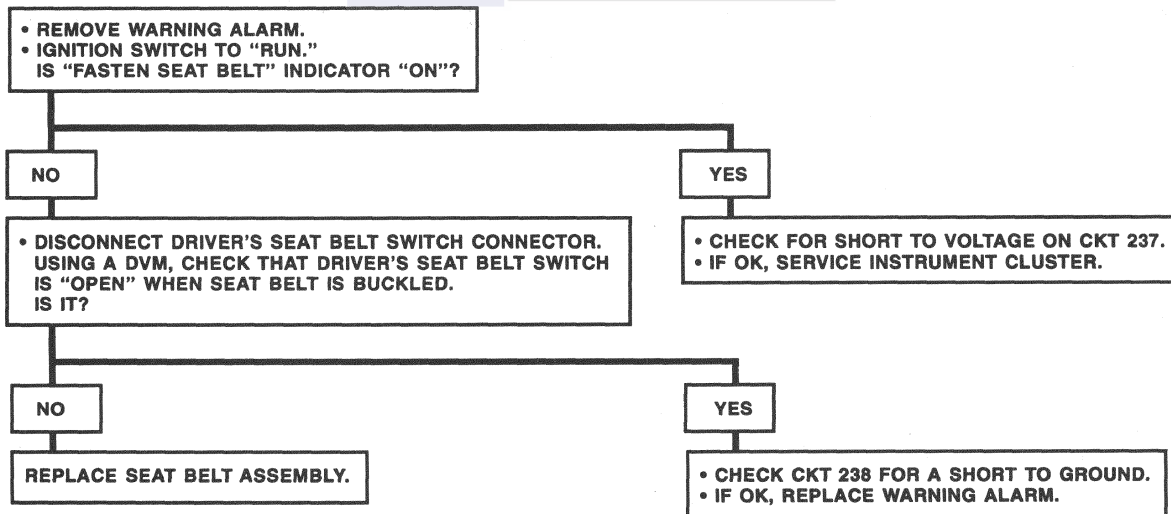
C9204

CHART #3
"FASTEN SEAT BELT" WARNING INOPERATIVE



C9240

CHART #4
**"FASTEN SEAT BELT" INDICATOR "ON" CONTINUOUSLY
 WITH DRIVER'S SEAT BELT LATCHED**



C9206

AUDIBLE WARNINGS

CHART #5
"FASTEN SEAT BELT" INDICATOR INOPERATIVE

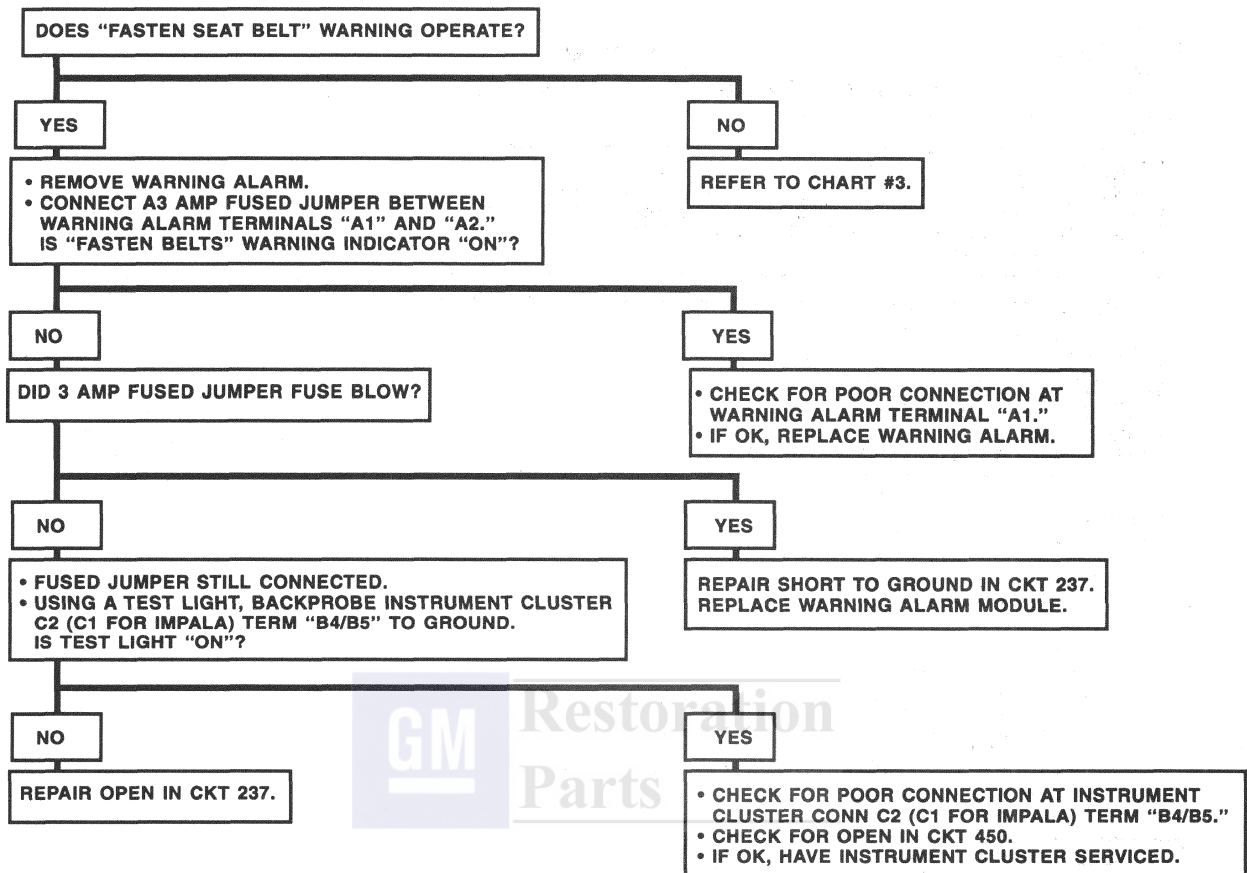


CHART #6 **TURN SIGNAL "ON" REMINDER INOPERATIVE**



IMPORTANT:

- CHECK FOR PCM DTC 24. IF PRESENT, REFER TO ENGINE CONTROLS.

- REMOVE IGNITION KEY FROM IGNITION LOCK CYLINDER.
- TURN HEADLAMP SWITCH TO "PARK" OR "HEAD."

LIGHTS "ON" WARNING SOUNDS

- REMOVE WARNING ALARM.
- TURN IGNITION SWITCH TO "RUN."
- MEASURE VOLTAGE AT WARNING ALARM CONN TERM "A6."

B+

- REINSTALL WARNING ALARM.
- RAISE AND SUITABLY SUPPORT VEHICLE.
- GEAR SELECTOR SWITCH TO "NEUTRAL."
- TURN DRIVE WHEELS BY HAND WHILE USING A DVM TO MEASURE VOLTAGE BETWEEN TERM "A5" AND GROUND.

VOLTAGE VARIES FROM LESS THAN 1 VOLT TO GREATER THAN 4 VOLTS

- CHECK FOR POOR CONNECTION AT TERM "A5."
- IF OK, REPLACE WARNING ALARM.

LIGHTS "ON" WARNING DOES NOT SOUND

- CHECK FOR POOR CONNECTION AT TERM "A4."
- IF OK, REPLACE WARNING ALARM.

0 VOLTS

- CHECK FOR OPEN IN CKTS 16 AND 239.
- IF OK, REPLACE TURN SIGNAL FLASHER.

VOLTAGE DOES NOT VARY FROM LESS THAN 1 VOLT TO GREATER THAN 4 VOLTS

- CHECK FOR OPEN OR SHORT TO GROUND IN CKT 817 BETWEEN WARNING ALARM TERM "A5" AND PCM B CONN TERM "8."
- IF OK, REPLACE PCM. REFER TO ENGINE CONTROLS.

C9207

AUDIBLE WARNINGS

CHART #7
COURTESY LIGHTS ARE INOPERATIVE WITH "DOOR(S) OPEN" (NON-SEO)

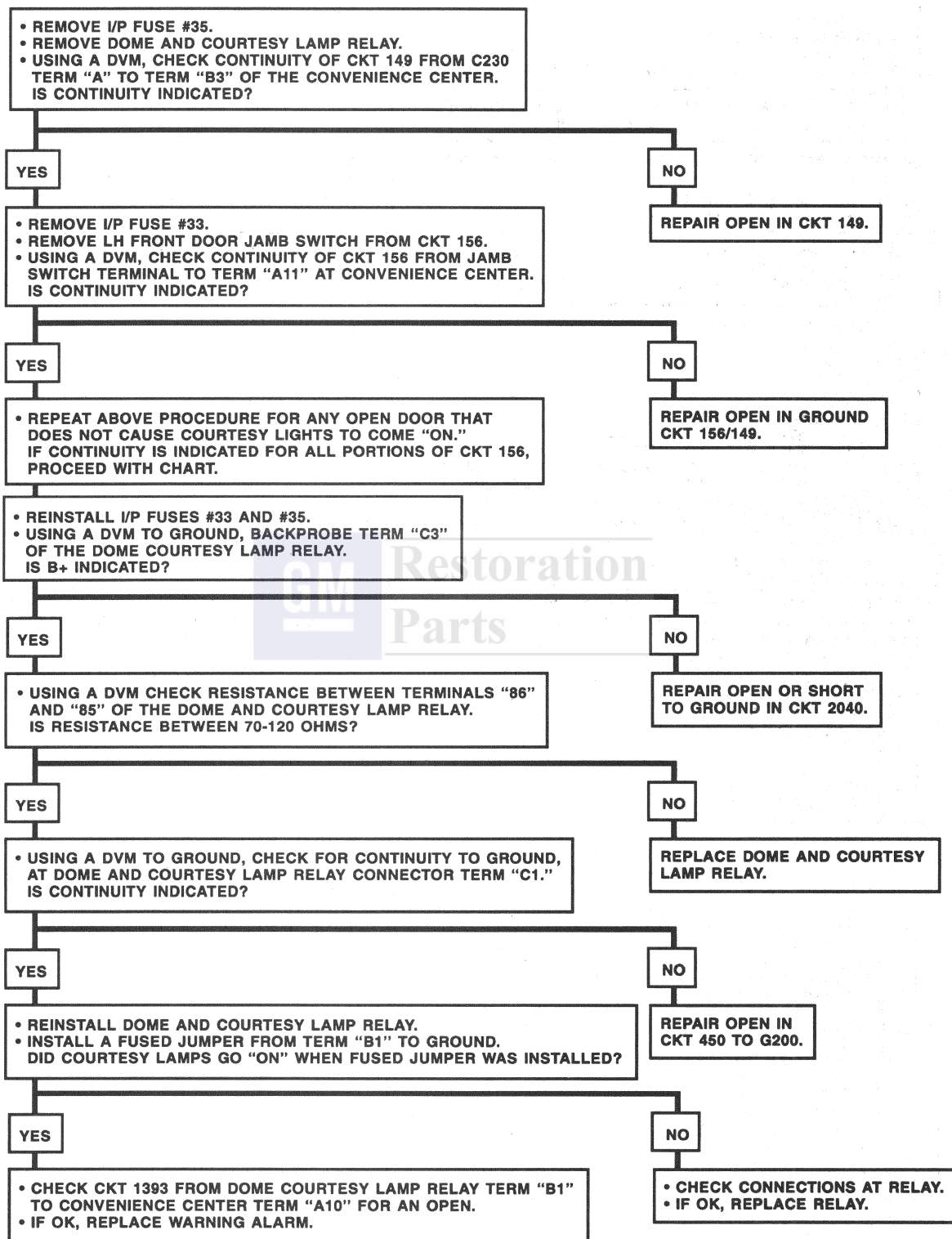
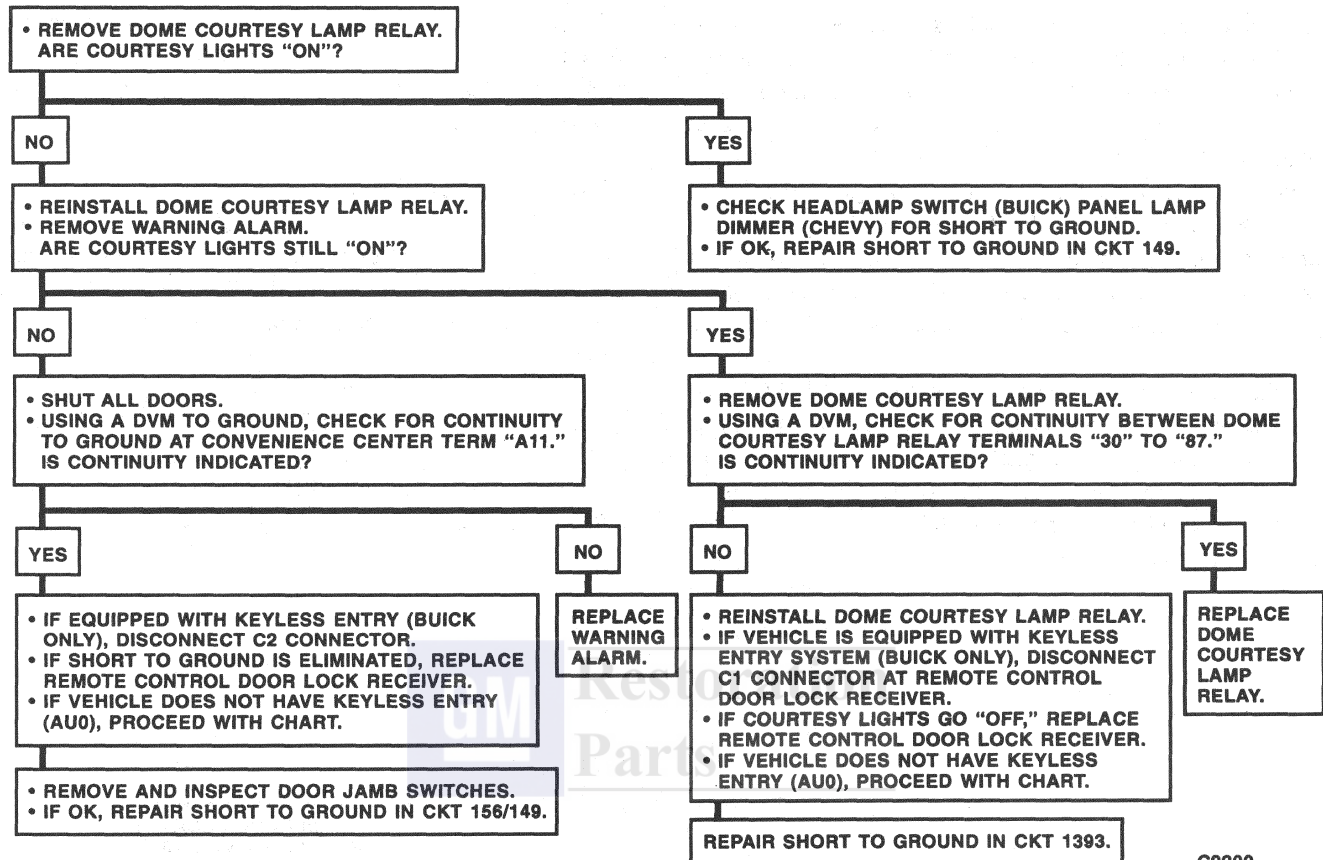


CHART #8
COURTESY LIGHTS STAY "ON" CONTINUOUSLY (NON-SEO)



C9209

CIRCUIT OPERATION

The Seat Belt/Ignition Key/Lamps/Turn Signal Alarm generates three audible warnings which are: Lamps "ON" Warning and Turn Signal "ON" Reminder, Ignition Key Warning and Fasten Seat Belt Warning. Each warning is a series of pulsed tones or chimes. The Lamps "ON" Warning and Turn Signal "ON" Reminder are pulsed approximately every one half second, sounding the quickest. The Ignition Key Warning is pulsed once every second. The Fasten Seat Belt Warning is pulsed approximately once every 1 1/2 seconds, sounding the slowest.

LAMPS "ON" WARNING

When the Headlamp Switch is in "PARK" or "HEAD," voltage is applied to the Lamps "ON" Signal of the Alarm. When the Ignition Switch is turned out of the "RUN" position, voltage is removed from the Ignition Signal of the Alarm. When voltage is present at the Lamps "ON" Signal and no voltage applied to the Ignition Signal, the Alarm will sound the Lamps "ON" Warning.

For non-T82 vehicles, the Lamps "ON" Warning can be turned off by turning the Instrument Panel Dimmer Switch to the "OFF" position.

TURN SIGNAL "ON" REMINDER

When a turn signal is operated, the Alarm begins to monitor the distance the vehicle has traveled. If a turn signal is still flashing after the vehicle has traveled 8 km (.5 mile), the Alarm turns the Lamps "ON" Warning on. The Lamps "ON" Warning continues to sound until the turn signal is turned "OFF."

IGNITION KEY WARNING

The Alarm applies voltage at all times to the Ignition Key Alarm Switch. When the Ignition Key is placed into the Ignition Lock Cylinder, the Ignition Key Alarm Switch is closed. When the LH front door is open, the LH Front Door Jamb Switch closes the circuit to ground. The Alarm senses a voltage drop at the Ignition Key Signal and will sound the Ignition Key Warning.

AUDIBLE WARNINGS

FASTEN SEAT BELT WARNING

The Alarm applies voltage to the Seat Belt Switch at all times. The Alarm senses a voltage drop at the Seat Belt Latch Signal through the closed contacts of the Seat Belt Switch when the driver's seat belt is unlatched. When the driver's seat belt is latched, the Seat Belt Switch is opened and the Alarm senses voltage at the Seat Belt Latch Signal. When the Ignition Switch is turned to "RUN," voltage is applied to the Alarm Ignition Signal. When voltage is present at the Ignition Signal and no voltage is present at the Seat Belt Latch Signal, the Alarm will sound the Fasten Seat Belt Warning for about 5 to 8 seconds. If voltage is present at the Ignition Signal and the Seat Belt Latch Signal, the Alarm will disable the Fasten Seat Belt Warning Chime.

When the Ignition Switch is turned to "RUN," the Alarm senses voltage at the Ignition Signal. When voltage is applied to the Ignition Signal, the Alarm applies voltage to the "FASTEN SEAT BELT" Indicator for 5 to 8 seconds independent of the Seat Belt Switch and Fasten Seat Belt Warning Chime.

COURTESY LAMPS

When CKT 156 is pulled low because a door has been opened, the Alarm will ground CKT 1393. When CKT 1393 is pulled low, the relay contacts in the Dome Courtesy Relay will close, allowing CKT 149 to go low via CKT 450. CKT 149 is the ground side of the Courtesy Lamp System. CKT 149 can also be grounded at the Headlamp/Panel Dimmer Switch.

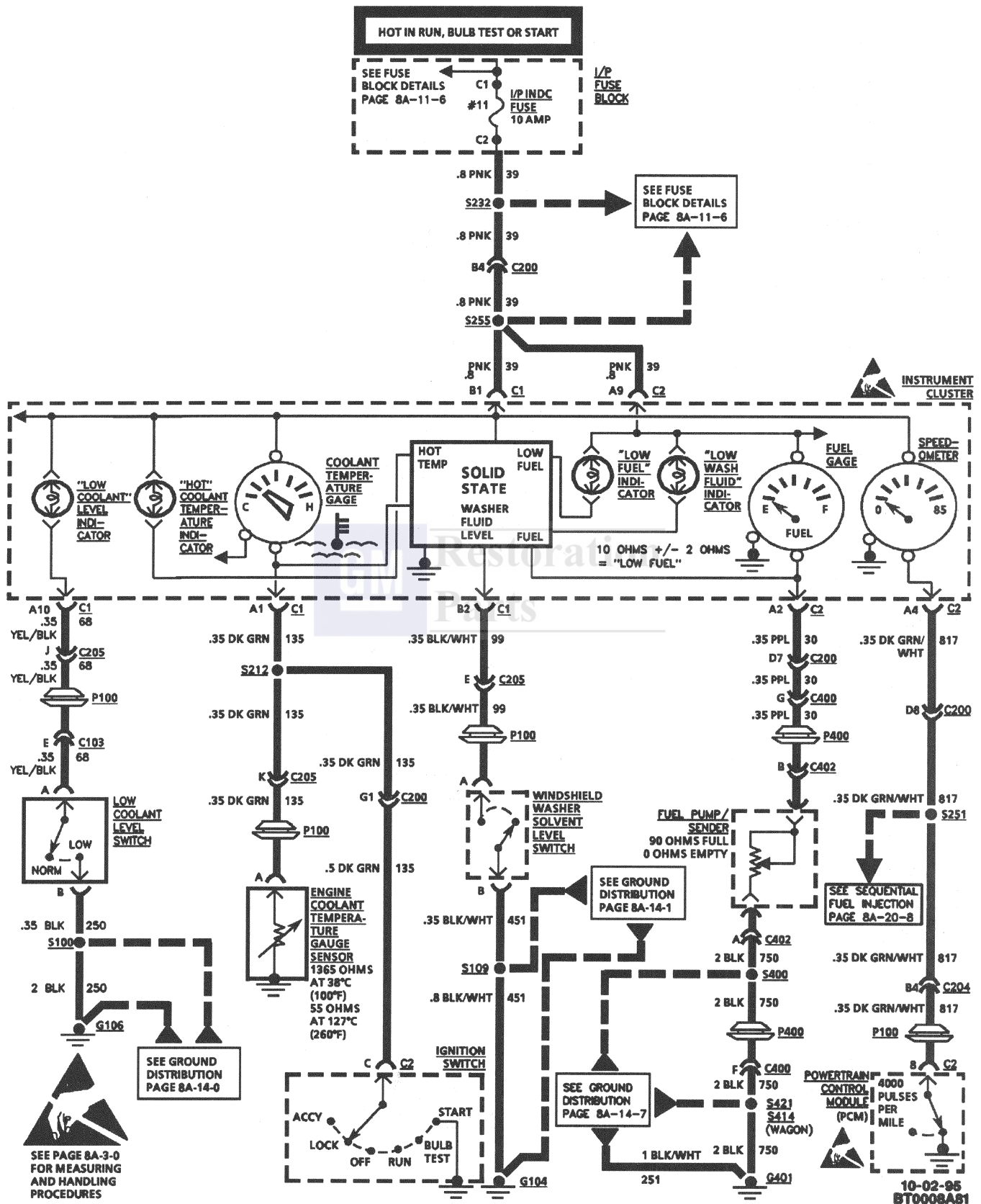
ILLUMINATED ENTRY

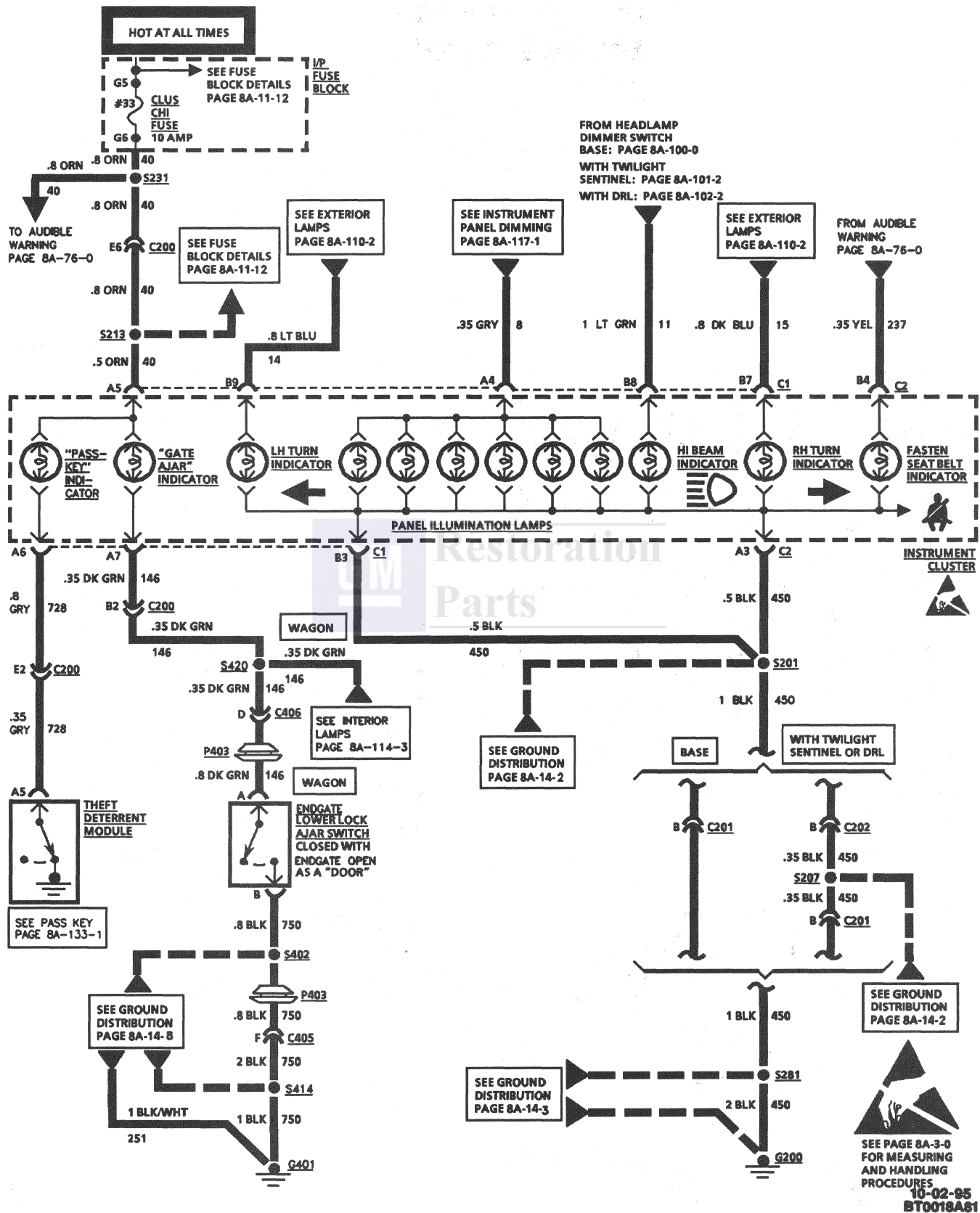
When a door is opened and closed, the Courtesy Lamps will stay "ON" for 30-40 seconds unless the Ignition Switch is turned to the "RUN" position. Voltage on CKT 639 will cause the Courtesy Lamps to shut "OFF" immediately.

If the vehicle (Buick only) is equipped with Keyless Entry (AUO), the RCDLR will ground CKT 1393 for 30-40 seconds, unless the Ignition Switch is in the "RUN" position. Refer to SECTION 8A-132 for Keyless Entry Schematic Details.

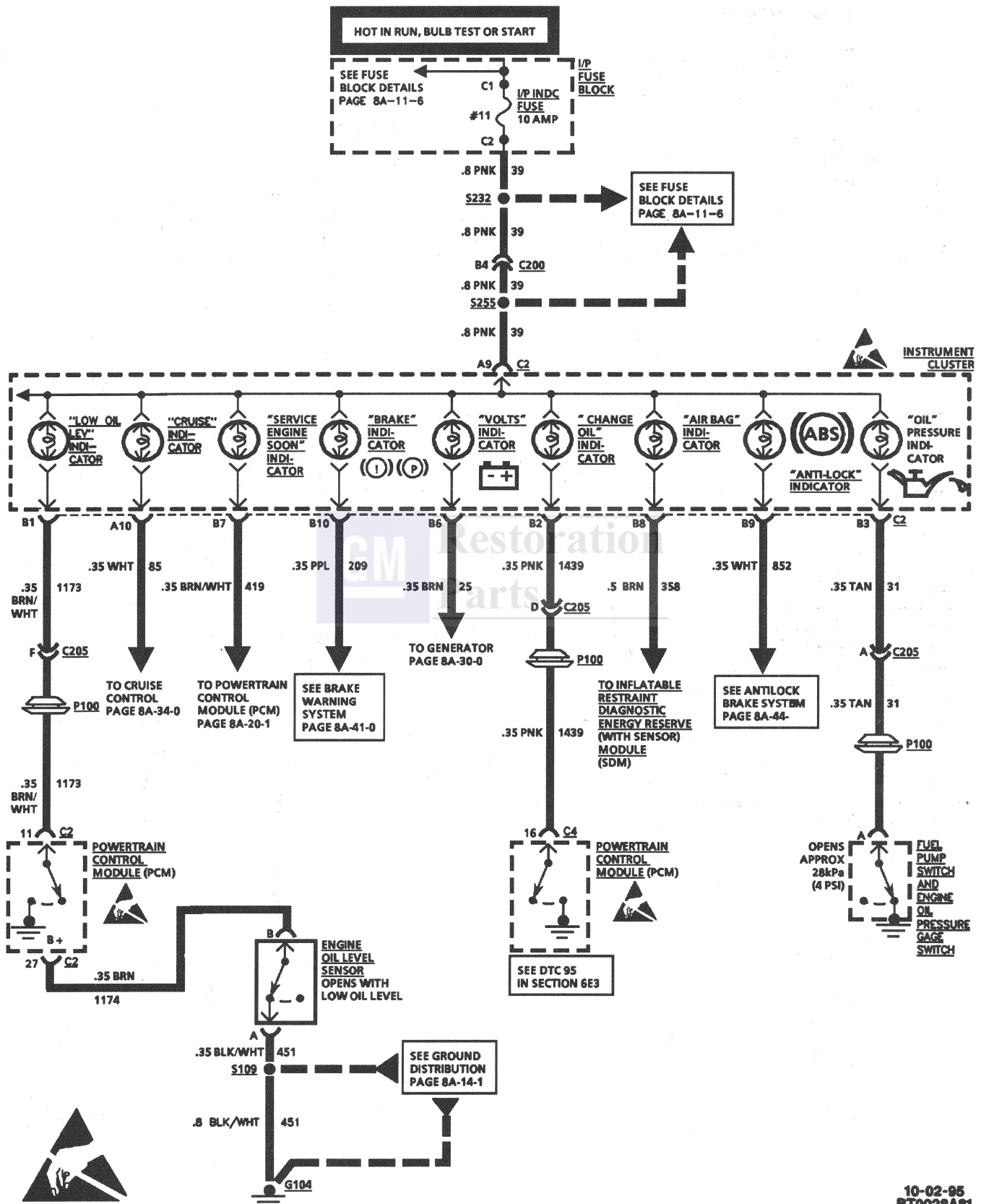


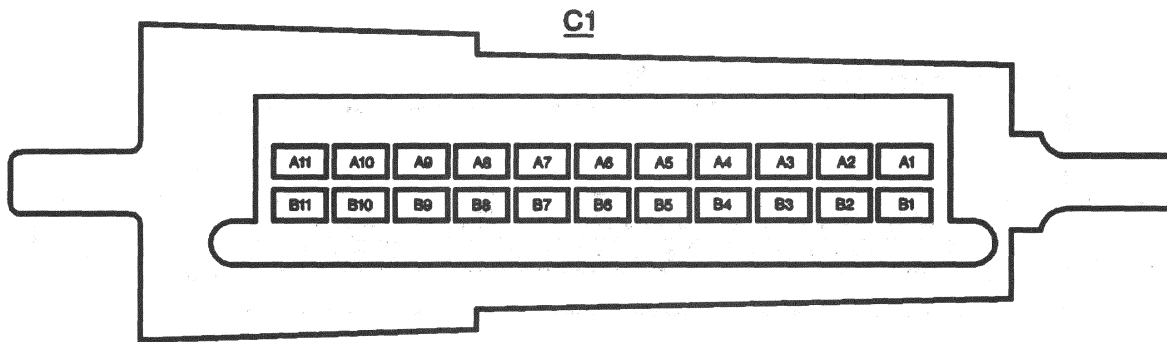






INSTRUMENT CLUSTER (BUICK)

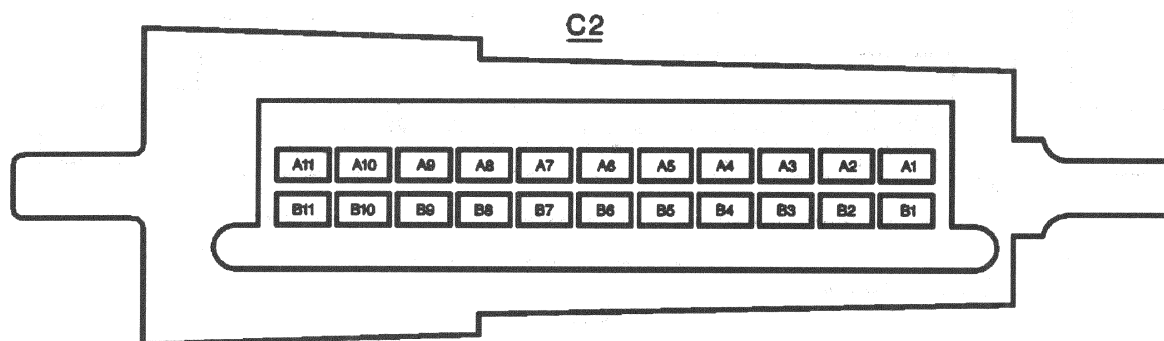


**12065804****22 - WAY F MICRO - PACK 100 SERIES****BLK****INSTRUMENT CLUSTER CONNECTOR****4-29-94
BS0038A81**

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A1	DK GRN	135	COOLANT TEMPERATURE GAGE	8A-81-0
A4	GRY	8	PANEL ILLUMINATION LAMPS	8A-117-1
A5	ORN	40	BATT FEED "GATE AJAR" AND "PASS-KEY" INDICATORS	8A-81-1
A6	GRY	728	"PASS-KEY" INDICATOR	8A-133-1
A7	DK GRN	146	"GATE AJAR" INDICATOR	8A-81-1
A10	YEL/BLK	68	"LOW COOLANT LEVEL" INDICATOR	8A-81-0
B1	PNK	39	IGNITION INPUT	8A-81-0
B2	BLK/WHT	99	"LOW WASH" FLUID INDICATOR	8A-81-0
B3	BLK	450	GROUND	8A-81-1
B7	DK BLU	15	TURN INDICATOR, RH	8A-110-2
B8	LT GRN	11	HI BEAM INDICATOR	8A-100-0
B9	LT BLU	14	TURN INDICATOR, LH	8A-81-1

8A - 81 - 4 ELECTRICAL DIAGNOSIS

INSTRUMENT CLUSTER



12065804

22 - WAY F MICRO - PACK 100 SERIES

BLK

INSTRUMENT CLUSTER CONNECTOR

4-29-94
BS0048A81

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A2	PPL	30	FUEL GAGE SENDER INPUT	8A-81-0
A3	BLK	450	GROUND	8A-81-1
A4	DK GRN/WHT	817	VEHICLE SPEED INPUT	8A-81-0
A9	PNK	39	IGNITION INPUT	8A-81-0
A10	WHT	85	"CRUISE" INDICATOR	8A-34-0
B1	BRN/WHT	1173	"LOW OIL LEVEL" INDICATOR	8A-81-2
B2	PNK	1439	"CHANGE OIL" INDICATOR	8A-81-2
B3	TAN	31	"OIL PRESSURE" INDICATOR	8A-81-2
B4	YEL	237	FASTEN SEAT BELT INDICATOR	8A-76-0
B6	BRN	25	"VOLTS" INDICATOR	8A-30-0
B7	BRN/WHT	419	"SERVICE ENGINE SOON" INDICATOR	8A-20-1
B8	BRN	358	"AIR BAG" INDICATOR	8A-47-0
B9	WHT	852	"ANTI LOCK" INDICATOR	8A-44-2
B10	PPL	209	"BRAKE" INDICATOR	8A-41-0

COMPONENT	LOCATION	201-PG	FIG.	CONN
Endgate Lower Lock Ajar Switch	In Endgate, near RH side	35	51	
Engine Coolant Temperature Gage Sensor	Forward LH side of Engine Block, below Manifold			
Engine Oil Level Sensor	Mounted in Oil Pan			
Fuel Pump Switch and Engine Oil Pressure Gage Sensor	Rear center of Engine			
Fuel Sender	Mounted in Fuel Tank			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Ignition Switch	Mounted on upper RH side of Steering Column	13	21	
Instrument Cluster	LH side of I/P centered above Steering Column	9	16	
Powertrain Control Module (PCM)	Engine Compartment forward of LH Wheelhouse under Air Cleaner	4	8	
Theft Deterrent Module	Behind LH I/P, Left of Brake Pedal Bracket	11	19	
Windshield Washer Solvent Level Switch	Mounted in Windshield Washer Solvent Container, at LH Front Fender	5	9	
C103	Engine Harn, to Forward Lamp Harn at RH Front Fender			
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, lower RH side of Steering Column, next to C200	11	19	202-5
C201 (6 cavities)(w/T61)	Daytime Running Lamps (DRL) Wiring Harn to Body Harn, lower RH side of Steering Column, above C200	11	19	202-5
C201 (6 cavities)(w/T82)	Twilight Sentinel Wiring Harn to Body Harn, at RH side of Steering Column, above C200	11	19	202-5
C202 (6 cavities)(w/T61)	I/P Harn to Daytime Running Lamps (DRL) Wiring Harn, RH side of Steering Column, above C200	11	19	202-5
C202 (6 cavities)(w/T82)	I/P Harn to Twilight Sentinel Wiring Harn, right of Steering Column, above C200	11	19	202-5
C204 (37 cavities)	Body Harn to Engine Harn, behind RH I/P between Blower Motor and I/P Compartment	16	26	202-3
C205 (10 cavities)	Engine Harn to I/P Harn, right of I/P Compartment	18	29	202-4
C400 (8 cavities)(Sedan)	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender	32	47	202-6
C400 (6 cavities)(Wagon)	Body Harn to LH Taillamp Harn, forward of Taillamps	31	46	202-5
C402 (3 cavities)(Sedan)	Rear Lamp Harn to Fuel Pump/Level Sender	33	48	
C405 (6 cavities)(Wagon)	Body Harn to Endgate Harn, near center of LH "D" Pillar ..	34	49	202-7
C406 (6 cavities)	Taillamp Harn to Body Harn, near center of LH "D" Pillar ..	34	49	
G104	Engine Compartment on front of LH Cylinder Head	6	11	
G106	RH Headlamp Support, forward of Battery	0	2	

8A - 81 - 6 ELECTRICAL DIAGNOSIS**INSTRUMENT CLUSTER**

COMPONENT	LOCATION	201-PG	FIG.	CONN
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment			
G401 (Wagon).....	Near center of LH "D" Pillar	31	46	
P100.....	RH I/P, forward of Blower Motor	18	29	
P403.....	Between Endgate and LH "D" Pillar			
P400.....	LH Rear of Vehicle near Taillamps.....	32	47	
S100.....	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S109.....	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S201.....	I/P Harn, approx 12 cm from C200 branch breakout			
S207 (w/T61).....	Daytime Running Lamps (DRL) Wiring Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn			
S207 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S213.....	I/P Harn, approx 4 cm from Instrument Cluster C200 Conn branch breakout, in spiral taping			
S228 (Sedan).....	Crosscar Harn, approx 4 cm from Door Lock Relay branch breakout, in spiral taping			
S231.....	Body Harn, approx 16 cm from Convenience Center breakout			
S232.....	Body Harn, approx 10 cm from SDM breakout			
S251.....	Body Harn, approx 7 cm from SDM breakout			
S255.....	I/P Harn, behind Instrument Cluster, 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S281.....	Body Harn, approx 24 cm from Convenience Center branch breakout			
S400 (Buick Sedan).....	Body Rear Wiring Harn, approx 4 cm from C416 branch breakout			
S400 (Chev Sedan).....	Body Rear Wiring Harn, approx 4 cm from C402 branch breakout			
S400 (Wagon).....	LH Stoplamp Wiring Harn, approx 12 cm from LH Lower Tail/Turn/Stoplamp Conn branch breakout			
S402.....	Tailgate Harn, approx 5 cm from High Mount Stoplamp Conn branch breakout			
S414 (Wagon).....	Body Harn, approx 26 cm from Remote Control Door Lock Module breakout			
S420 (Wagon).....	Body Harn, approx 12 cm from C400 breakout			
S421 (Sedan).....	Body Harn, approx 14 cm from High Mount Stoplamp breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse #33. If open, check CKT 40 for short to ground.
2. Check I/P Fuse #11. If open, check CKT 39 for short to ground.
3. Check any inoperative indicator bulb.
4. Make sure grounds G104, G106, G200 and G401 are clean and tight.
5. If Instrument Cluster is completely or partially inoperative, check CKT 39 and CKT 439 for an open.
 - For Instrument Cluster removal and replacement procedures, refer to SECTION 8C.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

"OIL" PRESSURE INDICATOR DIAGNOSIS

If the "OIL PRESSURE" Indicator stays "ON" with the Engine running:

- Disconnect Fuel Pump Switch and Engine Oil Pressure Gage Sender. If the indicator goes "OFF," replace sender. If the indicator stays "ON," check CKT 31 for short to ground.
 - Inspect the Instrument Cluster printed circuit for a short. Also check that the printed circuit is mating properly with its connectors and not shorted there.
- If the "OIL PRESSURE" Indicator does not come

"ON" before the Engine starts, and the bulb is good, measure the resistance from the Fuel Pump Switch and Engine Oil Pressure Gage Sender connector to ground.

- If the resistance is approximately 1 ohm or more, check CKT 31 for an open.
- Connect a fused jumper between Fuel Pump Switch and Engine Oil Pressure Gage Sender connector terminal "A" and ground. If the indicator comes "ON," replace the sender. If the indicator stays "OFF," remove Instrument Cluster for repair.
- Check that the printed circuit has no cracks or flaws and is mating properly with its connector.

"HOT" COOLANT TEMPERATURE INDICATOR DIAGNOSIS (COOLANT TEMPERATURE GAGE "NORMAL")

If the Coolant "HOT" Indicator comes "ON" with the Engine running, but not overheated:

- Check the Instrument Cluster printed circuits for shorts to ground. If OK, service Instrument Cluster.

If "HOT" Coolant Temperature Indicator does not come "ON" while starting the Engine, and the bulb is good:

- Ground CKT 135 at Ignition Switch connector C1 terminal "C." If the indicator comes "ON," the circuit is good. Replace the Ignition Switch.
- If the indicator does not come "ON," check the Instrument Cluster printed circuit for an open. If OK, service Instrument Cluster.

SYSTEM DIAGNOSIS

- For Instrument Cluster removal and replacement procedures, refer to SECTION 8C.
- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

INSTRUMENT CLUSTER

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Turn Ignition Switch to "RUN."	• "AIR BAG" Indicator will flash 7 times, then go "OFF." • "ANTI-LOCK" Indicator is "ON" for at least 2 seconds. • Coolant Temperature Gage shows the coolant temperature. • Fasten Seat Belt Indicator will come "ON." • Fuel Gage shows current fuel level. • "HOT" Coolant Temperature Indicator illuminates for 2 seconds. • "LOW FUEL" Indicator illuminates for 2 seconds. • "LOW OIL LEVEL" illuminates for 2 seconds or more. • "LOW WASH FLUID" Indicator illuminates for 2 seconds. • "OIL" Pressure Indicator is "ON." • "PASS KEY" Indicator illuminates for 5 seconds. • "SERVICE ENGINE SOON" Indicator is "ON." • "VOLTS" Indicator is "ON." • Warning Alarm will sound if the driver's safety belt is unbuckled.
[2] • With Ignition Switch in "RUN," first operate the RH Turn Signal then the LH Turn Signal.	RH and LH Turn Indicators flash.
[3] • With the Headlamp Switch in "HEAD," place Headlamp Dimmer Switch in "HI."	HI Beam Indicator is "ON."
[4] • With Ignition Switch in "RUN," apply the Park Brake.	"BRAKE" Indicator is "ON."
[5] • With the Headlamp Switch in "HEAD" or "PARK," adjust the dimmer control.	Instrument Cluster illumination varies with dimmer control.
[6] • Start Engine and let idle.	Coolant Temperature Gage indicates current coolant temperature. During "CRANK," "AIR BAG" Indicator is "ON" (not flashing). After "START" ("RUN"), indicator will flash 6 times, then go "OFF."
[7] • Open Endgate.	"GATE AJAR" Indicator is "ON."
[8] • Turn Ignition Switch to "BULB TEST."	"BRAKE" Indicator is "ON." Coolant Temperature gage reads "H".

SYMPTOM TABLE

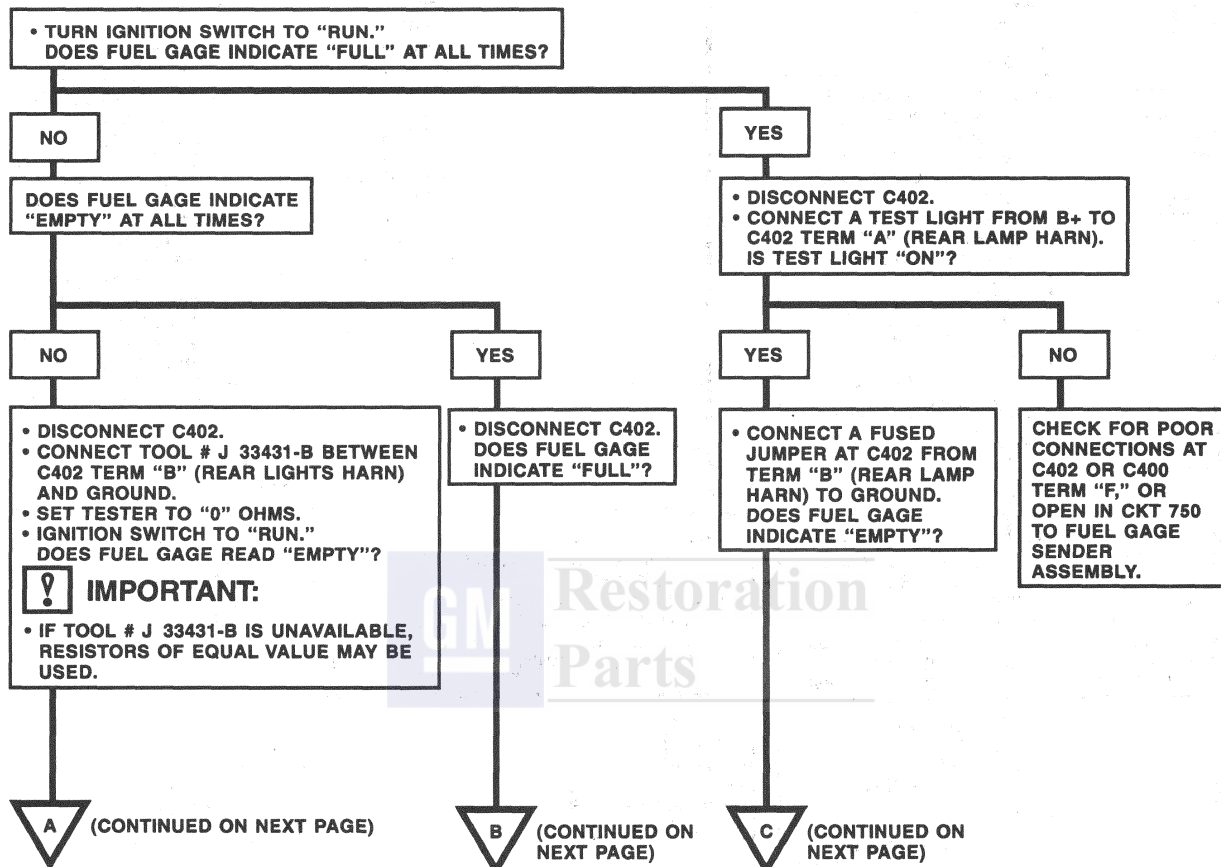
SYMPTOM	PROCEDURE	PAGE NUMBER
Fuel Gage inoperative or inaccurate.	Chart #1	8A-81-11, 12
Coolant Temperature Gage inoperative or inaccurate	Chart #2	8A-81-13
"LOW WASH FLUID"	Chart #3	8A-81-14
"LOW WASH FLUID" Indicator "ON" at all times.	Chart #4	8A-81-14
"LOW COOLANT LEVEL" Indicator "ON," coolant level OK.	Chart #5	8A-81-15
"LOW COOLANT LEVEL" Indicator inoperative, coolant level low.	Chart #6	8A-81-15
"LOW OIL LEVEL" Indicator "ON," oil level OK.	Chart #7	8A-81-16
"LOW OIL LEVEL" Indicator inoperative, oil level low.	Chart #8	8A-81-16
"GATE AJAR" Indicator inoperative.	Chart #9	8A-81-17
"GATE AJAR" Indicator "ON" at all times.	Chart #10	8A-81-17
"AIR BAG" Indicator does not illuminate and/or flash.	Refer to SECTION 9J.	
"ANTI-LOCK" Indicator is inoperative or does not work properly.	Refer to SECTION 5E1.	
"BRAKE" Indicator is inoperative or remains "ON" when Park Brake is released.	Refer to "Brake Warning System," page 8A-41-0	
Coolant Temperature, Speedometer and Fuel Gages are inaccurate.	Connect a jumper wire from a good chassis ground to Instrument Cluster connector C1 terminal "B3" and Instrument Cluster connector C2 terminal "A3." If gages are still inaccurate, remove Instrument Cluster for service. Refer to SECTION 8C.	
"CRUISE" Indicator does not work properly.	Refer to "Cruise Control," page 8A-34-0.	
"Fasten Seat Belt" Indicator does not work properly.	Refer to "Audible Warnings," page 8A-76-0.	
"HI BEAM" Indicator does not work properly.	Refer to "Headlamps," page 8A-100-0	
"HOT COOLANT" Temperature Indicator does not work properly.	See "HOT COOLANT" Temperature Indicator diagnosis on page 8A-81-15.	
"INSTRUMENT CLUSTER" and/or "PANEL ILLUMINATION LAMPS" do not dim properly.	Refer to "Interior Panel Dimming," page 8A-117-0.	
"LOW FUEL" Indicator is inoperative or "ON" at all times. (Fuel Gage works normal).	Repair/Replace Instrument Cluster.	

INSTRUMENT CLUSTER**SYMPTOM TABLE (Continued)**

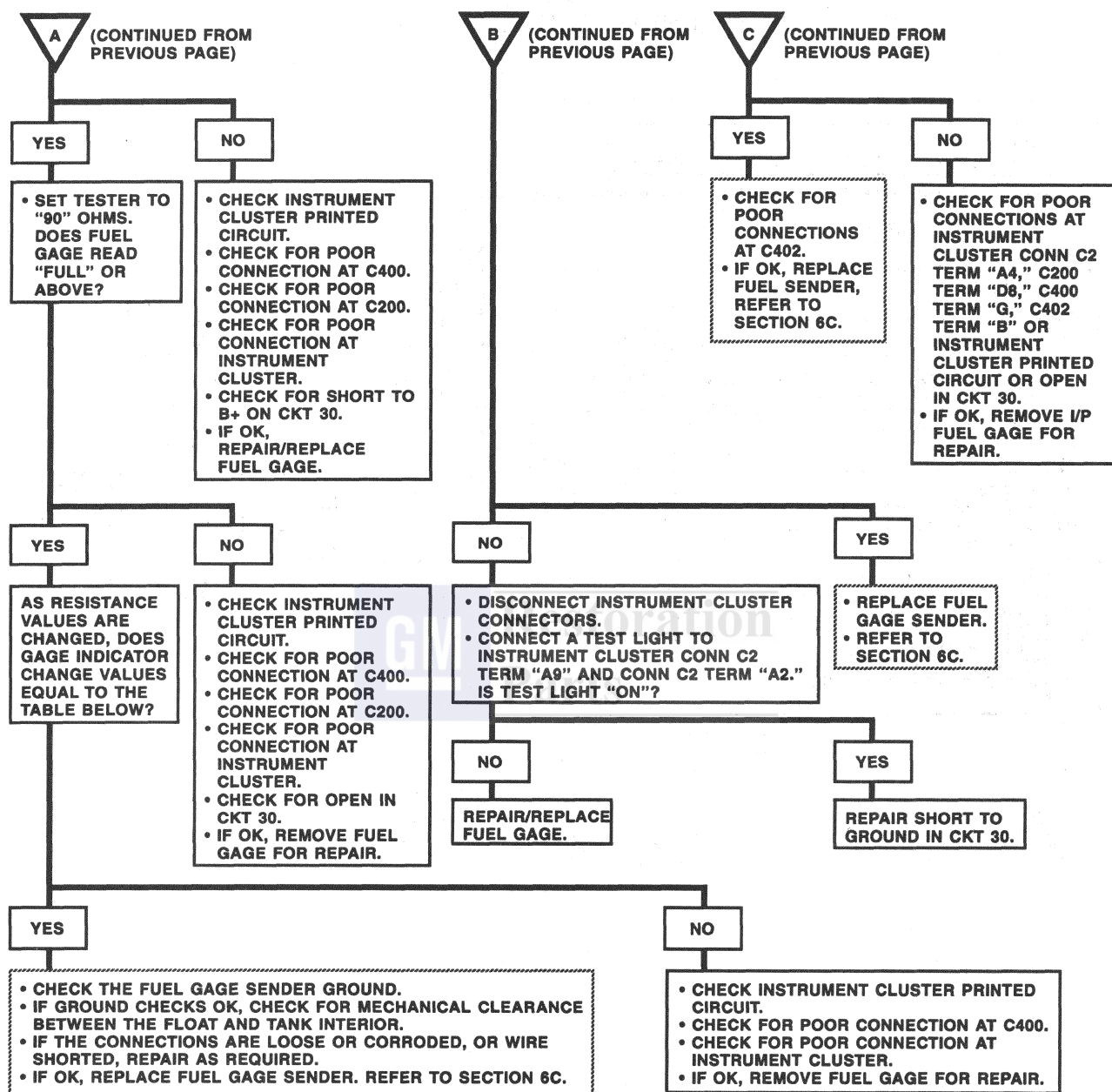
SYMPTOM	PROCEDURE	PAGE NUMBER
"OIL PRESSURE" Indicator does not work properly.	See "OIL PRESSURE" Indicator diagnosis on page 8A-81-16	
"SERVICE ENGINE SOON" Indicator remains illuminated or flashes.	Refer to Engine Controls.	
Speedometer inoperative. DTC P1652 set.	Refer to Engine Controls.	
Speedometer and Cruise Control inoperative; DTC P1652 not set.	Chart #11	8A-81-18
Speedometer inoperative. DTC P1652 not set. Cruise Control operates.	Check for open in CKT 817 between S251 and Instrument Cluster Connector. Also check for poor connection at I/P Cluster Connector C1 terminal "A2" (Chev) or connector C2 terminal "A4" (Buick). If OK, service Instrument Cluster.	
Turn Indicators do not work properly.	Refer to "Exterior Lights," page 8A-110-0.	
"VOLTS" Indicator does not work properly.	Refer to "Starter and Charging," page 8A-30-0.	



CHART #1
FUEL GAGE INOPERATIVE OR INCORRECT

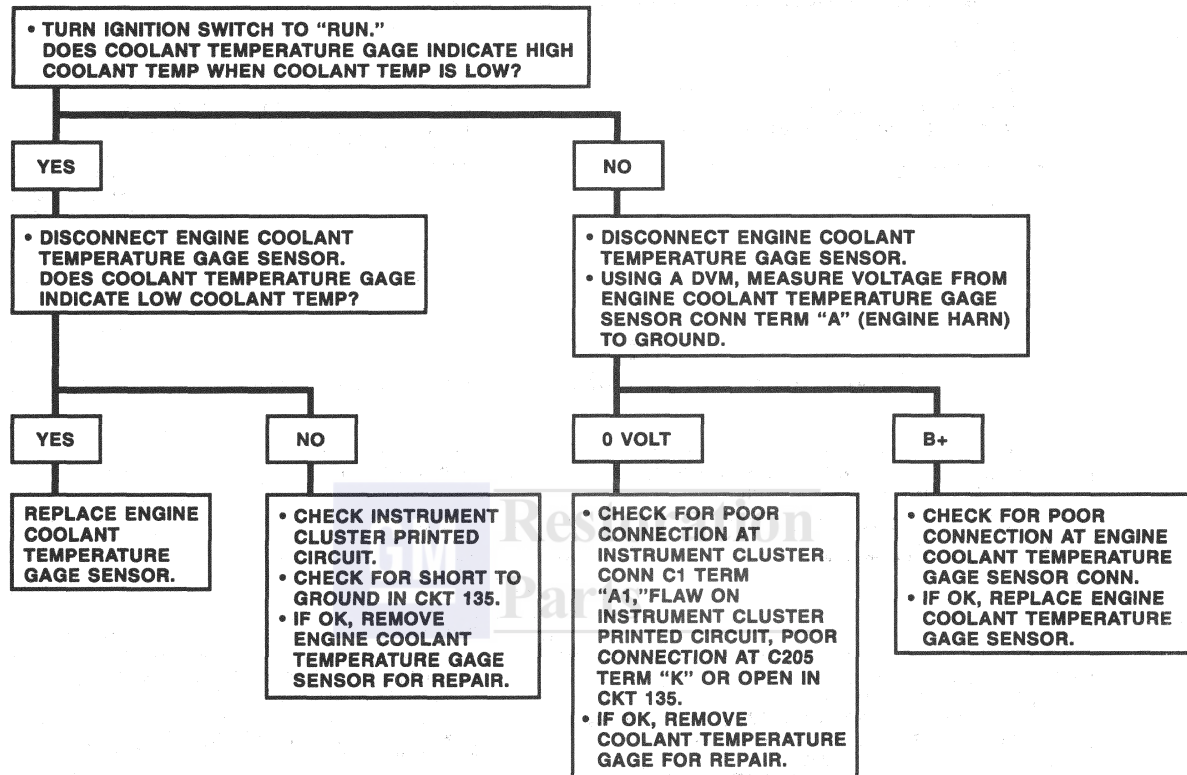


INSTRUMENT CLUSTER



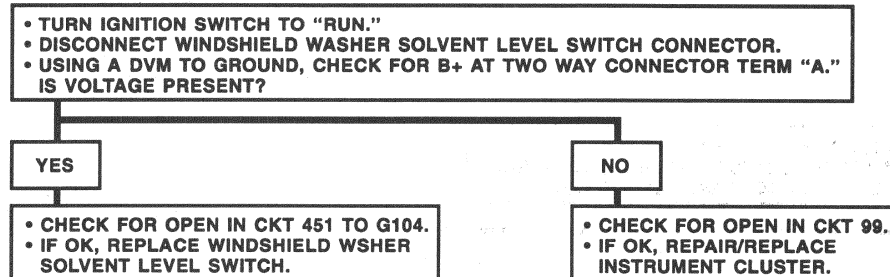
SENDER RESISTANCE	APPROXIMATE FUEL LEVEL
88 Ω	FULL
60 Ω	3/4
50 Ω	1/2
26 Ω	1/4
1.0 Ω	EMPTY

CHART #2
COOLANT TEMPERATURE GAGE INOPERATIVE OR INACCURATE



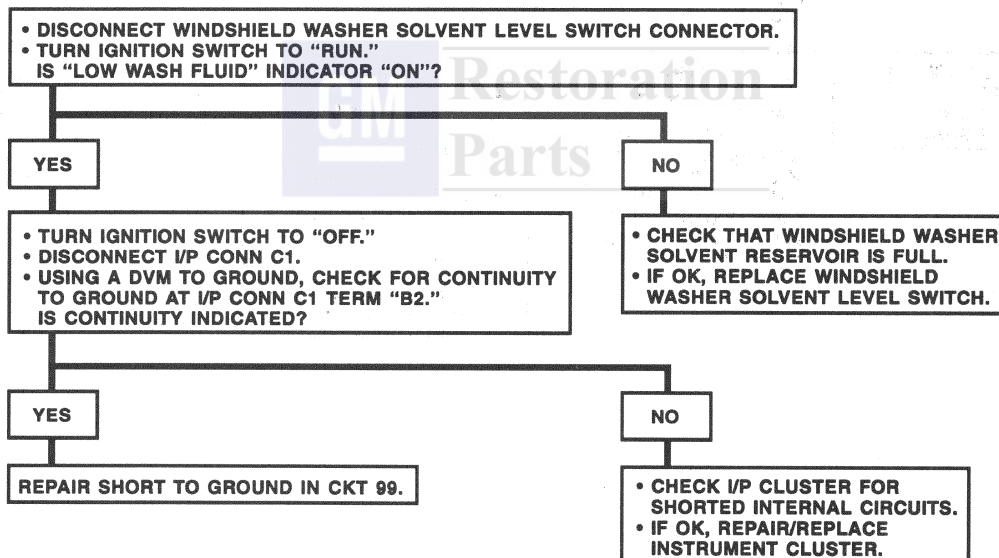
INSTRUMENT CLUSTER

CHART #3
"LOW WASH FLUID" INDICATOR INOPERATIVE



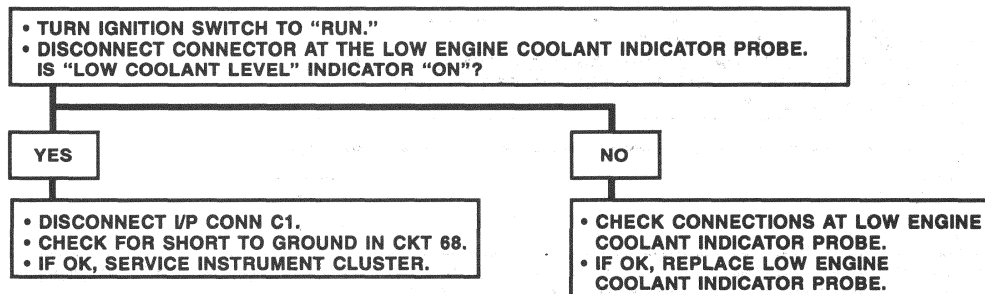
C9516

CHART #4
"LOW WASH FLUID" INDICATOR "ON" AT ALL TIMES



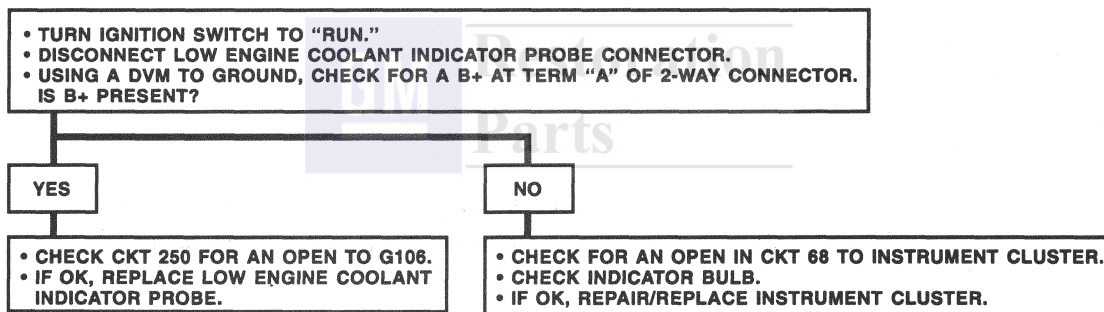
C9517

CHART #5
"LOW COOLANT LEVEL" INDICATOR "ON," COOLANT LEVEL OK



C9518

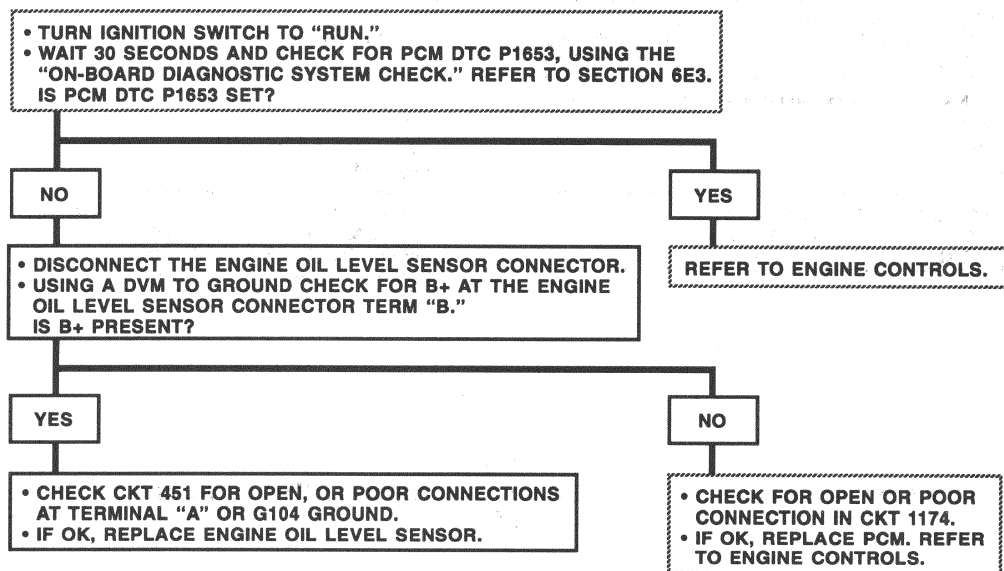
CHART #6
"LOW COOLANT LEVEL" INDICATOR INOPERATIVE, COOLANT LEVEL LOW



C9519

INSTRUMENT CLUSTER

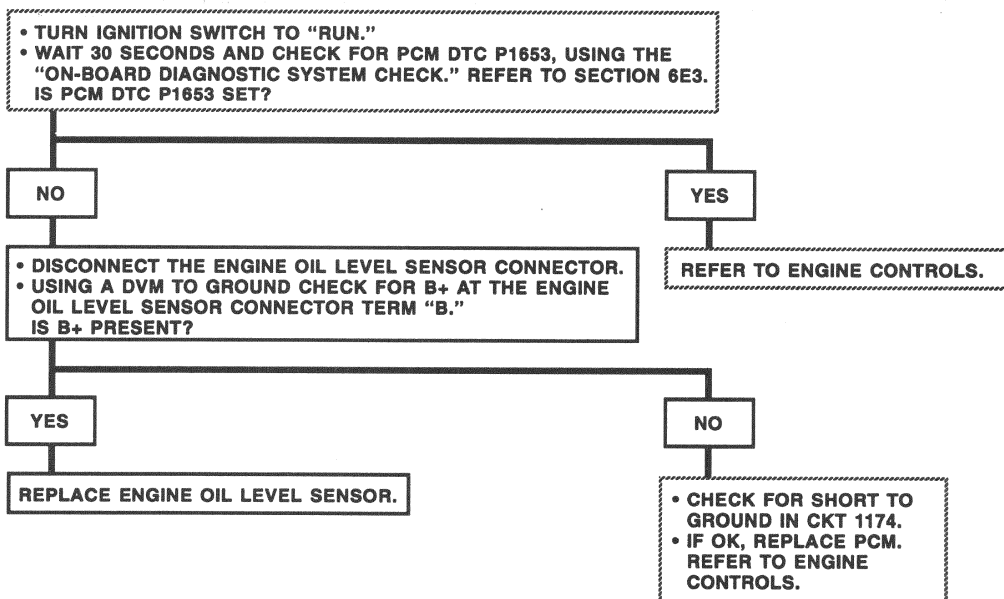
CHART #7
"LOW OIL LEVEL" INDICATOR "ON," OIL LEVEL OK



C9520

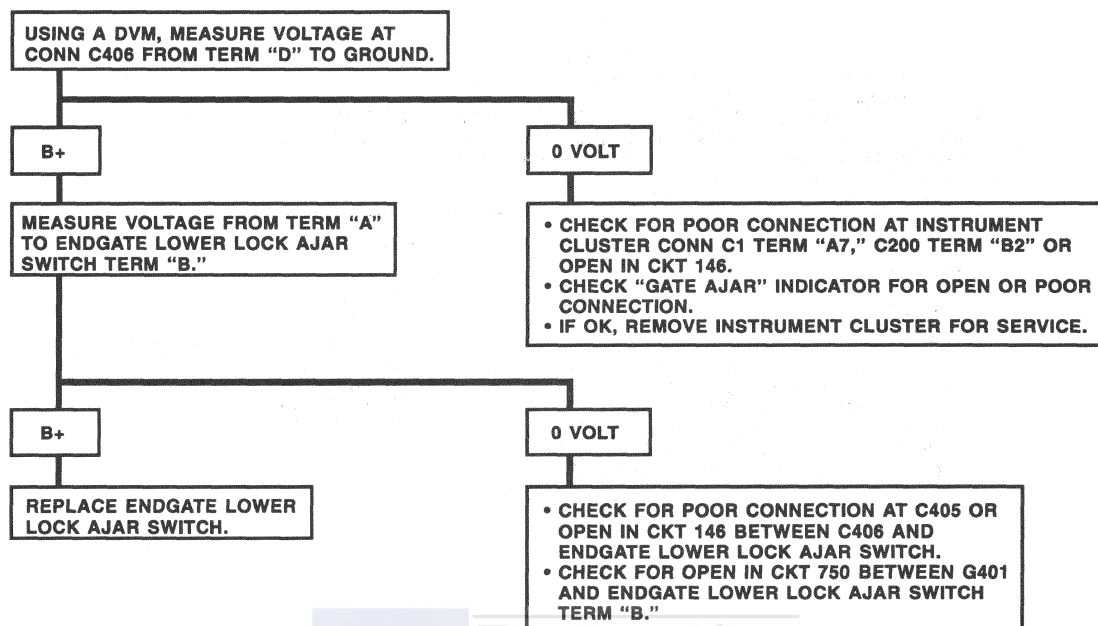


CHART #8
"LOW OIL LEVEL" INDICATOR INOPERATIVE OIL LEVEL LOW



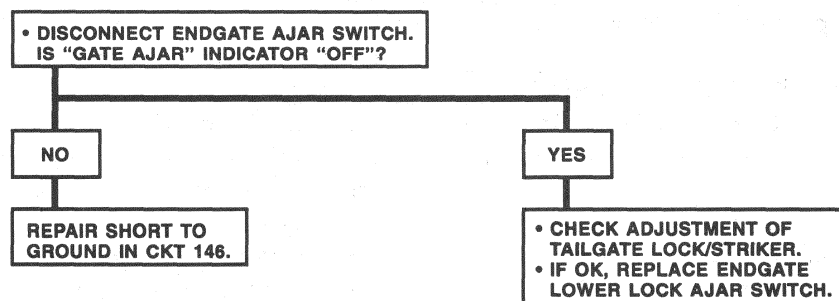
C9521

CHART #9
"GATE AJAR" INDICATOR INOPERATIVE



C9522

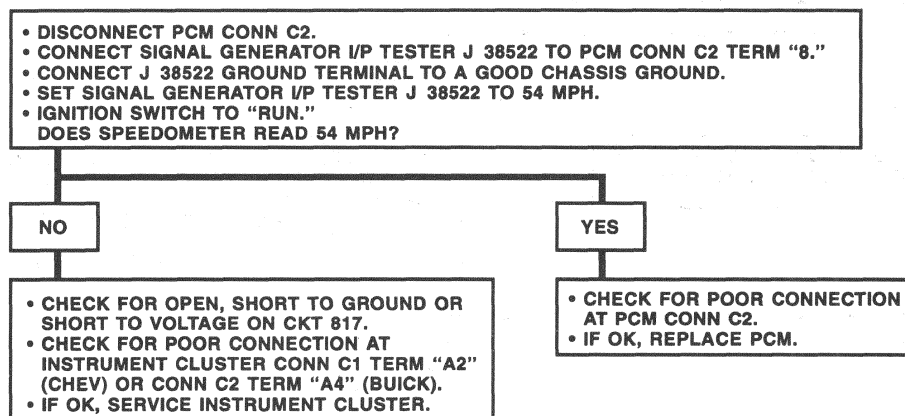
CHART #10
"GATE AJAR" INDICATOR ON AT ALL TIMES



C9523

INSTRUMENT CLUSTER

CHART #11
SPEEDOMETER AND CRUISE CONTROL INOPERATIVE;
VSS CODE NOT SET



C9524

CIRCUIT OPERATION

See the circuit referred to for the complete operation of an indicator and other components that work with it. Only the indicators that do not appear in other schematics are described in this section.

"OIL" PRESSURE INDICATOR

The "OIL PRESSURE" Indicator bulb will ground at the Fuel Pump Switch and Engine Oil Pressure Gage Sensor, when Engine oil pressure drops below 4 lbs.

"HOT" COOLANT TEMPERATURE INDICATOR

The "HOT COOLANT TEMPERATURE" Indicator comes "ON" to warn the driver of high coolant temperature.

With the Ignition Switch in "RUN," "BULB TEST" or "START," voltage from I/P Fuse #11 is applied to the "HOT" Coolant Temperature Indicator. In "BULB TEST" or "START," the lamp is grounded through the Instrument Cluster Logic Chip so that the bulb can be tested. In

"RUN," the current path is also completed through the Logic Chip in the Instrument Cluster. The Engine Coolant Temperature Gage Sensor resistance will be low when the coolant temperature exceeds 1265°C (2585°F) causing the Logic Chip to command the lamp "ON."

FUEL GAGE

With the Ignition Switch in "RUN," "BULB TEST" or "START," voltage is applied from I/P Fuse #11 to the Fuel Gage. The Fuel Gage pointer is controlled by varying the Fuel Sender resistance. Voltage is applied from Fuse #11 to the Empty coil of the Fuel Gage and divides into two paths: 1) through the Fuel Gage Sender to ground, and 2) through the Full coil to ground. The Gage pointer is controlled by changes in the Sender's resistance. When the Fuel Gage resistance decreases, more current flows through the Sender and the Empty coil. At the same time, the current through the Full coil decreases.

With two coils operating the pointer, the gage is not affected by changes in the voltage of the system.

COOLANT TEMPERATURE GAGE

The Coolant Temperature Gage applies voltage from CKT 135 to the Engine Coolant Temperature Gage Sensor. The Engine Coolant Temperature Gage Sensor contains a variable resistor. At 385°C (1005°F) the resistance is approximately 1365 ohms and at 1275°C (2605°F) the resistance is approximately 55 ohms. As the resistance of the Engine Coolant Temperature Gage Sensor decreases, the Coolant Temperature Gage senses a smaller voltage drop across the Engine Coolant Temperature Gage Sensor, indicating higher coolant temperature. As the resistance of the Engine Coolant Temperature Gage Sensor increases, the Coolant Temperature Gage senses a larger voltage drop across the Engine Coolant Temperature Gage Sensor, indicating a lower coolant temperature.

"GATE AJAR" INDICATOR

Voltage is applied at all times to the "GATE AJAR" Indicator from I/P Fuse #33. When the Endgate is opened, (as a door) the "GATE AJAR" Switch closes completing the path to ground and turns the indicator "ON."

"LOW OIL LEVEL" INDICATOR

The "LOW OIL LEVEL" Indicator ground is controlled by the PCM. The PCM also supplies B+ to the Engine Oil Level Sensor, mounted in the Engine oil pan. The PCM will not check for a low oil condition until the drop in Engine Coolant Temperature corresponds with the chart below. The PCM compares the drop in coolant temperature from the last Ignition "OFF" cycle to the coolant temperature at the start of the current Ignition "ON" cycle.

If the coolant temperature drop conditions are not met, the "LOW OIL LEVEL" Indicator will come on for the 2 second bulb test only. (The Ignition must be "OFF" for a minimum of 5 seconds before the "LOW OIL LEVEL" Indicator can come "ON" again.) If the Indicator is "ON" because of a low oil condition, it will remain "ON" for the rest of the current Ignition Cycle, even if oil is added to the crankcase. A low oil condition exists with 2 3/4 or less quarts of oil remaining in Engine oil pan.

Ignition "ON"°C	Temperature drop since last Ignition "OFF" Cycle°C
-40	7
-28	7
-16	7
-4	7
8	7
20	8
32	10
44	12
56	14
68	16
80	19
92	22
104	22
116	22
128	22
140	22
152	22

"LOW COOLANT LEVEL" INDICATOR

Ignition voltage is applied at all times to the Low Engine Coolant Indicator Probe. A magnetic float in the Coolant Recovery Reservoir rises and falls with the coolant level. A serviceable Reed-Type Switch (mounted in the bottom of the reservoir) senses the floating magnet. When the float (magnet) position gets lower in the reservoir, the Switch contacts are pulled together, grounding CKT 68.

"LOW WASH FLUID" LEVEL INDICATOR

When the Ignition Switch is turned to "RUN," voltage is applied to the Windshield Washer Solvent Level Switch. If washer solvent level is low, and the Windshield Washer Solvent Level Switch is closed, ground is applied to the "LOW WASH FLUID" Indicator. Once the indicator has been turned "ON," it will stay "ON" until the windshield washer solvent container has been refilled, causing the Windshield Washer Solvent Level Switch to open. The Ignition Switch must then be cycled from "OFF" to "RUN" for the Indicator to turn "OFF."

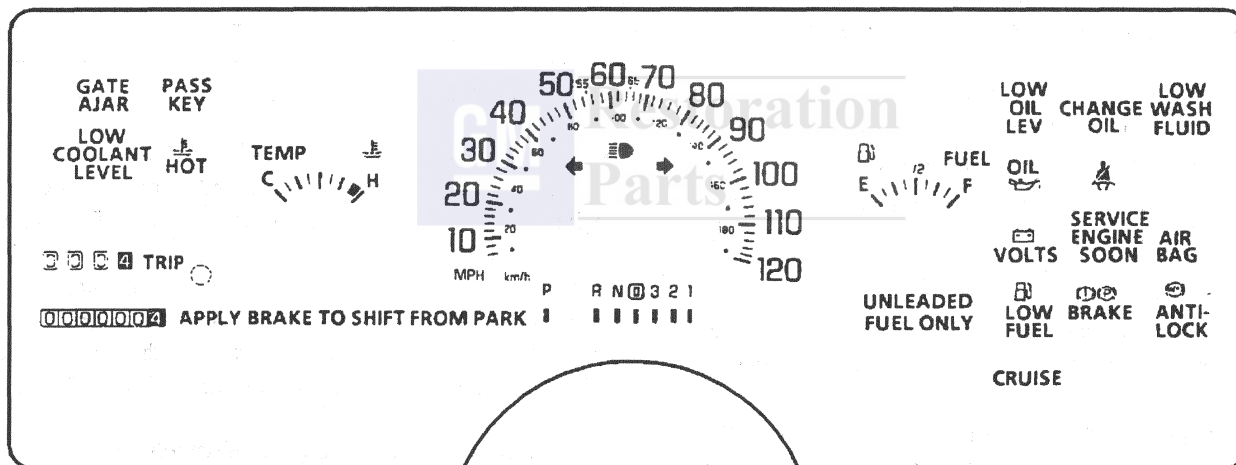
INSTRUMENT CLUSTER

"LOW FUEL" INDICATOR

The Instrument Cluster Logic Chip monitors the Fuel Sender resistance using CKT 30. When the Fuel Gage registers less than 1/8 tank of fuel, the resistance at terminal "A2" of connector C2 will be approximately $10 \pm 2 \Omega$. If this condition is met for 128 ± 64 seconds, the Logic Chip within the Instrument Cluster will ground the "LOW FUEL" Indicator, causing it to turn "ON." After refueling, the resistance at terminal "A2" of connector C2 will be above $15 \pm 2 \Omega$, depending on the amount of fuel in the fuel tank. Within the same Ignition Cycle, after approximately 128 ± 64 seconds, the Logic Chip within the Instrument Cluster will turn the "LOW FUEL" Indicator "OFF."

SPEEDOMETER

The Speed Sensor Circuit consists of a magnetic type sensor and wiring. Gear teeth pressed on the Transmission Output Shaft induce an alternating current in the sensor. This sensor generates a sine wave output with a frequency proportional to vehicle speed. The PCM converts this signal to an output that is switched to ground at a frequency of 4000 pulses per mile at the DK GRN/WHT wire (CKT 817), which feeds the Turn Signal Alarm, Power Steering Control Module, Instrument Cluster, Cruise Control Module and Radio (Chev only).

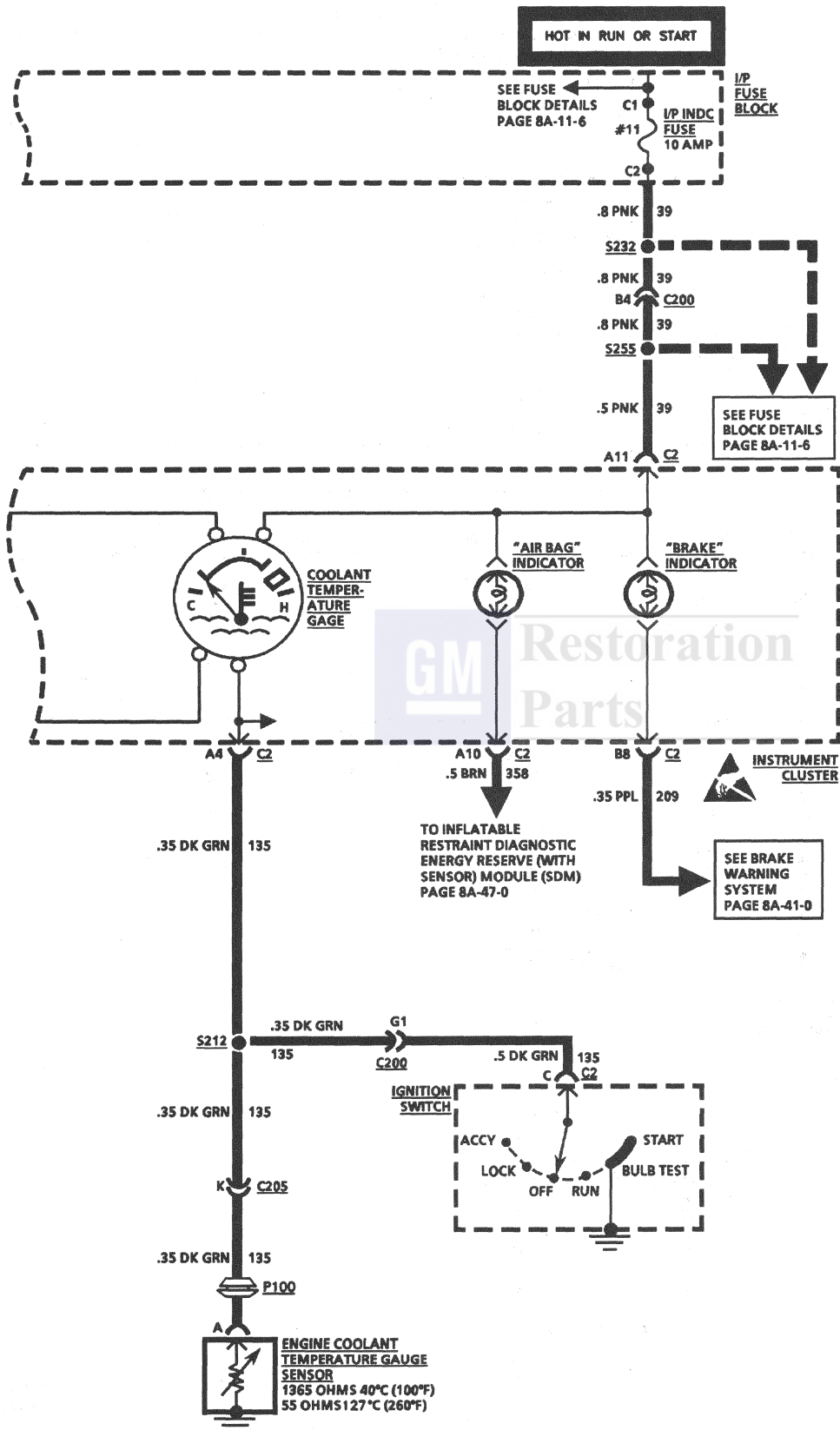
ROADMASTER INSTRUMENT CLUSTER

(BUICK)

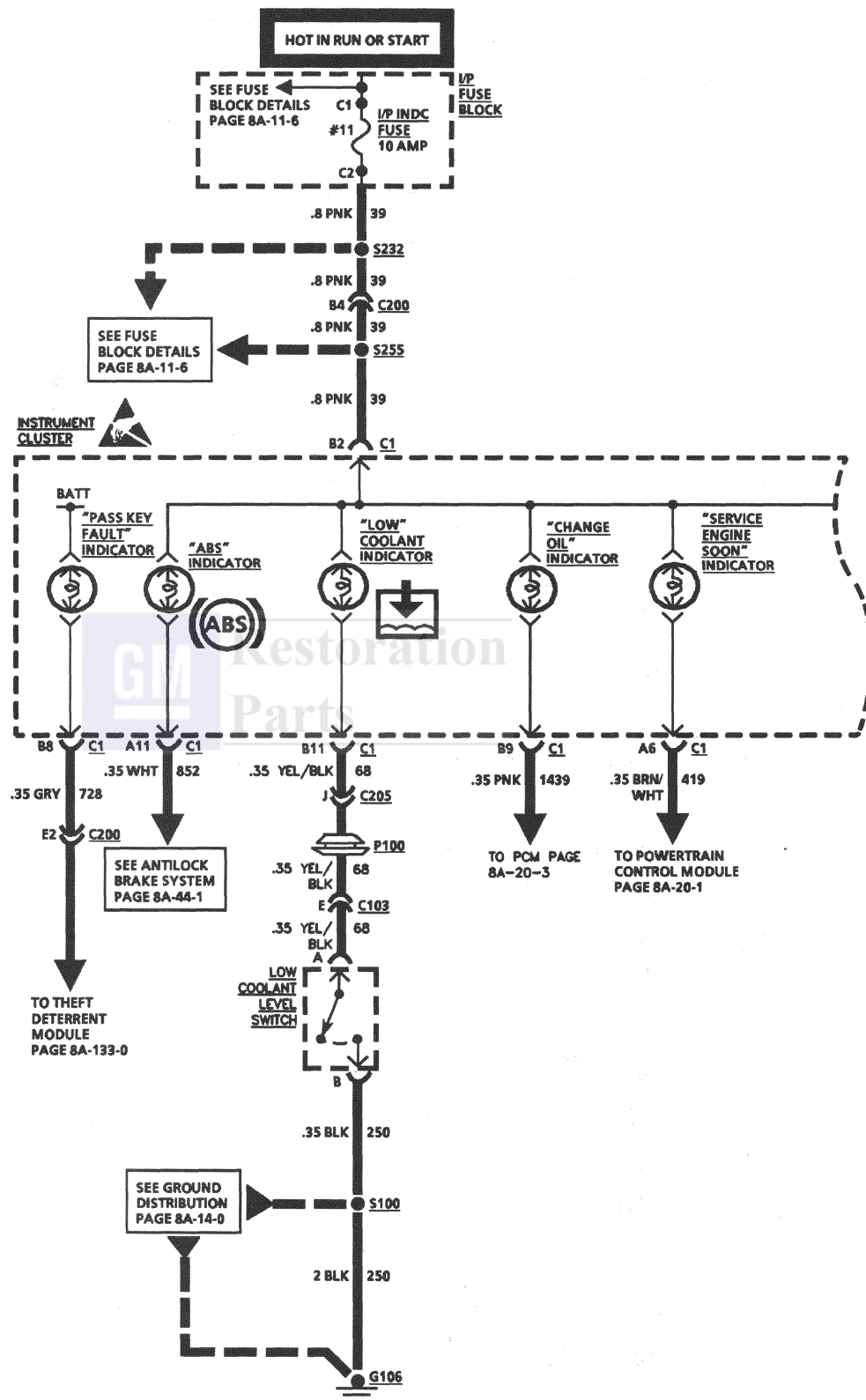
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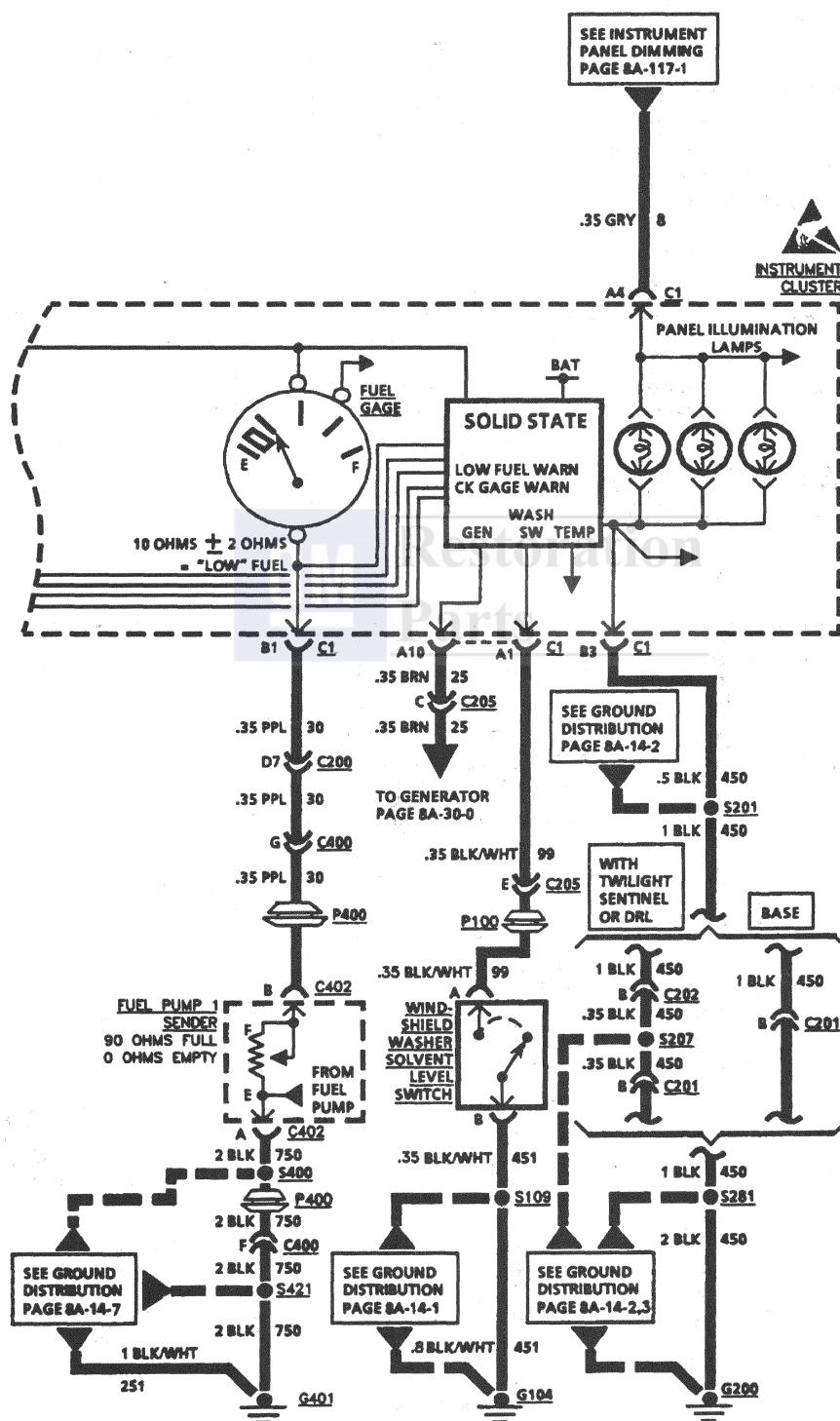
INSTRUMENT CLUSTER: DIGITAL (CHEV)





**INSTRUMENT CLUSTER: DIGITAL
(CHEV)**



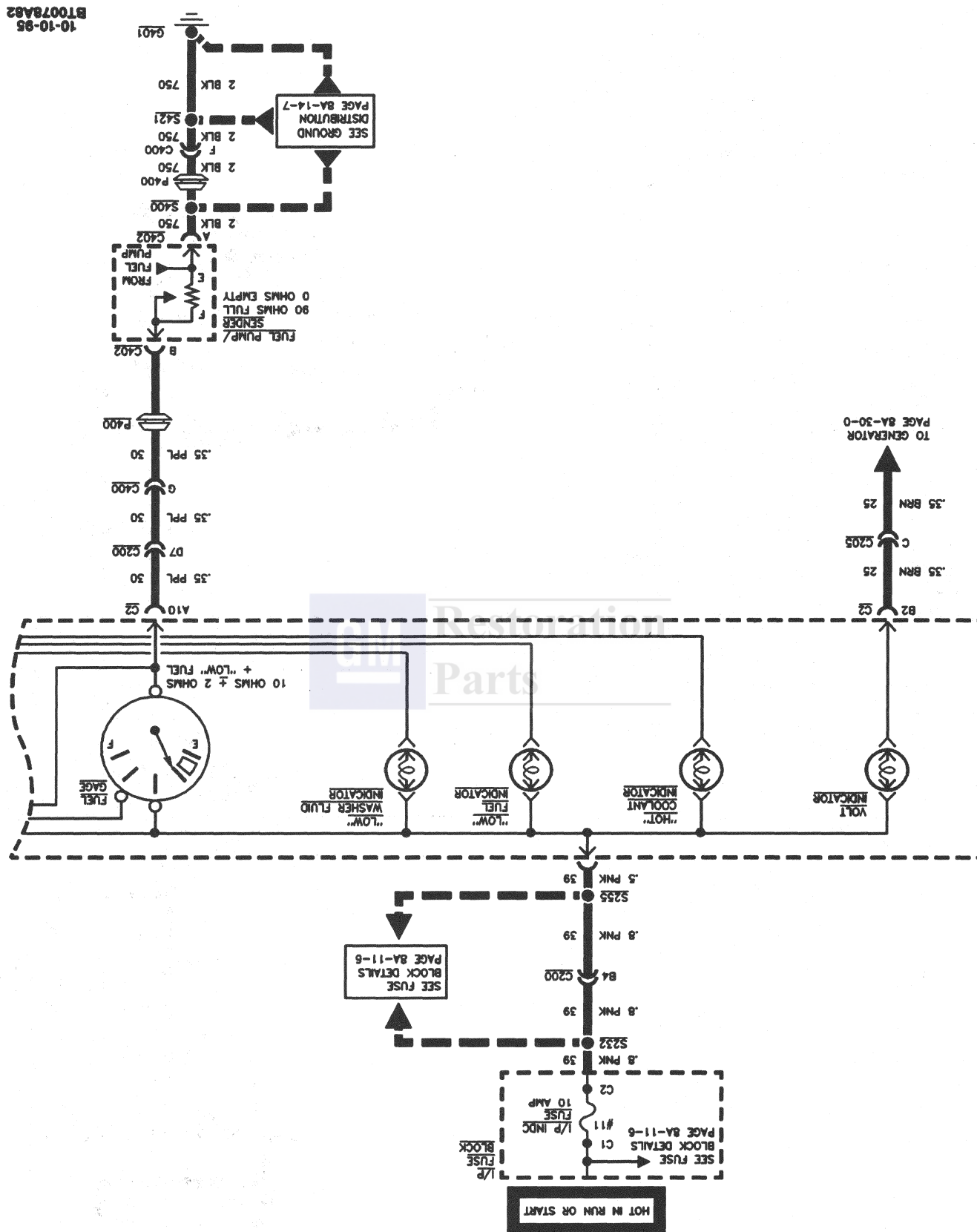


**SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES**

10-10-95
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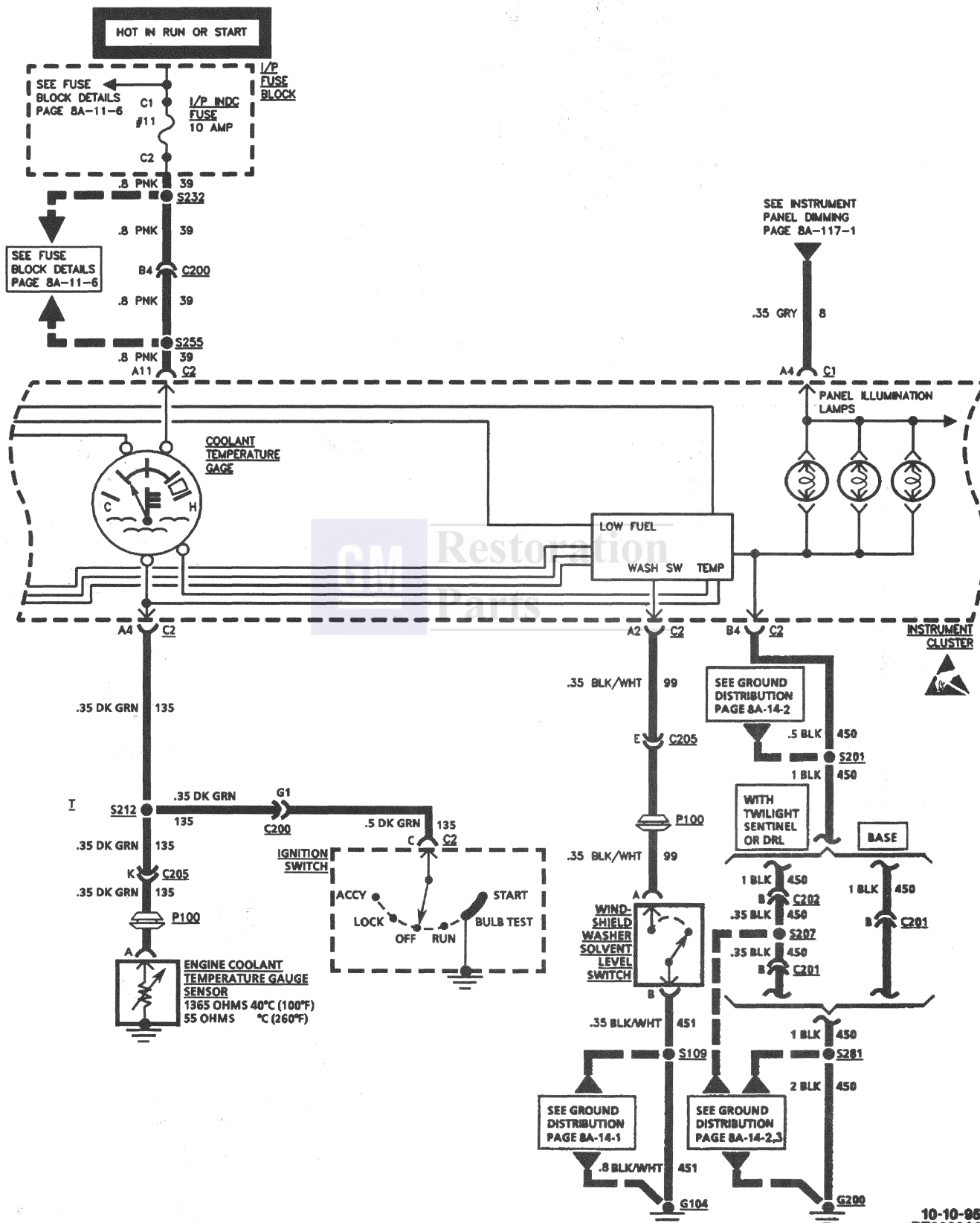
**INSTRUMENT CLUSTER: DIGITAL
(IMPALA)**





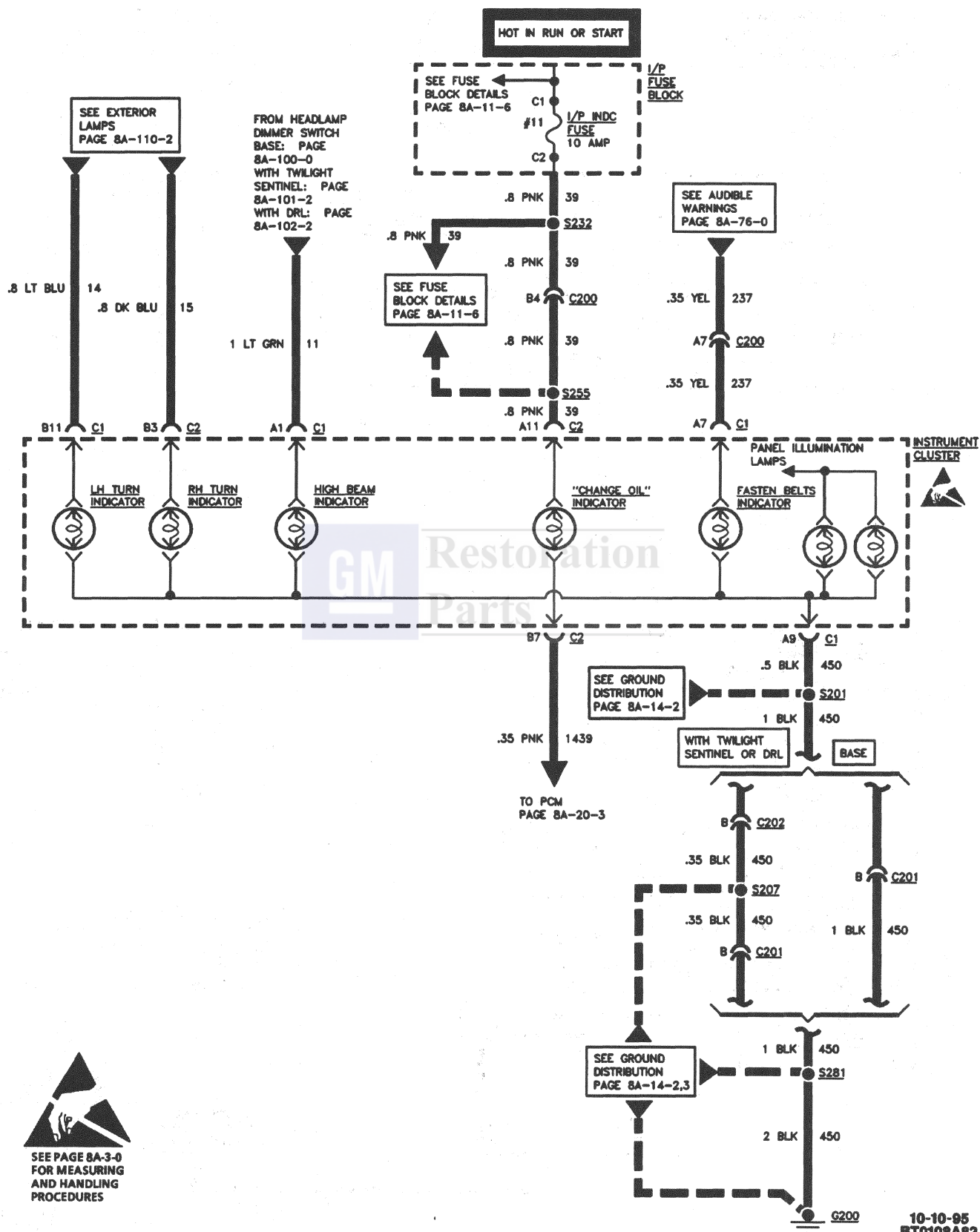
8A - 82 - 8 ELECTRICAL DIAGNOSIS

INSTRUMENT CLUSTER: DIGITAL (IMPALA)

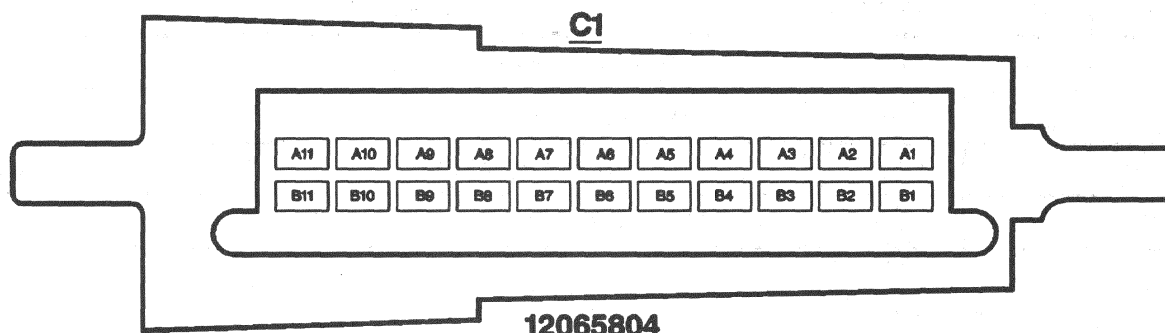




INSTRUMENT CLUSTER: DIGITAL (IMPALA)



INSTRUMENT CLUSTER: DIGITAL



22 - WAY F MICRO - PACK 100 SERIES

BLK

LEFT INSTRUMENT CLUSTER CONNECTOR

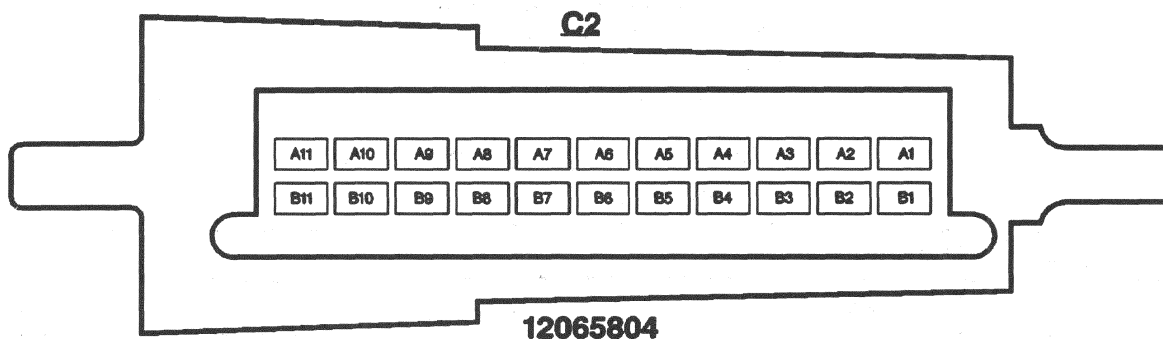
11-8-84
BS0038A82

APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
CHEV	A1	BLK/WHT	99	"LOW" WASHER FLUID INDICATOR	8A-82-5
IMPALA	A1	LT GRN	11	HIGH BEAM HEADLAMP FEED	8A-82-10
	A2	DK GRN/WHT	817	VEHICLE SPEED INPUT	8A-82-0
	A3	LT GRN	376	TRIP RESET	8A-82-0
	A4	GRY	8	PANEL ILLUMINATION LAMPS	8A-82-0
CHEV	A5	TAN	31	OIL PRESSURE GAGE	8A-82-4
IMPALA	A5	LT BLU	811	METRIC CONVERSION SWITCH SIGNAL	8A-82-9
CHEV	A6	BRN/WHT	419	"SERVICE ENGINE SOON" INDICATOR	8A-20-1
IMPALA	A6	YEL	32	INSRUMENT PANEL LAMPS FUSE OUTPUT	8A-82-9
CHEV	A7	BRN/WHT	1173	"LOW OIL LEVEL" INDICATOR	8A-82-4
IMPALA	A7	YEL	237	SEAT BELT SWITCH	8A-82-10
IMPALA	A9	BLK	450	LAMP GROUND	8A-82-10
CHEV	A10	BRN	25	VOLT GAGE	8A-30-0
IMPALA	A10	BRN/WHT	419	CHECK ENGINE INDICATOR LAMP OUTPUT	8A-82-6
	A11	WHT	852	"ABS" INDICATOR	8A-44-1
CHEV	B1	PPL	30	FUEL GAGE	8A-82-5
	B2	PNK	39	IGNITION INPUT	8A-82-2
CHEV	B3	BLK	450	GROUND	8A-82-3
CHEV	B8	GRY	728	"PASS KEY FAULT" INDICATOR	8A-133-0
IMPALA	B8	TAN	31	OIL PRESSURE INDICATOR LAMP	8A-82-6
CHEV	B9	PNK	1439	"CHANGE OIL" INDICATOR	8A-20-3

8A - 82 - 12 ELECTRICAL DIAGNOSIS

INSTRUMENT CLUSTER: DIGITAL

APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
IMPALA	B9	BRN	358	SIR INDICATOR LAMP	8A-82-9
IMPALA	B10	PPL	209	BRAKE FLUID LEVEL INDICATOR LAMP	8A-82-9
CHEV	B11	YEL/BLK	68	"LOW" COOLANT INDICATOR	8A-82-1
IMPALA	B11	LT BLU	14	LEFT FRONT TURN SIGNAL LAMP FEED	8A-82-10



22 - WAY F MICRO - PACK 100 SERIES

BLK

RIGHT INSTRUMENT CLUSTER CONNECTOR

**5-24-84
BS0048A82**

APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
CHEV	A1	LT BLU	14	TURN INDICATOR, LH	8A-110-2
CHEV	A2	LT GRN	11	HIGH BEAM INDICATOR	8A-100-0
IMPALA	A2	BLK/WHT	99	WINDSHIELD WASHER FLUID LEVEL SENSOR SIGNAL	8A-82-8
	A4	DK GRN	135	COOLANT TEMPERATURE GAGE	8A-82-1
	A5	BRN	241	IGNITION	8A-82-0
	A6	BLK/WHT	351	GROUND	8A-82-0
CHEV	A8	DK BLU/WHT	149	"DOOR OPEN" INDICATOR	8A-82-3
CHEV	A9	DK GRN	146	"GATE AJAR" INDICATOR	8A-82-3
CHEV	A10	BRN	358	"AIR BAG" INDICATOR	8A-47-0
IMPALA	A10	PPL	30	FUEL GAGE SENSOR SIGNAL	8A-82-7
	A11	PNK	39	IGNITION	8A-82-1
CHEV	B1	LT BLU	811	ENGLISH/METRIC DISPLAY	8A-82-0
IMPALA	B1	WHT	121	TACHOMETER SIGNAL	8A-82-9
CHEV	B2	YEL	32	STEP DIM INPUT	8A-117-0, 1
CHEV	B2	BRN	1244 (SEO)	STEP DIM INPUT	8A-117-4

APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
IMPALA	B2	BRN	25	CHARGE INDICATOR LAMP OUTPUT	8A-82-7
	B3	DK BLU	15	TURN INDICATOR, RH	8A-110-2
	B4	BLK	450	GROUND	8A-82-3
CHEV	B5	YEL	237	"FASTEN SEAT BELT" INDICATOR	8A-76-0
SEO	B6	ORN	40	BATT FEED "DOOR OPEN" INDICATOR	8A-82-3
IMPALA	B7	PNK	1439	IGNITION 1 FUSE OUTPUT	8A-82-6
CHEV	B8	PPL	209	"BRAKE" INDICATOR	8A-41-0
IMPALA	B8	GRY	728	SECURITY INDICATOR LAMP OUTPUT	8A-82-6
IMPALA	B10	BRN/WHT	1173	LOW OIL LEVEL INDICATOR LAMP OUTPUT	8A-82-6
IMPALA	B11	YEL/BLK	68	LOW COOLANT LEVEL INDICATOR LAMP OUTPUT	8A-82-6

COMPONENT LOCATION 201-PG FIG. CONN

Endgate Lower Lock Ajar Switch.....	In Endgate near RH side.....	34.....	50
Engine Coolant Temperature Gage Sensor.....	Forward LH side of Engine Block, below Manifold		
Engine Oil Level Sensor.....	LH side of Engine Oil Pan		
Fuel Pump Switch and Engine Oil Pressure Gage Sensor.....	Rear center of Engine		
Fuel Sender.....	Mounted in Fuel Tank, part of Fuel Tank Unit		
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19
Ignition Switch.....	Mounted on upper RH side of Steering Column.....	13.....	21
Instrument Cluster.....	LH side of I/P centered above Steering Column		
Powertrain Control Module (PCM).....	Engine Compartment, forward of LH Wheelhouse under Air Cleaner.....	4.....	8
Windshield Washer Solvent Level Switch.....	Mounted in Windshield Washer Solvent Container, LH Front Fender.....	5.....	9
C103 (3 cavities).....	Engine Harn to Forward Lamp Harn, at RH Fender		
C200 (56 cavities).....	Body Harn to I/P Harn, bolted to bracket above Accelerator Pedal.....	14.....	22..... 202-1
C201 (6 cavities)(Base).....	Body Harn to I/P Harn, lower RH side of Steering Column, next to C200.....	11.....	19..... 202-5
C201 (6 cavities)(w/T61).....	Daytime Running Lamps (DRL) Wiring Harn to Body Harn, lower RH side of Steering Column, above C200.....	11.....	19..... 202-5
C201 (6 cavities)(w/T82).....	Twilight Sentinel (TWS) Wiring Harn to Body Harn, lower RH side of Steering Column, next to C200.....	11.....	19..... 202-5
C202 (6 cavities)(w/T61).....	I/P Harn to Daytime Running Lamps (DRL) Wiring Harn, right of Steering Column, next to C200.....	11.....	19..... 202-5

INSTRUMENT CLUSTER: DIGITAL

COMPONENT	LOCATION	201-PG	FIG.	CONN
C202 (6 cavities)(w/T82).....	I/P Harn to Twilight Sentinel Wiring Harn, right of Steering Column, next to C200.....	11	19.....	202-5
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	26.....	202-3
C205 (10 cavities).....	Engine Harn to I/P Harn, right of I/P Compartment.....	18	29.....	202-4
C400 (8 cavities)(Sedan)	Body Harn to Rear Lamp Harn, in Luggage Compartment, on LH Rear Fender	32	47.....	202-6
C400 (6 cavities)(Wagon).....	LH Stoplamp Harn to Rear Body Harn at LH "D" Pillar.....	31	46.....	202-5
C402 (3 cavities)(Wagon).....	Rear Lamp Harn to Fuel Pump/Level Sender			
C405 (6 cavities)(Wagon).....	Body Harn to Endgate Harn, near center of LH "D" Pillar..	34	49.....	202-7
C406 (6 cavities)(Wagon).....	Tailgate Harn to Body near center of LH "D" Pillar.....	34	49.....	202-8
G104.....	Engine Compartment on front of LH Cylinder Head	6	11	
G106.....	RH Headlamp Support, forward of Battery	0	2	
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G202.....	Base of RH "A" Pillar, behind kickpad	16	26	
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment			
G401 (Wagon)	Near center of LH "D" Pillar	31	46	
P100	RH I/P, forward of Blower Motor	18	29	
P400	LH Rear of Vehicle in Luggage Compartment (Sedan) or near Taillamps (Wagon)	32	47	
P403	Between Tailgate and LH "D" Pillar			
S100	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S200	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S201	I/P Harn, approx 12 cm from C200 branch breakout			
S202 (w/T61).....	Daytime Running Lamps (DRL) Wiring Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S207 (w/T61).....	Daytime Running Lamps (DRL) Wiring Harn, approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn			
S207 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S212	I/P Harn, approx 12 cm from I/P Compartment Lamp Conn branch breakout			
S213	I/P Harn, approx 12 cm from Heater-A/C Control Conn branch breakout			

COMPONENT	LOCATION	201-PG FIG. CONN
S221 (w/WX7)	I/P Harn, approx 4 cm from C200 branch breakout	
S224	I/P Harn, behind Instrument Cluster approx 26 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S231	Body Harn, approx 16 cm from Convenience Center breakout	
S232	Body Harn, approx 10 cm from SDM breakout	
S251	Body Harn, approx 7 cm from SDM breakout	
S255	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout, before spiral taping	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	
S400 (Sedan)	Body Rear Wiring Harn, approx 4 cm from C416 branch breakout	
S400 (Wagon)	LH Stoplamp Wiring Harn, approx 12 cm from LH Lower Tail/Turn/Stoplamp Conn branch breakout	
S402 (SEO Wagon)	Tailgate Harn, approx 5 cm from High Mount Stoplamp Conn breakout	
S412 (Sedan)	Body Harn, approx 21 cm from C308 branch breakout, in Rear Compartment	
S414	Body Harn, approx 26 cm from Remote Control Door Lock Module breakout	
S420	Body Harn, approx 12 cm from C400	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuses #11, #20, #33 and #42.
2. Check the indicator bulbs.
3. If more than one indicator is out, check the Instrument Cluster Printed Circuit for flaws.
4. Check that grounds G104, G106, G200, G202 and G401 are clean and tight.
 - For Instrument Cluster removal and replacement procedures, refer to SECTION 8C.
5. If any segment of Speedometer fails to illuminate, send cluster out for repair.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SPEEDOMETER SEGMENTS FAIL TO DIM

If the Speedometer segments fail to dim, perform the following check:

- Remove Instrument Cluster, disconnect Instrument Cluster connector C1. Check for varying voltage on terminal "A4" while turning dimming wheel, with Headlamp Switch in "PARK."
 - 0 volts: Repair open in CKT 8 to source.
 - Voltage present: Check for battery voltage on terminal "B2" of Instrument Cluster connector C2.
 - 0 volts: Repair open in CKT 32.
 - Voltage present: Service Instrument Cluster.

INSTRUMENT CLUSTER: DIGITAL

INSTRUMENT CLUSTER IS PARTIALLY OR COMPLETELY INOPERATIVE

If the Instrument Cluster is not operating properly, perform the following checks:

- Check terminals "A5," "B6," and "A11" of Instrument Cluster connector C2, and terminal "B2" of Instrument Cluster connector C1 for battery voltage.
 - No voltage one or more terminals: Repair open circuit to Fuse Block.
 - Battery voltage all terminals: Service Instrument Cluster.

- Check terminals "A6" and "B4" of Instrument Cluster connector C2, and terminal "B3" of Instrument Cluster connector C1 for continuity to ground.

- No continuity to ground on one or more terminals: Repair open circuit to ground.
- Continuity to ground all terminals: Service Instrument Cluster.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Turn Ignition Switch to "RUN."	• "AIR BAG" Indicator will flash 7 times, then go "OFF." • "ABS" Indicator is "ON" for at least 2 seconds. • "CHECK GAGE" Indicator will illuminate. • Coolant Temperature Gage shows the coolant temperature. • Fasten Seat Belt Indicator will come "ON" for 6-8 seconds. • Fuel Gage shows current fuel level. • "LOW" Fuel Indicator will come "ON" for 2 seconds. • "LOW OIL LEVEL" Indicator illuminates for 2 seconds. • Oil Pressure Gage reads low. • "PASS KEY FAULT" Indicator will illuminate for 2-3 seconds. • "SERVICE ENGINE SOON" Indicator is "ON." • Speedometer illuminates briefly. • Voltmeter displays battery voltage. • Warning Alarm will sound if the driver's safety belt is unbuckled.
[2] • With Ignition Switch in "RUN," first operate the RH Turn Signal then the LH Turn Signal.	RH and LH Turn Indicators flash.
[3] • With the Headlamp Switch in "HEAD," place Headlamp Dimmer Switch in "HI."	HI Beam Indicator is "ON."
[4] • With Ignition Switch in "RUN," apply the Park Brake.	"BRAKE" Indicator is "ON."
[5] • With the Headlamp Switch in "HEAD" or "PARK," adjust the dimmer control.	Instrument Cluster illumination varies with Dimmer Control.
[6] • Start Engine and let idle.	• Coolant Temperature Gage indicates current coolant temperature. • During "CRANK," "AIR BAG" Indicator is "ON" (not flashing). • After "START" ("RUN"), Indicator will flash again 6 times, then go "OFF."

SYSTEM CHECK (Continued)

ACTION	NORMAL RESULTS
[7] • Turn Ignition Switch to "BULB TEST."	• "BRAKE" Indicator is "ON." • Coolant Temperature Gage reads "H." • Voltmeter reads low voltage.
[8] • Open any door.	"DOOR OPEN" Indicator is "ON."
[9] • Open Endgate as a door.	"GATE AJAR" Indicator comes "ON."

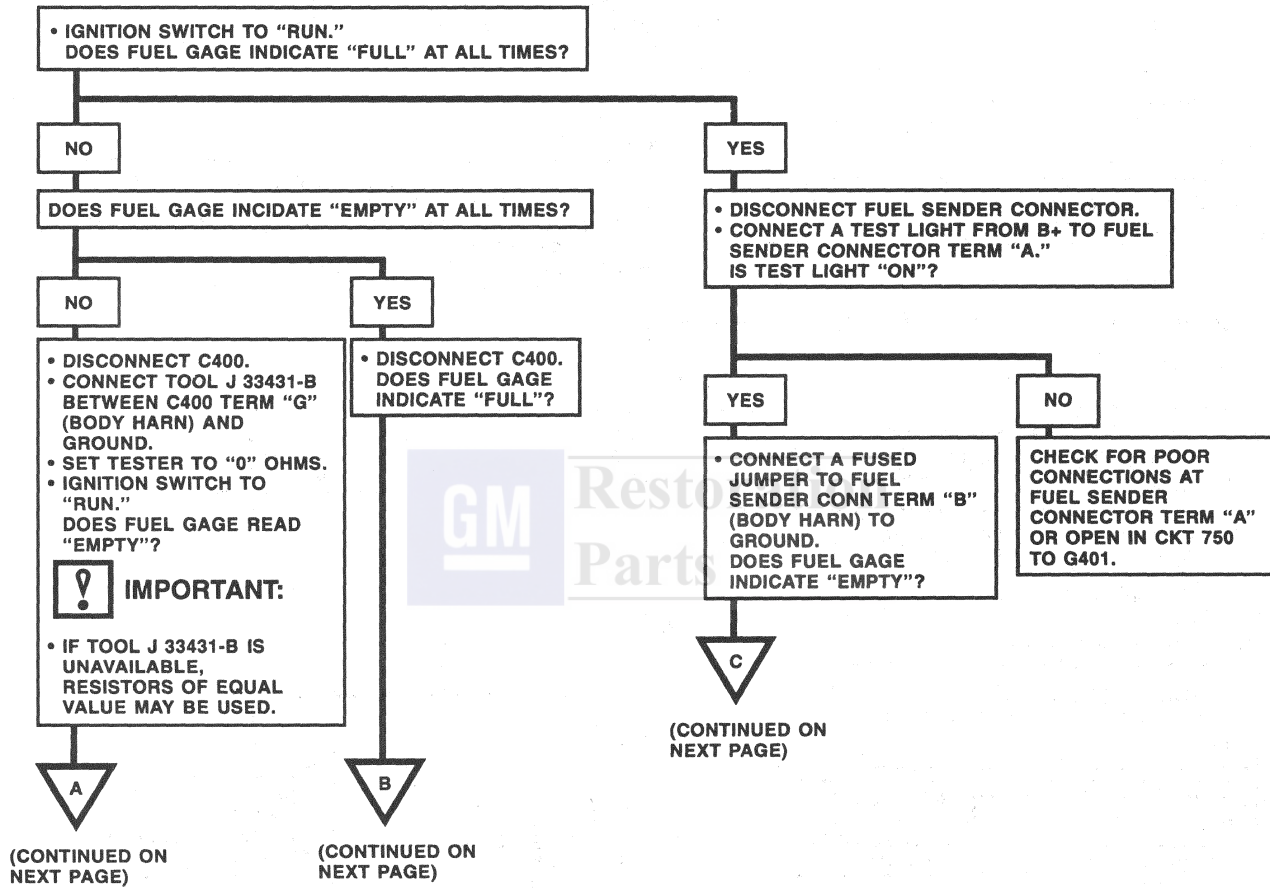
SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Fuel Gage inoperative or inaccurate.	Chart #1	8A-82-19
Coolant Temperature Gage inoperative or inaccurate.	Chart #2	8A-82-21
Oil Pressure Gage low at all times. (Non-SEO.)	Chart #3	8A-82-21
Oil Pressure Gage reads approx 3/4 scale with Ignition Switch in "RUN" and Engine not running. (non-SEO)	Chart #4	8A-82-22
"LOW OIL LEVEL" Indicator "ON," oil level OK.	Chart #5	8A-82-22
"LOW OIL LEVEL" Indicator inoperative, oil level low.	Chart #6	8A-82-23
"GATE AJAR" Indicator inoperative from Endgate.	Chart #7	8A-82-23
"GATE AJAR" Indicator "ON" at all times; Tailgate closed	Chart #8	8A-82-24
"LOW COOLANT" Indicator "ON," Coolant level OK.	Chart #9	8A-82-25
"LOW COOLANT" Indicator inoperative, Coolant level low.	Chart #10	8A-82-25
"LOW WASHER FLUID" Indicator does not come "ON" with Low Windshield Solvent Level.	Chart #11	8A-82-26
"LOW WASHER FLUID" Indicator is always "ON."	Chart #12	8A-82-26
Oil Pressure Gage inoperative or inaccurate. (SEO)	Chart #13	8A-82-27
"CHECK GAGE" Indicator does not come "ON" with Ignition in "RUN."	Check bulb. If bulb is OK, service Instrument Cluster.	
"DOOR OPEN" Indicator operates improperly.	Refer to SECTION 8A-114.	

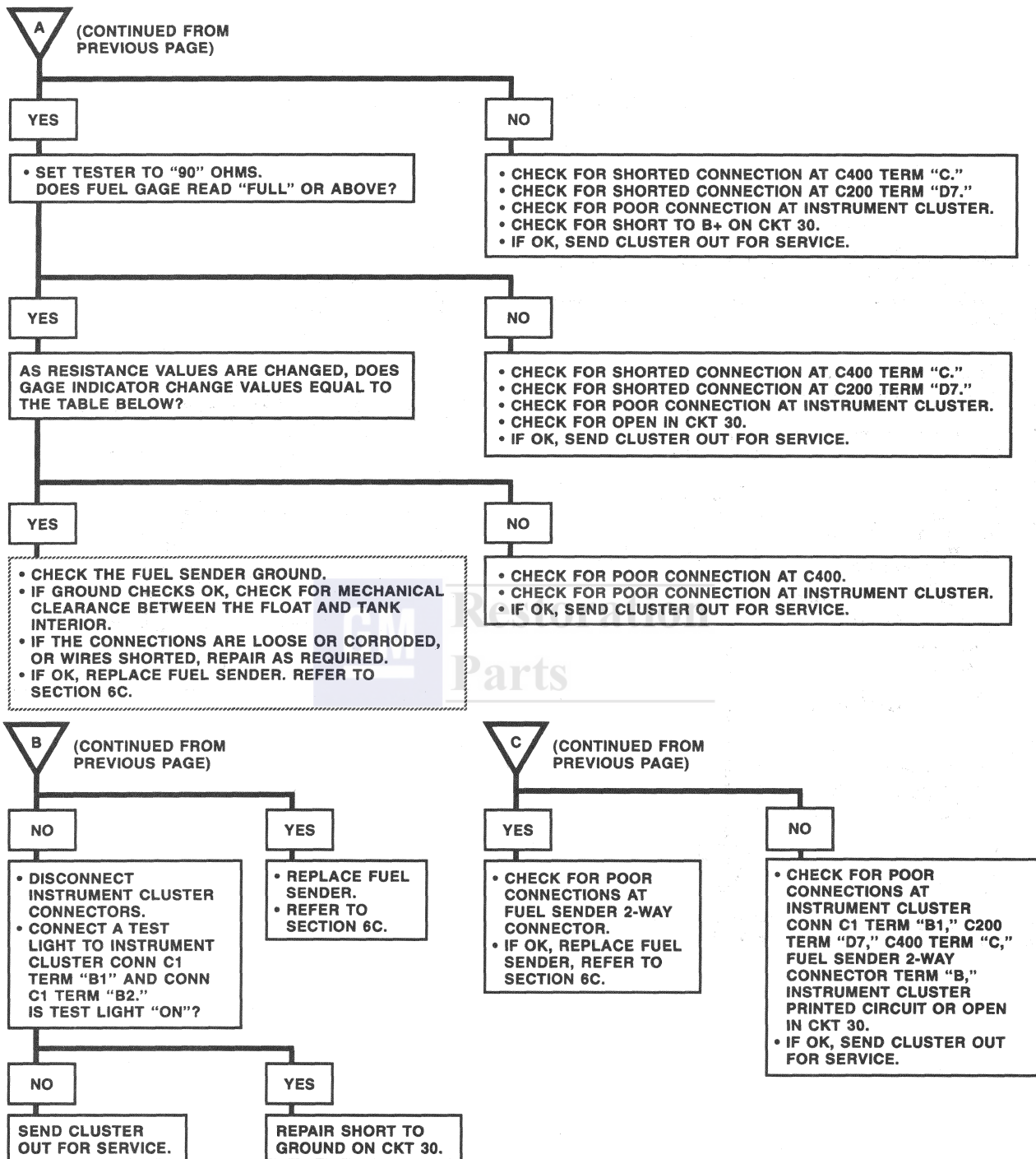
8A - 82 - 18 ELECTRICAL DIAGNOSIS**INSTRUMENT CLUSTER: DIGITAL****SYMPTOM TABLE (Continued)**

SYMPTOM	PROCEDURE	PAGE NUMBER
Voltmeter inoperative or inaccurate.	Check that Charging System is operating normally and the Battery is fully charged. If OK, service Instrument Cluster.	
Oil Pressure and Fuel Gages are inaccurate.	Connect a jumper wire from a good chassis ground to Instrument Cluster Connector C1 terminal "B3." If Gages are still inaccurate, service Instrument Cluster.	
"BRAKE" Indicator is inoperative or remains "ON" when Park Brake is released.	Refer to "Brake Warning System," page 8A-41-0.	
"FASTEN SEAT BELT" Indicator does not work properly.	Refer to "Audible Warnings," page 8A-76-0.	
"HI BEAM" Indicator does not work properly.	Refer to "Headlamps," page 8A-100-0.	
"TURN" Indicators do not work properly.	Refer to "Exterior Lamps," page 8A-110-0.	
"LOW FUEL" Indicator operates improperly.	Check bulb. Fuel Gage must operate normally for "LOW FUEL" Indicator to function. If Fuel Gage is OK, service Instrument Cluster.	
"SERVICE ENGINE SOON" Indicator remains illuminated or flashes.	Refer to Engine Controls.	
"AIR BAG" Indicator does not illuminate and/or flash.	Refer to SECTION 9J.	
"ABS" Indicator is inoperative or does not work properly.	Refer to SECTION 5E1.	
Instrument Cluster and/or Panel Illumination Lamps do not dim properly.	Refer to "Instrument Panel Dimming," page 8A-117-0.	
Speedometer inoperative. DTC P1652 set.	Refer to Engine Controls.	
Speedometer inoperative; DTC P1652 not set.	Chart #14	8A-82-28
Speedometer is Inaccurate	Chart #15	8A-82-28
Tachometer is Inoperative or Inaccurate (Engine runs normally)	Chart #16	8A-82-29
Speedometer inoperative. DTC P1652 not set. Cruise Control operates.	Check for open in CKT 817 between S251 and Instrument Cluster Connector. Also check for poor connection at I/P Cluster Connector C1 terminal "A2" (Chev) or connector C2 terminal "A4" (Buick). If OK, service Instrument Cluster.	
"DOOR OPEN" Indicator inoperative.	Check CKT 149 from Instrument Cluster connector C2 terminal "A8" to S229. If OK, refer to "Interior Lamps" page 8A-114-0.	

CHART #1
FUEL GAGE INOPERATIVE OR INACCURATE

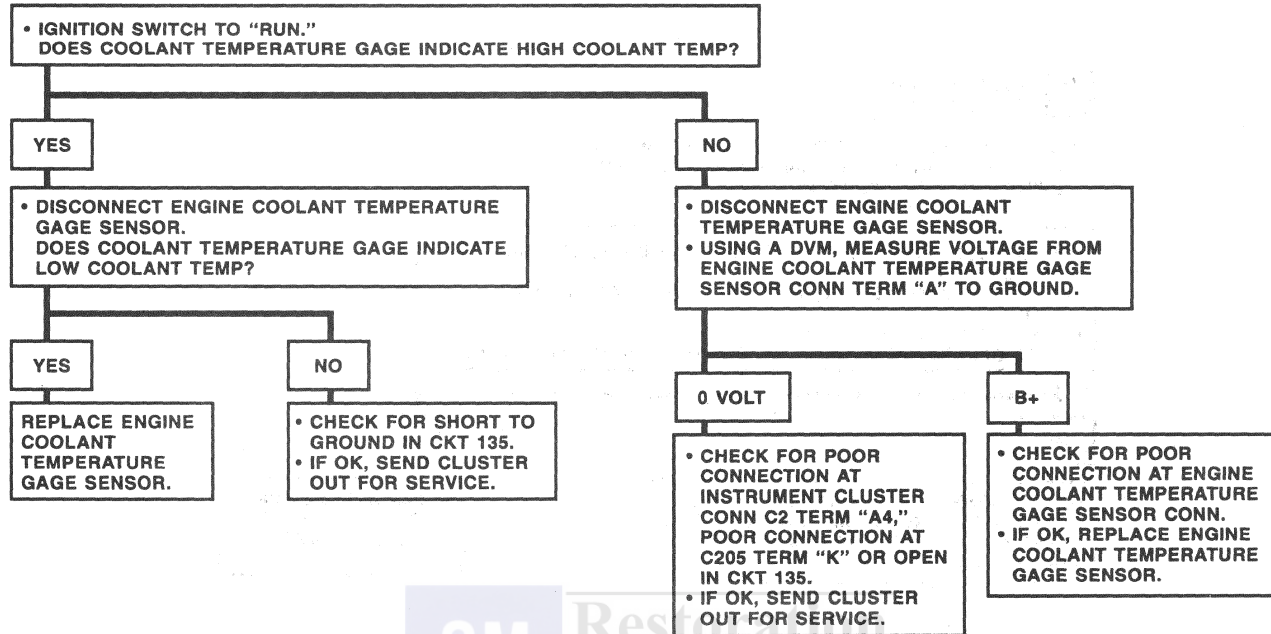


INSTRUMENT CLUSTER: DIGITAL



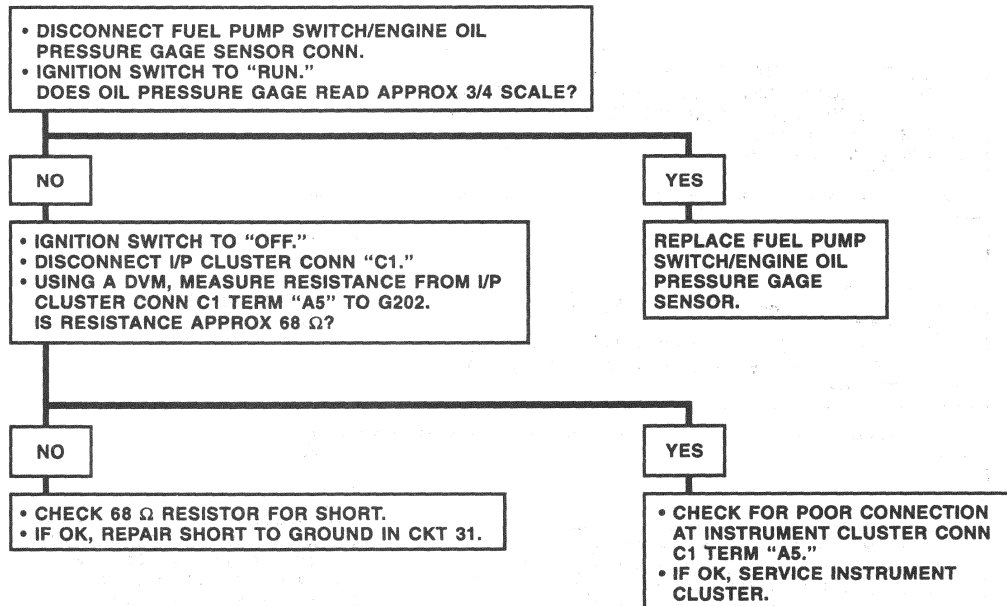
SENDER RESISTANCE	APPROXIMATE FUEL LEVEL
88 Ω	FULL
60 Ω	3/4
50 Ω	1/2
26 Ω	1/4
10 Ω	EMPTY

CHART #2
COOLANT TEMPERATURE GAGE INOPERATIVE OR INACCURATE



C9547

CHART #3
OIL PRESSURE GAGE LOW AT ALL TIMES



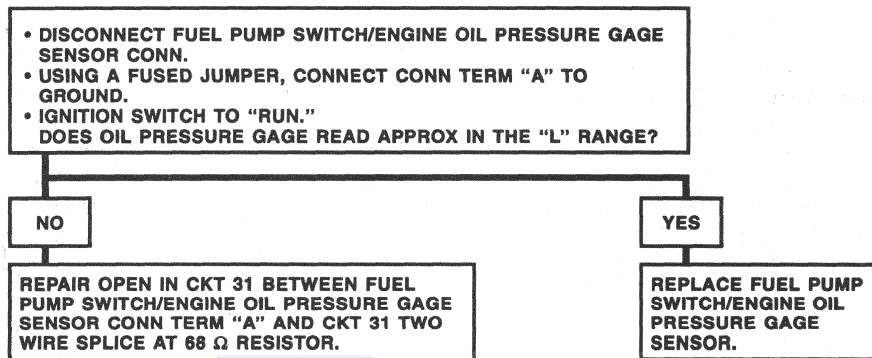
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INSTRUMENT CLUSTER: DIGITAL

CHART #4
OIL PRESSURE GAGE READS APPROX 3/4 SCALE WITH IGNITION
SWITCH IN "RUN" AND ENGINE NOT RUNNING

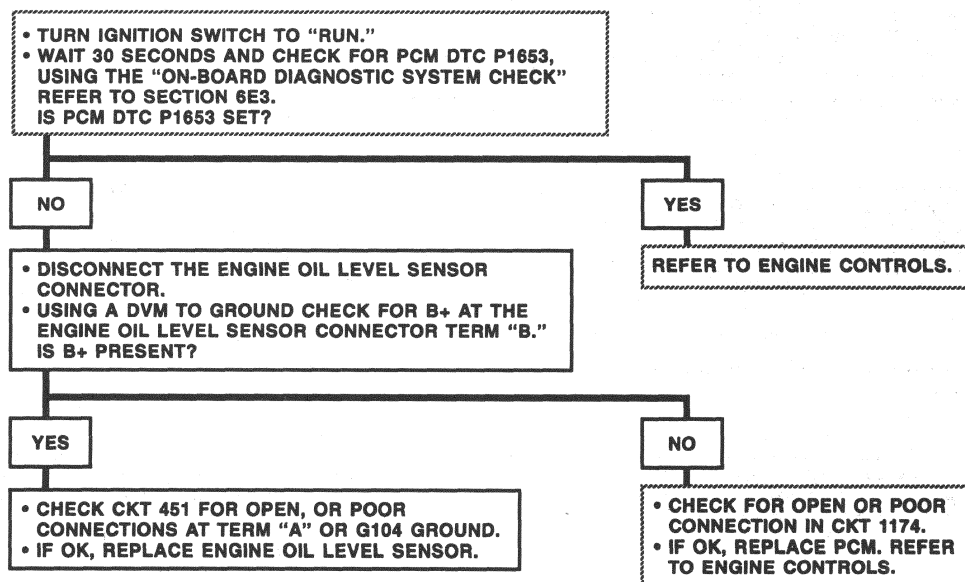
! IMPORTANT:

- IT IS NORMAL FOR THE OIL PRESSURE GAGE TO REMAIN APPROXIMATELY 3/4 SCALE WITH IGNITION SWITCH IN "OFF" POSITION.



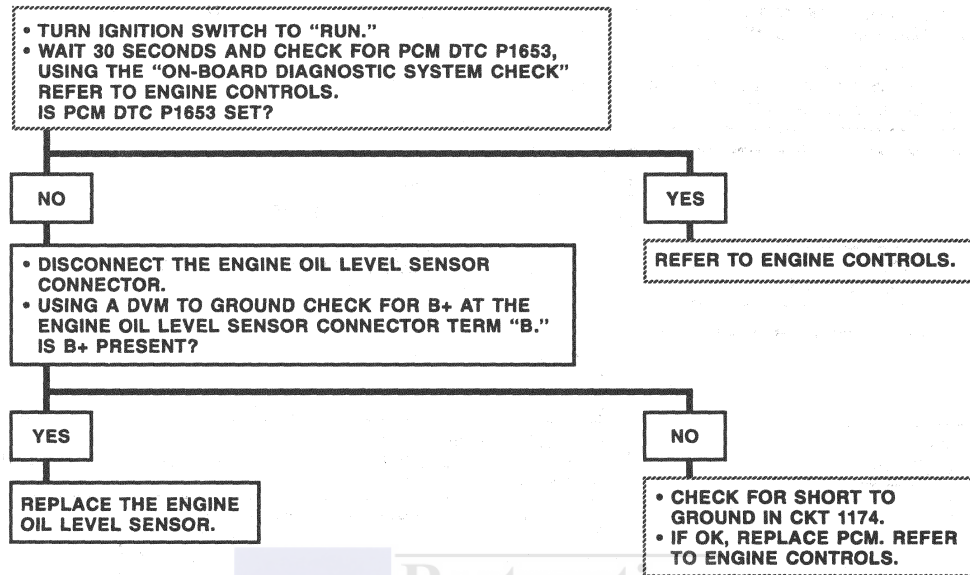
C9549

CHART #5
"LOW OIL LEVEL" INDICATOR "ON," OIL LEVEL OK



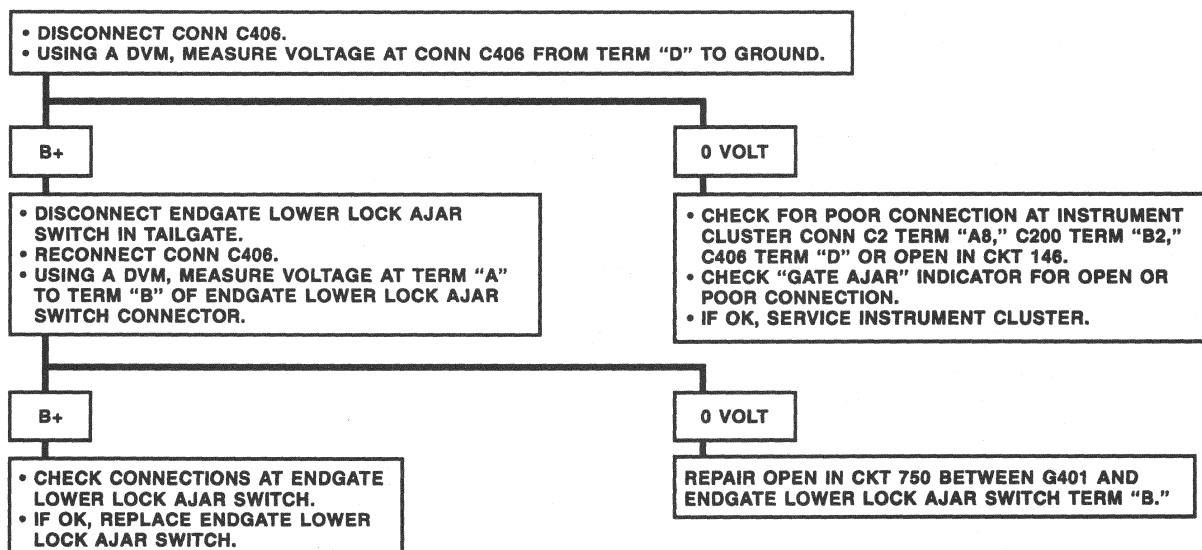
C9550

CHART #6
"LOW OIL LEVEL" INDICATOR INOPERATIVE, OIL LEVEL LOW



C9551

CHART #7
"GATE AJAR" INDICATOR INOPERATIVE FROM END GATE



C9552

INSTRUMENT CLUSTER: DIGITAL

CHART #8
"GATE AJAR" INDICATOR "ON" AT ALL TIMES; TAILGATE CLOSED

**IMPORTANT:**

- A MISADJUSTED REAR STRIKER CAN CAUSE THE "GATE AJAR" INDICATOR TO STAY ON. REFER TO SECTION 10-8 FOR PROPER ADJUSTMENT OF ENDGATE AND/OR STRIKER ADJUSTMENT.

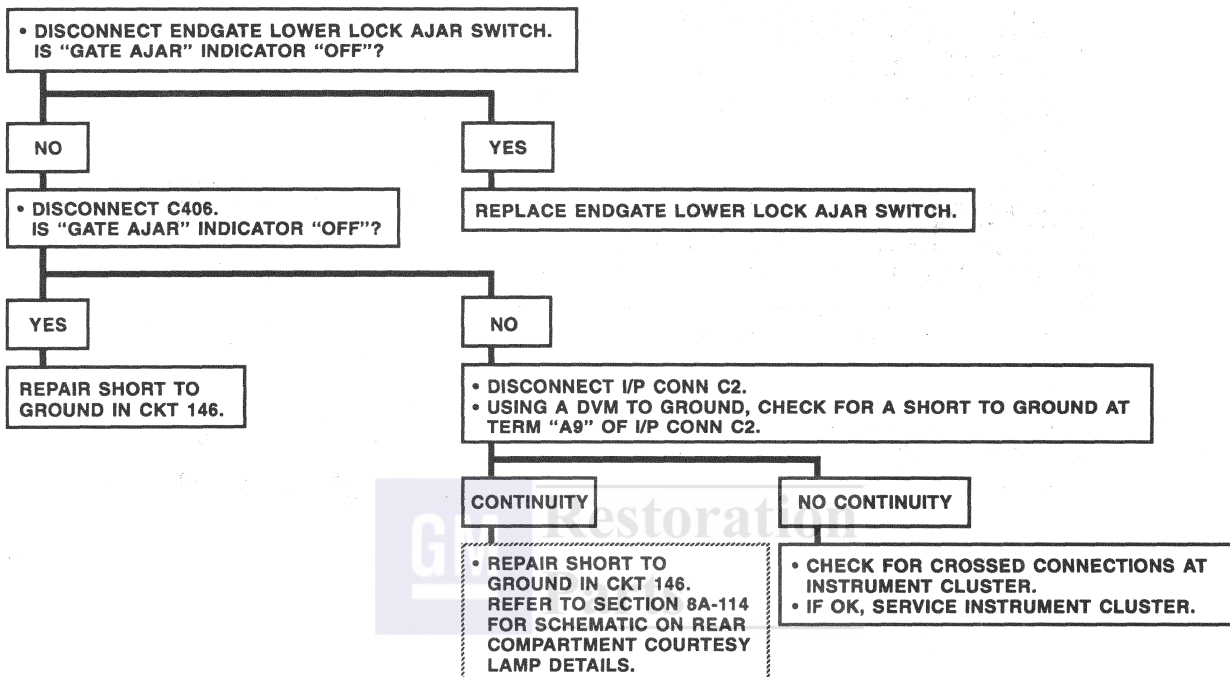
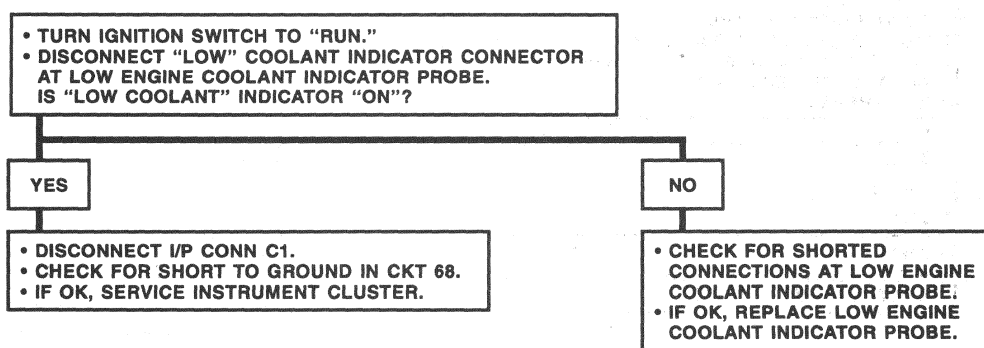
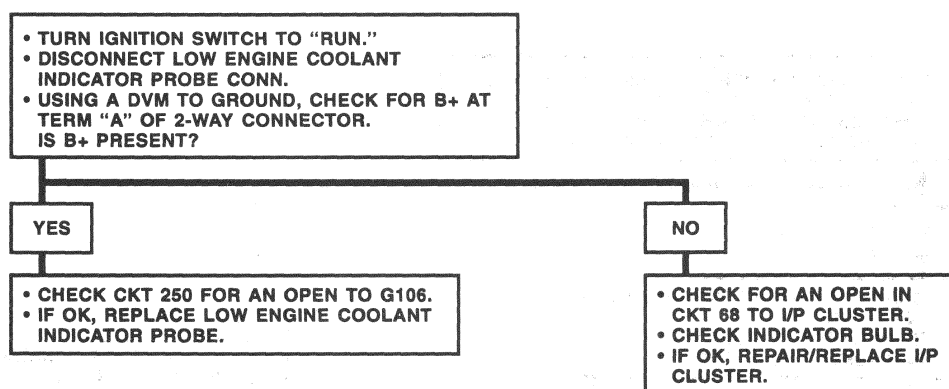


CHART #9
"LOW COOLANT" INDICATOR "ON," COOLANT LEVEL OK



C9554

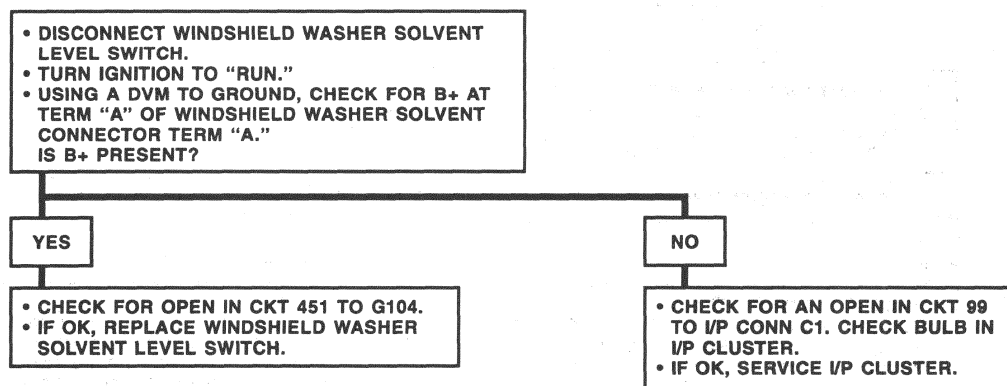
CHART #10
"LOW COOLANT" INDICATOR INOPERATIVE, COOLANT LEVEL LOW



C9555

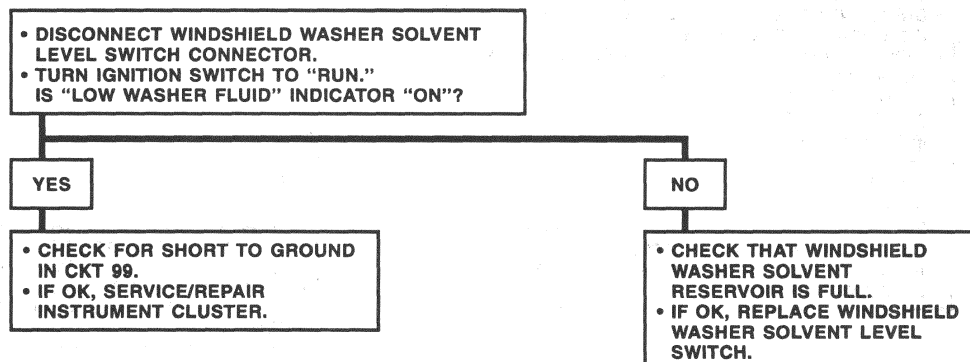
INSTRUMENT CLUSTER: DIGITAL

CHART #11
"LOW WASHER FLUID" INDICATOR DOES NOT COME "ON" WITH LOW
WINDSHIELD SOLVENT LEVEL



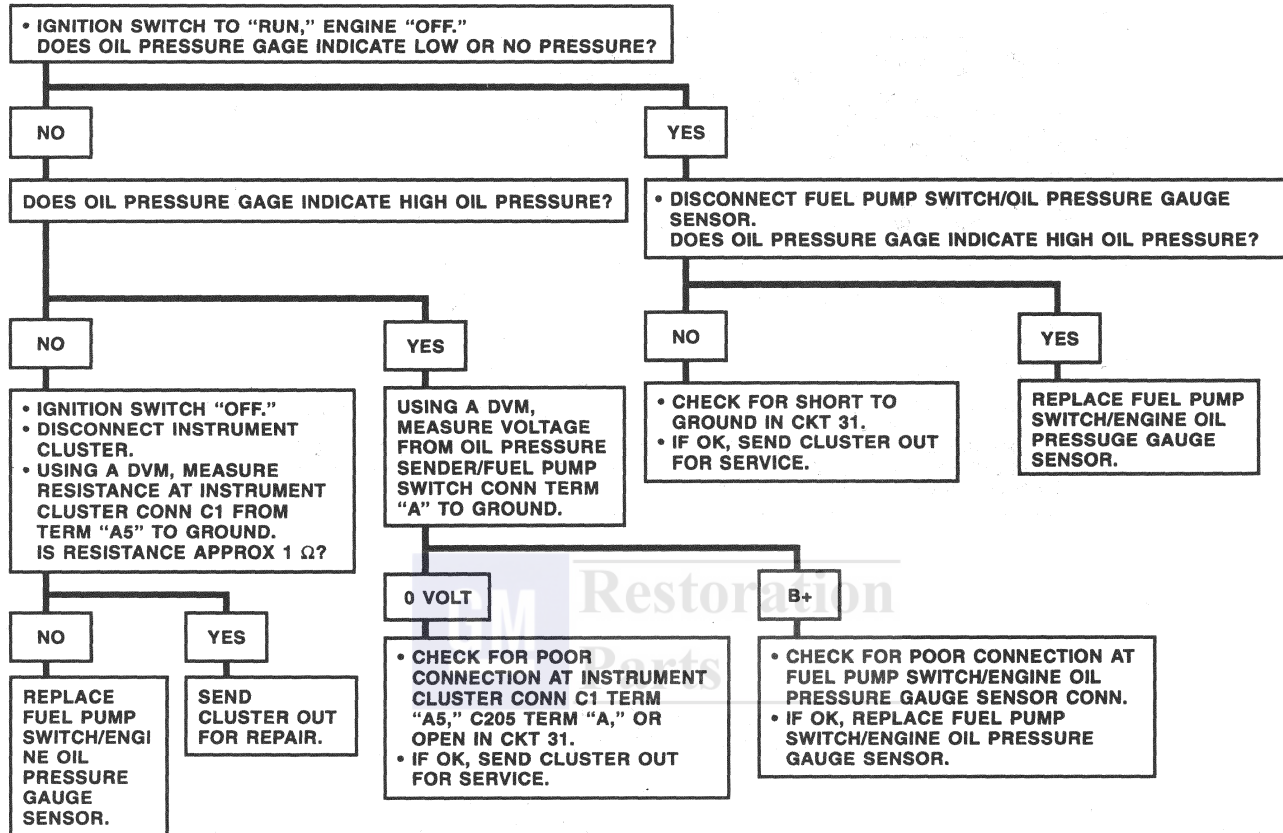
C9556

CHART #12
"LOW WASHER FLUID" INDICATOR IS ALWAYS "ON"



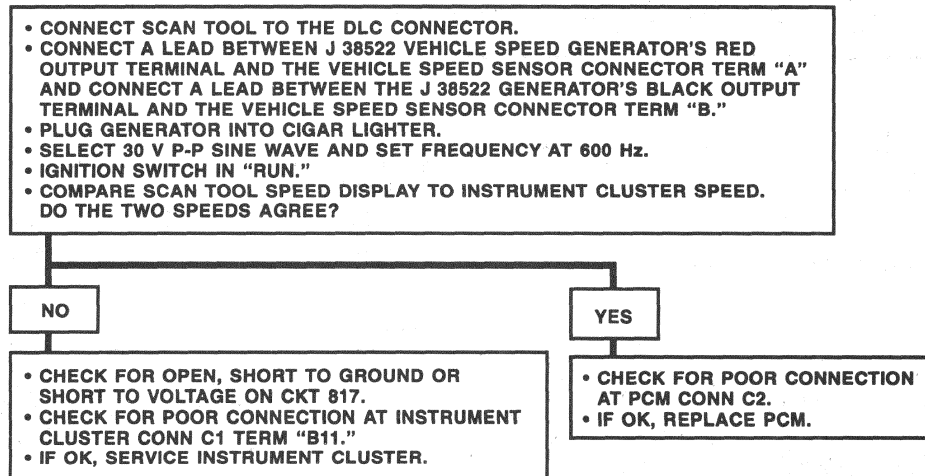
C9557

CHART #13
OIL PRESSURE GAGE INOPERATIVE OR INACCURATE (SEO)



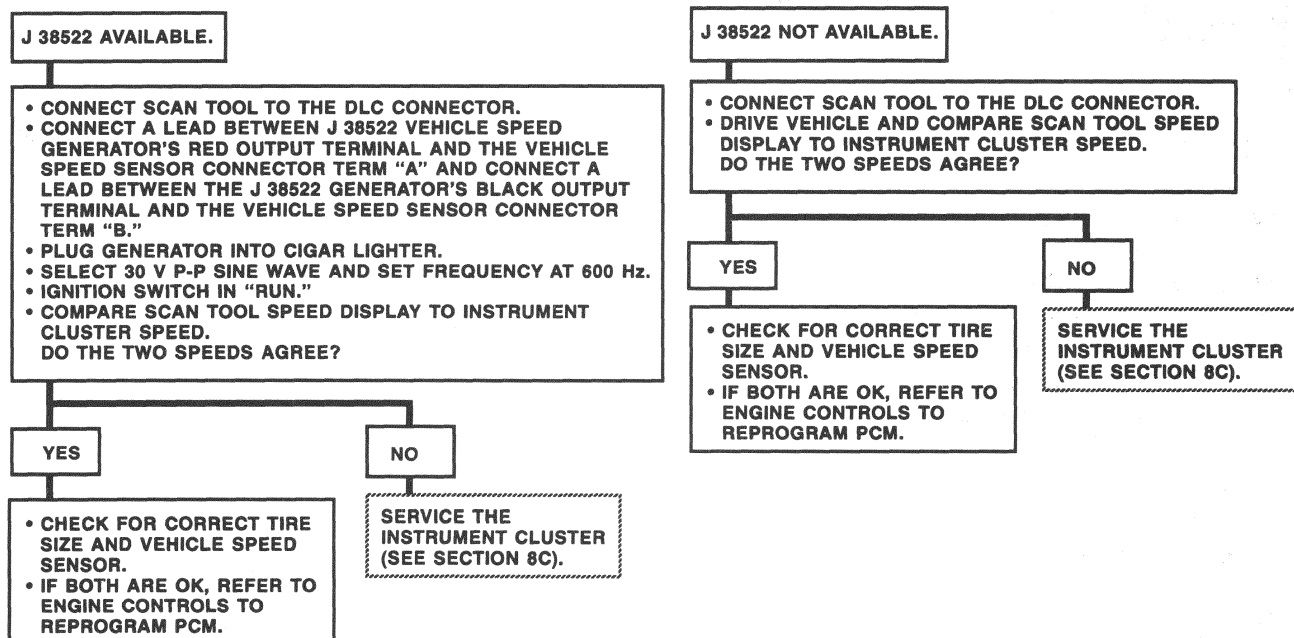
INSTRUMENT CLUSTER: DIGITAL

CHART #14
SPEEDOMETER INOPERATIVE; VSS CODE NOT SET



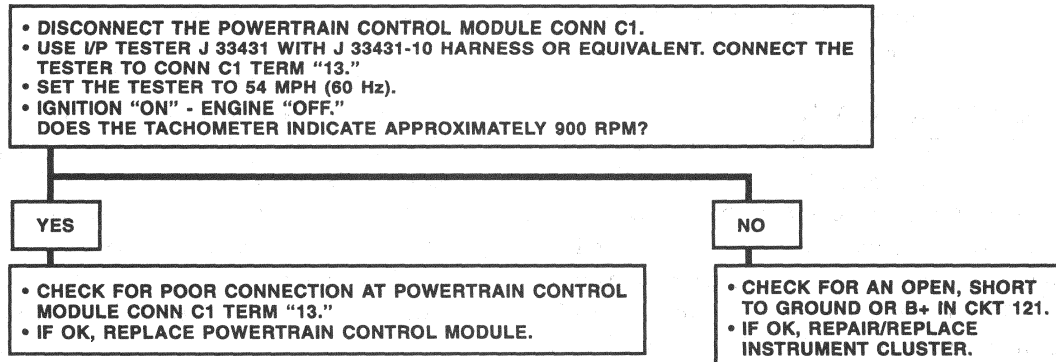
C10392

CHART #15
SPEEDOMETER IS INACCURATE



C10391

CHART #16 TACHOMETER INOPERATIVE OR INACCURATE (ENGINE RUNS NORMALLY)



C10016

CIRCUIT OPERATION

See the circuit referred to for the complete operation of an indicator and other components that work with it. Only the indicators that do not appear in other schematics are described in this section.

"CHECK GAGE" INDICATOR

When the Ignition Switch is in "RUN" and Engine oil pressure is at 0-3 psi, if the Generator voltage is below 10V or above 16V or Engine coolant temperature exceeds 140°C (255°F), the Instrument Cluster Logic Chip turns the "CHECK GAGE" Indicator "ON."

FUEL GAGE

The Fuel Gage pointer is controlled by varying the Fuel Level Sender resistance. With the Ignition Switch in "RUN," voltage is applied from I/P Fuse #11 to the Empty coil of the Fuel Gage and divides into two paths: 1) through the Fuel Sender to ground, and 2) through the Full coil to ground. The Gage pointer is controlled by changes of the Fuel Sender resistance. When the Fuel Gage resistance decreases, more current flows through the Fuel Sender and the Empty coil. At the same time, the current through the Full coil decreases.

With two coils operating the pointer, the gage is not affected by changes in the voltage of the system.

COOLANT TEMPERATURE GAGE

The Coolant Temperature Gage applies voltage from CKT 135 to the Engine Coolant Temperature Gage Sensor. The Engine Coolant Temperature Gage Sensor contains a

variable resistor. At 405°C (1005°F) the resistance is approximately 1365 ohms and at 1255°C (2605°F) the resistance is approximately 55 ohms. As the resistance of the Engine Coolant Temperature Gage Sensor decreases, the Coolant Temperature Gage senses a smaller voltage drop across the Engine Coolant Temperature Gage Sensor, indicating a higher coolant temperature. As the resistance of the Engine Coolant Temperature Gage Sensor increases, the Coolant Temperature Gage senses a larger voltage drop across the Engine Coolant Temperature Gage Sensor, indicating a lower coolant temperature.

OIL PRESSURE GAGE (NON-SEO)

A two position switch opens with oil pressure greater than approximately 24 kPa (3 psi), directing current flow in CKT 31 through a 68 ohm resistor to ground. This causes the Oil Pressure Gage to deflect approximately 3/4 scale.

VOLTMETER

The voltmeter senses Ignition voltage on CKT 241 and is grounded on CKT 351.

DIGITAL SPEEDOMETER

The Digital Speedometer Display uses a vacuum fluorescent display to show vehicle speed only. With the Ignition Switch in "RUN," current flows from I/P Fuse #20 to the Instrument Cluster connector C2. For 3 seconds, the entire display lights up to check all segments. After the segment check, only the vehicle speed data is displayed.

INSTRUMENT CLUSTER: DIGITAL

"GATE AJAR" INDICATOR

B+ is applied at all times to Instrument Cluster connector C2 terminal "B6," powering the "GATE AJAR" Indicator. CKT 146 connects this indicator to the Endgate Lower Lock Ajar Switch. When this switch closes to ground, the "GATE AJAR" Indicator comes "ON."

"LOW OIL LEVEL" INDICATOR

The "LOW OIL LEVEL" Indicator ground is controlled by the PCM. The PCM also supplies B+ to the Engine Oil Level Sensor, mounted in the Engine oil pan. The PCM will not check for a low oil condition until the drop in Engine Coolant Temperature corresponds with the chart below. The PCM compares the drop in coolant temperature from the last Ignition "OFF" cycle to the coolant temperature at the start of the current Ignition "ON" cycle.

If the coolant temperature drop conditions are not met, the "LOW OIL LEVEL" Indicator will come on for the 2 second bulb test only. (The Ignition must be "OFF" for a minimum of 5 seconds before the "LOW OIL LEVEL" Indicator can come "ON" again.) If the Indicator is "ON" because of a low oil condition, it will remain "ON" for the rest of the current Ignition Cycle, even if oil is added to the crankcase. A low oil condition exists with 2 3/4 or less quarts of oil remaining in Engine Oil Pan.

Ignition "ON"°C	Temperature drop since last Ignition "OFF" Cycle°C
-40	7
-28	7
-16	7
-4	7
8	7
20	8
32	10
44	12
56	14
68	16
80	19
92	22
104	22
116	22
128	22
140	22
152	22

OIL PRESSURE GAGE (SEO)

SEO vehicles use a Fuel Pump Switch and Engine Oil Pressure Gage Sensor to allow for a constant reading of the engines oil pressure. The resistance of the sensing portion varies from 1 to 88 ohms.

"LOW COOLANT" INDICATOR

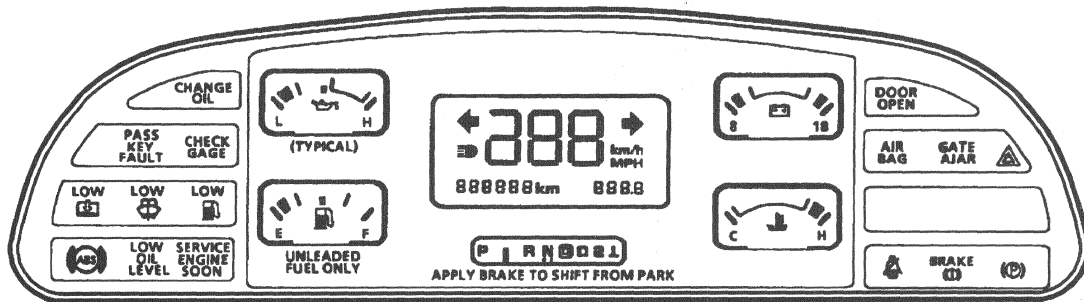
Ignition voltage is applied at all times to the Low Engine Coolant Indicator Probe. A magnetic float in the Coolant Recovery Reservoir rises and falls with the coolant level. A serviceable Reed-Type Switch (mounted in the bottom of the reservoir) senses the floating magnet. When the float (magnet) position gets lower in the reservoir, the Switch contacts are pulled together, grounding CKT 68.

"LOW FUEL" INDICATOR

The Instrument Cluster Logic Chip monitors the Fuel Sender resistance using CKT 30. When the Fuel Gage registers less than 1/8 tank of fuel, the resistance at terminal "A2" of connector C2 will be approximately $10 \pm 2 \Omega$. If this condition is met for 128 ± 64 seconds, the Logic Chip within the Instrument Cluster will ground the "LOW FUEL" Indicator, causing it to turn "ON." After refueling, the resistance at terminal "A2" of connector C2 will be above $15 \pm 2 \Omega$, depending on the amount of fuel in the fuel tank. Within the same Ignition Cycle, after approximately 128 ± 64 seconds, the Logic Chip within the Instrument Cluster will turn the "LOW FUEL" Indicator "OFF."

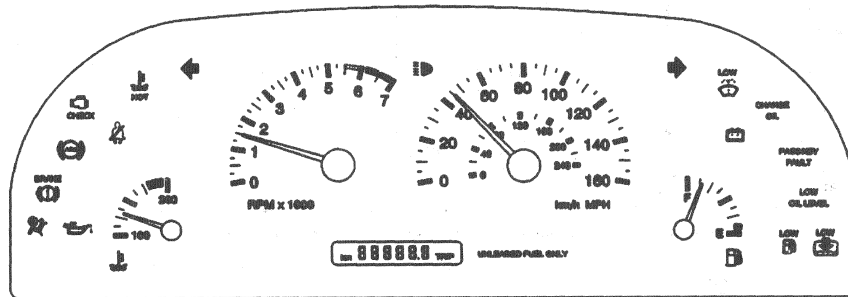
"LOW WASHER FLUID" INDICATOR

When the Ignition Switch is turned to "RUN," voltage is applied to the Windshield Washer Solvent Level Switch. If washer solvent level is low, the Windshield Washer Solvent Level Switch is closes, grounding CKT 99. The Instrument Cluster Logic Chip monitors CKT 99. When CKT 99 goes low, the Logic Chip grounds the "LOW WASHER FLUID" Indicator, causing it to turn "ON." Once the indicator has been turned "ON," it will stay "ON" until the windshield washer solvent container has been refilled, causing the Windshield Washer Solvent Level Switch to open. The Ignition Switch must then be cycled from "OFF" to "RUN" for the Indicator to turn "OFF."



(CHEVROLET)

06-07-95
BT0138A82

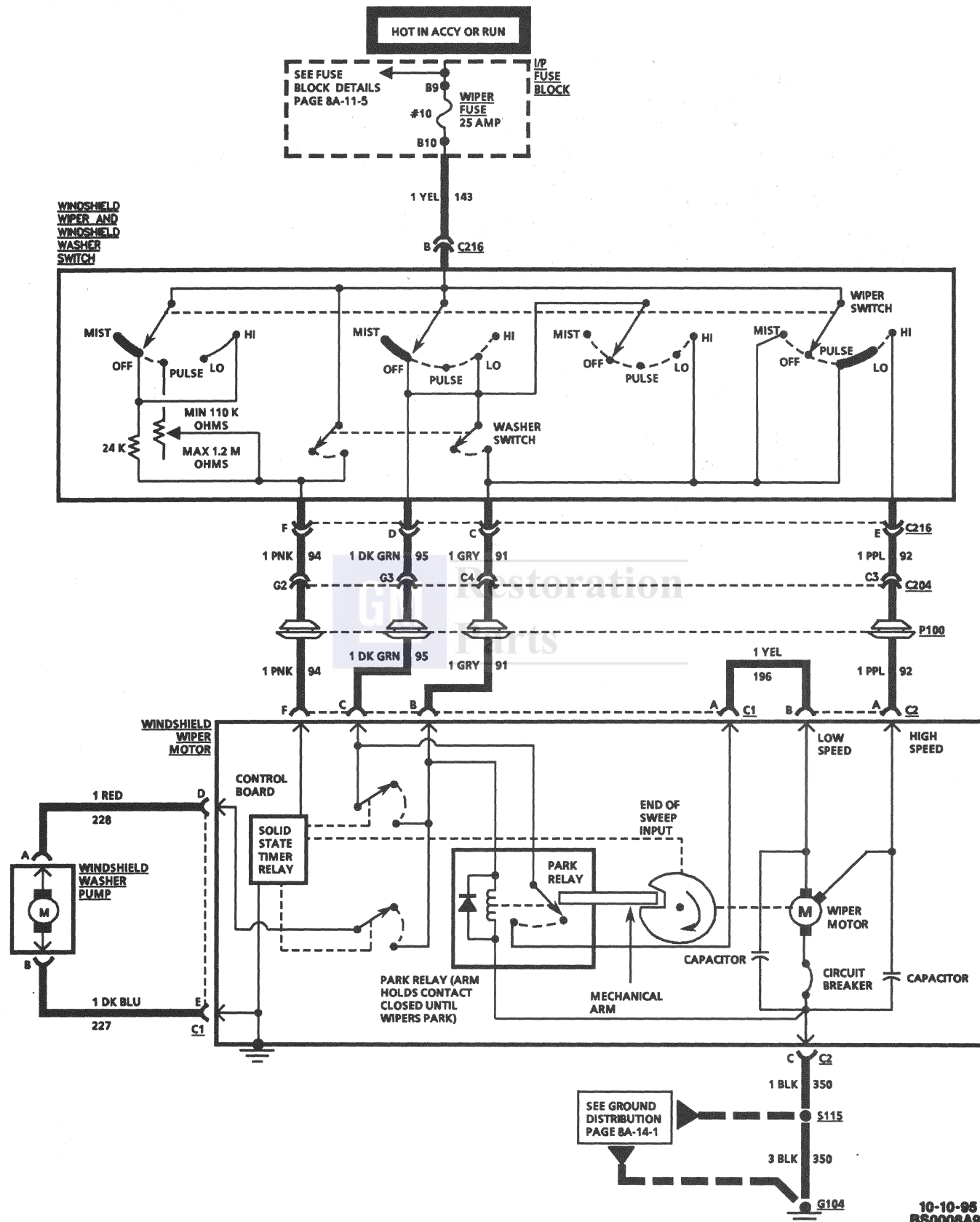


(IMPALA)

04-25-95
BT0148A82



WIPER/WASHER: PULSE



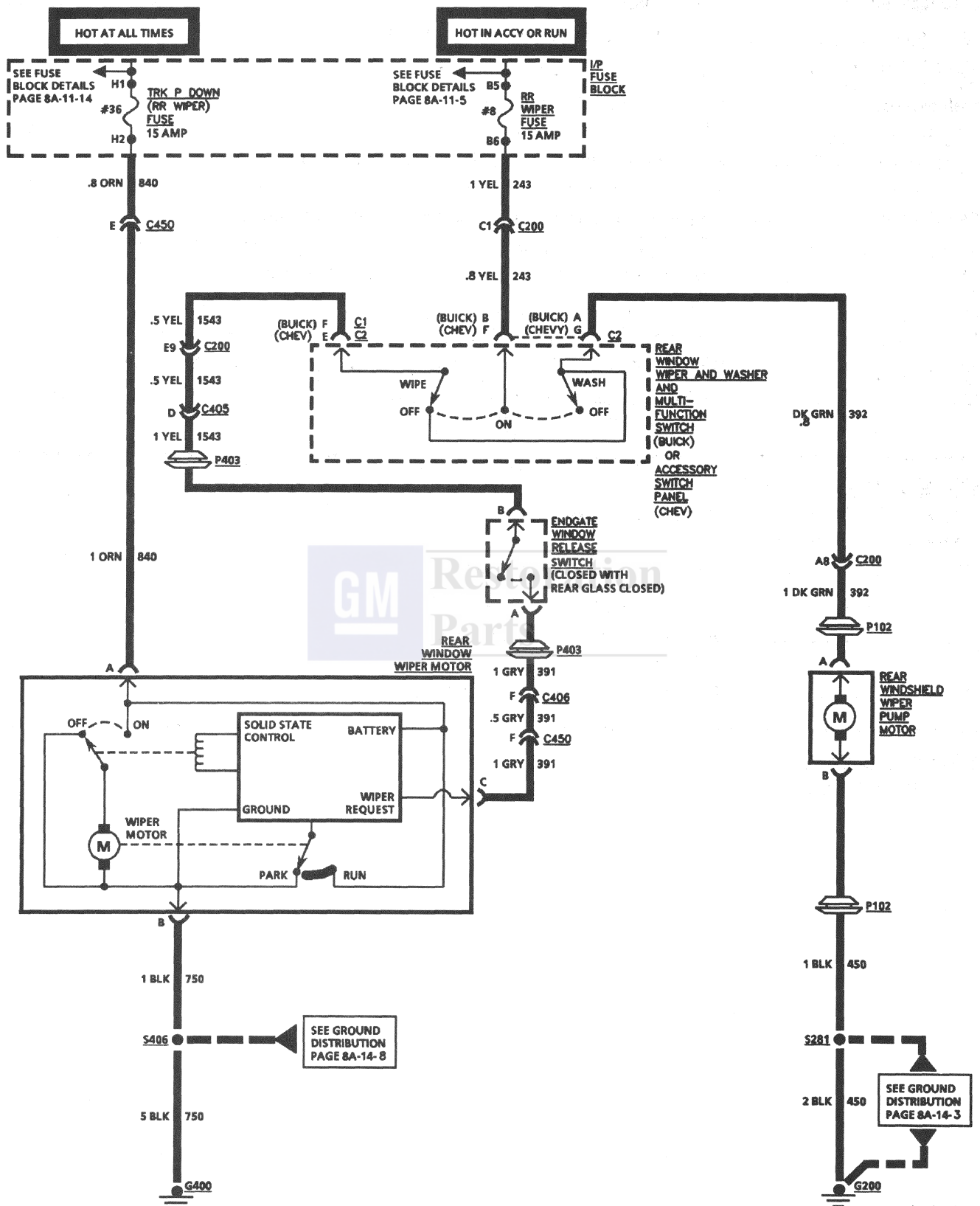
COMPONENT	LOCATION	201-PG	FIG.	CONN
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
Windshield Washer Pump.....	Attached to Washer Fluid Reservoir.....	5	.....	9
Windshield Wiper Motor	LH Rear Engine Compartment			
Windshield Wiper and Windshield Washer Switch.....	Part of Rear Window Wiper, Washer and Multifunction Switch	13	.....	21..... 202-6
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	.....	26..... 202-3
C216 (7 cavities).....	Body Harn to Windshield Wiper and Windshield Washer Switch			
G104.....	Engine Compartment front of LH Cylinder Head.....	6	.....	11
P100	RH I/P, forward of Blower Motor	18	.....	29
S115.....	Engine Harn, left side, approx 4 cm from Automatic Transmission Control Conn branch breakout			

SYSTEM DIAGNOSIS

- Refer to SECTION 8E for System Diagnosis and Service Procedures.



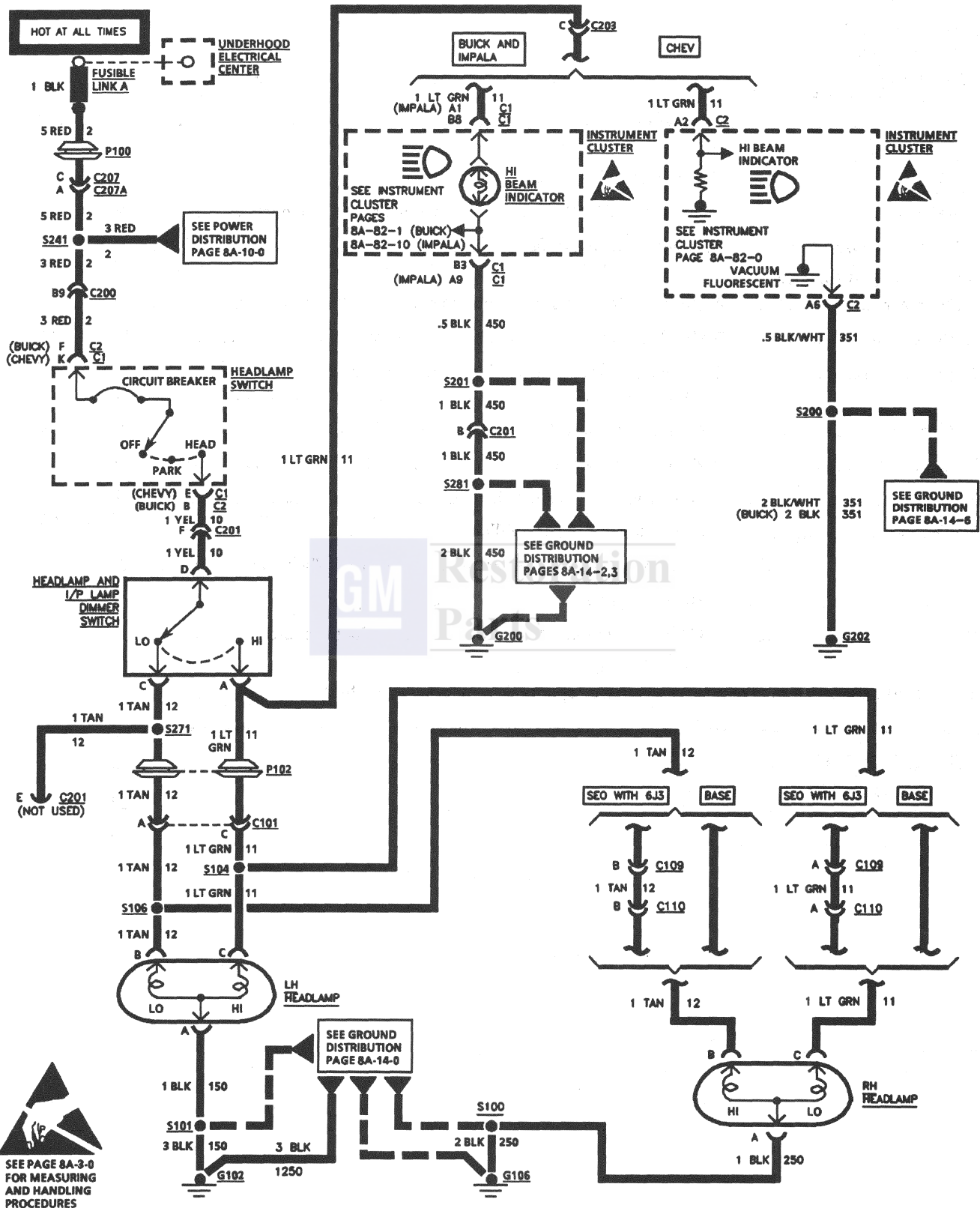
REAR WIPER/WASHER



COMPONENT	LOCATION	201-PG	FIG.	CONN
Accessory Switch Panel (Chev) or Rear Window Wiper/Washer and Multi-function Switch (Buick).....	LH side of I/P	10	17.....	202-8
Endgate Window Release Switch.....	Near center of Tailgate			
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Rear Window Wiper Motor.....	Attached to Rear Header	36	52	
Rear Windshield Washer Wiper Pump Motor.....	Attached to Washer Fluid Reservoir, in Engine Compartment	5	9	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C451 (6 cavities).....	Body Harn to Rear Header Harn, near center of LH "D" Pillar.....	34	49.....	202-6
C405 (6 cavities).....	Body Harn to Tailgate Harn, center of LH "D" Pillar.....	34	49.....	202-7
C406.....	Body Harn to Tailgate Harn, center LH "D" Pillar.....	34	49	
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G401 (Wagon)	Near center of RH "D" Pillar	34	49	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5	10	
P403	Between Endgate and LH "D" Pillar			
S281	Body Harn, approx 24 from Convenience Center branch breakout			
S406 (Wagon).....	Rear Body Harn, approx 17 cm from C412 breakout			

SYSTEM DIAGNOSIS

- See SECTION 8E1.



COMPONENT	LOCATION	201-PG	FIG.	CONN
Headlamp and I/P Lamp Dimmer Switch.....	LH side of I/P			
Fusible Link A.....	RH Engine Compartment, bolted to Underhood Electrical Center			
Headlamp, LH.....	LH Front of Vehicle.....	0.....	1	
Headlamp, RH.....	RH Front of Vehicle.....	0.....	2	
Headlamp Switch.....	LH side of I/P, part of Headlamp and I/P Lamp Dimmer Accessory Switch.....	9.....	16	
Instrument Cluster.....	LH side of I/P, centered above Steering Column.....	9.....	16	
Underhood Electrical Center.....	Engine Compartment, mounted to RH Wheelhouse.....	9.....	15	
C101 (4 cavities).....	Forward Lamp Harn to Body Harn, LH Front Engine compartment, near PCM.....	0.....	1.....	202-5
C109 (2 cavities).....	Forward Lamp Harn to SEO Flasher			
C110 (2 cavities).....	Forward Lamp Harn to SEO Flasher			
C201 (6 cavities).....	Body Harn to I/P Harn, at RH side of Steering Column above C200.....	11.....	19.....	202-5
C203 (10 cavities).....	Body Harn to I/P Harn, at RH side of Steering Column.....	11.....	19.....	202-5
C207 (6 cavities).....	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad.....	18.....	29	
C207A (3 cavities).....	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad.....	18.....	29	
G102.....	Behind LH Headlamp Support, forward of Air Cleaner.....	5.....	9	
G106.....	RH Headlamp Support, forward of Battery.....	0.....	2	
G200.....	Base of LH "A" Pillar, behind kickpad.....	11.....	19	
G202.....	At base of RH "A" Pillar, behind kickpad.....	16.....	26	
P100.....	RH I/P, forward of Blower Motor.....	18.....	29	
P102.....	Visible from Engine Compartment, behind LH Wheelhouse...	5.....	10	
S100.....	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S101.....	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout			
S104.....	Forward Lamp Harn, approx 20 cm from C100 branch breakout			
S106.....	Forward Lamp Harn, approx 13 cm from C100 branch breakout			
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S201 (Buick).....	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			

HEADLAMPS

COMPONENT	LOCATION	201-PG FIG. CONN
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout	
S241	Body Harn, approx 20 cm from SDM breakout	
S271	Body Harn, approx 14 cm from SDM breakout	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check LO Beam Lamps and HI Beam Lamps for damage to the filament or bulb.

CAUTION: Halogen bulbs contain a gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn the Headlamp Switch to "OFF" and allow bulb to cool before changing bulbs. Leave the Switch in the "OFF" position until bulb change is complete.
- Always wear eye protection when changing a halogen bulb.
- Handle the bulb only by its base. Avoid touching the glass.
- Do not drop or scratch the bulb. Keep moisture away.
- Place the used bulb in the new bulb's carton and dispose of it properly. Keep halogen bulbs out of reach of children.

2. Check Fusible Link A for damage, refer to "Power Distribution," page 8A-10-0 wiring schematic. If Fusible Link A is open, check for short to ground in CKT 2 or Headlamp Switch.

3. Check the LH and RH Headlamp connectors to be sure the connector seal is not damaged or missing.

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYSTEM CHECK

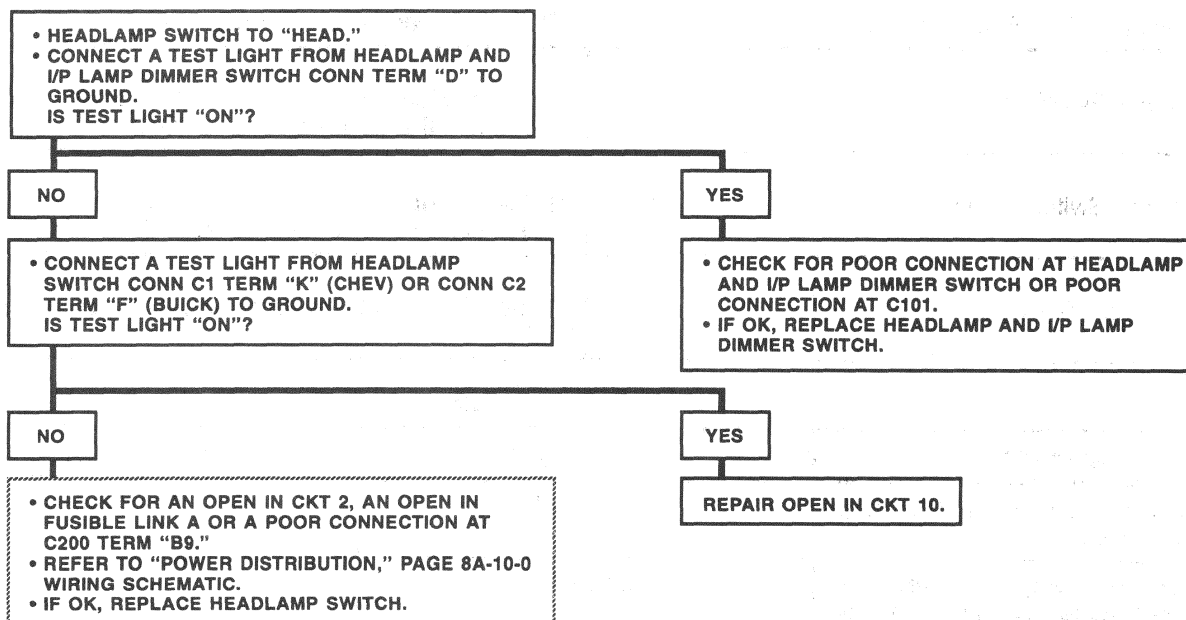
ACTION	NORMAL RESULTS
[1] • Headlamp Switch to "HEAD."	LO Beam Headlamps only are "ON."
[2] • Dimmer Switch to "HI."	LO Beam Headlamps are "OFF." HI Beam Headlamps are "ON." HI Beam Indicator is "ON."
[3] • Dimmer Switch to "LO."	HI Beam Headlamps are "OFF." HI Beam Indicator is "OFF." LO Beam Headlamps are "ON."
[4] • Headlamp Switch to "OFF."	HI and LO Beam Headlamps and HI Beam Indicator are "OFF."

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
LO Beam and HI Beam Headlamps are inoperative.	Chart #1	8A-100-4
LO Beam Headlamps inoperative, HI Beam Headlamps operate normally.	Chart #2	8A-100-4
HI Beam Headlamps inoperative, LO Beam Headlamps operate normally.	Chart #3	8A-100-5
HI Beam Indicator inoperative, HI Beam Headlamps operate normally.	Chart #4	8A-100-5
One LO Beam or one HI Beam Headlamp inoperative.	Chart #5	8A-100-6
HI Beam Headlamps and LO Beam Headlamps "ON" at the same time.	Replace Headlamp Dimmer Switch.	

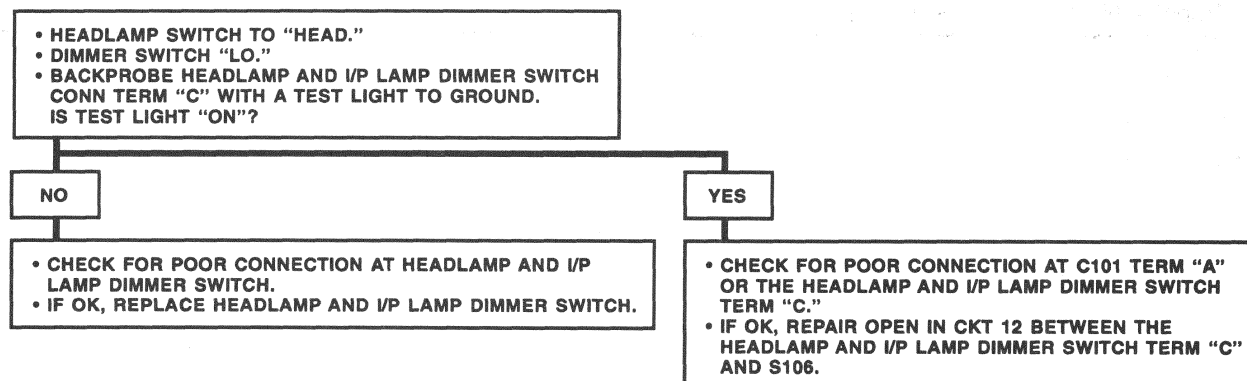
HEADLAMPS

CHART #1
LO BEAM AND HI BEAM HEADLAMPS ARE INOPERATIVE



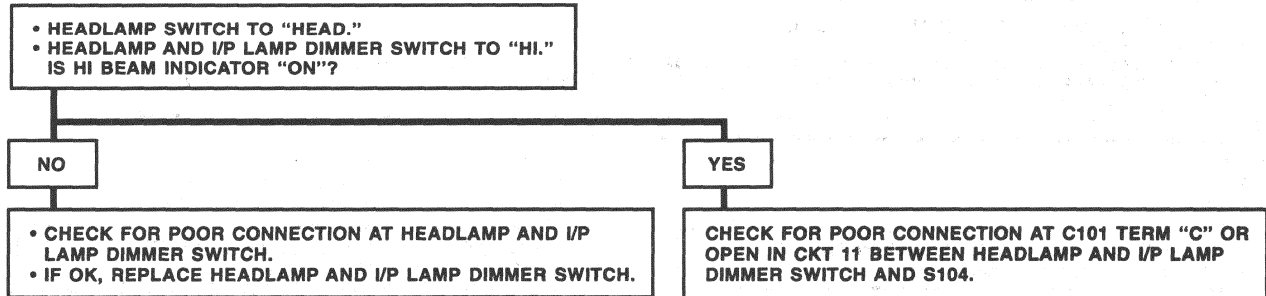
C9686

CHART #2
**LO BEAM HEADLAMPS INOPERATIVE,
HI BEAM HEADLAMPS OPERATE NORMALLY**



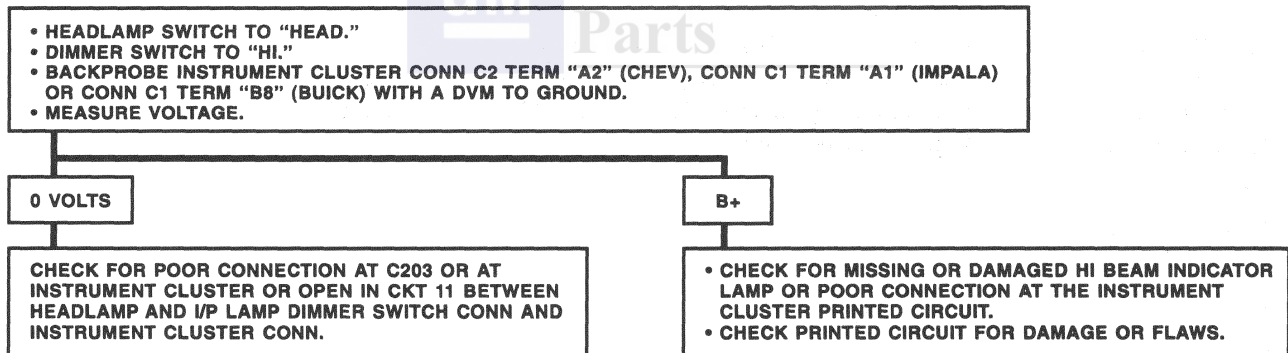
C9687

CHART #3
HI BEAM HEADLAMPS INOPERATIVE,
LO BEAM HEADLAMPS OPERATE NORMALLY



C9688

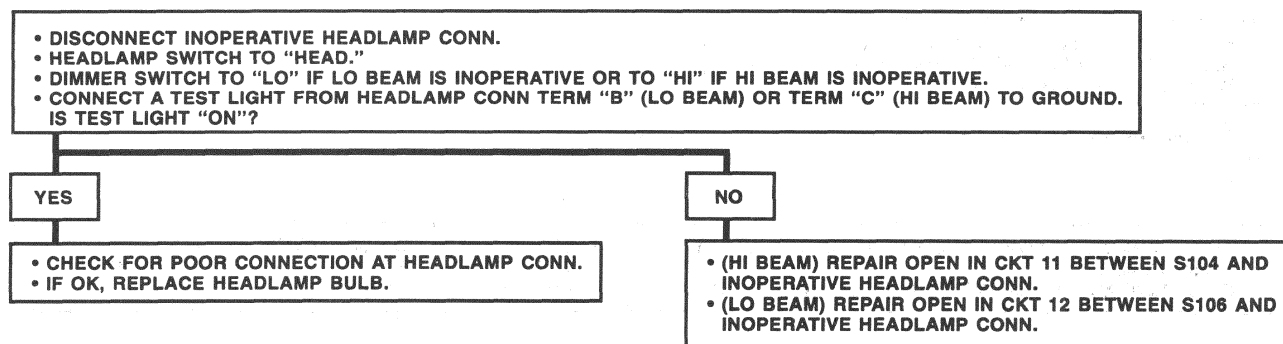
CHART #4
HI BEAM INDICATOR INOPERATIVE,
HI BEAM HEADLAMPS OPERATE NORMALLY



C9689

HEADLAMPS

CHART #5
ONE LO BEAM OR ONE HI BEAM HEADLAMP INOPERATIVE



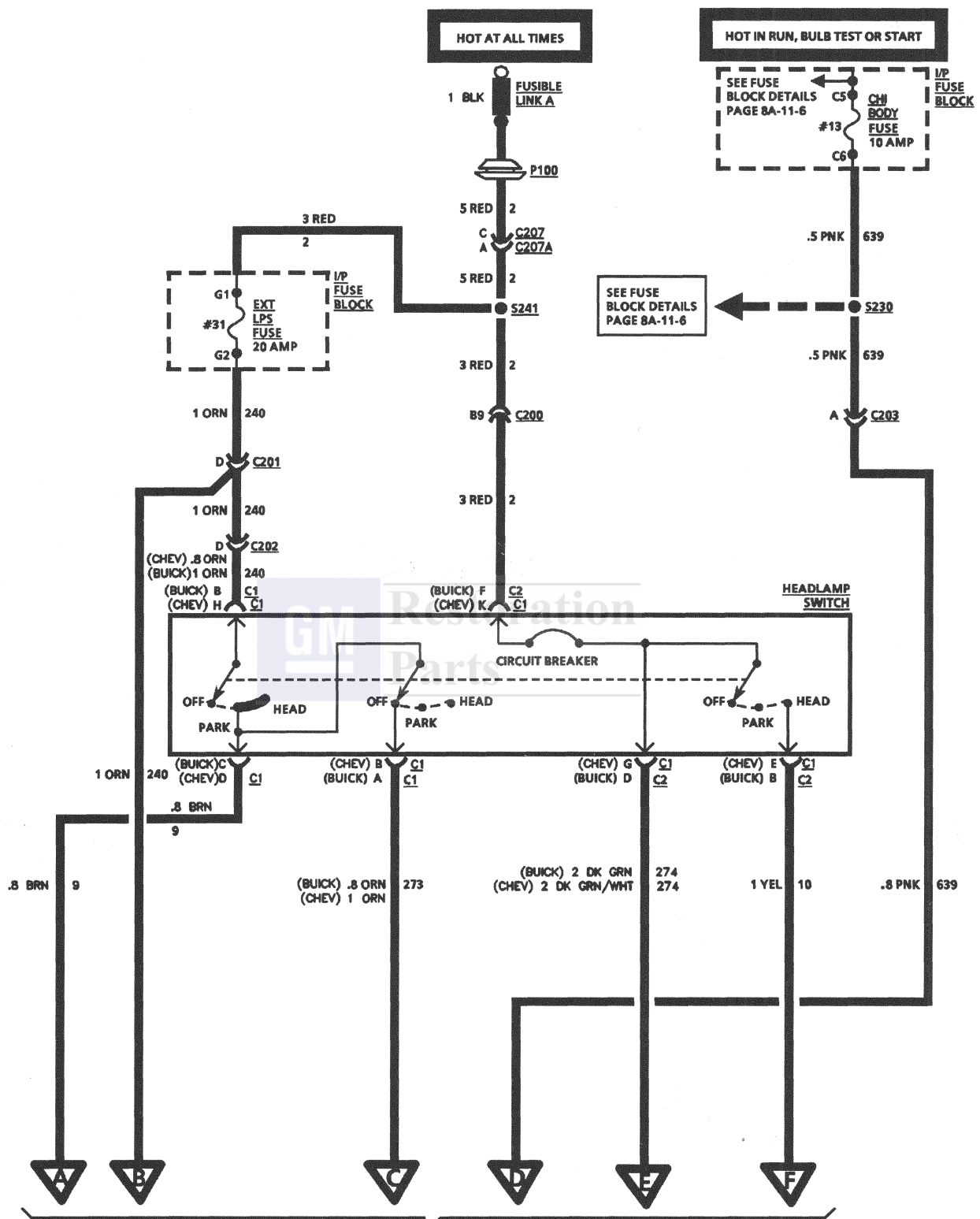
C9690

CIRCUIT OPERATION

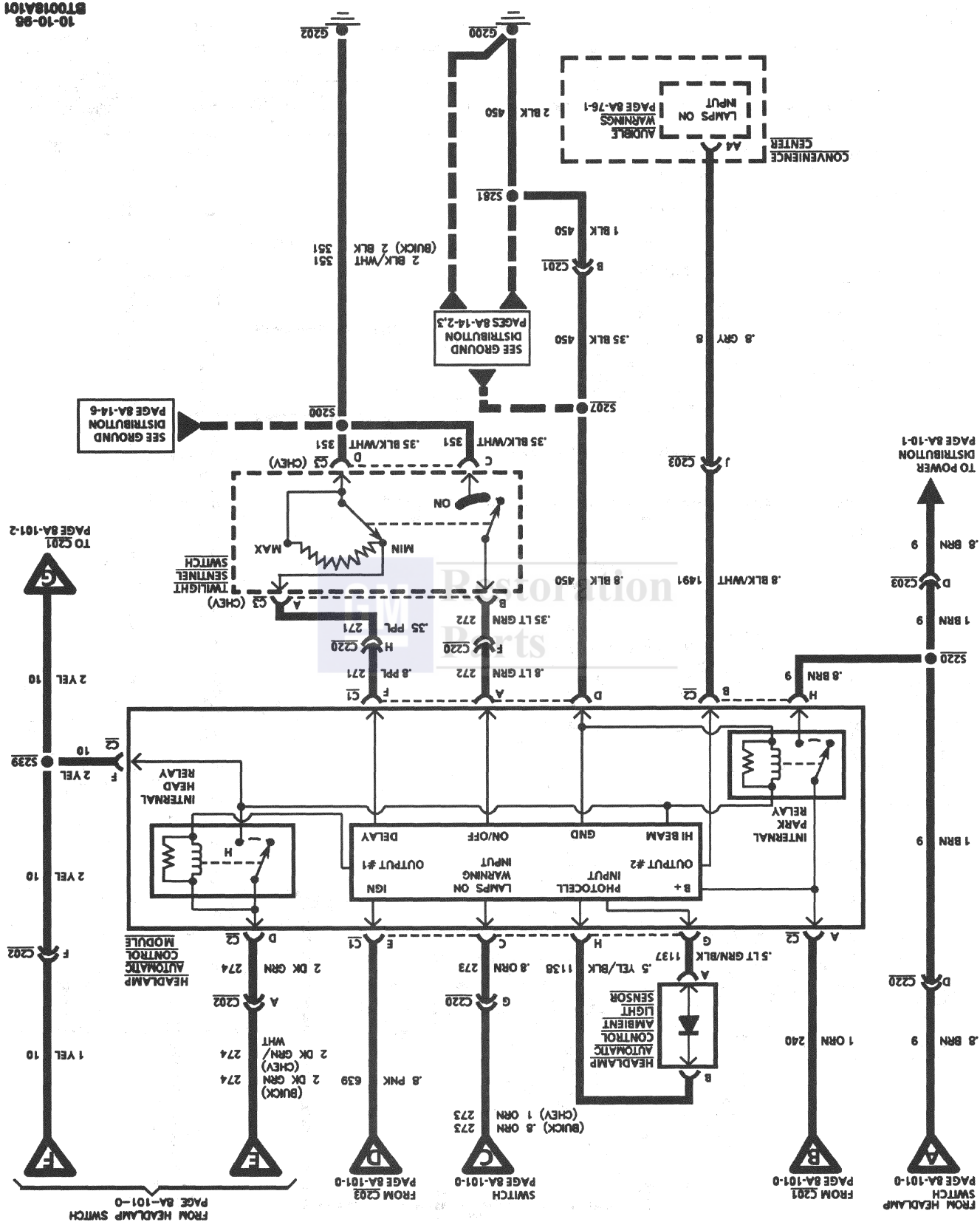
When the Headlamp Switch is moved to "HEAD," battery voltage is applied to the Dimmer Switch. When the Dimmer Switch is placed in "LO," battery voltage is applied, through the closed contacts of the Dimmer Switch, to the LO Beam Lamps. When the Dimmer Switch is placed in "HI," battery voltage is applied to the HI Beam Lamps and HI Beam Indicator. The LO Beam Lamps, HI Beam Lamps and HI Beam Indicator are permanently grounded so that when battery voltage is applied, the lamps operate.



HEADLAMPS WITH TWILIGHT SENTINEL



TO HEADLAMP AUTOMATIC CONTROL MODULE PAGE 8A-101-1



HEADLAMPS WITH TWILIGHT SENTINEL



COMPONENT	LOCATION	201-PG	FIG.	CONN
Convenience Center	LH I/P, left of Steering Column	11	19	
Fusible Link A	RH Engine Compartment, bolted to Underhood Electrical Center			
Headlamp and I/P Lamp Dimmer Switch	LH side of I/P			
Headlamp, LH	LH Front of Vehicle	0	1	
Headlamp, RH	RH Front of Vehicle	0	2	
Headlamp Automatic Control Ambient Light Sensor	Top of I/P, mounted on Defrost Grill	14	22	
Headlamp Automatic Control Module	RH "A" Pillar behind Kickpad			
Headlamp Switch	LH side of I/P, part of Headlamp and I/P Lamp Dimmer and Accessory Switch	9	16	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open	11	19	
Instrument Cluster	LH side of I/P, centered above Steering Column	9	16	
Twilight Sentinel Switch	Left of Steering Column, below Headlamp Switch			
C101 (4 cavities)	Forward Lamp Harn to Body Harn, LH front Engine Compartment, near PCM	4	10	202-5
C109 (2 cavities)	Forward Lamp Harn to SEO Flasher			
C110 (2 cavities)	Forward Lamp Harn to SEO Flasher			
C200 (56 cavities)	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C201 (6 cavities)	Body Harn to Twilight Sentinel Wiring Harn, at RH side of Steering Column, above C200	11	19	202-5
C202 (6 cavities)	I/P Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column, above C200	11	19	202-5
C203 (10 cavities)	Body Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column	11	19	202-5
C207 (6 cavities)	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad			
C207A (6 cavities)	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad			
C220 (10 cavities)	I/P Harn to Twilight Sentinel Wiring Harn, RH side of Steering Column	11	19	202-5
G102	Behind LH Headlamp Support, forward of Air Cleaner	0	1	
G106	RH Headlamp Support, forward of Battery	0	2	
G200	Base of LH "A" Pillar, behind kickpad	11	19	
G202	Base of RH "A" Pillar, behind kickpad	16	26	
P100	RH I/P, forward of Blower Motor	18	29	
P102	Visible from Engine Compartment, behind LH Wheelhouse ...	5	10	
S100	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			

8A - 101 - 4 ELECTRICAL DIAGNOSIS

HEADLAMPS WITH TWILIGHT SENTINEL

COMPONENT	LOCATION	201-PG FIG. CONN
S101	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout	
S104	Forward Lamp Harn, approx 20 cm from C100 breakout	
S106	Forward Lamp Harn, approx 13 cm from C100 breakout	
S200 (Buick)	I/P Harn, approx 4 cm Ashtray Lamp Conn breakout, in spiral taping	
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout	
S201 (Buick)	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout in spiral taping	
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout	
S207 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S220 (w/T82).....	Twilight Sentinel Wiring Harn, approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S230	Body Harn, approx 4 cm from BTSI Conn breakout	
S239	Headlamp Automatic Beam Control Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S241	Body Harn, approx 20 cm from SDM breakout	
S271	Body Harn, Approx. 14 cm from SDM breakout	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check LO Beam Headlamps and HI Beam Headlamps for damage to the filament or bulb.

CAUTION: Halogen bulbs contain a gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn the Lamp Switch to "OFF" and allow bulb to cool before changing bulbs. Leave the switch in "OFF" until bulb change is complete.
- Always wear eye protection when changing a halogen bulb.
- Handle the bulb only by its base. Avoid touching the glass.
- Do not drop or scratch the bulb. Keep moisture away.
- Place the used bulb in the new bulb's carton and dispose of it properly. Keep halogen bulbs out of reach of children.

2. Check I/P Fuse #31 for open. If open, check for short to ground in CKT 240.
3. Check I/P Fuse #13 for open. If open, check for short to ground in CKT 639.
4. Check that grounds G102, G106, G200 and G202 are clean and tight.
5. Check that the Headlamp Automatic Control Ambient Light Sensor is not obstructed.
6. If Headlamps are dimly lit on one side, check the ground on that side.
7. If HI Beam Headlamps do not operate and the HI Beam Indicator is "ON," check LT GRN (11) wire for an open.

8. If one Headlamp does not work, check the connections, the Headlamp, and the wires to that Headlamp.

9. If either the Headlamps or the Park Lamps, but not both, remain "ON," disconnect Headlamp Automatic Control Module.

- If lamps go "OFF," replace the Headlamp Auto Control Module.
- If lamps remain "ON," replace the Headlamp Switch.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

Perform the System Check in the order shown. When a fault is found, refer to the Symptom Table for the appropriate diagnostic procedure(s). If a normal result is found at each and every step of the System Check, the fault may be intermittent.

To help isolate an intermittent fault, first examine the mating terminals at each component and connector for a poor connection. Also check that each terminal of mating connectors is properly seated in the connector body. If the connections appear to be reliable, try the System Check again while moving the wiring harness from side to side at each component and in-line connector, to try and induce the intermittent fault.

Once a fault has been corrected, perform the System Check to verify the diagnosis.

8A - 101 - 6 ELECTRICAL DIAGNOSIS**HEADLAMPS WITH TWILIGHT SENTINEL****SYSTEM CHECK**

ACTION	NORMAL RESULTS
[1] • Twilight Sentinel Switch to "OFF." • Headlamp Switch to "OFF." • Apply a bright light to the Headlamp Automatic Control Ambient Light Sensor. • Ignition Switch to "RUN."	• Tail and License Lamps "OFF." • Front Park Lamps "OFF." • Headlamps "OFF."
[2] • Twilight Sentinel Switch to "ON." • Cover Headlamp Automatic Control Ambient Light Sensor.	• Tail and License Lamps "ON." • Front Park and Opera Lamps (if equipped) "ON." • Headlamps "ON," after 15-20 seconds.
[3] • Apply a bright light to the Headlamp Automatic Control Ambient Light Sensor.	• Tail, License, Front Park and Opera Lamps (if equipped) "OFF." • Headlamps "OFF," after 15-20 seconds.
[4] • Cover the Headlamp Automatic Control Ambient Light Sensor and wait for lamps to turn "ON." • Wait 5 seconds, turn Ignition Switch "OFF."	• Lamps turn "OFF" after a time delay of 5 seconds with Twilight Sentinel Switch set to "MIN" and 3 minutes with Switch set to "MAX."
[5] • Turn Ignition "ON." • Headlamps "ON" under Twilight Sentinel Control. • Open Driver's Door.	Lamps "ON" Warning does not sound.
[6] • Turn Ignition "OFF." • Headlamp Switch in "PARK." • Open Driver's Door. • Ignition Key out of Lock Cylinder.	Lamps "ON" Warning sounds.
[7] • Twilight Sentinel Switch to "OFF." • Headlamp Switch "OFF." • Open Driver's Door.	Lamps "ON" Warning does not sound.
[8] • Ignition Switch to "OFF."	Headlamps, Tail, License, Front Park and Opera Lamps (if equipped) "OFF."

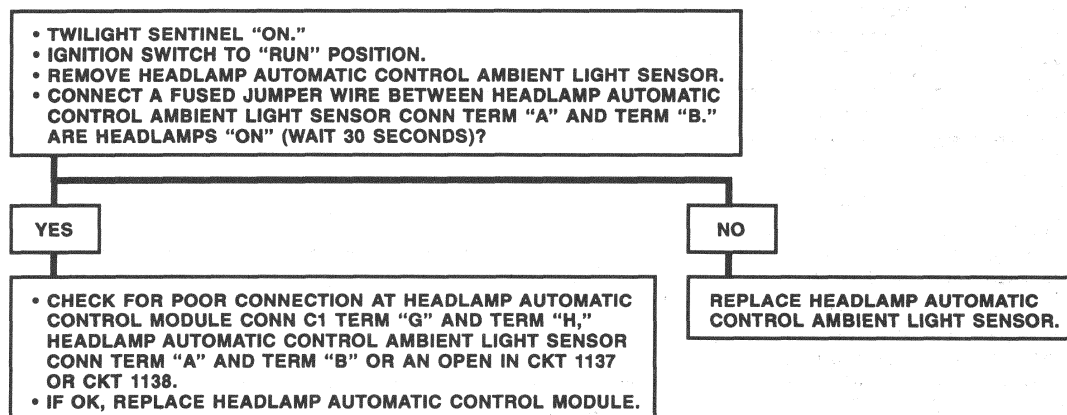
SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Headlamps and/or Tail, Front Park and Opera Lamps "ON" with daylight conditions.	Chart #1	8A-101-8
Using Twilight Sentinel Control: Tail, Front Park and Opera Lamps are inoperative, Headlamps operate normally.	Chart #2	8A-101-9
Using Twilight Sentinel Control: Headlamps are inoperative. Tail, Front Park and Opera Lamps operate normally and Headlamp Switch operates normally.	Chart #3	8A-101-10
Using Twilight Sentinel Control: Headlamps, Tail, Front Park and Opera Lamps are inoperative, Headlamp Switch operates normally.	Chart #4	8A-101-11, 12
Headlamps "DELAY OFF," inoperative.	Chart #5	8A-101-13
Lamps "ON" Warning inoperative.	Chart #6	8A-101-14
Headlamps, Tail, Front Park and Opera Lamps remain "ON" at all times after maximum delay time, Headlamp Switch operates normally.	Check for short to voltage on CKT 639. If OK, replace Headlamp Automatic Control Module.	
LO Beam and HI Beam Headlamps are inoperative.	*Refer to Chart #1.	8A-100-3
LO Beam Headlamps inoperative, HI Beam Headlamps operate normally.	*Refer to Chart #2.	8A-100-4
HI Beam Headlamps inoperative, LO Beam Headlamps and HI Beam Indicator operate normally.	Check for poor connection at C101 terminal "C" or open in CKT 11 between Headlamp Dimmer Switch and S104.	
HI Beam Indicator inoperative.	*Refer to Chart #3.	8A-100-4
One LO Beam or one HI Beam Headlamp inoperative.	*Refer to Chart #4.	8A-100-5
HI Beam Headlamps and LO Beam Headlamps "ON" at the same time.	Replace Headlamp Dimmer Switch.	

*When referencing charts from Section 8A-100, use the wiring diagrams from Section 8A-101.

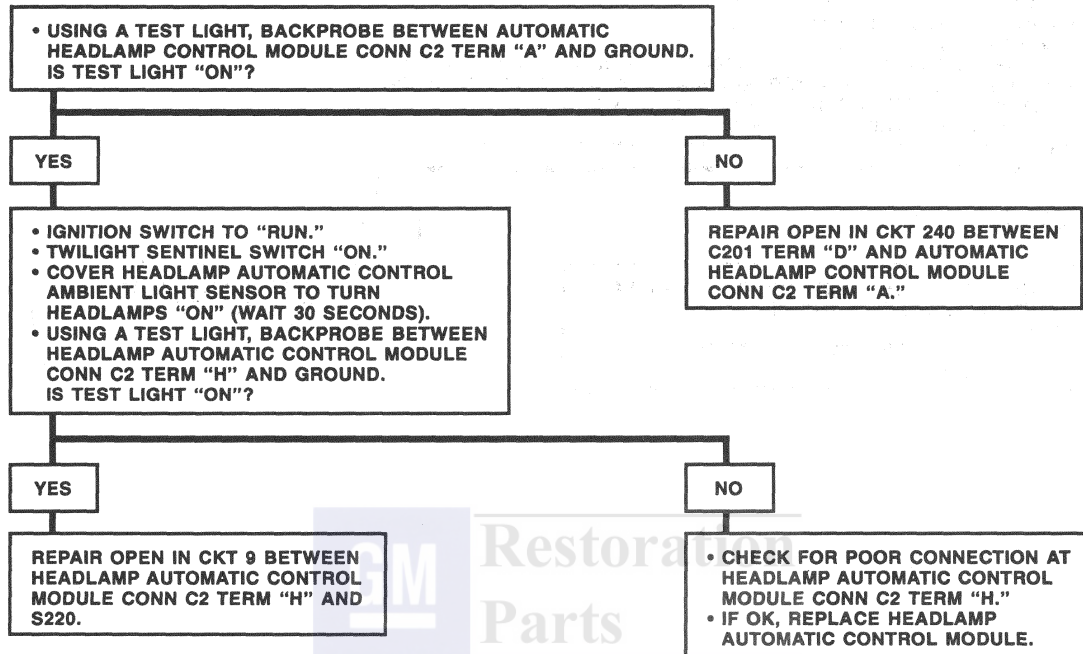
HEADLAMPS WITH TWILIGHT SENTINEL

CHART #1
HEADLAMPS AND/OR TAIL, FRONT PARK AND
OPERA LAMPS "ON" WITH DAYLIGHT CONDITIONS



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CHART #2
USING TWILIGHT SENTINEL CONTROL: TAIL, FRONT PARK AND
OPERA LAMPS INOPERATIVE, HEADLAMPS OPERATE NORMALLY



HEADLAMPS WITH TWILIGHT SENTINEL

CHART #3

USING TWILIGHT SENTINEL CONTROL: HEADLAMPS ARE INOPERATIVE. TAIL, FRONT PARK AND OPERA LAMPS OPERATE NORMALLY AND HEADLAMP SWITCH OPERATES NORMALLY.

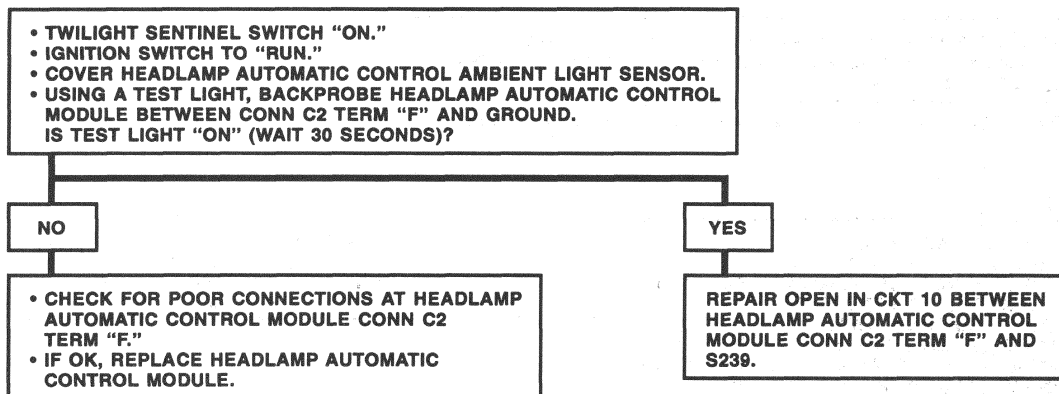
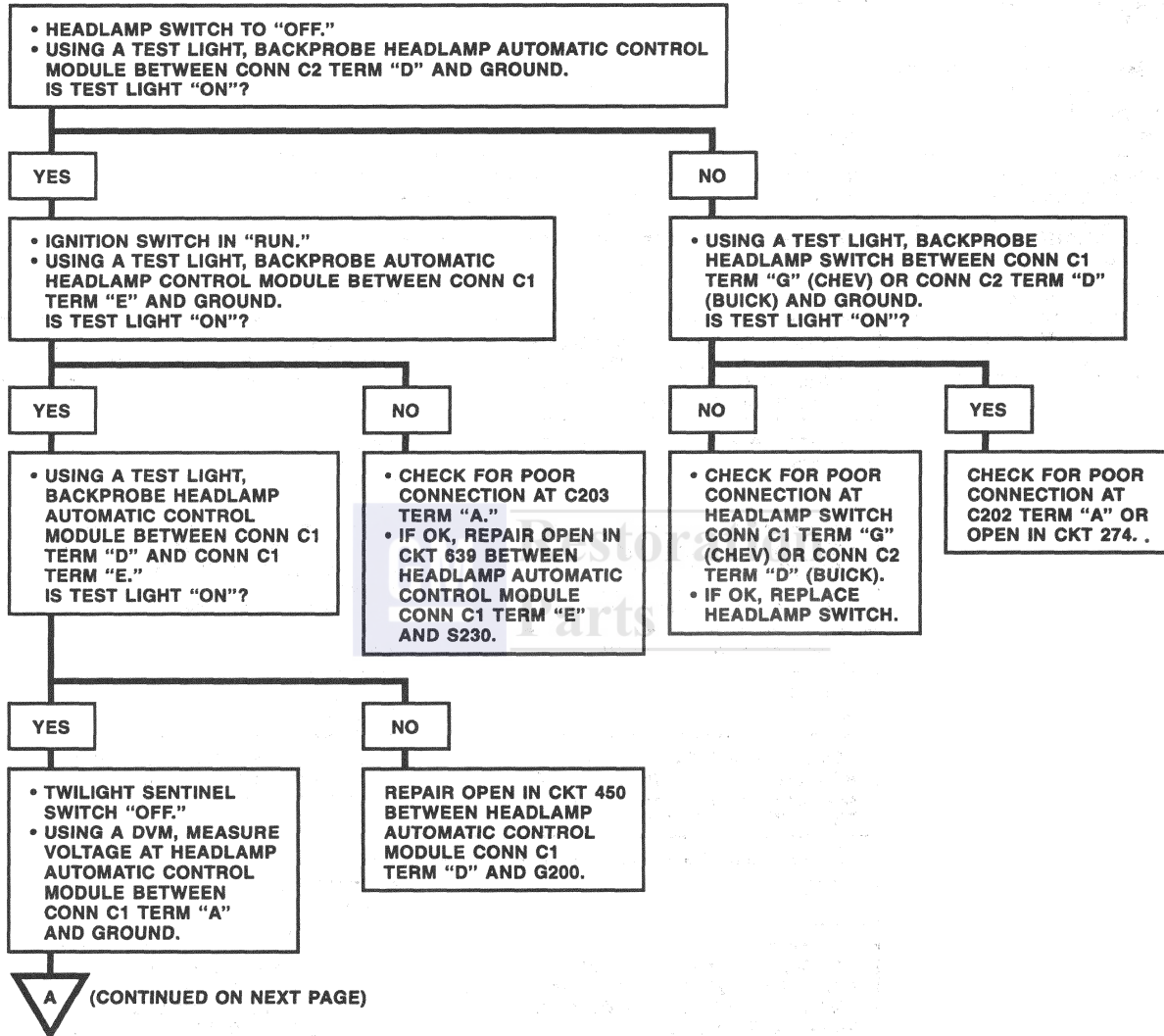


CHART #4
USING TWILIGHT SENTINEL CONTROL: HEADLAMPS, TAIL, FRONT
PARK AND OPERA LAMPS ARE INOPERATIVE, HEADLAMP SWITCH
OPERATES NORMALLY



HEADLAMPS WITH TWILIGHT SENTINEL

CHART #4 (continued)
USING TWILIGHT SENTINEL CONTROL: HEADLAMPS, TAIL, FRONT
PARK AND OPERA LAMPS ARE INOPERATIVE, HEADLAMP SWITCH
OPERATES NORMALLY

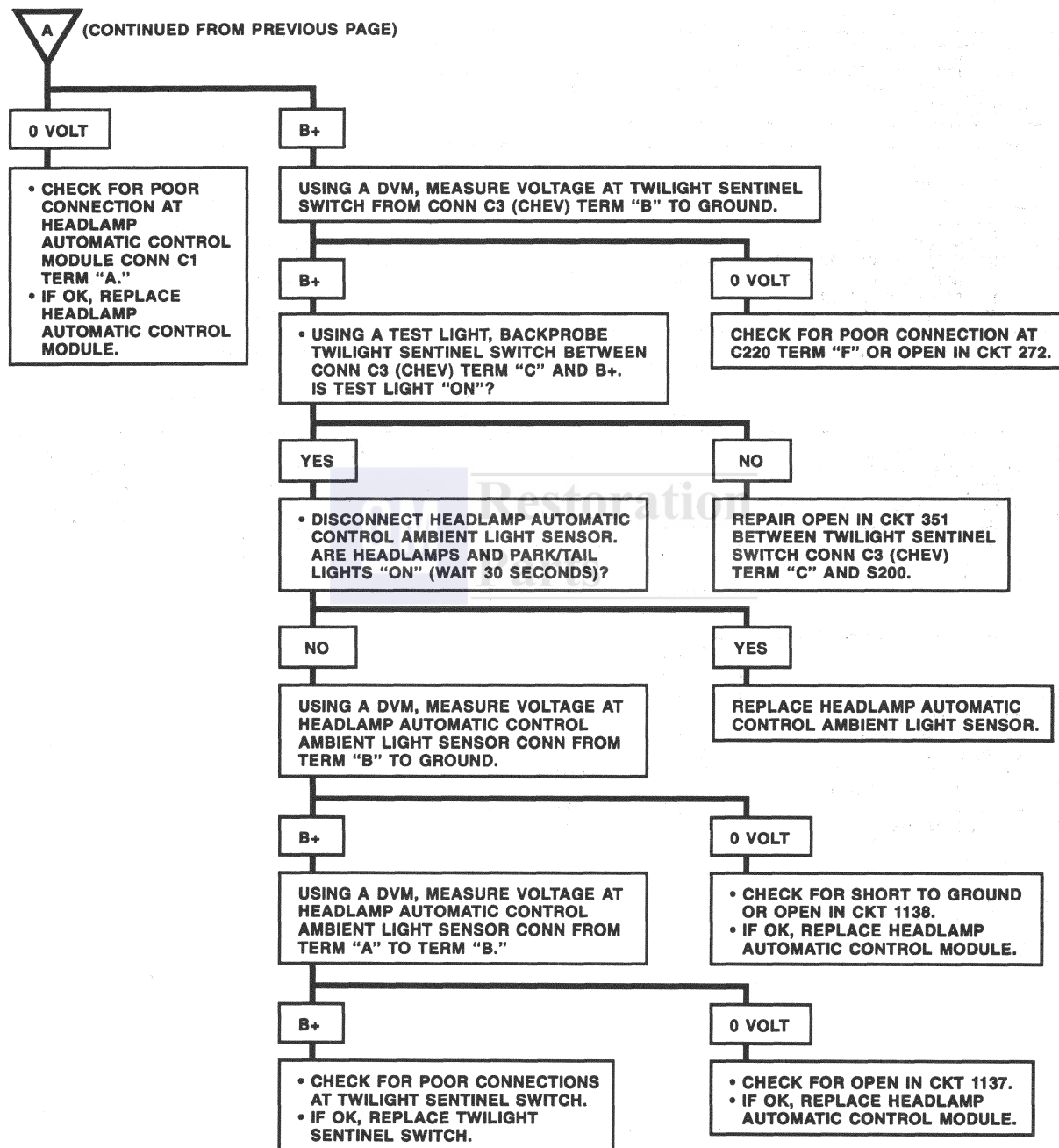
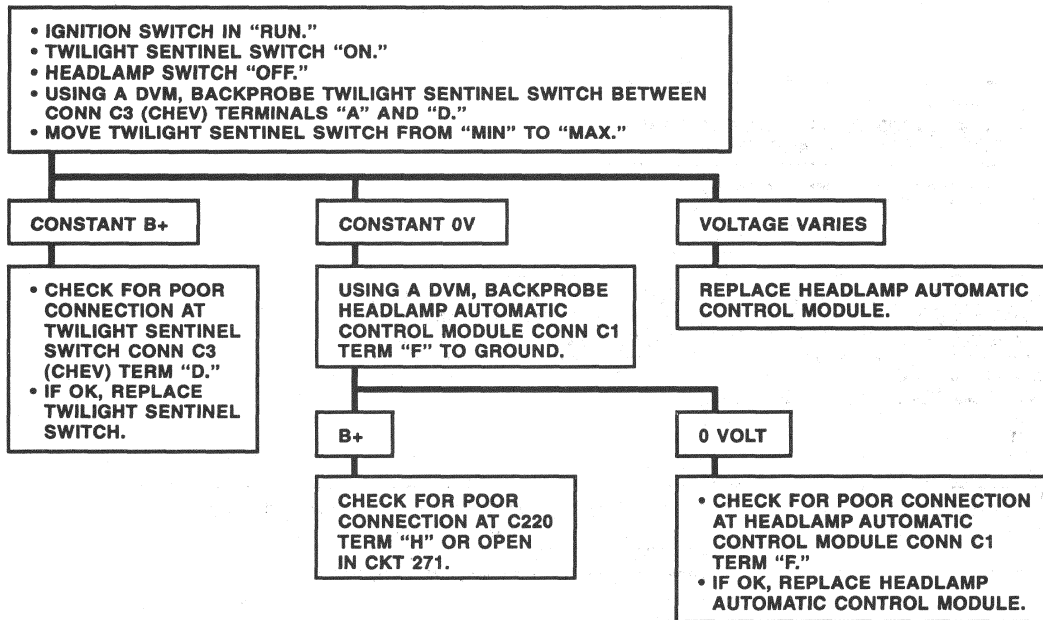


CHART #5
HEADLAMPS "DELAY OFF" INOPERATIVE

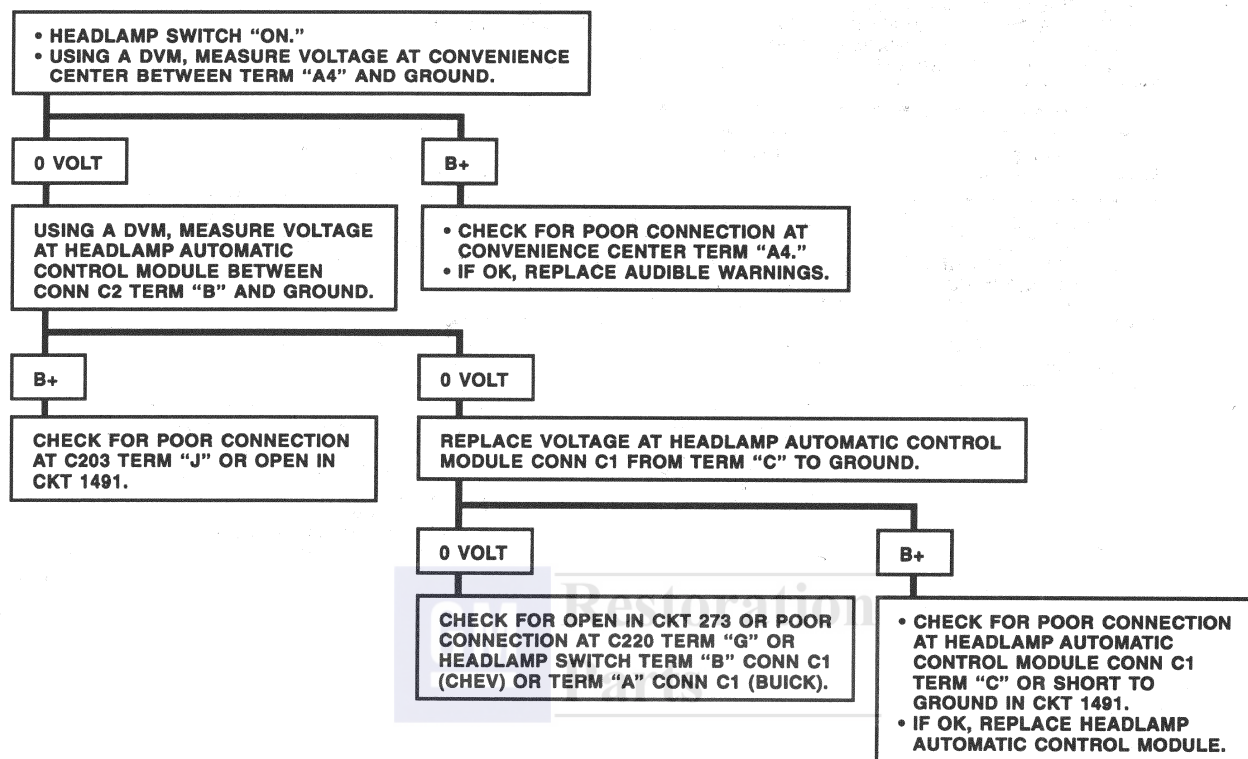


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8A - 101 - 14 ELECTRICAL DIAGNOSIS

HEADLAMPS WITH TWILIGHT SENTINEL

CHART #6
LAMPS "ON" WARNING INOPERATIVE



CIRCUIT OPERATION

HEADLAMPS

Voltage is applied to the Headlamp Switch at all times. The Headlamp Switch includes a self-resetting circuit breaker which opens if the headlamp circuit draws too much current. When the Headlamp Switch is in "HEAD," the Dimmer Switch directs current to either the LO Beams or the HI Beams. When the Dimmer Switch is in "HI," current also flows to the HI Beam Indicator.

TWILIGHT SENTINEL

The Twilight Sentinel System automatically turns the interior and exterior driving lamps on and off according to light conditions. The system also keeps the lamps on for a selected amount of time after the driver has parked and left the vehicle. The system can be turned off to give the driver manual control over the lamps.

The Twilight Sentinel will send a lamps "ON" signal to the Audible Warnings only if the Headlamp Switch is in the "PARK" or "HEAD" position.

Voltage is applied at all times through Fusible Link A to the Headlamp Switch terminal "K" (Chev) or terminal "F" conn C2 (Buick) and from the Headlamp Switch terminal "G" (Chev) or terminal "D" conn C2 (Buick) to the Headlamp Automatic Control Module connector C2 terminal "D."

When the Ignition Switch is in "RUN," voltage from I/P Fuse #13 is applied to connector C1 terminal "E" of the Headlamp Automatic Control Module. Ground is supplied from G200.

As the intensity of light reaching the Headlamp Automatic Control Ambient Light Sensor decreases, the resistance of the Headlamp Automatic Control Ambient Light Sensor increases. When the Headlamp Automatic Control Module senses a high resistance in the Headlamp

Automatic Control Ambient Light Sensor, the Headlamp Automatic Control Module energizes the Internal Head Relay. Battery voltage is applied through the closed contacts of the Head Relay to CKT 10. With the Dimmer Switch in "LO," the LO Beam Headlamps are "ON." With the Dimmer Switch in "HI," the HI Beam Headlamps and Indicator are "ON." The Headlamp Automatic Control Module also energizes the Internal Park Relay, which applies battery voltage to CKT 9 and turns "ON" the Tail, Front Side Marker and Opera Lamps.

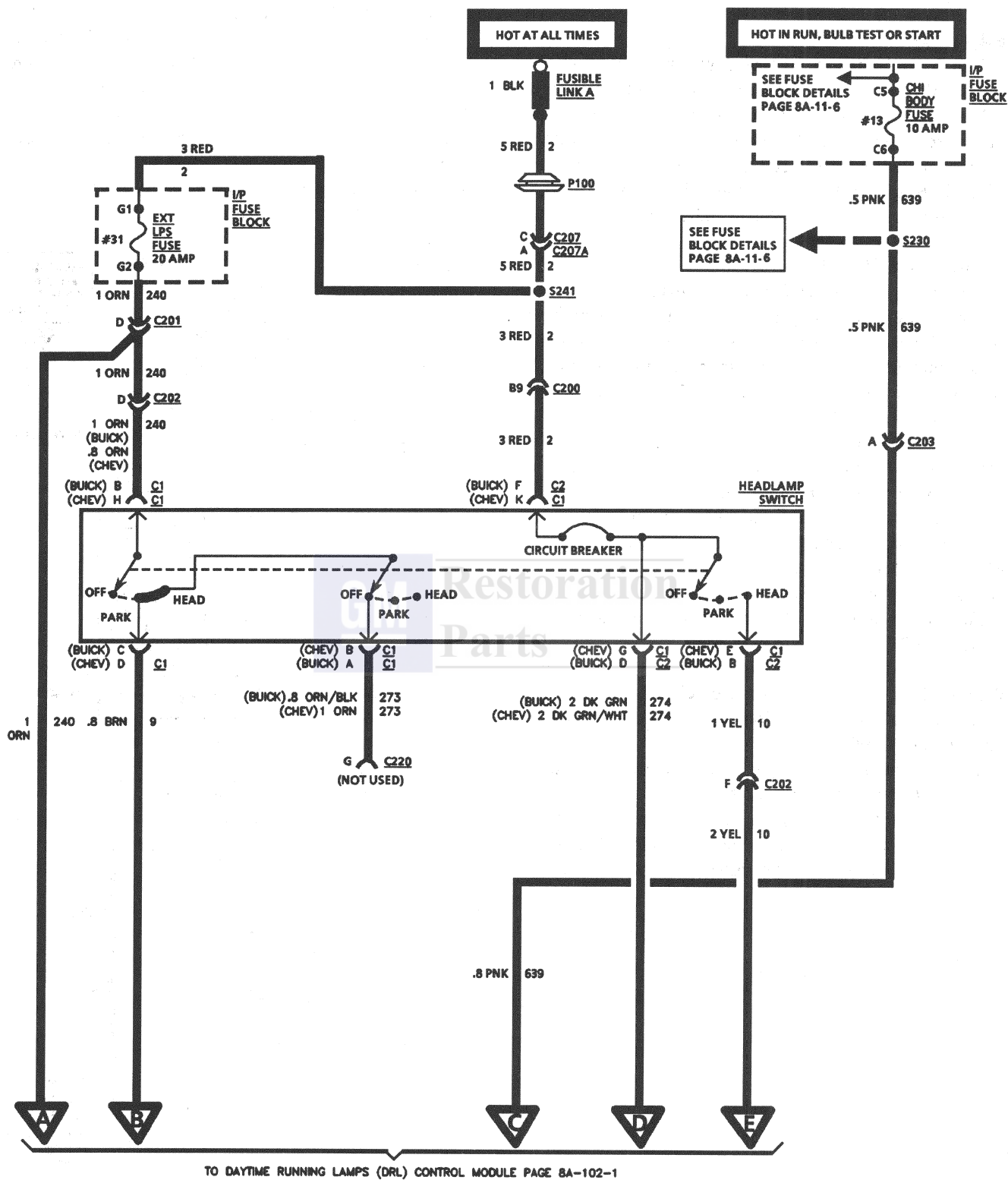
As the intensity of light reaching the Headlamp Automatic Control Ambient Light Sensor increases, the resistance of the Headlamp Automatic Control Ambient Light Sensor decreases. When the Headlamp Automatic Control Module senses a low resistance in the Headlamp Automatic Control Ambient Light Sensor, the Headlamp Automatic Control Module de-energizes the Internal Head Relay which turns the Headlights "OFF," and also de-energizes the Internal Park Relay which turns the Tail, Front Side Marker and Opera Lamps "OFF."

If the Ignition Switch is moved to "OFF," the Headlamp Automatic Control Module loses ignition voltage through I/P Fuse #13, and will cause a delay of five (5) seconds to three (3) minutes and then turn the lamps off. This delay is set by changing the resistance of a delay rheostat in the Twilight Sentinel Switch.

When the Twilight Sentinel Switch is turned to "OFF," the path to ground at connector C1 terminal "A" at the Headlamp Automatic Control Module is opened. The system is turned off and the Headlamps will operate only by moving the Headlamp Switch to the "PARK" or "HEAD" position.

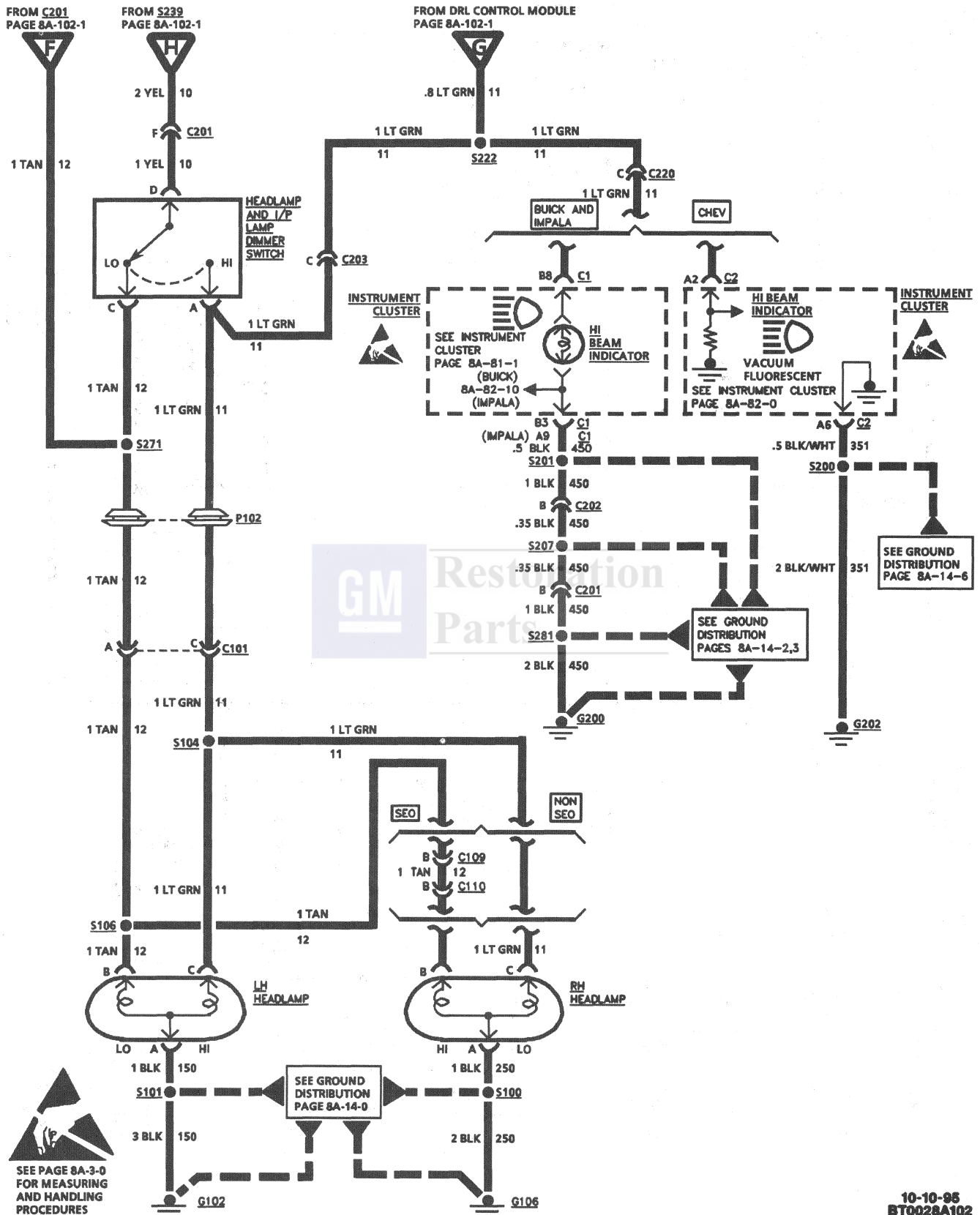
The Headlamp Automatic Control Module does not react instantly to ambient signals. Turn-on or turn-off is delayed from 15-20 seconds. This avoids needless operation for short periods of time.

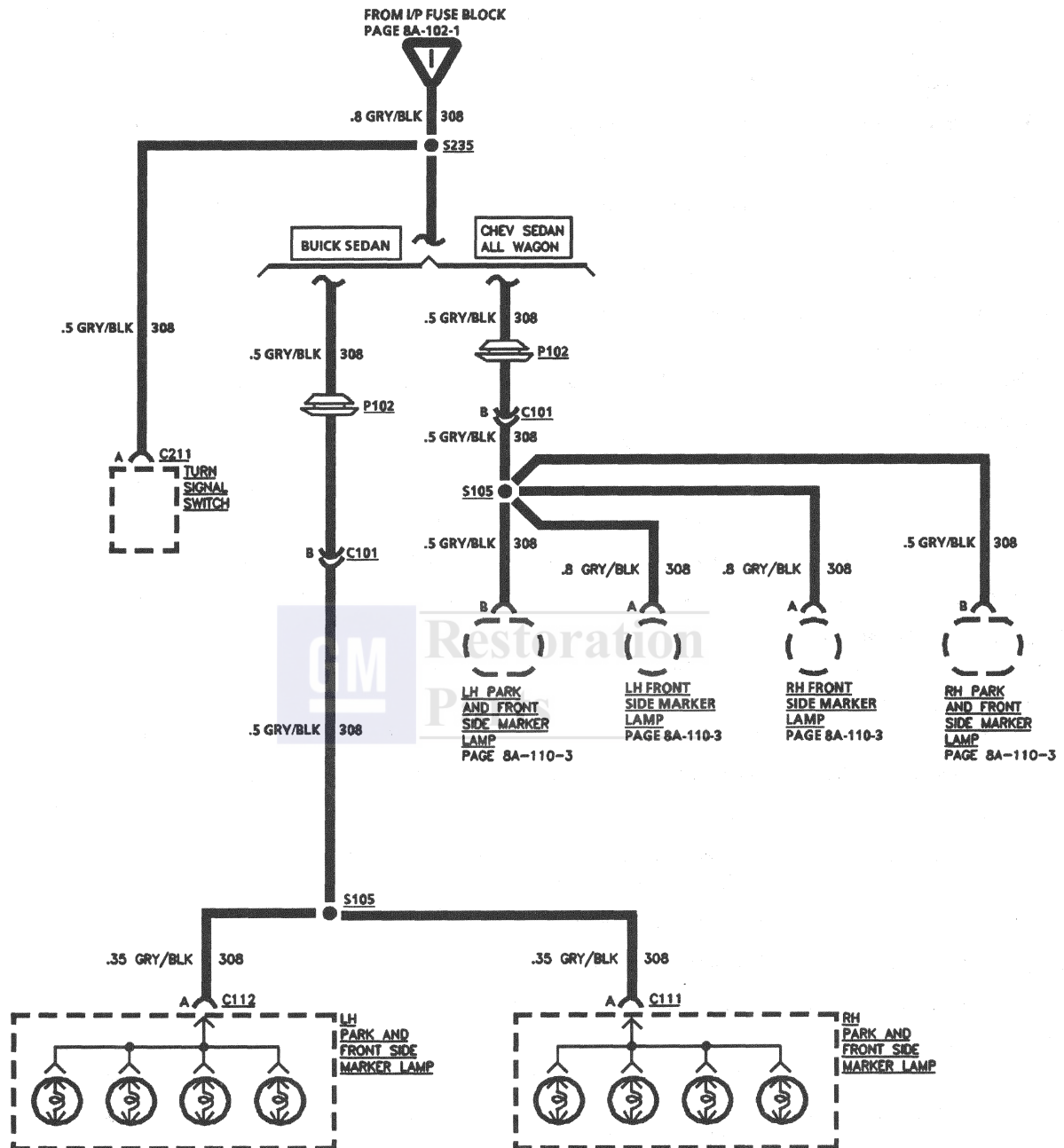
HEADLAMPS: DAYTIME RUNNING LAMPS (T61)





HEADLAMPS: DAYTIME RUNNING LAMPS (T61)





8A - 102 - 4 ELECTRICAL DIAGNOSIS**HEADLAMPS: DAYTIME RUNNING LAMPS (T61)**

COMPONENT	LOCATION	201-PG	FIG.	CONN
Daytime Running Lamps (DRL) Diode.....	Attached to Brake Pedal Bracket.....	14.....	22	
Daytime Running Lamps (DRL) Control Module	RH "A" Pillar behind kickpad	18.....	29	
Front Side Marker Lamp, LH...	LH Front of Vehicle.....	0.....	1	
Front Side Marker Lamp, RH...	RH Front of Vehicle	0.....	2	
Fusible Link A.....	RH Engine Compartment, bolted to Underhood Electrical Center			
Headlamp, LH	LH Front of Vehicle.....	0.....	1	
Headlamp, RH.....	RH Front of Vehicle	0.....	2	
Headlamp Automatic Control Ambient Light Sensor	Top of I/P, mounted on Defrost Grill.....	14.....	22	
Headlamp and I/P Lamp Dimmer Switch.....	LH side of I/P			
Headlamp Switch	LH side of I/P, part Headlamp and I/P Lamp Dimmer and Accessory Switch.....	9.....	16	
Instrument Cluster	LH side of I/P centered above Steering Column	9.....	16	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Park and Front Side Marker Lamp, LH.....	LH Front of Vehicle, near Headlamp	0.....	1	
Park and Front Side Marker Lamp, RH	RH forward Engine Compartment, near Headlamp.....	0.....	2	
Park Brake Indicator Switch	Mounted on Park Brake, forward of LH kickpad	10.....	18	
Turn Signal Switch	Mounted on upper LH side of Steering Column	13.....	21	
C101 (4 cavities).....	Forward Lamp Harn to Body Harn, LH front Engine Compartment, near PCM.....	5.....	9.....	202-5
C109 (2 cavities).....	Forward Lamp Harn to SEO Flasher			
C110 (2 cavities).....	Forward Lamp Harn to SEO Flasher			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14.....	22.....	202-1
C201 (6 cavities).....	Body Harn to Daytime Running Lamps (DRL) Wiring Harn, at RH side of Steering Column, above C200	11.....	19.....	202-5
C202 (6 cavities).....	I/P Harn to Daytime Running (DRL) Lamps Wiring Harn, RH side of Steering Column, above C200.....	11.....	19.....	202-5
C203 (10 cavities).....	Body Harn to Daytime Running Lamps (DRL) Harn, RH side of Steering Column	11.....	19.....	202-5
C207 (6 cavities).....	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad.....	18.....	29	
C207A (3 cavities).....	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad.....	18.....	29	
C220 (10 cavities).....	I/P Harn to Daytime Running Lamps (DRL) Wiring Harn, RH side of Steering Column.....	11.....	19.....	202-5
G102.....	Behind LH Headlamp Support, forward of Air Cleaner.....	0.....	1	

COMPONENT	LOCATION	201-PG	FIG.	CONN
G106.....	RH Headlamp Support, forward of Battery	0	2	
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G202.....	Base of RH "A" Pillar, behind kickpad	16	26	
P100	RH I/P, forward of Blower Motor	18	29	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5	10	
S100	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S101	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout			
S104	Forward Lamp Harn, approx 20 cm from C100 branch breakout			
S105	Forward Lamp Harn, approx 11 cm from C100 branch breakout			
S106	Forward Lamp Harn, approx 13 cm from C100 branch breakout			
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout in spiral taping			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S201 (Buick).....	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 branch breakout in spiral taping			
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout			
S202 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 8 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S207 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn			
S220 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 13cm from Daytime Running Lamp Diode Conn			
S222 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 7 cm from Daytime Running Lamp Diode Conn branch breakout			
S230	Body Harn, approx 4 cm from BTSI Conn breakout			
S235	Body Harn, approx 16 cm from P102			
S239 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 20 cm from Daytime Running Lamp Diode Conn branch breakout			
S241	Body Harn, approx 20 cm from SDM breakout			
S271	Body Harn, approx 14 cm from SDM breakout			
S281	Body Harn, approx 24 cm from Convenience Center Branch breakout			

HEADLAMPS: DAYTIME RUNNING LAMPS (T61)

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

CAUTION: Halogen bulbs contain a gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn the Headlamp Switch to the "OFF" position and allow bulb to cool before changing bulbs. Leave the switch in the "OFF" position until bulb change is complete.
 - Always wear eye protection when changing a halogen bulb.
 - Handle the bulb only by its base. Avoid touching the glass.
 - Do not drop or scratch the bulb.
 - Keep moisture away.
 - Place the used bulb in the new bulb's carton and dispose of it properly. Keep halogen bulbs out of the reach of children.
1. Check LO Beam Lamps and HI Beam Lamps for damage to the filament or bulb.
 2. Check I/P Fuse Block Fuse #31. If open, check for a short to ground in CKT 240.
 3. Check I/P Fuse Block Fuse #13. If open, check for a short to ground in CKT 639.
 4. Check I/P Fuse Block Fuse #20. If open, check for a short to ground in CKT 241.
 5. Check that the Headlamp Automatic Control Ambient Light Sensor is not obstructed.

6. Check Fusible Link A. If open, check for short to ground in CKT 2 or Headlamp Switch.
7. Check the LH and RH Headlamp connectors to be sure the connector seal is not damaged or missing.
8. If one Headlamp doesn't work, check the connections, Headlamp and the wires to the Headlamp.
9. If HI Beam Headlamps do not light, but the HI Beam Indicator lamps, check LT GRN (11) wire for an open.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

SYSTEM DIAGNOSIS

Perform the System Check in the order shown. When a fault is found, refer to the Symptom Table for the appropriate diagnostic procedure(s). If a normal result is found at each and every step of the System Check, the fault may be intermittent.

To help isolate an intermittent fault, first examine the mating terminals at each component and connector for a poor connection. Also check that each terminal of mating connectors is properly seated in the connector body. If the connections appear to be reliable, try the System Check again while moving the wiring harness from side to side at each component and in-line connector, to try and induce the intermittent fault.

Once a fault has been corrected, perform the System Check to verify the diagnosis.

SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Headlamp Switch to "OFF." • Set Park Brake. • Apply a bright light to the Headlamp Automatic Control Ambient Light Sensor. • Ignition Switch to "RUN."	• Tail and License Lamps "OFF." • Front Park Lamps "OFF." • Headlamps "OFF."
[2] • Remove bulb from Headlamp Automatic Control Ambient Light Sensor. • Cover Headlamp Automatic Control Ambient Light Sensor. • Release Park Brake.	• Tail, License and Front Park Lamps "ON." • LO Beam Headlamps "ON" at full intensity.
[3] • Apply a bright light to the Headlamp Automatic Control Ambient Light Sensor.	• Tail, License and Front Park Lamps "OFF." • LO Beam Headlamps "ON" at reduced intensity.
[4] • Cover Headlamp Automatic Control Ambient Light Sensor. • Headlamp Dimmer Switch to "HI."	• Tail, License and Front Park Lamps "ON." • LO Beam Headlamps "OFF." • HI Beam Headlamps and HI Beam Indicator "ON."
[5] • Headlamp Dimmer Switch to "LO."	• Tail, License and Front Park Lamps "ON." • LO Beam Headlamps "ON."
[6] • Ignition Switch to "OFF."	Tail, License, Front Park Lamps and Headlamps "OFF."

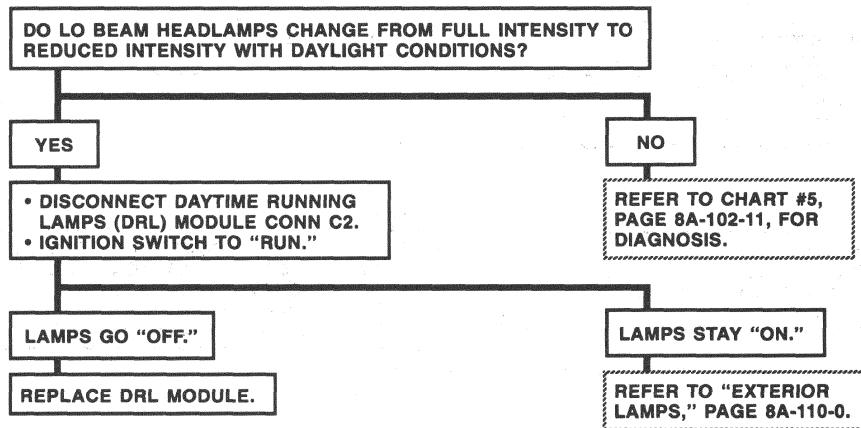
8A - 102 - 8 ELECTRICAL DIAGNOSIS**HEADLAMPS: DAYTIME RUNNING LAMPS (T61)****SYMPTOM TABLE**

SYMPTOM	PROCEDURE	PAGE NUMBER
Park Lamps remain "ON" with daylight conditions and Headlamp Switch "OFF."	Chart #1	8A-102-9
Park Lamps do not turn "ON" with low light conditions and Lamp Switch "OFF."	Chart #2	8A-102-9
LO Beam Headlamps remain "OFF" with daylight or low light conditions.	Chart #3	8A-102-10
LO Beam Headlamps remain "OFF" with daylight conditions but switch to full intensity with low light conditions.	Chart #4	8A-102-11
LO Beam Headlamps "ON" at full intensity with daylight conditions.	Chart #5	8A-102-11
LO Beam Headlamps do not switch from reduced intensity to full intensity with low light conditions.	Chart #6	8A-102-12
LO Beam Headlamps "ON" with Headlamp Switch "OFF."	Chart #7	8A-102-12
HI Beam Headlamps "ON" with Headlamp Switch "OFF."	Check for short to voltage in CKT 11. If OK, replace DRL Module.	
DRL System (Park, Tail and LO Beam Headlamps) completely inoperative, Headlamp Switch operates normally.	Check for open in CKT 241 or CKT 450 to DRL Module or poor connection at DRL Module connector C1 terminal "A" and terminal "F." If OK, replace DRL Module.	
LO Beam Headlamp switch "ON" when the Park Brake is set and the Ignition Switch is turned to "RUN."	Replace DRL Module.	
LO Beam Headlamps switch "OFF" when the Ignition Switch is in "RUN" and the Park Brake is applied.	Replace DRL Module.	
LO Beam and HI Beam Headlamps are inoperative.	*Refer to Chart #1.	8A-100-3
LO Beam Headlamps inoperative, HI Beam Headlamps operate normally.	*Refer to Chart #2.	8A-100-4
HI Beam Headlamps inoperative, LO Beam Headlamps and HI Beam Indicator operate normally.	Check for poor connection at C101 terminal "C" or open in CKT 11 between Headlamp Dimmer Switch and S104.	
HI Beam Indicator inoperative.	*Refer to Chart #3.	8A-100-4
One LO Beam or one HI Beam Headlamp inoperative.	*Refer to Chart #4.	8A-100-5
HI Beam Headlamps and LO Beam Headlamps "ON" at the same time.	Replace Headlamp Dimmer Switch.	

***When referencing charts from Section 8A-100, use the wiring diagrams from Section 8A-101.**

CHART #1

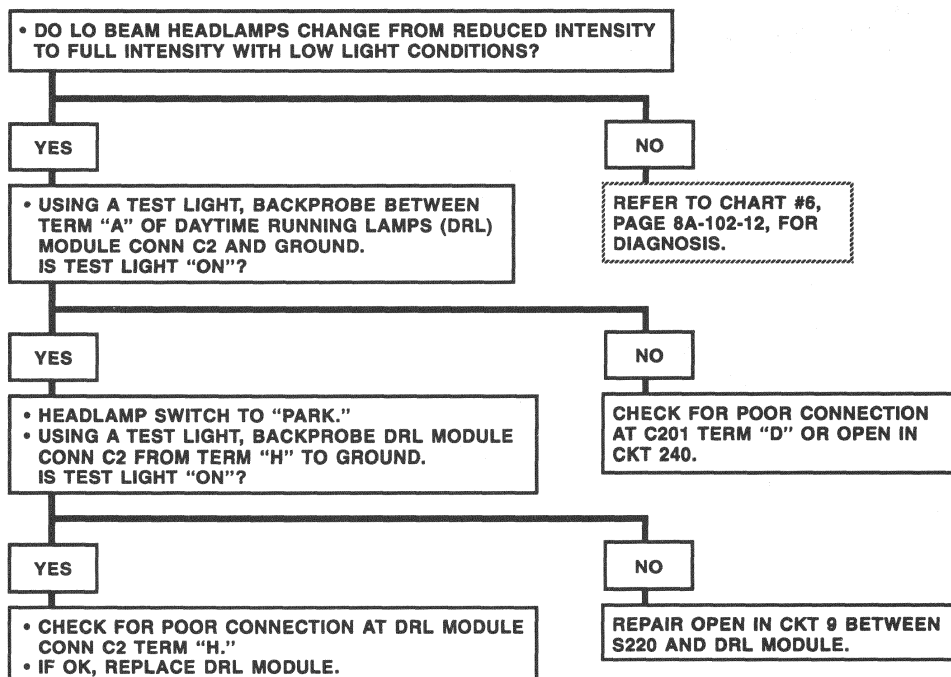
PARK LAMPS REMAIN "ON" WITH DAYLIGHT CONDITIONS AND HEADLAMPS SWITCH "OFF"



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CHART #2

PARK LAMPS DO NOT TURN "ON" WITH LOW LIGHT CONDITIONS AND HEADLAMP SWITCH "OFF"



C9777

HEADLAMPS: DAYTIME RUNNING LAMPS (T61)

CHART #3

LO BEAM HEADLAMPS REMAIN "OFF" WITH DAYLIGHT OR LOW LIGHT CONDITIONS

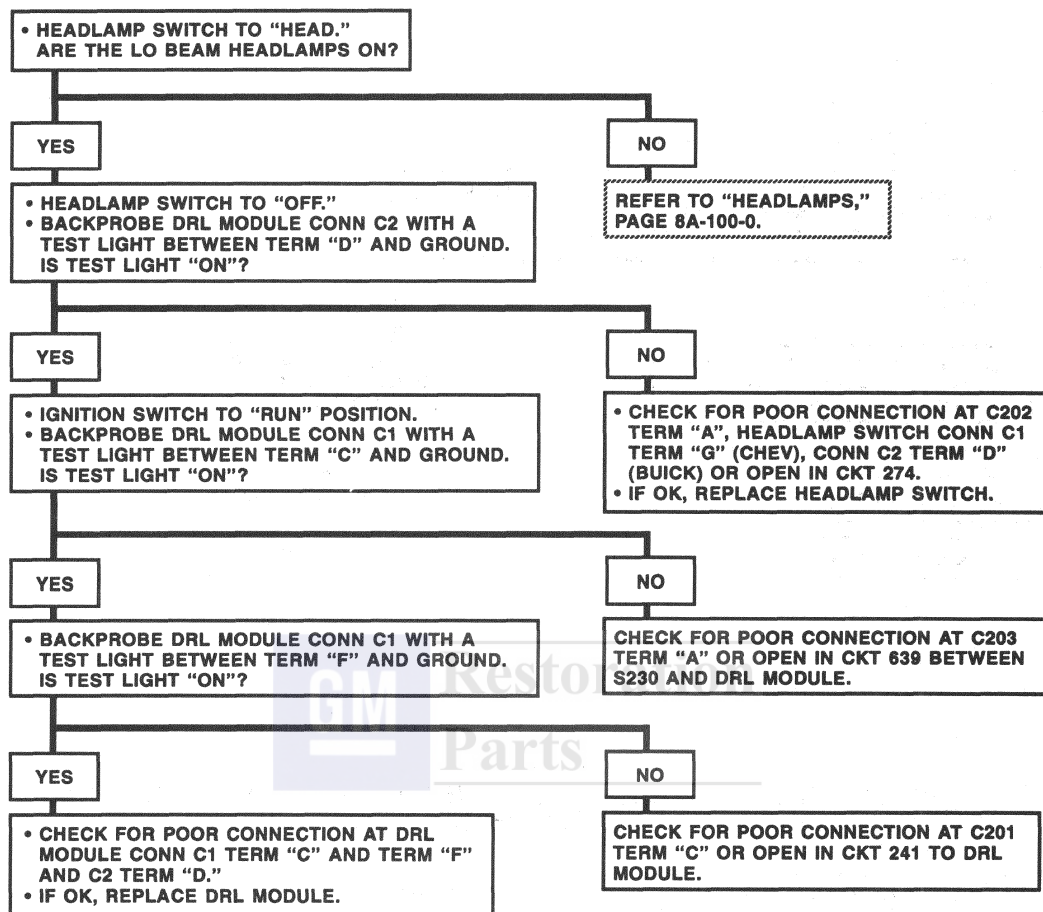
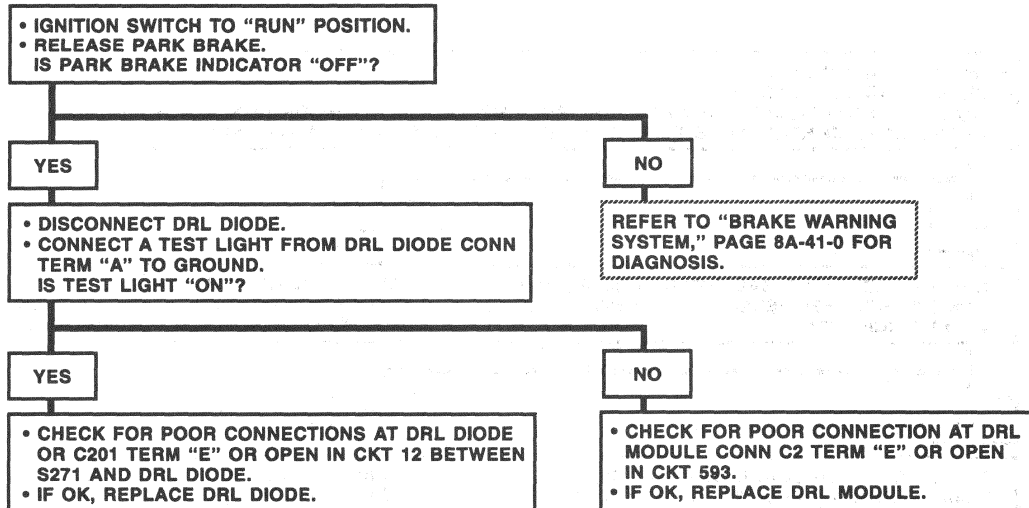


CHART #4

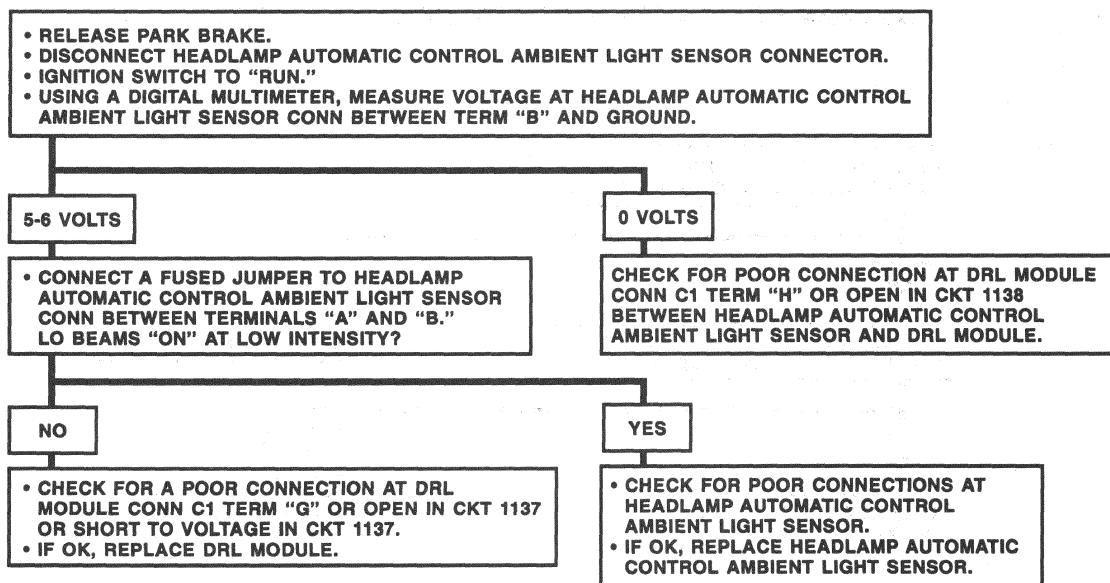
LO BEAM HEADLAMPS REMAIN "OFF" WITH DAYLIGHT CONDITIONS BUT SWITCH TO FULL INTENSITY WITH LOW LIGHT CONDITIONS



C9779

CHART #5

LO BEAM HEADLAMPS "ON" AT FULL INTENSITY WITH DAYLIGHT CONDITIONS

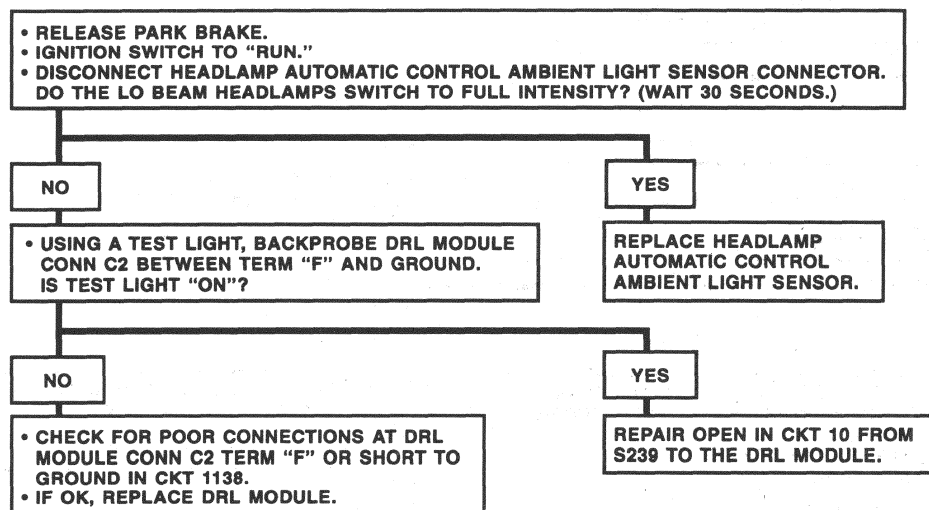


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HEADLAMPS: DAYTIME RUNNING LAMPS (T61)

CHART #6

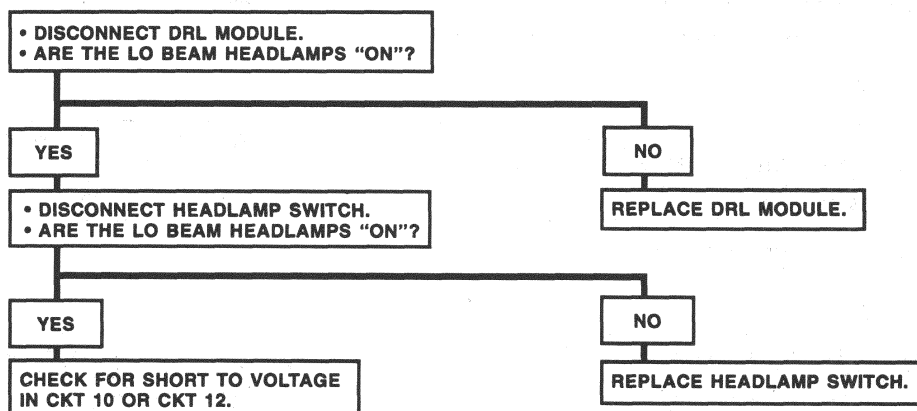
LO BEAM HEADLAMPS DO NOT SWITCH FROM REDUCED INTENSITY TO FULL INTENSITY WITH LOW LIGHT CONDITIONS



C9781

CHART #7

LO BEAM HEADLAMPS "ON" WITH HEADLAMP SWITCH "OFF"



C9782

CIRCUIT OPERATION

The LO Beam Headlamps are automatically controlled by the Daytime Running Lamps (DRL) Module. With sufficient ambient light (daylight), the DRL Module will activate the LO Beam Headlamps at a reduced intensity. With low light conditions, the DRL Module will activate the Park and Tail Lamps, and LO Beam Headlamps at full intensity. If the DRL System is inoperative, the Headlamp Switch overrides the DRL System to provide manual control of the Headlamps. If the Park Brake is set when the Ignition Switch is turned to "RUN," the DRL Module will not activate the LO Beam Headlamps until the Park Brake is released.

Battery voltage is applied at all times to the DRL Module through I/P Fuse #31 to power the Park and Tail Lamps. Voltage is applied to the DRL Module through I/P Fuse #20 to power the control circuitry of the DRL Module. Battery voltage is applied to the DRL Module through CKT 274 with the Headlamp Switch "OFF," to power the LO Beam Headlamps at reduced or full intensity.

As the intensity of light reaching the Headlamp Automatic Control Ambient Light Sensor decreases, the resistance of the Sensor increases. When the DRL Module senses a high resistance in the Sensor, the DRL Module

de-energizes the internal DRL Relay and energizes the internal Head Relay. Battery voltage is applied through the closed contacts of the Head Relay to CKT 10. With the Headlamp Dimmer Switch in "LO," the LO Beam Headlamps are "ON" at full intensity. With the Dimmer Switch in "HI," the HI Beam Headlamps and Indicator are "ON."

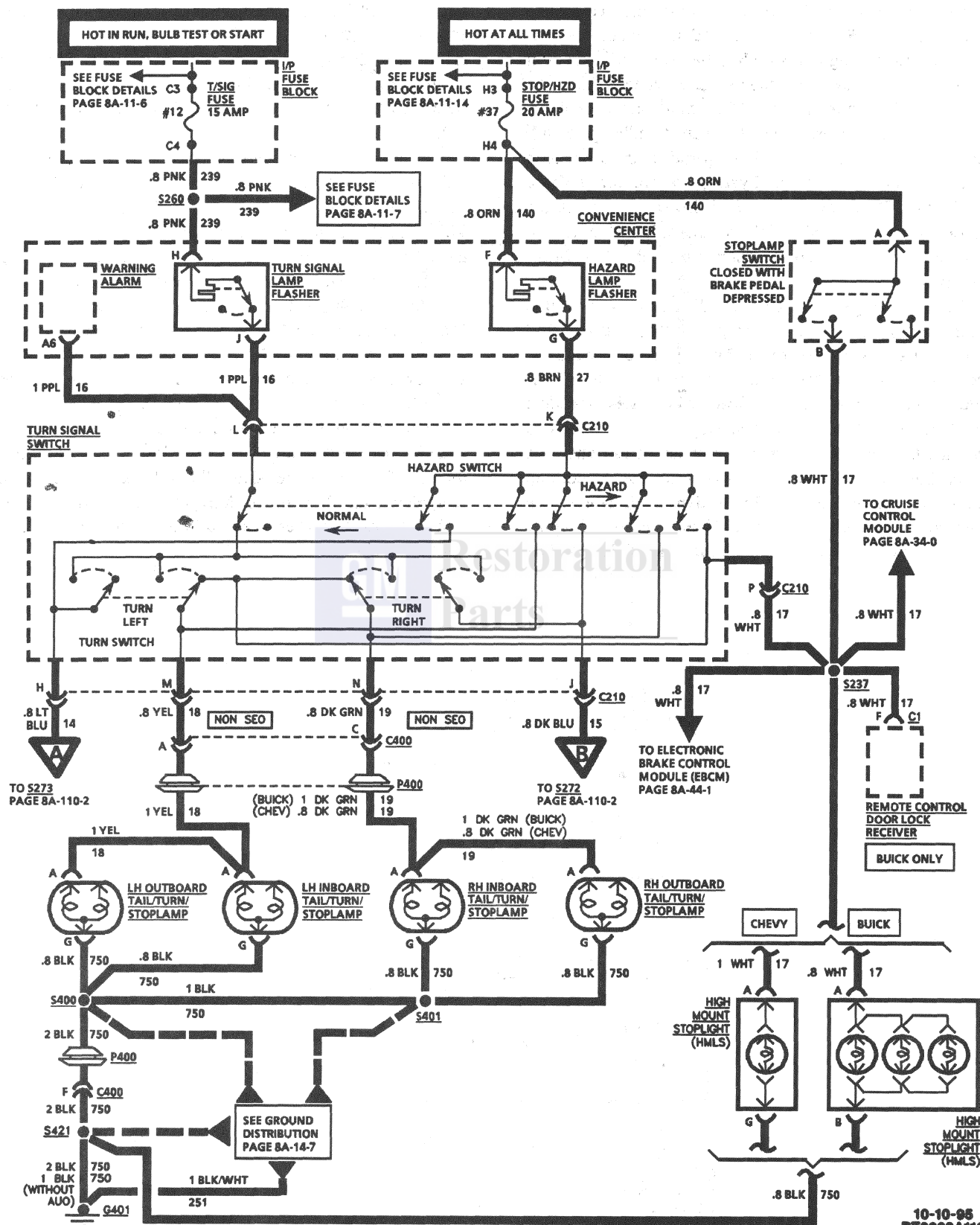
As the intensity of light reaching the Sensor increases, the resistance of the Sensor decreases. When the DRL Module senses a low resistance in the Sensor, the DRL Module de-energizes the internal Head Relay and energizes the internal DRL Relay. Battery voltage is applied through the closed contacts of the DRL Relay to the DRL Diode. Due to the voltage drop across the DRL Diode, the LO Beam Headlamps are "ON" at a reduced intensity.

When the Park Brake Switch is closed (Park Brake set), CKT 33 is grounded. If the Ignition Switch is turned to "RUN" when CKT 33 is grounded, the DRL Module senses a voltage drop at the Park Brake Input and will not energize the Head Relay or the DRL Relay until the ground through CKT 33 is removed (Park Brake Switch open). Reapplying the Park Brake during the same Ignition cycle will not affect further DRL operation, during the same ignition cycle.



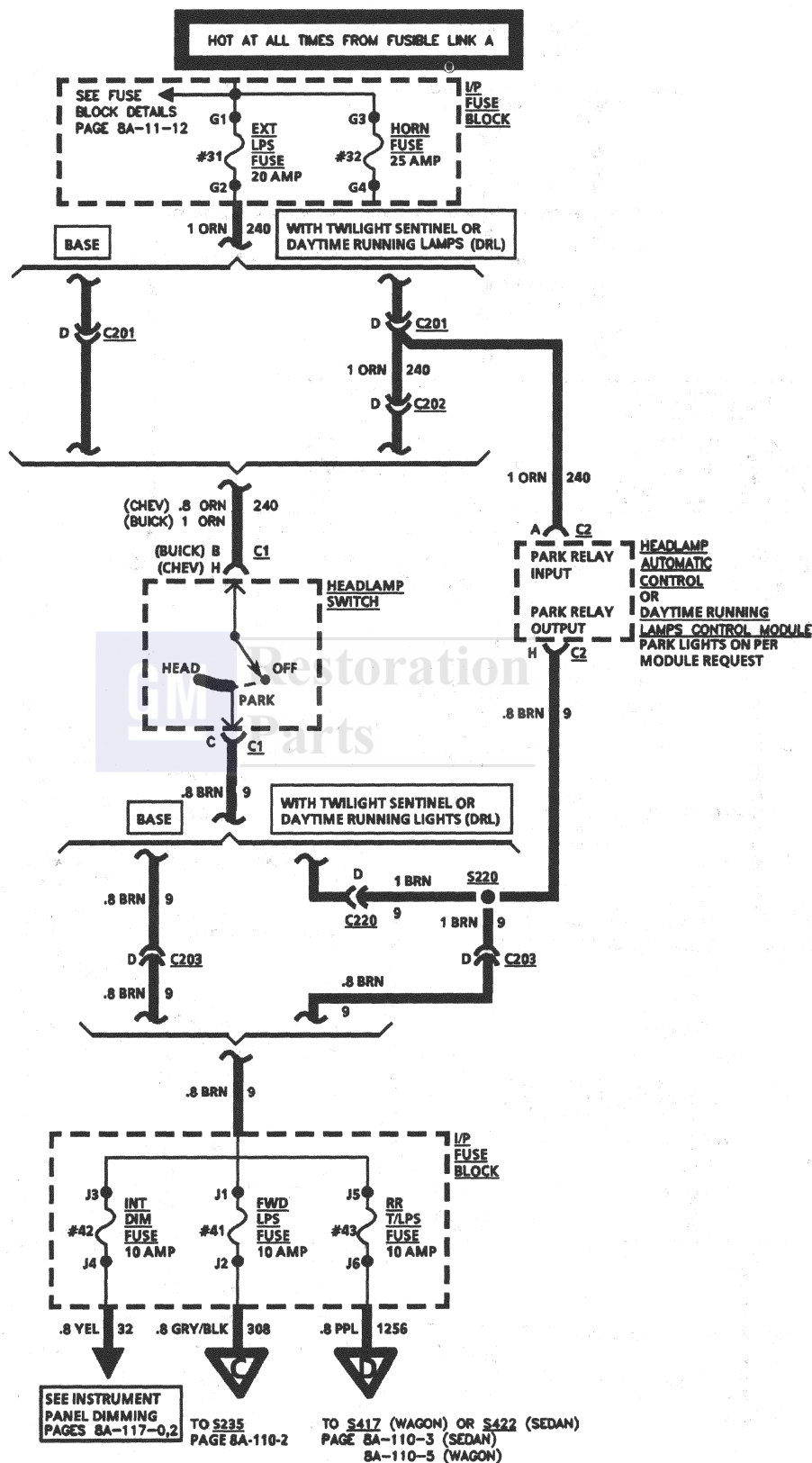
EXTERIOR LAMPS

TURN/STOP/HAZARD/ HIGH MOUNT STOP (SEDAN)

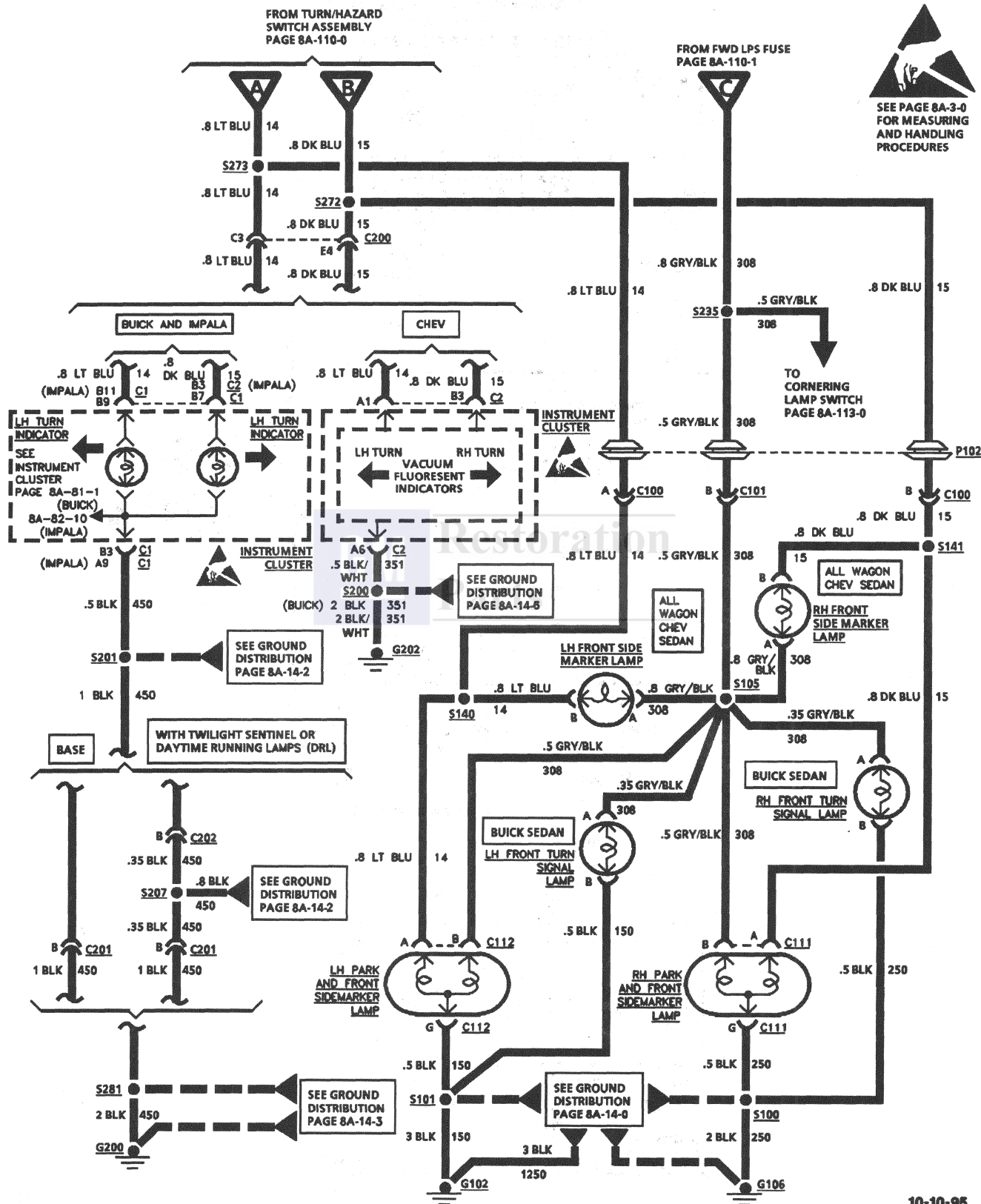


EXTERIOR LAMPS

FRONT MARKER/HAZARD/PARK/TURN/LICENSE



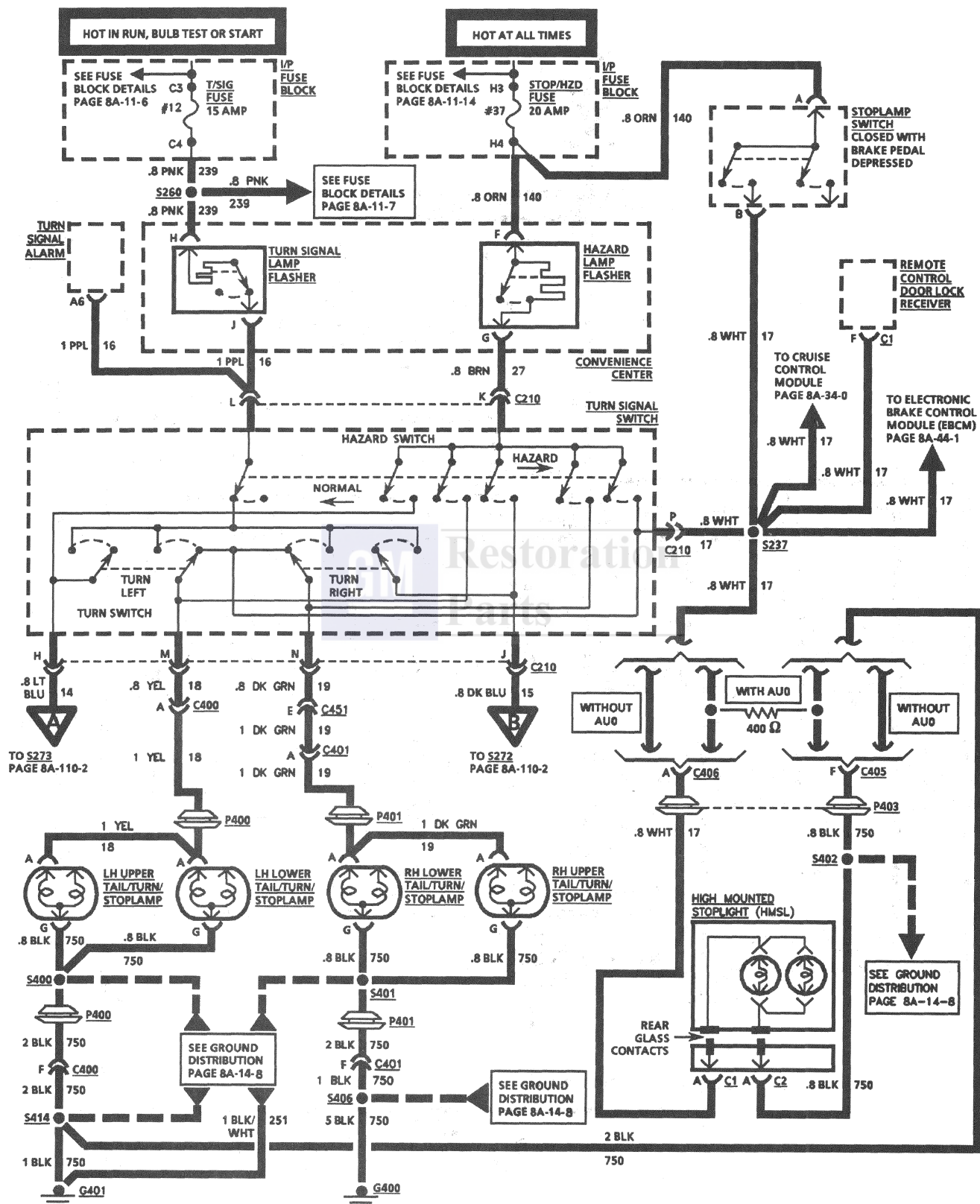
EXTERIOR LAMPS



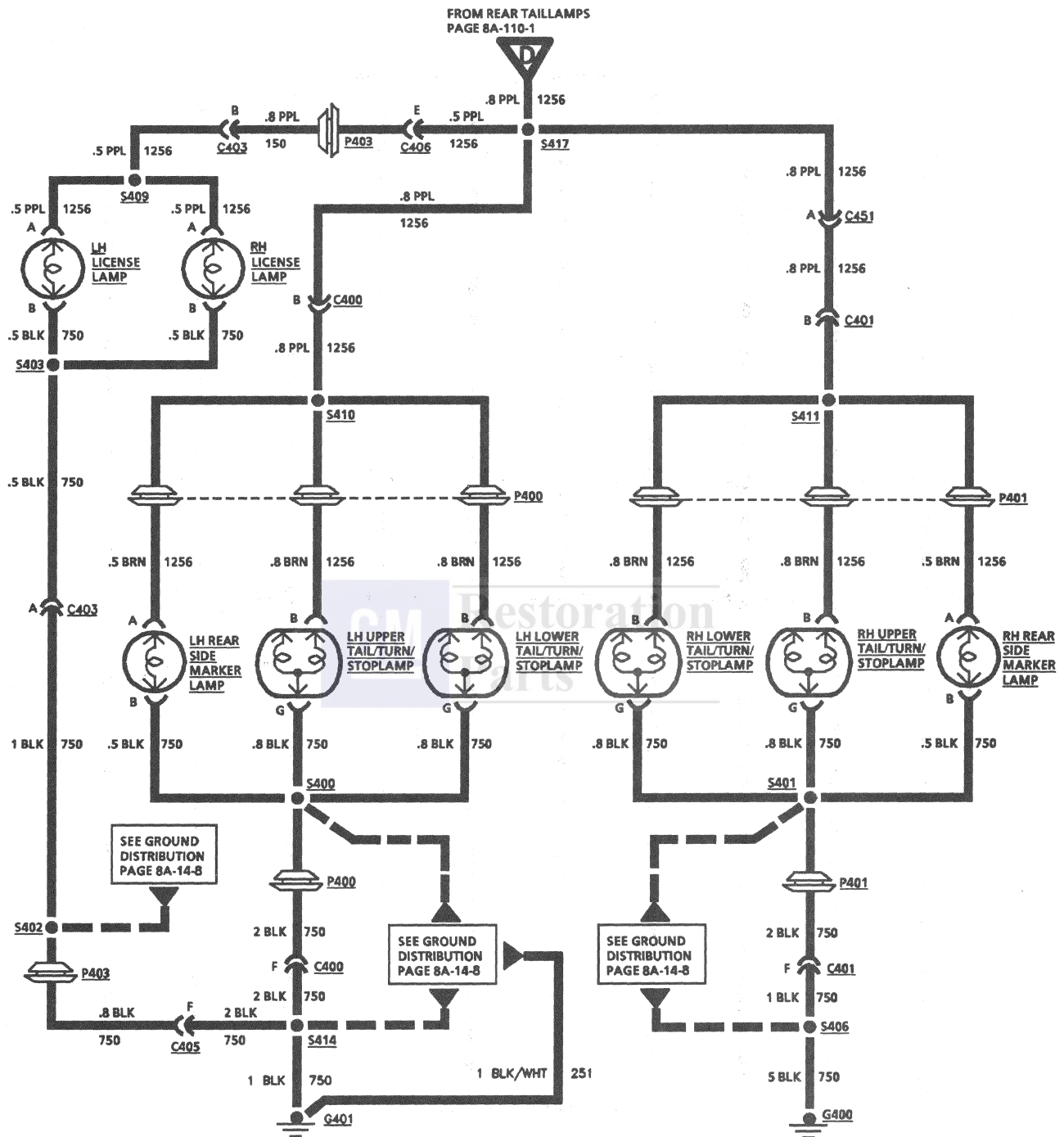


EXTERIOR LAMPS

TURN/STOP/HAZARD/HIGH MOUNT STOP (WAGON)

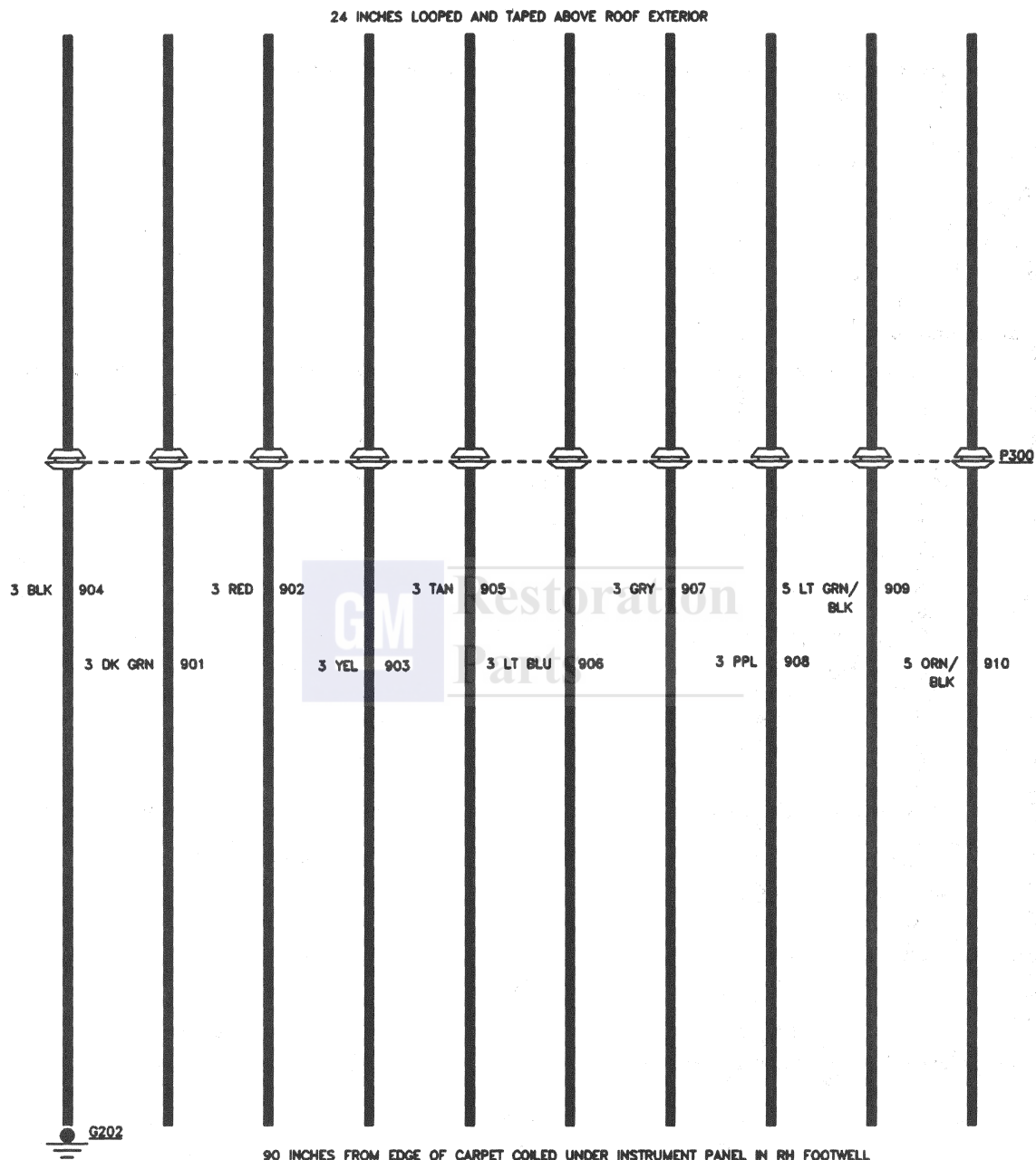


EXTERIOR LAMPS TAILLAMPS (WAGON)



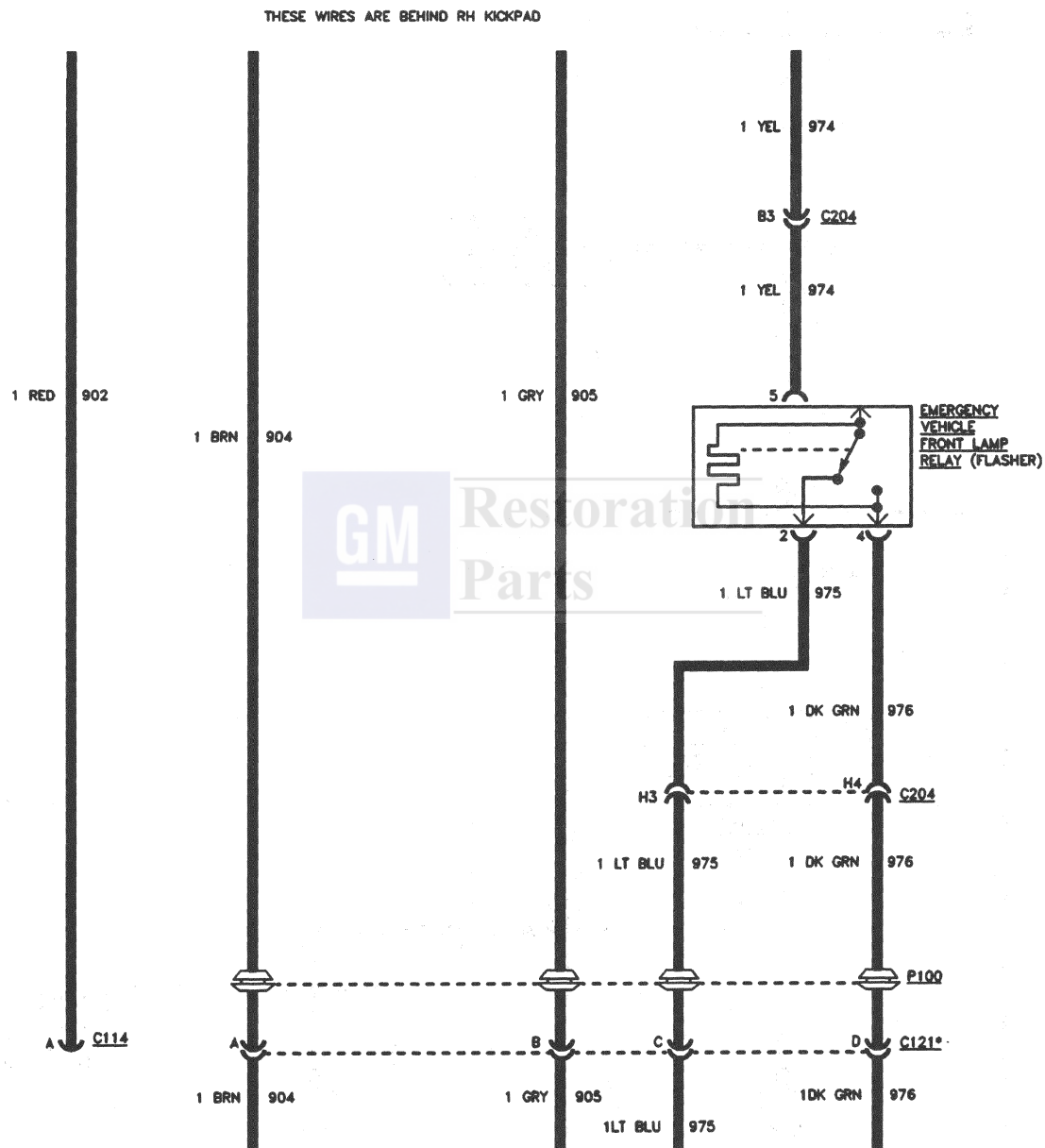
8A - 110 - 6 ELECTRICAL DIAGNOSIS

EXTERIOR LAMPS EXTERNAL ROOF (6F5)(SEO)



EXTERIOR LAMPS

GRILLE LAMPS (6J3)(SEO)

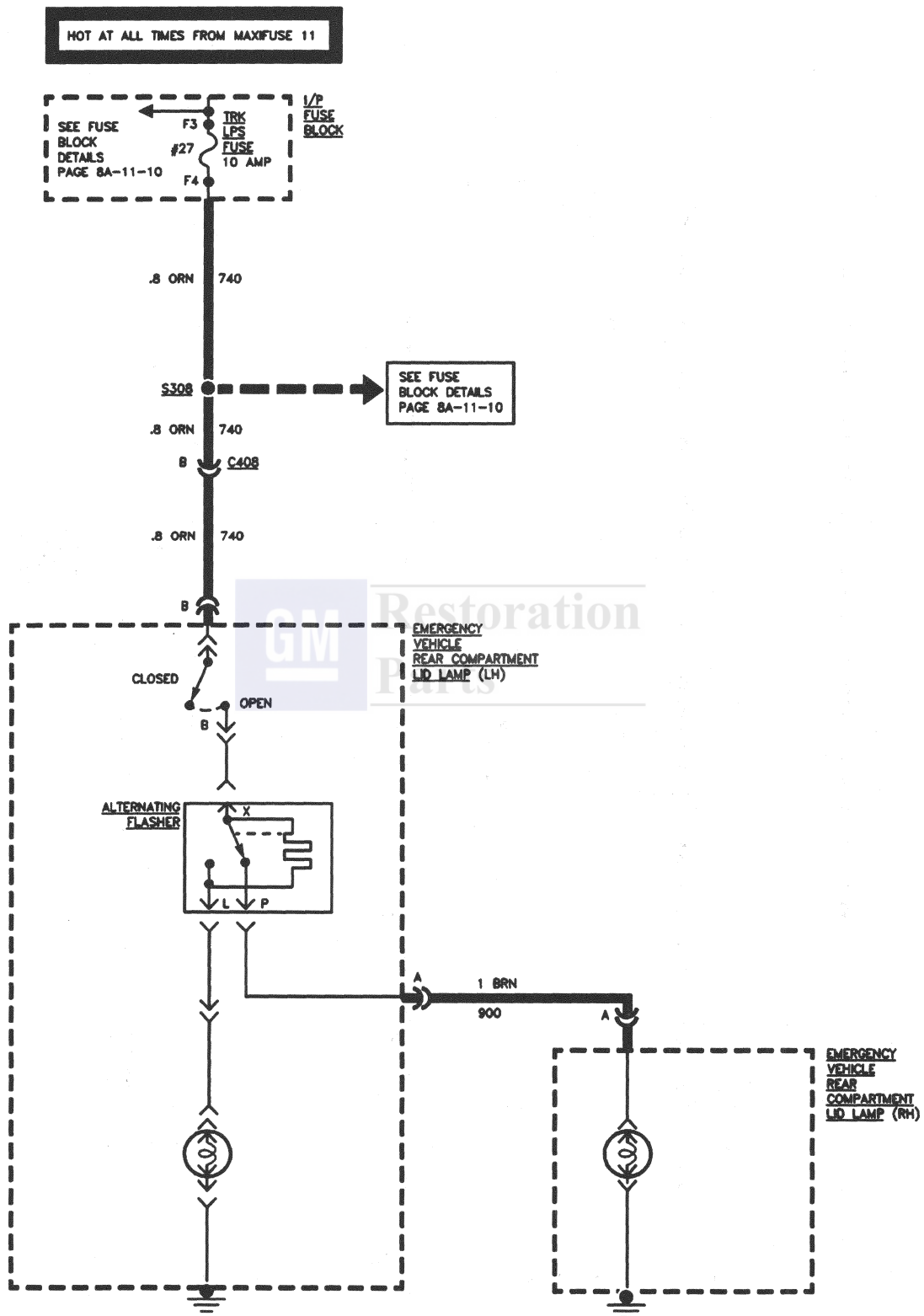


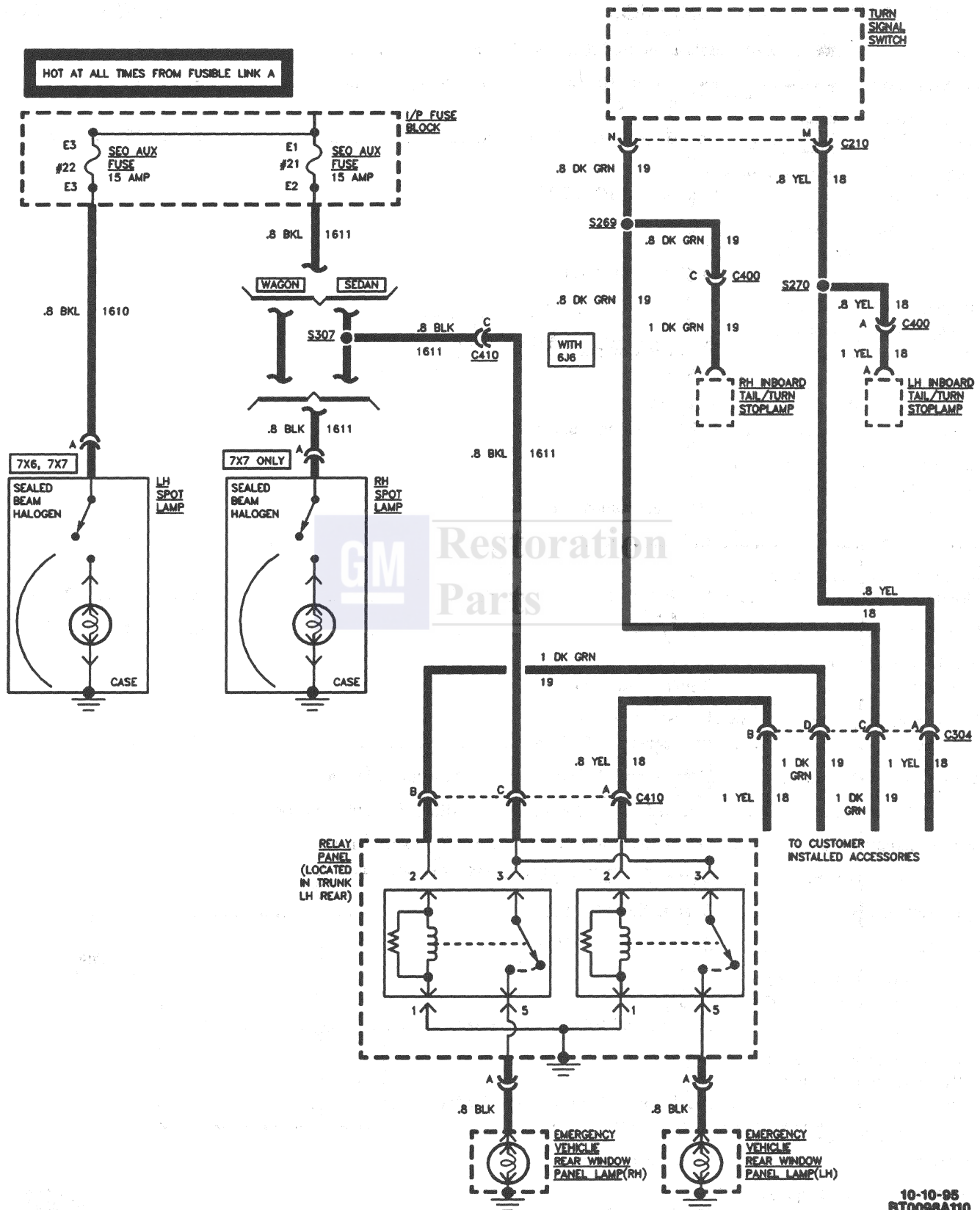
TO FORWARD LAMPS SEO GRILLE LAMPS

*(C121 IS LOCATED AT THE RH SIDE OF THE RADIATOR ATTACHED TO THE SUPPORT BRACKET)

EXTERIOR LAMPS

EMERGENCY VEHICLE REAR COMPARTMENT LID LAMPS (T53)(SEO)



EXTERIOR LAMPS**SPOT LAMPS, REAR WINDOW PANEL LAMPS (6J6, 7X6, 7X7)(SEO)**

8A - 110 - 10 ELECTRICAL DIAGNOSIS**EXTERIOR LAMPS**

COMPONENT	LOCATION	201-PG	FIG.	CONN
Convenience Center	LH I/P, left of Steering Column.....	11	19	
Cornering Lamps Switch.....	Part of Turn/Hazard Switch in Steering Column	13	21	
Daytime Running Lamp Control Module.....	At RH "A" Pillar, behind kickpad.....	18	29.....	202-14
Emergency Vehicle Front Lamp Relay Flasher	Mounted on HVAC Module			
Emergency Vehicles Rear Compartment Lid Lamp, LH.....	LH Rear Compartment			
Emergency Vehicles Rear Compartment Lid Lamp, RH	LH Rear Compartment			
Emergency Vehicles Rear Compartment Window Panel Lamp, LH.....	LH Rear Compartment			
Emergency Vehicles Rear Compartment Window Panel Lamp, RH	RH Rear Compartment			
Hazard Lamp Flasher.....	In Convenience Center, LH I/P.....	12	20	
Headlamp Automatic Control Module	At RH "A" Pillar, behind kickpad.....	18	29.....	202-7
Headlamp Switch	Left of Steering Column.....	9.....	16.....	202-11
High Mount Stoplamp (Sedan).....	Center of Rear Shelf			
High Mount Stoplamp (Wagon)	Near center of Endgate	35	51	
Instrument Cluster.....	LH side of I/P, centered above Steering Column			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
License Lamp (Sedan).....	Center Rear of Vehicle, in Rear Compartment Lid.....	35	51	
License Lamp (Wagon).....	Center of Rear Bumper			
Opera Lamp, LH.....	Outside LH "C" Pillar			
Opera Lamp, RH.....	Outside RH "C" Pillar			
Park and Front Side Marker Lamp, LH (Wagon and Chev Sedan).....	LH Front of Vehicle, near Headlamp.....	0.....	1	
Park and Front Side Marker, RH (Wagons and Chev Sedan).....	RH Front of Vehicle, near Headlamp.....	0.....	2	
Rear Side Marker Lamp, LH (Sedan).....	LH Rear of Vehicle			
Rear Side Marker Lamp, RH (Sedan).....	RH Rear of Vehicle			

COMPONENT	LOCATION	201-PG	FIG.	CONN
Relay Panel.....	In RH Rear Compartment			
Remote Control Door Lock Receiver (Buick Only)	Center Front of Vehicle			
Side Marker Lamp, LH Front (Wagon)	LH side of Vehicle, left of Headlamp	0	1	
Side Marker Lamp, RH Front (Wagon)	RH Front of Vehicle, left of Headlamp	0	2	
Side Marker Lamp, LH Rear (Wagon)	LH Rear of Vehicle	37	53	
Side Marker Lamp, RH Rear (Wagon)	RH Rear of Vehicle	38	54	
Spot Lamp, LH (SEO).....	At LH "A" Pillar			
Spot Lamp, RH (SEO)	At RH "A" Pillar			
Stoplamp/Cruise Release Switch	Attached to Brake Pedal Bracket (bottom switch)	11	19	
Tail/Turn/Stoplamp, LH Inboard (Sedan).....	LH Rear of Vehicle			
Tail/Turn/Stoplamp, RH Inboard (Sedan).....	RH Rear of Vehicle			
Tail/Turn/Stoplamp, LH Lower (Wagon)	LH Rear of Vehicle	37	53	
Tail/Turn/Stoplamp, RH Lower (Wagon)	RH Rear of Vehicle	38	54	
Tail/Turn/Stoplamp, LH Outboard (Sedan).....	LH Rear of Vehicle			
Tail/Turn/Stoplamp, RH Outboard (Sedan).....	RH Rear of Vehicle			
Tail/Turn/Stoplamp, LH Upper (Wagon)	LH Rear of Vehicle	37	53	
Tail/Turn/Stoplamp, RH Upper (Wagon)	RH Rear of Vehicle	38	54	
Taillamp, LH (Sedan).....	LH Rear of Vehicle			
Taillamp, RH (Sedan)	RH Rear of Vehicle			
Taillamp, LH Inboard (Buick Sedan)	LH Rear of Vehicle			
Taillamp, RH Inboard (Buick Sedan)	RH Rear of Vehicle			
Turn Signal Alarm	LH side of I/P, in Convenience Center	12	20	
Turn Signal Lamp, LH	LH Rear of Vehicle			
Turn Signal Lamp, RH	RH Rear of Vehicle			
Turn Signal Switch	Mounted on upper LH side of Steering Column.....	13	21	202-4
C100 (10 cavities).....	Forward Lamp Harn to Body Harn, right of Vehicle	5	9	202-0

8A - 110 - 12 ELECTRICAL DIAGNOSIS**EXTERIOR LAMPS**

COMPONENT	LOCATION	201-PG	FIG.	CONN
C101 (4 cavities).....	Forward Lamp Harn to Body Harn, LH Front Engine Compartment, near PCM.....	5.....	9.....	202-5
C111 (3 cavities).....	Forward Lamp Harn to RH Park Front Side Marker Lamp Jumper, forward of Battery			
C112 (3 cavities).....	Forward Lamp Harn to LH Park Front Side Marker Lamp Jumper, forward of PCM			
C121.....	RH Side of the Radiator attached to the support bracket			
C122 (2 cavities) (SEO).....	Engine Harn to Forward Lamp Harn			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal.....	14.....	22.....	202-1
C201 (6 cavities) (Base).....	Body Harn to I/P Harn, at RH side of Steering Column, above C200.....	11.....	19.....	202-5
C201 (6 cavities) (w/T61).....	Body Harn to Daytime Running Lamps (DRL) Harn, at RH side of Steering Column, above C200.....	11.....	19.....	202-5
C201 (6 cavities) (w/T82).....	Body Harn to Twilight Sentinel Harn, at RH side of Steering Column, above C200.....	11.....	19.....	202-5
C202 (6 cavities) (w/T61).....	I/P Harn to Daytime Running (DRL) Lamps Harn, right of Steering Column, above C200.....	11.....	19.....	202-5
C202 (6 cavities) (w/T82).....	I/P Harn to Twilight Sentinel Harn, RH side of Steering Column, above C200.....	11.....	19.....	202-5
C203 (10 cavities) (Base).....	Body Harn to I/P Harn, at RH side of Steering Column.....	11.....	19.....	202-5
C203 (10 cavities) (w/T61).....	Body Harn to Daytime Running Lamps (DRL) Harn, RH side of Steering Column.....	11.....	19.....	202-5
C203 (10 cavities) (w/T82).....	Body Harn to Twilight Sentinel Harn, RH side of Steering Column.....	11.....	19.....	202-5
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P between Blower Motor and I/P Compartment.....	18.....	29.....	202-3
C210 (11 cavities).....	Body Harn to Turn/Hazard Switch Conn, under Steering Column			
C220 (10 cavities) (w/T61).....	I/P Harn to Daytime Running Lamps (DRL) Harn, at RH side of Steering Column.....	11.....	19.....	202-5
C220 (10 cavities) (w/T82).....	I/P Harn to Twilight Sentinel Harn, at RH side of Steering Column.....	11.....	19.....	202-5
C400 (8 cavities) (Sedan).....	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender.....	31.....	46.....	202-6
C401 (6 cavities) (Wagon).....	RH Stoplamp Harn to Rear Body Harn, at RH "D" Pillar			
C403 (2 cavities).....	License Lamp Harn to Endgate Harn, center of Endgate.....	35.....	51	
C405 (6 cavities).....	Body Harn to Endgate Harn, near center of LH "D" Pillar..	34.....	49.....	202-7
C406 (8 cavities).....	RH Tailgate Harn to Body near center of LH "D" Pillar.....	34.....	49	
C408 (6 cavities).....	Body Harn to Rear Compartment Courtesy Lamp Harn.....	30.....	43.....	202-7
C410.....	Passenger Side, Front of Vehicle Crosscar Harn			

COMPONENT	LOCATION	201-PG	FIG.	CONN
C451 (6 cavities).....	Body Harn to Rear Header Harn, near center of LH "D" Pillar.....	34	49	202-6
G102.....	Behind LH Headlamp Support, forward of Air Cleaner.....	0	1	
G106.....	RH Headlamp Support, forward of Battery	0	2	
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G202 (SEO).....	Base of RH "A" Pillar, behind kickpad			
G400.....	Near center of RH "D" Pillar			
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment.....	31	46	
G401 (Wagon)	Near center of LH "D" Pillar	34	49	
P100	RH I/P, forward of Blower Motor	18	29	
P102	Visible from Engine Compartment, Behind LH Wheelhouse..	5	10	
P300 (SEO).....	RH exterior of Roof			
P400 (Sedan)	LH Rear of Vehicle, in Luggage Compartment.....	32	47	
P400 (Wagon).....	LH Rear of Vehicle, at Taillamps.....	37	53	
P401	RH Rear of Vehicle, at Taillamps			
P403 (Wagon).....	Between Tailgate and LH "D" Pillar			
S100	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S101	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout			
S105	Forward Lamp Harn, approx 11 cm from C100 branch breakout			
S140	Forward Lamp Harn, approx 4 cm from LH Horn Conn branch breakout			
S141	Forward Lamp Harn, approx 7 cm from C103 branch breakout			
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp conn breakout			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S201 (Buick).....	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 breakout, in spiral taping			
S201 (Chev).....	I/P Harn, approx 12 cm from C200 branch breakout			
S207 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn			
S207 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S220 (w/T61).....	Daytime Running Lamps (DRL) Harn, approx 13 cm from Daytime Running Lamp (DRL) Diode Conn			

EXTERIOR LAMPS

COMPONENT	LOCATION	201-PG	FIG.	CONN
S220 (w/T82).....	Headlamp Automatic Beam Control Harn, approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S235	Body Harn, approx 16 cm from P102			
S237	Body Harn, approx 11 cm from Starter Motor Theft Deterrent Relay breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S269 (SEO Sedan).....	Body Harn, approx 28 cm from SDM breakout			
S270 (SEO Sedan).....	Body Harn, approx 21 cm from SDM breakout			
S272	Body Harn, approx 7 cm from C200 breakout			
S273	Body Harn, approx 11 cm from C200 breakout			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			
S307 (SEO)	Body Harn, approx 17 cm from C309 breakout			
S308 (Sedan)	Body Harn, Approx. 11 cm from C309 breakout			
S400 (Buick Sedan).....	Body Rear Harn, approx 4 cm from C416 branch breakout			
S400 (Chev Sedan)	Body Rear Harn, approx 4 cm from C402 branch breakout			
S400 (Wagon).....	LH Stoplamp Harn, approx 12 cm from LH lower Tail/Turn/Stoplamp Conn branch breakout			
S401 (Buick Sedan).....	Body Rear Harn, approx 4 cm from C417 Conn branch breakout			
S401 (Chev Sedan)	Body Rear Harn, approx 4 cm from RH Backup Lamp Conn branch breakout			
S401 (Wagon).....	RH Stoplamp Harn, approx 12 cm from RH lower Tail/Turn/Stoplamp Conn branch breakout			
S402 (Wagon).....	Tailgate Harn, approx 5 cm from High Mount Stoplamp Conn breakout			
S403	Rear lamp Harn, approx 11 cm from C405			
S404 (Buick Sedan).....	Body Rear Harn, approx 21 cm from C400			
S404 (Chev Sedan)	Body Rear Harn, approx 31 cm from C400			
S406 (Wagon).....	Body Rear Harn, approx 17 cm from C412 breakout			
S408	Deck Lid Harn, approx 4 cm from Rear License Plate Lamp breakout			
S409 (Buick Sedan).....	Body Rear Harn, approx 15 cm from C400			
S410 (Wagon).....	LH Stoplamp Harn, approx 5 cm from C400			
S411 (Wagon).....	RH Stoplamp Harn, approx 5 cm from C401			
S414 (Wagon).....	Body Harn, approx 26 cm from Remote Control Door Lock Module breakout			

COMPONENT	LOCATION	201-PG FIG. CONN
S417 (Wagon).....	Body Harn, approx 12 cm from Remote Control Door Lock Module breakout	
S422 (Sedan)	Body Harn, approx 27 cm from C408 branch breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. If the Turn Lamps or Backup Lamps do not work, check I/P Fuse #12. If open, check for short to ground in CKT 239.
2. If the Stop Lamps or Hazard Lamps do not work, check I/P Fuse #37. If open, check for short to ground in CKT 140.
3. If one of the Turn Indicators goes on when the Park Lamps are turned on, check the Park and Front Side Marker Lamp on that side for open or poor connection.
4. If Turn Lamps stay on (do not flash) in both Turn Left and Turn Right, replace the Turn Flasher.
5. For any of the following symptoms, replace the Turn Signal Switch:
 - Turn Signal Switch will not turn "ON/OFF."
 - All Turn/Hazard/Stop Lamps do not work and C210 is firmly mated.
 - Some Turn Lamps work and all Hazard Lamps work.
 - Some Hazard Lamps work and all Turn Lamps work.
 - Hazard Lamps do not turn "OFF."
6. If Hazard Lamps stay on (do not flash) in "Hazard," but Stop Lamps operate normally, replace the Hazard Flasher.
7. If Stop Lamps do not turn "OFF" adjust/replace the Stoplamp Switch.
8. If a Turn Indicator does not light but the Turn Signal works, check the bulb, connections and wiring to the Indicator. Refer to "Instrument Cluster," page 8A-81-0 (Buick) or 8A-82-0 (Chevrolet).
9. If only one lamp does not operate, check the lamp, socket and related wiring for opens or corrosion (see schematic).
10. With Twilight Sentinel, if Parking Lamps stay on and Headlamps stay at full intensity with daylight conditions check for an obstruction covering the Twilight Sentinel Photocell (See "Headlamps With Twilight Sentinel," page 8A-101-0).
11. If one Front Park and/or Marker Lamp does not light, check that its ground is clean and tight.
12. If none of the Park/Taillamps work, check I/P Fuse #31. If open, check for short to ground in CKT 240.
13. If Park Lamps do not turn "OFF," check Headlamp Switch. If OK, repair short to B+ in CKT 9.
14. Sedan: If License Lamp is inoperative, check for open in CKT 750 between S408 and lamp socket. Check for open in CKT 1256 between S417 and lamp socket. Wagon: If one License Lamp is inoperative, check for open in CKT 750 between S403 and inoperative lamp socket. Check for open in CKT 1256 between S409 and inoperative lamp socket.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
 - Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
 - Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedures.

EXTERIOR LAMPS**SYSTEM CHECK**

ACTION	NORMAL RESULTS
[1] • Headlamp Switch to "PARK."	All Exterior Lamps are "ON" (except Headlamps).
[2] • Hazard Switch to "ON."	Front and Rear Turn Lamps flash continuously from minimum intensity to maximum intensity. Front Marker Lamps flash continuously from "OFF" to "ON."
[3] • Headlamp Switch still set in "PARK" position. • Hazard Switch "ON." • Depress brake pedal.	Front and Rear Turn Lamps stay "ON" at maximum intensity and Front Marker Lamps stay "OFF," as long as brake pedal is depressed.
[4] • Headlamp Switch "OFF." • Brake pedal released. • Hazard Lamps still "ON."	Front and Rear Turn Lamps flash continuously from "OFF" to "LOW" intensity.
[5] • Operate LH or RH Turn Switch.	Turn Lamps flash continuously "ON" and "OFF."

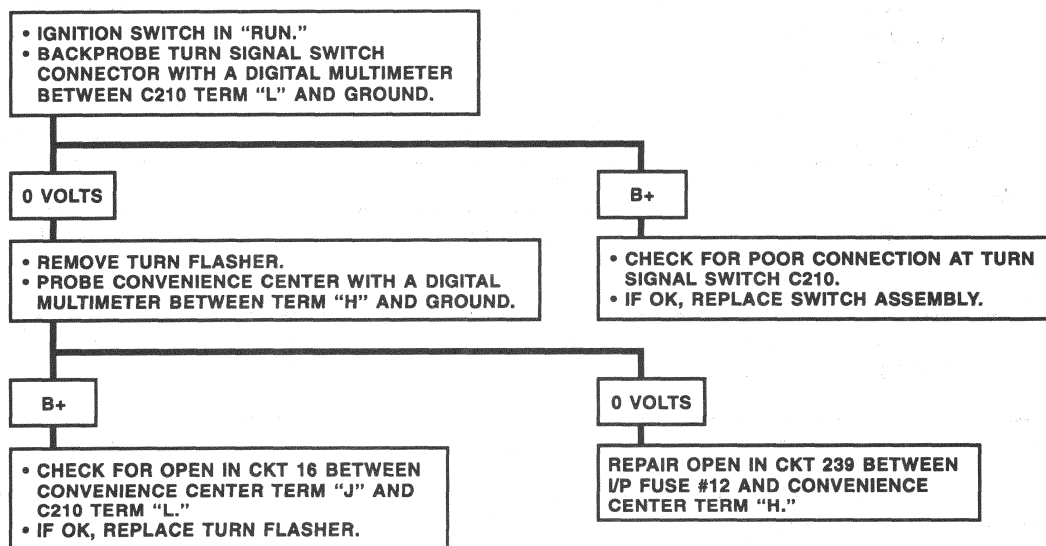


SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Turn Lamps inoperative, Hazard Lamps operate normally.	Chart #1	8A-110-18
Hazard Lamps inoperative, Turn Signals and Stop Lamps operate normally.	Chart #2	8A-110-18
Park and Taillamps inoperative.	Chart #3	8A-110-19
Stop Lamps inoperative.	Chart #4	8A-110-19
RH and/or LH Stop/Turn Lamps inoperative, Front Turn Lamps operate normally.	Chart #5	8A-110-20
Front Park Lamps inoperative, Taillamps and Turn Signals operate normally.	Chart #6	8A-110-20
Turn Indicator and Front Turn Lamp on one side inoperative.	Chart #7	8A-110-21
All Rear Marker and Taillamps inoperative, Front Park Lamps operate normally.	Chart #8	8A-110-21
License Lamps inoperative, Front Park and Taillamps operate normally.	Chart #9	8A-110-22
High Mount Stoplamp inoperative.	Chart #10	8A-110-22
Park, Marker and Taillamps remain on with daylight conditions and Headlamp Switch "OFF" (with Twilight Sentinel or DRL).	• Refer to "Headlamps With Twilight Sentinel," page 8A-101-0. • Refer to "Headlamps: Daytime Running Lamps," page 8A-102-0.	
Park, Marker and Taillamps do not turn on with low light conditions and Headlamp Switch "OFF" (with Twilight Sentinel or DRL).	• Refer to "Headlamps With Twilight Sentinel," page 8A-101-0. • Refer to "Headlamps: Daytime Running Lamps," page 8A-102-0.	
High Mount Stoplamp "ON" at all times.	Check for short to B+ on CKT 17. If OK, replace Brake Lamp/Cruise Release Switch.	

EXTERIOR LAMPS

CHART #1
TURN LAMPS INOPERATIVE, HAZARD LAMPS OPERATE NORMALLY

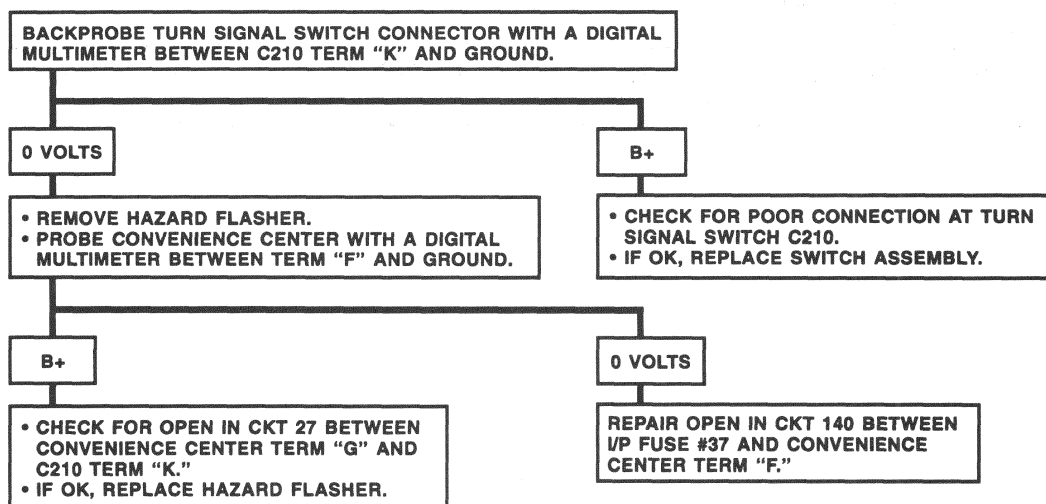


C9766

CHART #2
**HAZARD LAMPS INOPERATIVE, TURN SIGNALS AND STOP LAMPS
 OPERATE NORMALLY**

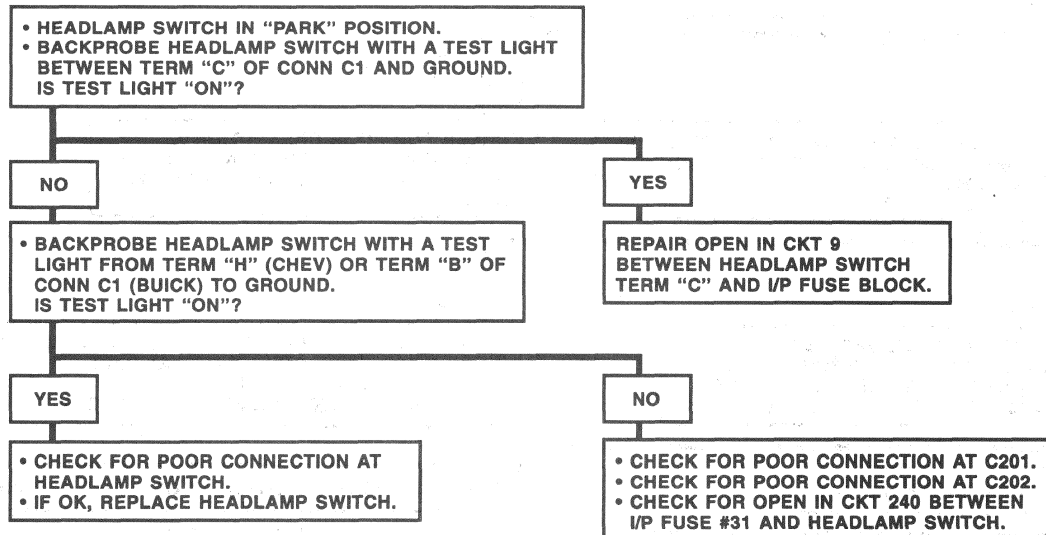
**IMPORTANT:**

- TO AVOID MISDIAGNOSIS CHECK THAT FLASHER IS OK AND SEATED PROPERLY.



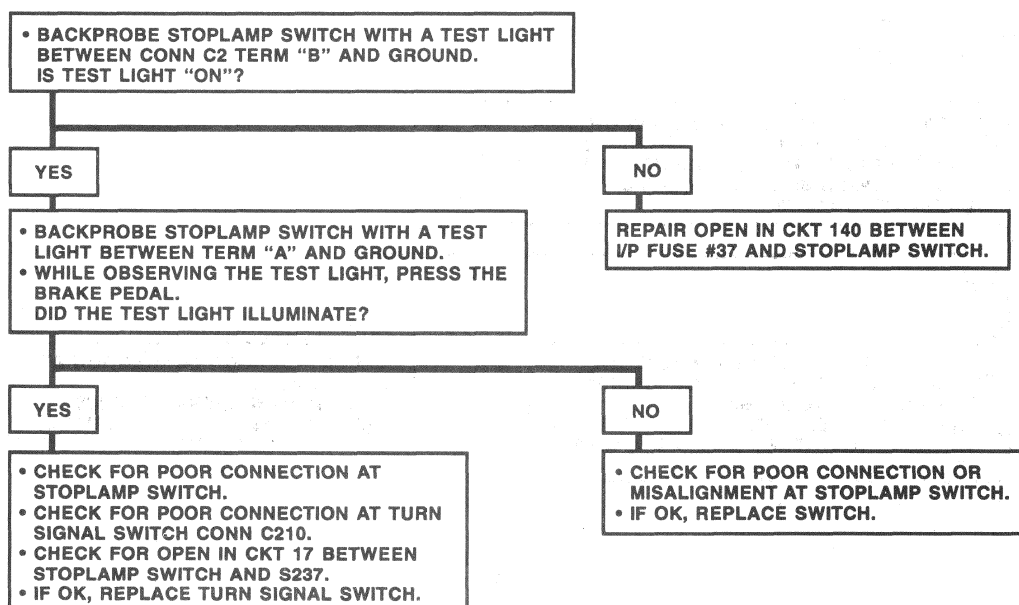
C9767

CHART #3 PARK AND TAILLAMPS INOPERATIVE



C9768

CHART #4 STOP LAMPS INOPERATIVE

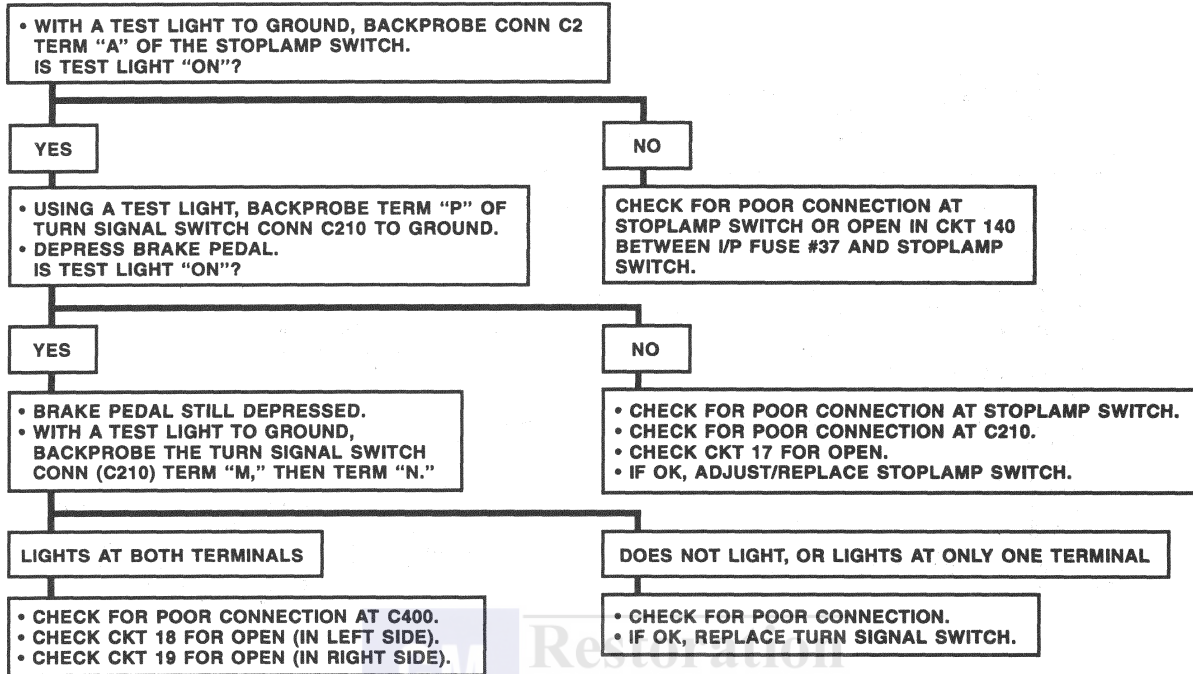


C9769

EXTERIOR LAMPS

CHART #5

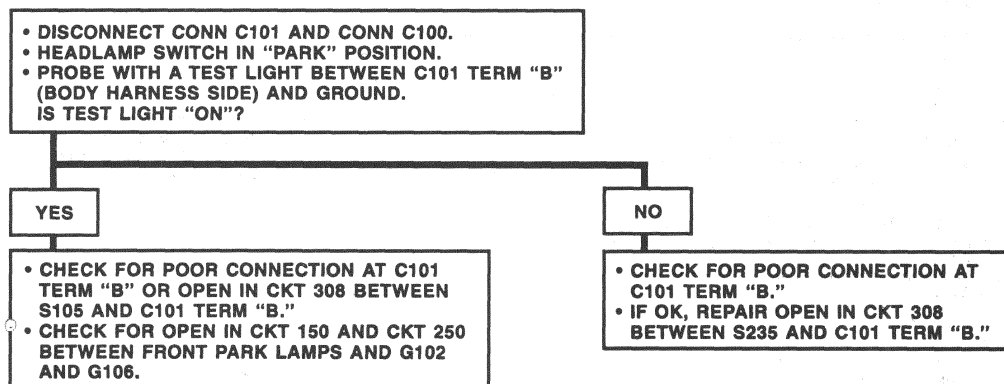
RH AND/OR LH STOP/TURN LAMPS INOPERATIVE, FRONT TURN LAMPS OPERATE NORMALLY



C9770

CHART #6

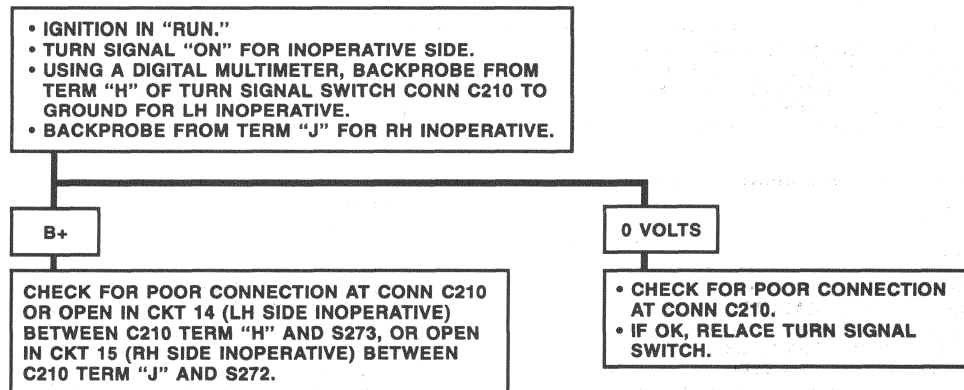
FRONT PARK LAMPS INOPERATIVE, TAILLAMPS AND TURN SIGNALS OPERATE NORMALLY



C9771

CHART #7

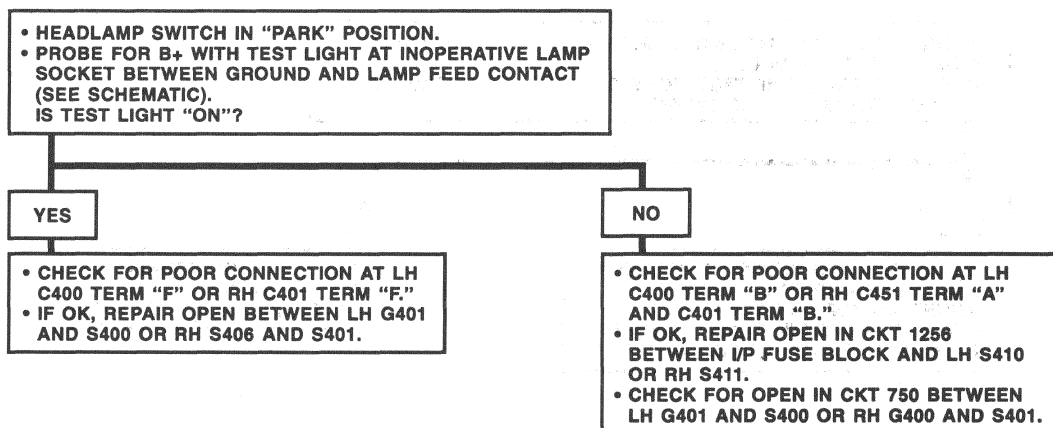
TURN INDICATOR AND FRONT TURN LAMP ON ONE SIDE INOPERATIVE



C9772

CHART #8

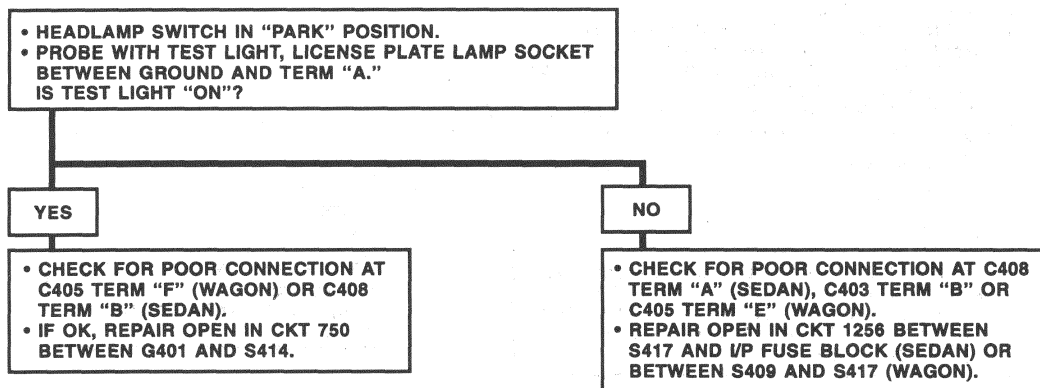
ALL REAR MARKER AND TAILLAMPS (ON ONE SIDE) INOPERATIVE, FRONT PARK LAMPS OPERATE NORMALLY



C9773

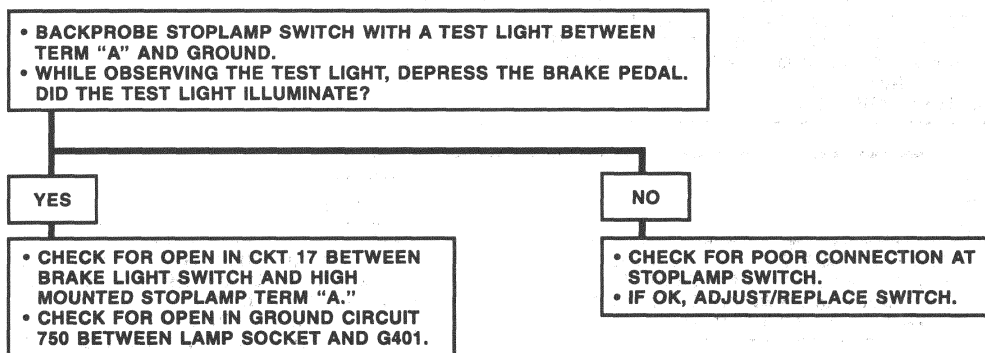
EXTERIOR LAMPS

CHART #9
LICENSE LAMPS INOPERATIVE, FRONT PARK AND TAILLAMPS OPERATE NORMALLY



C9774

CHART #10
CENTER HIGH MOUNTED STOPLAMP INOPERATIVE



C9775

PARK, MARKER, TAIL AND LICENSE LAMPS

Voltage is applied at all times from I/P Fuse #31 to the Headlamp Switch and, if equipped, to the Automatic Headlamp Control or DRL Module from CKT 240. With the Headlamp Switch in "PARK" or "HEAD" or with low light conditions, if equipped with Twilight Sentinel, voltage is applied to CKT 9. Current flows through CKT 9, to I/P Fuse Block, which feeds all Park, Marker, Tail and License Lamps turning them "ON." The only lamps that see a current from CKT 308 and do not turn "ON," are the turn filaments in the Park/Turn Lamps. They do not activate because the voltage drop across the Front Side Marker Lamps is much higher than that across the Turn Lamp Filaments.

TURN LAMPS

With the Ignition Switch in "RUN," "BULB TEST" or "START," voltage is applied from I/P Fuse #12 and the Turn Flasher to the normally closed pole of the Hazard Switch in the Turn/Hazard Switch Assembly. With the Turn Switch in the "TURN LEFT" position, voltage is applied from the Turn Switch to CKT 14 at terminal "H" of the Turn Signal Switch connector C210 and to CKT 18 at terminal "M" of C210. LH Front Turn, Rear Turn and Indicator Lamps flash "ON" and "OFF" as current flow heats up the timing element in the Turn Flasher, and it continuously opens and closes the circuit (for RH Turn Lamps CKT 15 terminal "J" of C210 and CKT 19 terminal "N" of C210). With Park Lamps "ON" and Turn Lamps "ON," voltage is applied to both terminals of the Front Marker Lamp causing it to be "OFF." When the Front Turn Lamp is "OFF," voltage is applied to only one terminal of the Marker Lamp causing it to flash "ON." They continue to flash "ON" and "OFF" out of sequence until Turn Switch is turned "OFF."

HAZARD LAMPS

Voltage is applied at all times from I/P Fuse #37 and the Hazard Flasher to the normally open poles of the Hazard Switch in the Turn/Hazard Switch Assembly. With the Hazard Switch in "HAZARD," voltage is applied to the Stop-Turn Lamps. All of the Stop-Turn Lamps and both Turn Indicators flash on and off.

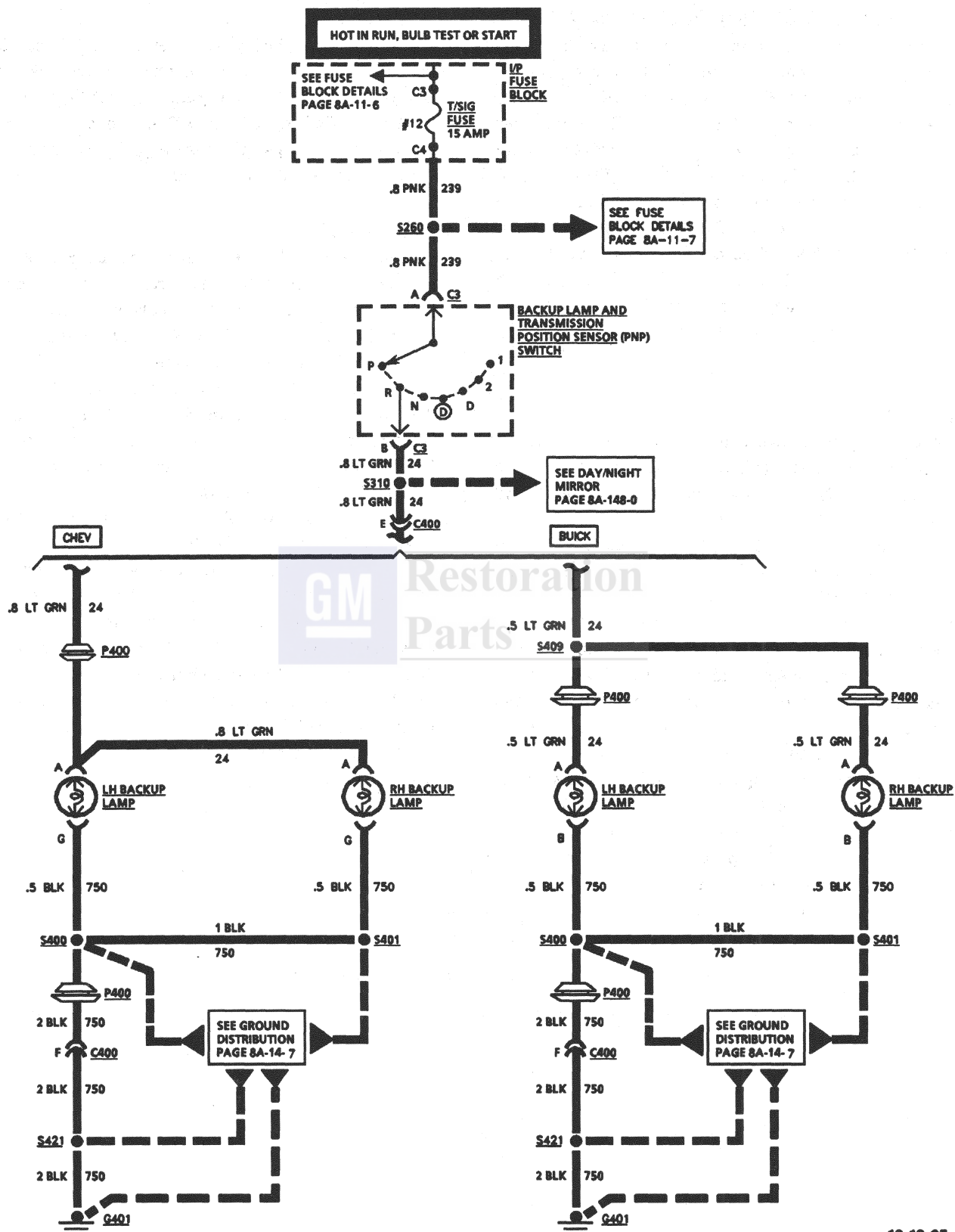
STOP LAMPS

Voltage is applied at all times from I/P Fuse #37 to the Stoplamp Switch. When the brake pedal is depressed, voltage is applied from the Stoplamp Switch and Turn Signal Switch to CKT 18 and CKT 19, turning "ON" the LH and RH Tail/Stop/Turn Lamps.

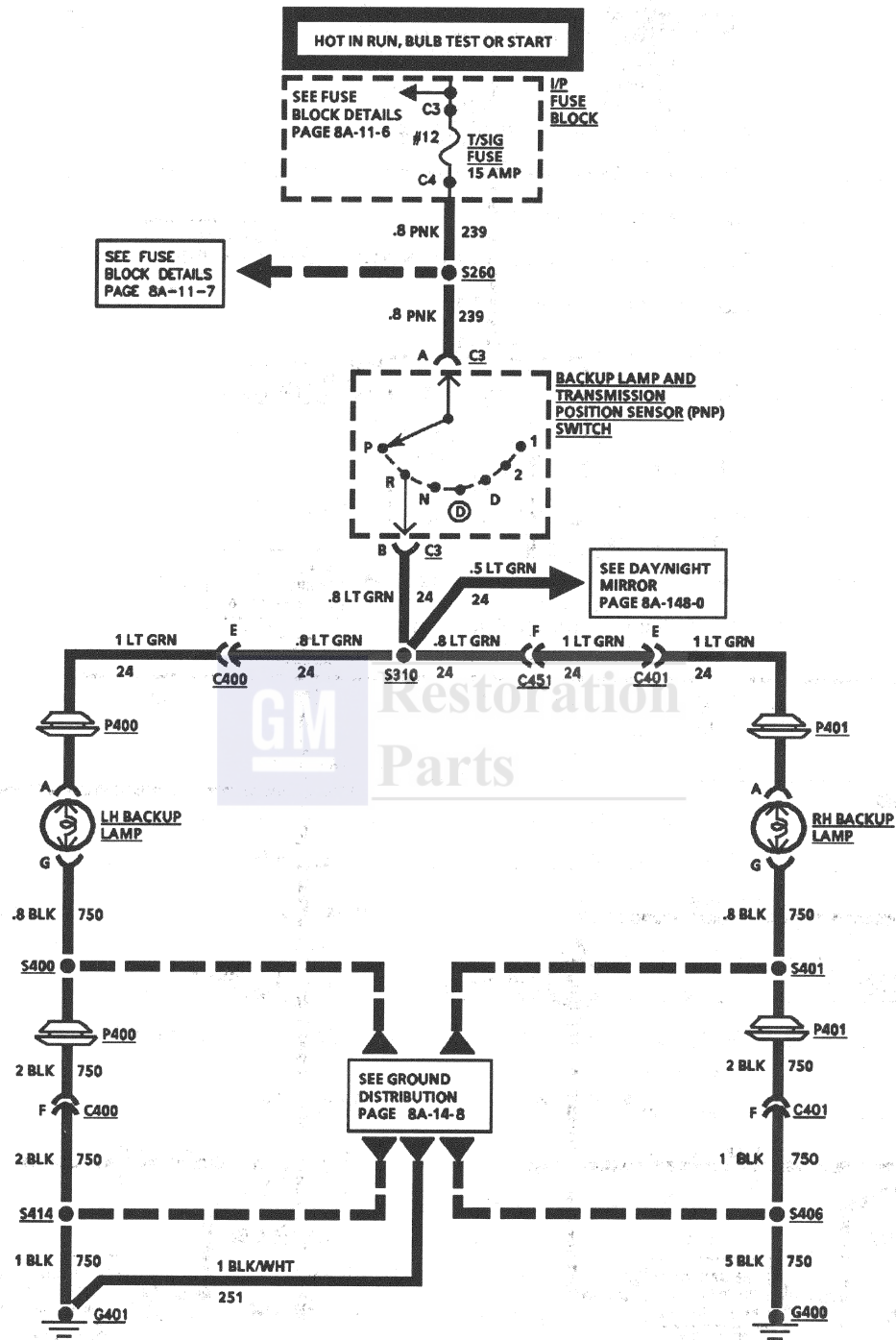
Voltage is supplied at all times through I/P Fuse #37 to the Stoplamp/Cruise Release Switch. When the brake pedal is depressed, voltage is applied from the Stoplamp/Cruise Release Switch to CKT 17 and the High Mount Stoplamp, turning "ON" the High Mount Stoplamp.

Buick Wagons with Remote Keyless Entry (AU0) have a 400 ohm resistor in CKT 17 and CKT 750. This Resistor is used to prevent accidental locking of the door locks in cases where the Hazard Switch has been activated and the Rear glass is released. Residual voltage in CKT 17 could cause the Remote Control Door Lock Receiver to activate a Door Lock Cycle. The 400 ohm resistor will keep CKT 17 "LOW," thus preventing an unwanted Lock Cycle. Refer to SECTION 9K for additional information on the Remote Keyless Entry System.

BACKUP LAMPS (SEDAN)



BACKUP LAMPS (WAGON)



8A - 112 - 2 ELECTRICAL DIAGNOSIS

BACKUP LAMPS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Backup Lamp and Transmission Position Sensor (PNP) Switch	Near base of Steering Column, on Column			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
LH Backup Lamp (Sedan)	LH Rear of Vehicle			
LH Backup Lamp (Wagon).....	LH Rear of Vehicle.....	37	53	
RH Backup Lamp (Sedan)	RH Rear of Vehicle			
RH Backup Lamp (Wagon).....	RH Rear of Vehicle	38	54	
C340 (8 cavities) (Impala)	Crossbody and Side Door Harn to Body Harn			
C340 (4 cavities).....	Electronic Brake Control Harn to Body Harn, LH Rear Floor Pan			
C400 (8 cavities) (Sedan).....	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender	31	36	202-6
C400 (6 cavities) (Wagon)	LH Taillamp Harn to rear Body Harn at LH "D" Pillar.....	37	53	202-4
C401 (6 cavities).....	RH Taillamp Harn to Rear Header Harn, forward of Taillamps	36	52	
C451 (6 cavities).....	Body Harn to Rear Header Harn, near center of LH "D" Pillar	34	49	202-6
G400 (Wagon)	Near center of RH "D" Pillar			
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment.....	31	46	
G401 (Wagon)	Near center of LH "D" Pillar	34	49	
P400 (Sedan)	LH Rear of Vehicle, in Luggage Compartment.....	32	47	
P400 (Wagon).....	LH Rear of Vehicle, at Taillamps.....	37	53	
P401 (Wagon).....	RH Rear of Vehicle, at Taillamps			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S310	Body Harn, approx 4 cm from C309 breakout			
S400 (Buick Sedan)	Body Rear Harn, approx 4 cm from C416 branch breakout			
S400 (Chev Sedan)	Body Rear Harn, approx 4 cm from C402 branch breakout			
S400 (Wagon).....	LH Stoplamp Harn, approx 12 cm from LH Lower Tail/Turn/Stoplamp Conn branch breakout			
S401 (Buick Sedan)	Rear Lamp Harn, approx 4 cm from C417 Conn breakout			
S401 (Chev Sedan)	Body Rear Harn, approx 4 cm from RH Backup Lamp Conn branch breakout			
S401 (Wagon).....	RH Stoplamp Harn, approx 12 cm from RH Lower Tail/Turn/Stoplamp Conn branch breakout			
S406 (Wagon).....	Body Rear Harn, approx 17 cm from C412 breakout			
S409	Body Rear Harn, approx 15 cm from C400			

COMPONENT	LOCATION	201-PG FIG. CONN
S414 (Wagon)	Body Harn, approx 26 cm from Remote Control Door Lock Module breakout	
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse Block Fuse #12. If open, check CKT 239 for a short to ground.
2. Check the Backup Lamps for damage to the filament or corrosion between the Backup Lamp and Backup Lamp Socket.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system

disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Both Backup Lamps inoperative (Sedan).	Chart #1	8A-112-4
One Backup Lamp inoperative (Sedan).	Chart #2	8A-112-5
Backup Lamps "ON" at all times.	Chart #3	8A-112-5
Both Backup Lamps inoperative (Wagon).	Chart #4	8A-112-6
One Backup Lamp inoperative (Wagon).	Chart #5	8A-112-6

BACKUP LAMPS

CHART #1
BOTH BACKUP LAMPS INOPERATIVE (SEDAN)



IMPORTANT:

- TO AVOID MISDIAGNOSIS, BE CERTAIN BACKUP LAMPS ARE NOT DAMAGED OR OPEN.

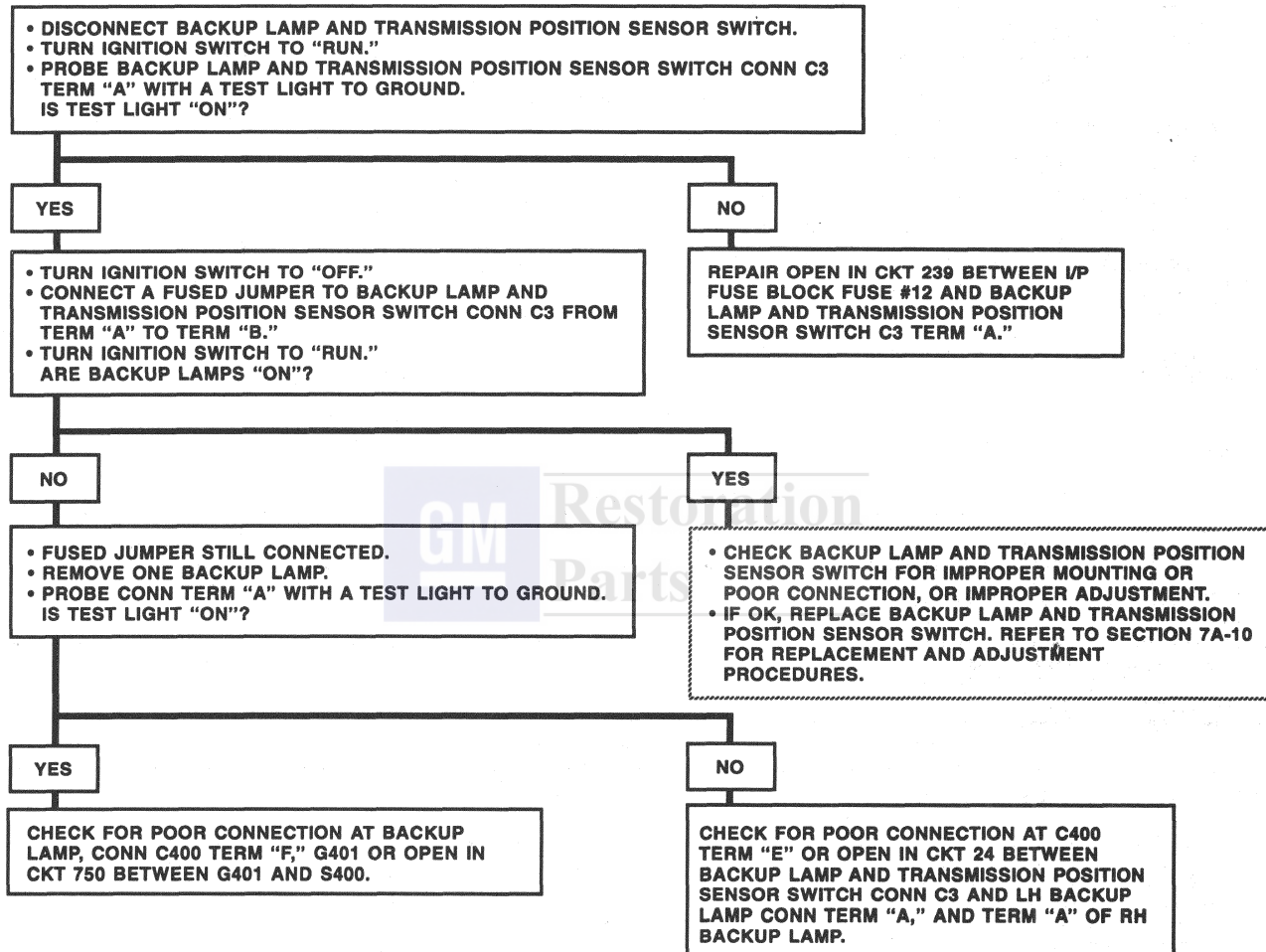
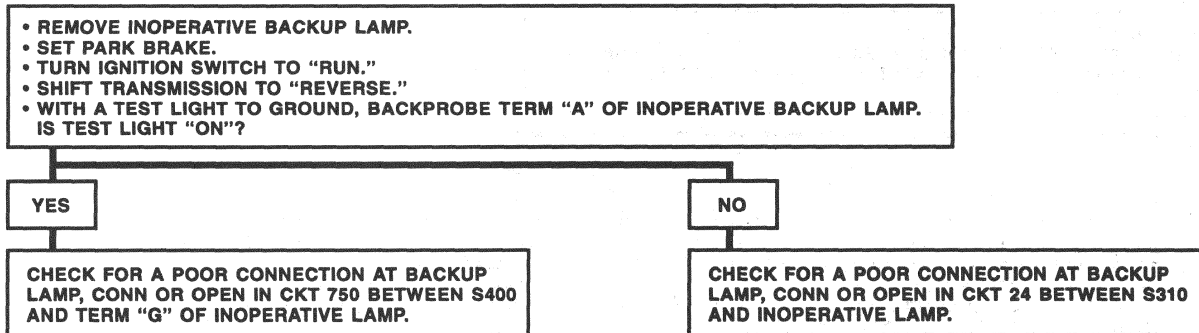


CHART #2 ONE BACKUP LAMP INOPERATIVE (SEDAN)

! IMPORTANT:

- TO AVOID MISDIAGNOSIS, BE CERTAIN BACKUP LAMPS ARE NOT DAMAGED OR OPEN.

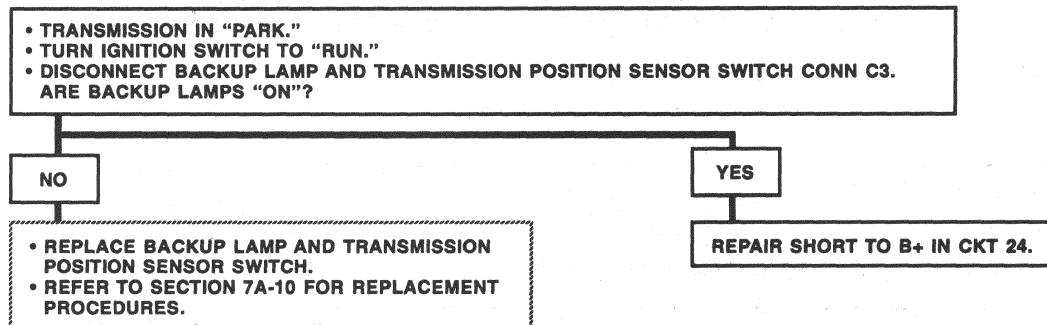


C9916

CHART #3 BACKUP LAMPS "ON" AT ALL TIMES

! IMPORTANT:

- TO AVOID MISDIAGNOSIS, BE CERTAIN BACKUP LAMP IS NOT DAMAGED OR OPEN.



C9917

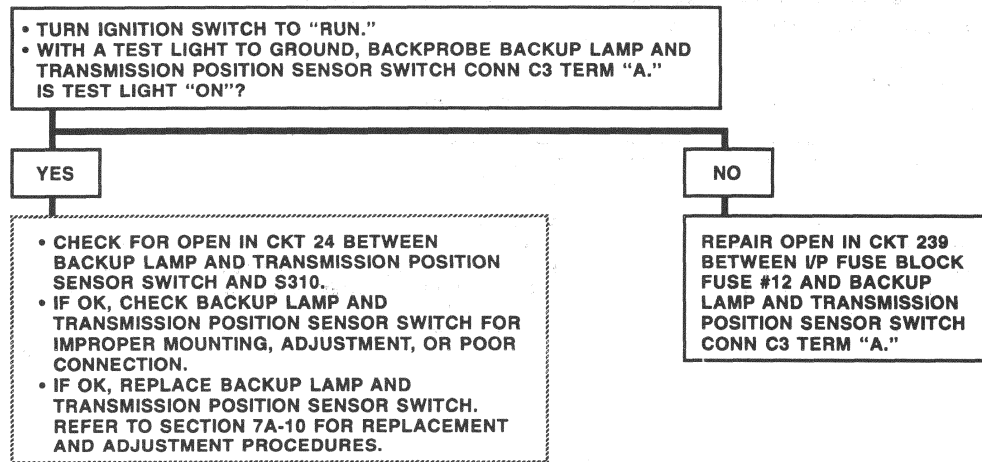
BACKUP LAMPS

CHART #4
BOTH BACKUP LAMPS INOPERATIVE (WAGON)



IMPORTANT:

- TO AVOID MISDIAGNOSIS, BE CERTAIN BACKUP LAMP IS NOT DAMAGED OR OPEN.



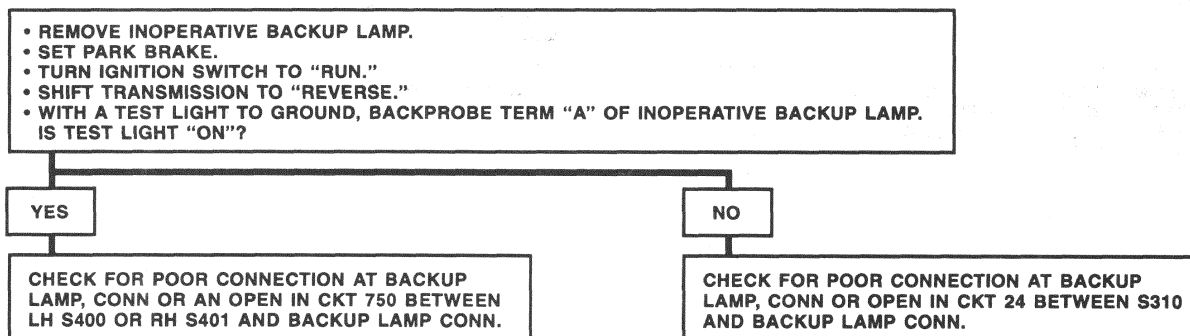
C9918

CHART #5
ONE BACKUP LAMP INOPERATIVE (WAGON)



IMPORTANT:

- TO AVOID MISDIAGNOSIS, BE CERTAIN BACKUP LAMP IS NOT DAMAGED OR OPEN.



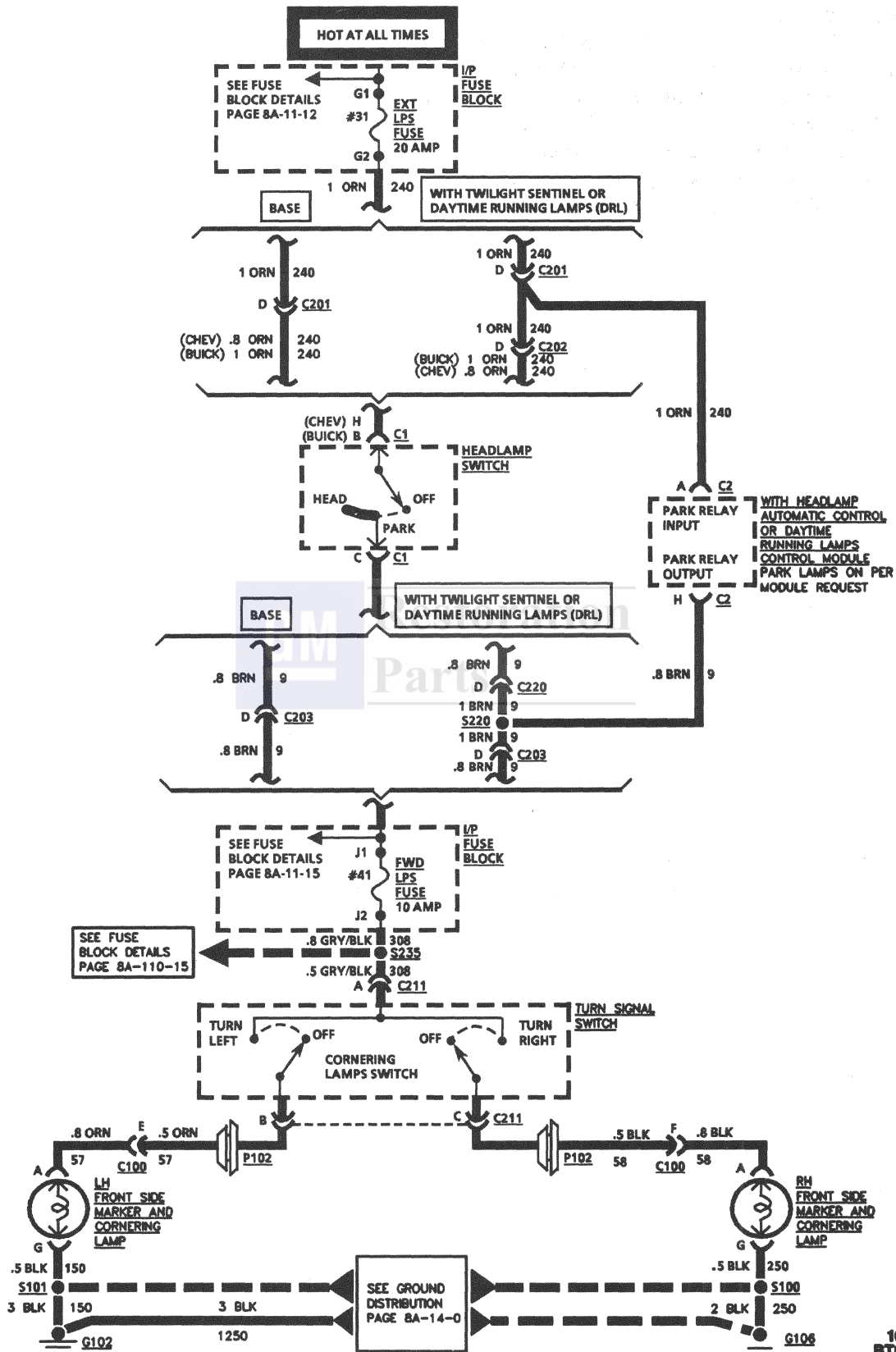
C9919

CIRCUIT OPERATION

Voltage is applied to the Backup Lamp and Transmission Position Sensor (PNP) Switch with the Ignition Switch in "RUN," "BULB TEST" or "START." When the Transmission is shifted into "REVERSE," the Backup Lamp and Transmission Position Sensor (PNP) Switch closes the circuit and voltage is applied to the Backup Lamps. The Backup Lamps are permanently grounded.



CORNERING LAMPS (CHEV SEDAN, ALL BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Daytime Running Lamps Control Module.....	RH "A" Pillar, behind Kickpad.....	18	29	202-14
Headlamp Automatic Control Module.....	RH "A" Pillar, behind Kickpad.....	18	29	202-7
Headlamp Switch	LH side of I/P part of Headlamp and I/P Lamp Dimmer and Accessory Switch	9	16	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
LH Front Side Marker and Cornering Lamp.....	LH Front of Vehicle.....	0	1	
RH Front Side Marker and Cornering Lamp.....	RH Front of Vehicle	0	2	
Turn Signal Switch	Mounted on upper LH side of Steering Column.....	13	21	
C100 (10 cavities).....	Forward Lamp Harn to Body Harn, behind LH Front Park/Turn Lamp	5	9	202-0
C201 (6 cavities) (Base).....	Body Harn to I/P Harn, RH side of Steering Column, above C200.....	11	19	202-5
C201 (6 cavities) (with DRL or TWS).....	Body Harn to DRL Harn or Twilight Sentinel Harn, at RH side of Steering Column, above C200.....	11	19	202-5
C202 (6 cavities).....	I/P Harn to Twilight Sentinel or DRL Harn, RH side of Steering Column, above C200.....	11	19	202-5
C203 (10 cavities) (Base).....	Body Harn to I/P Harn, RH side of Steering Column	11	19	202-5
C203 (10 cavities) (with DRL or TWS).....	Body Harn to DRL or Twilight Sentinel Harn, RH side of Steering Column	11	19	202-5
C211 (3 cavities).....	Body Harn to Turn Signal Switch			
C220 (10 cavities).....	I/P Harn to Twilight Sentinel or DRL Harn, at RH side of Steering Column	11	19	202-5
G102.....	Behind LH Headlamp Support, forward of Air Cleaner.....	0	1	
G106.....	RH Headlamp Support, forward of Battery	0	2	
P102	Visible from Engine Compartment, behind LH Wheelhouse...	5	10	
S100	Forward Lamp Harn, approx 22 cm from RH Headlamp Conn			
S101	Forward Lamp Harn, approx 11 cm from LH Headlamp Conn branch breakout			
S220 (with DRL)	Daytime Running Lamps Harn, approx 13 cm from DRL Diode Conn			
S220 (with TWS).....	Headlamp Automatic Beam Control Harn approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S235	Body Harn, approx 16 cm from P102			

CORNERING LAMPS

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse #31. If it is open, check CKT 240 for a short to ground.
 2. Check I/P Fuse #41. If it is open, check CKT 308 for a short to ground and Refer to 8A-110 for Diagnosis of Park Lamps.
 3. Make sure that G102 and G106 are clean and tight.
 4. Check bulbs and sockets for damage or corrosion.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a

continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

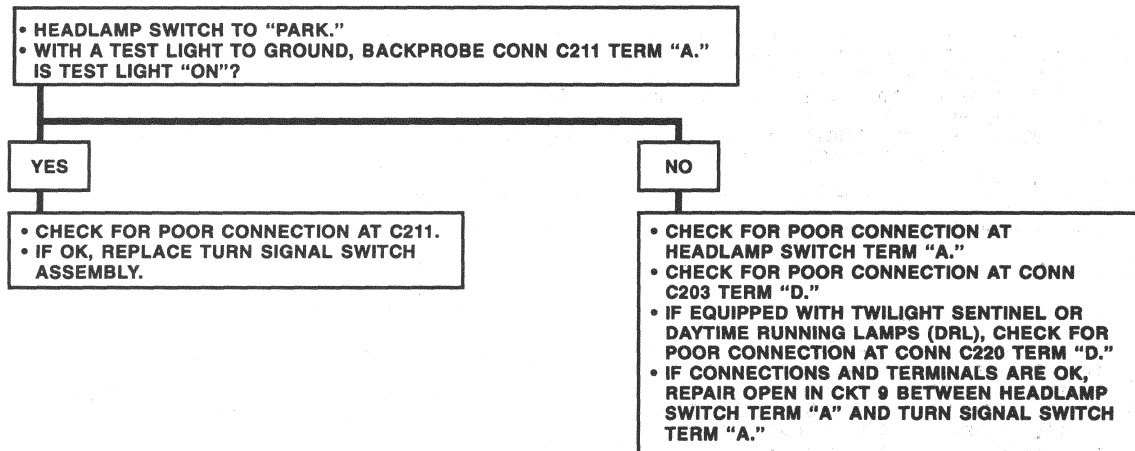
SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Both Cornering Lamps are inoperative, Park Lamps inoperative.	Refer to SECTION 8A-110.	
Both Cornering Lamps are inoperative, Park Lamps OK.	Chart #1	8A-113-3
One Cornering Lamp is inoperative.	Chart #2	8A-113-4
Both Cornering Lamps are on whenever Park Lamps are activated.	Replace Turn Signal Switch Assembly.	
One Cornering Lamp is on whenever Park Lamps are activated.	Chart #3	8A-113-5

CHART #1
BOTH CORNERING LAMPS ARE INOPERATIVE, PARK LAMPS OPERATE



C9912

CORNERING LAMPS

CHART #2
ONE CORNERING LAMP IS INOPERATIVE

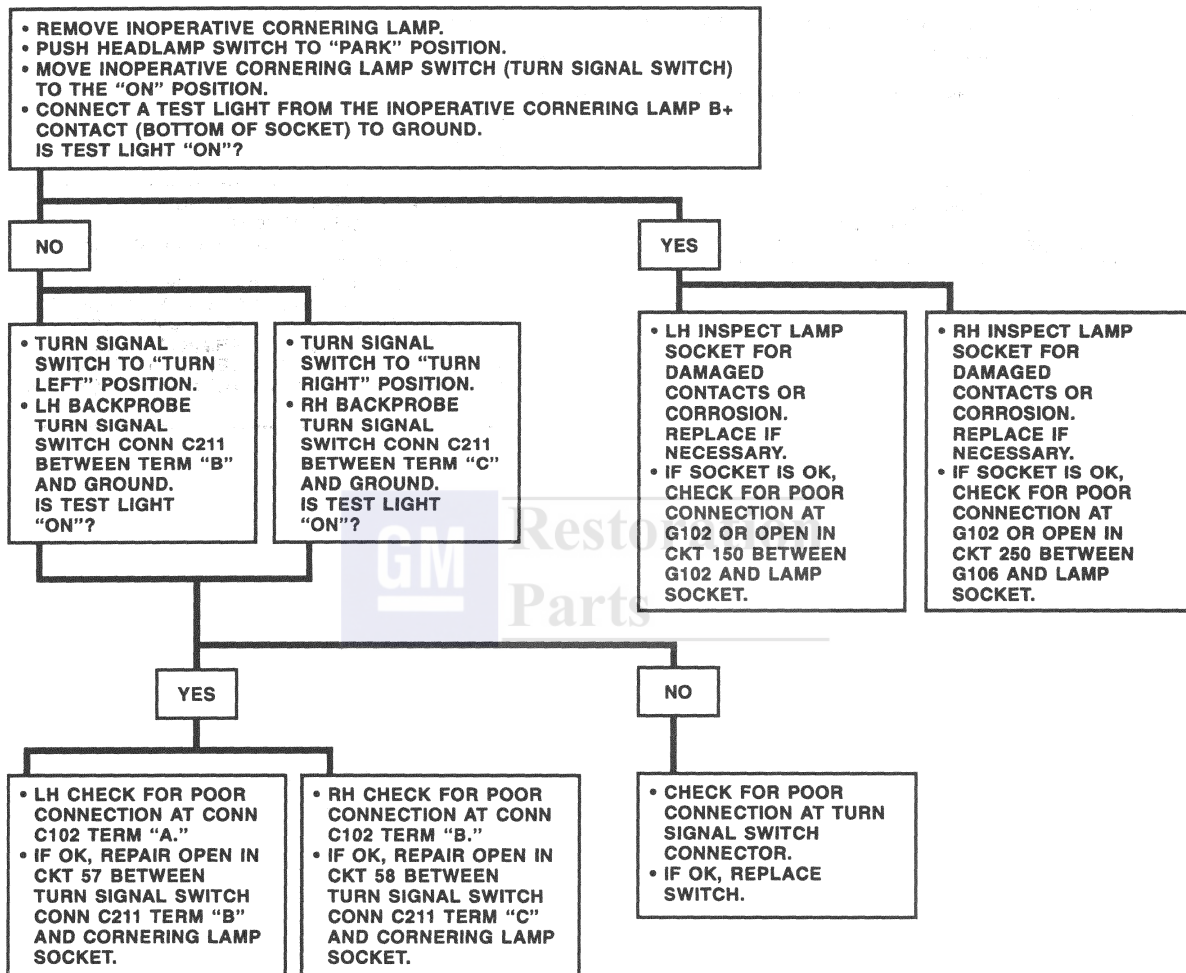
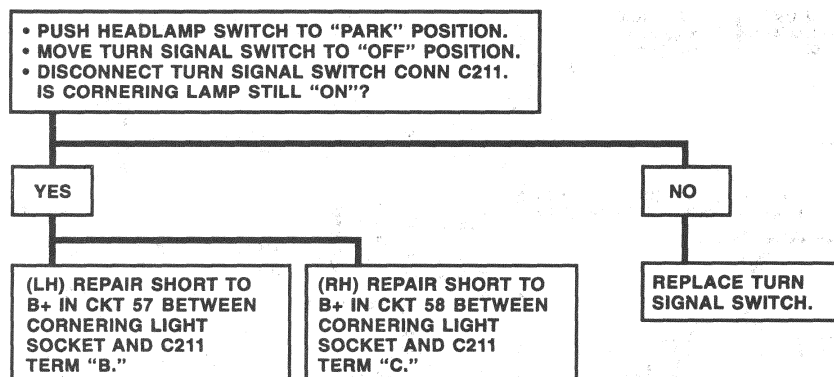


CHART #3

ONE CORNERING LAMP IS ON WHENEVER PARK LAMPS ARE ACTIVATED

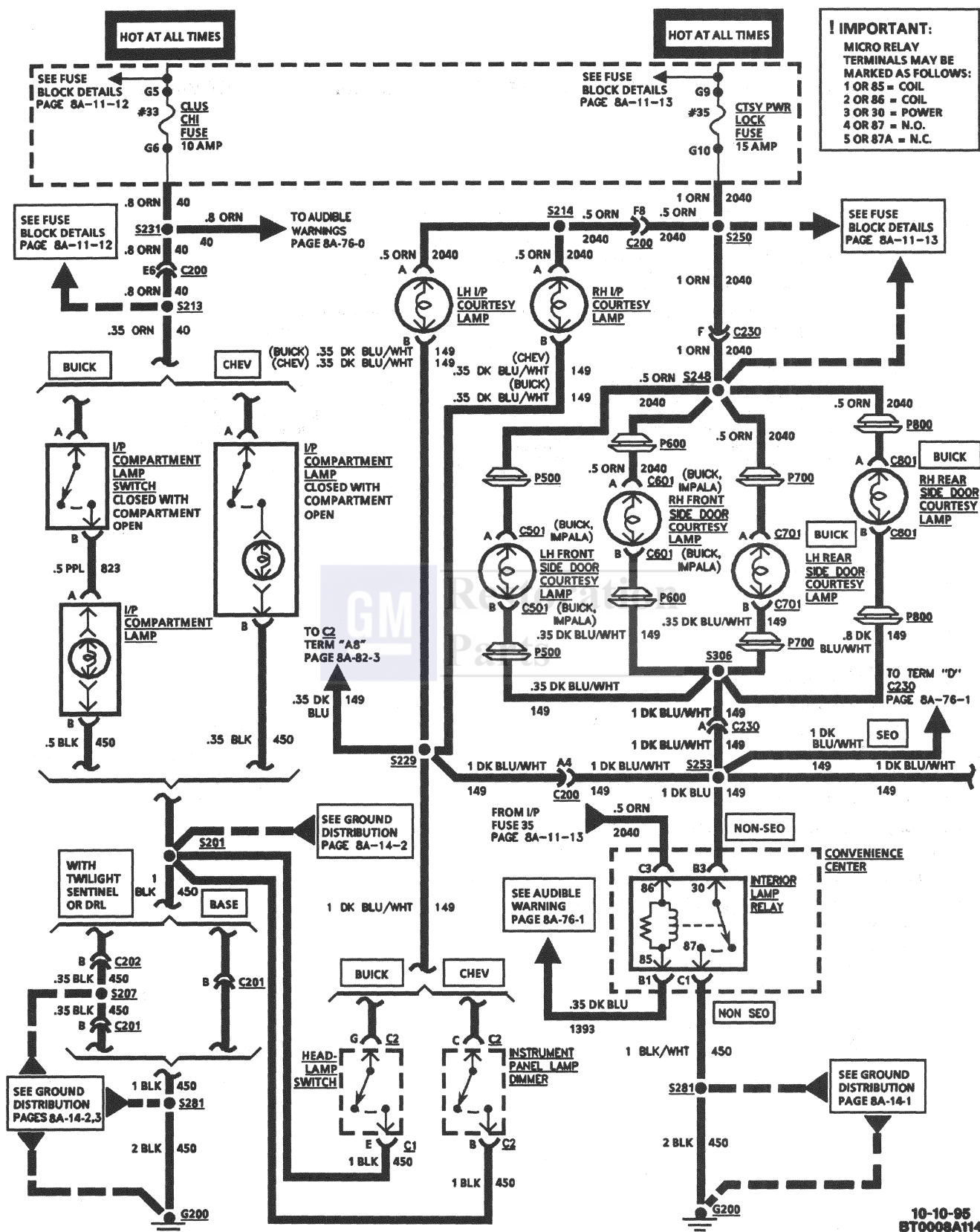


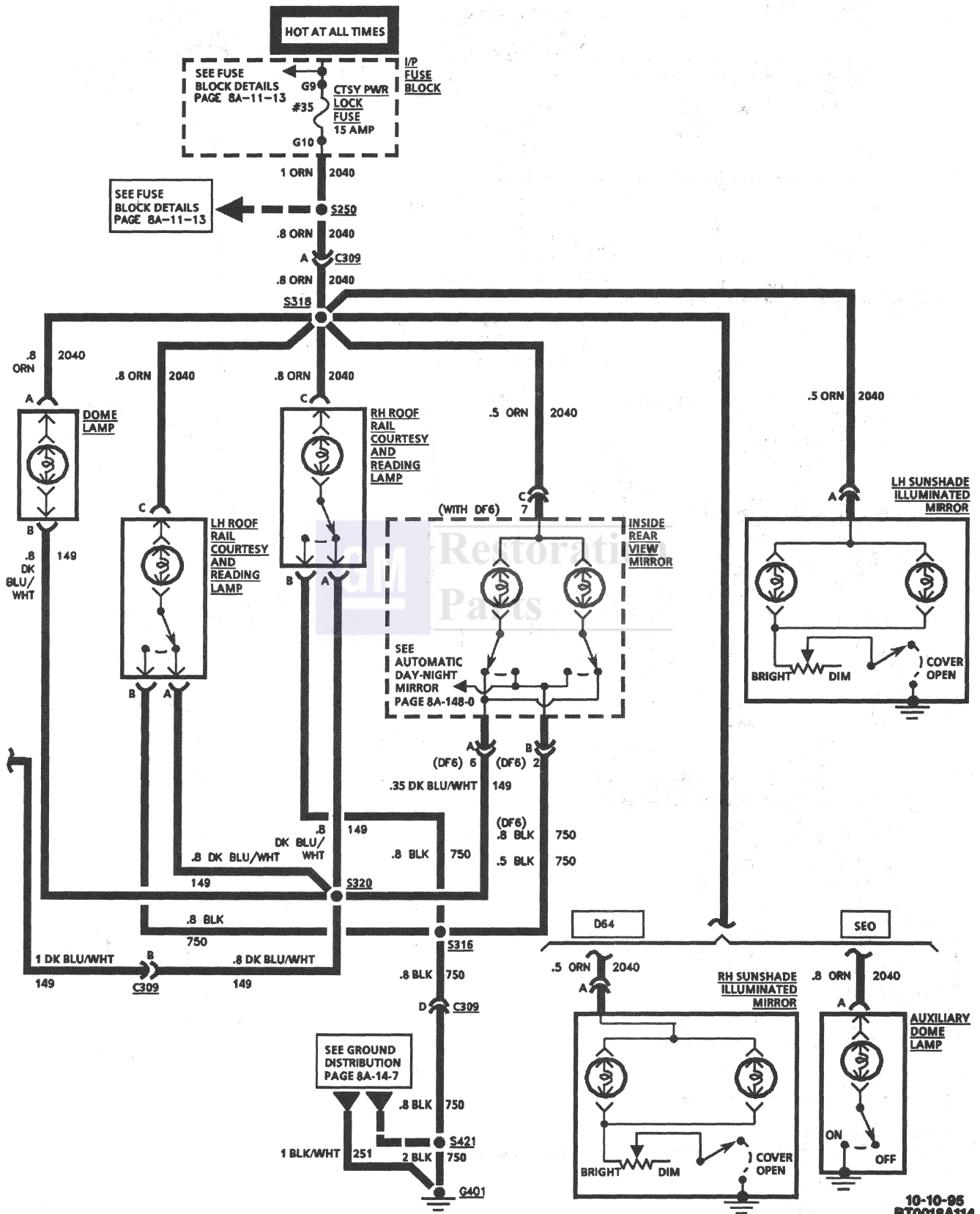
C9914

CIRCUIT OPERATION

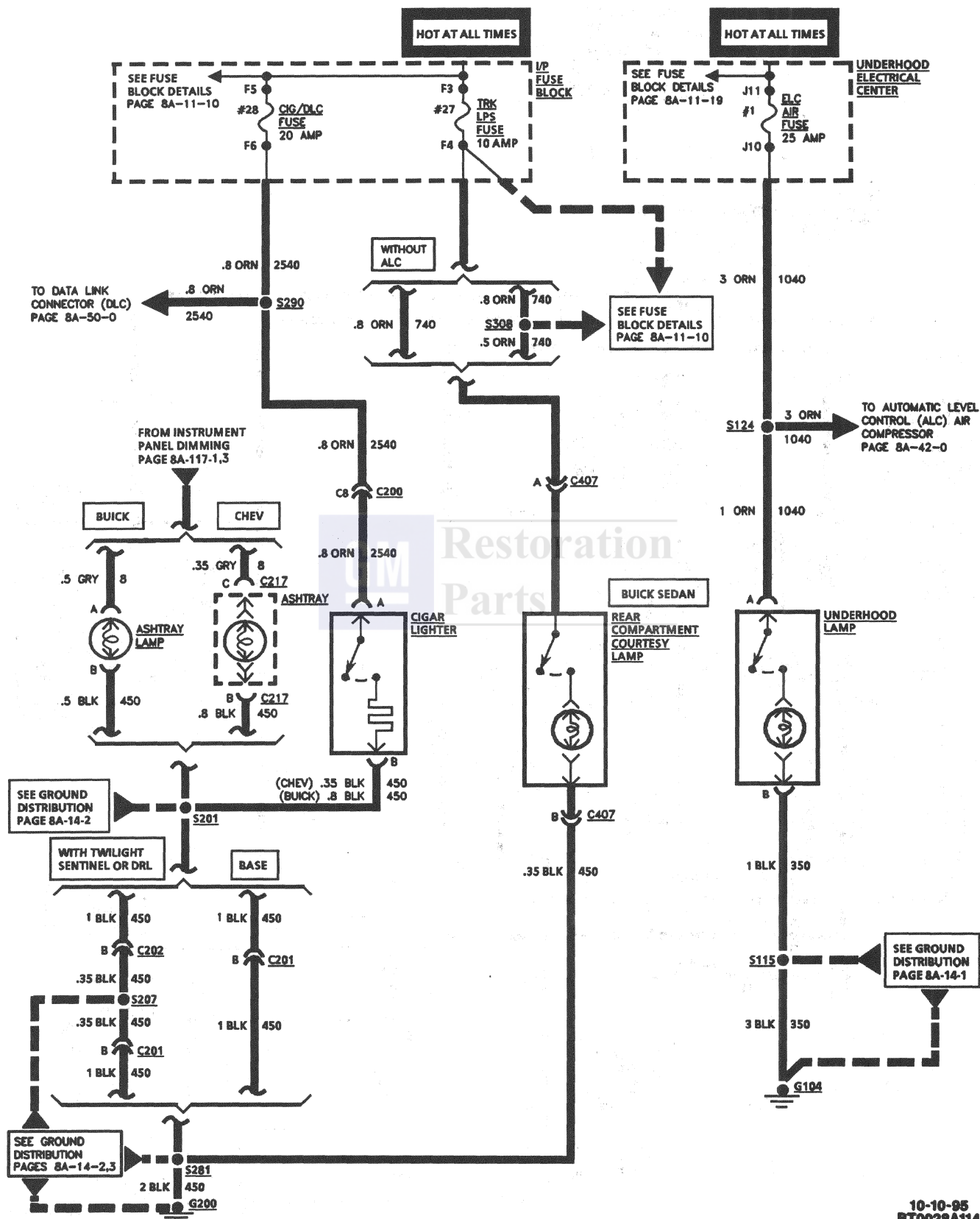
Voltage is applied to the Headlamp Switch at all times. With the Headlamp Switch in "PARK" or "HEAD," voltage is applied to the Cornering Lamps Switch, which is part of the Turn Signal Switch. With the Turn Signal Switch in either the "TURN LEFT" or "TURN RIGHT" position, voltage is applied to the corresponding Front Side Marker and Cornering Lamp. The LH Front Side Marker and Cornering Lamp is permanently grounded to G102 and the RH Front Side and Cornering Lamp is permanently grounded to G106.

INTERIOR LAMPS



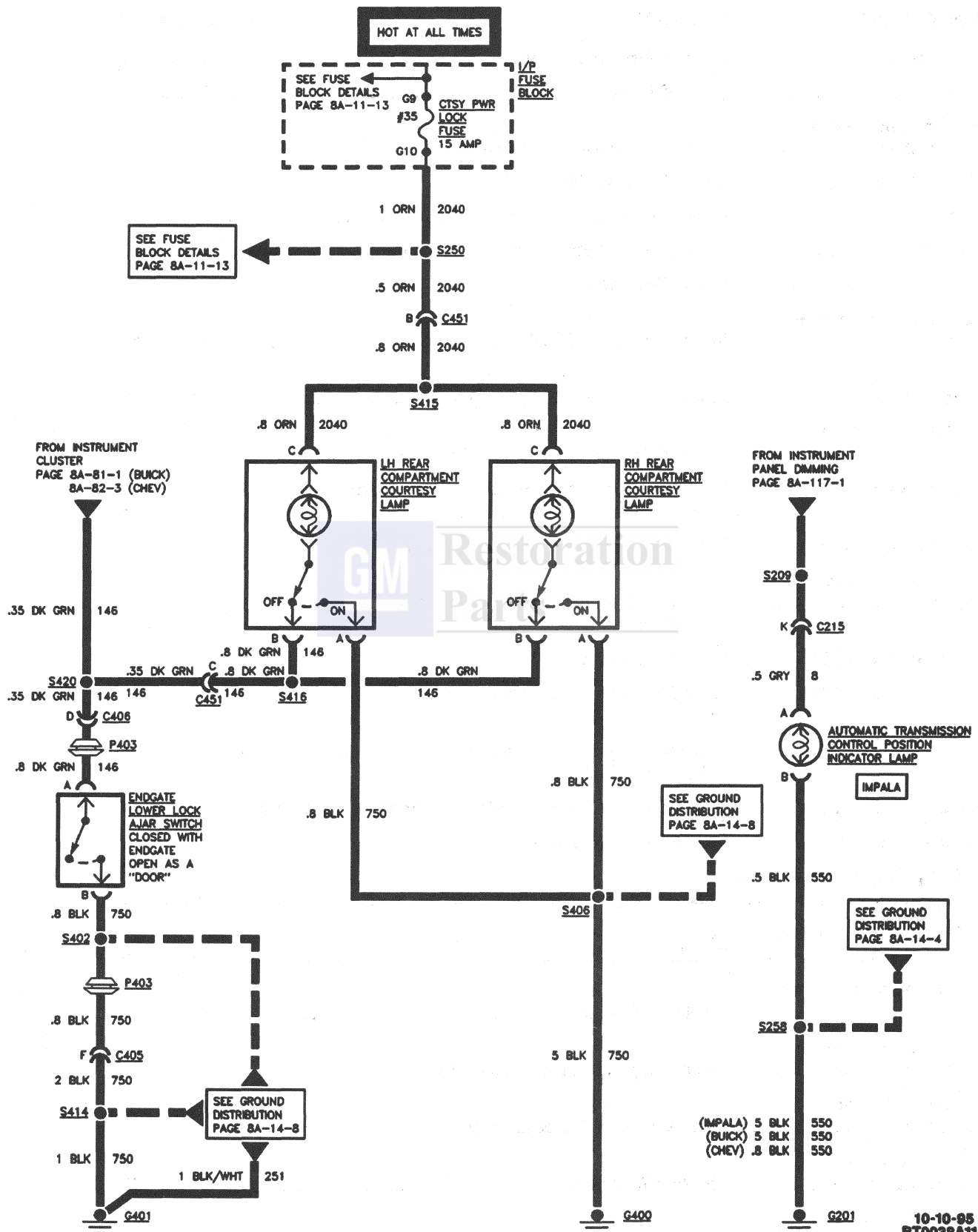


INTERIOR LAMPS



INTERIOR LAMPS

REAR COURTESY/READING LAMPS (WAGON)



8A - 114 - 4 ELECTRICAL DIAGNOSIS**INTERIOR LAMPS**

COMPONENT	LOCATION	201-PG	FIG.	CONN
Ashtray Lamp.....	Front of Instrument Panel.....	17.....	28	
Ashtray.....	Front of Instrument Panel.....	17.....	28	
Automatic Transmission Control Module.....	Part of Transmission, LH Rear			
Auxiliary Dome Lamp.....	Center Front of Vehicle			
Cigar Lighter	Center I/P to RH side of Radio.....	17.....	28	
Convenience Center	LH side of I/P, left of Steering Column.....	11.....	19	
Dome Lamp.....	Center Front of Vehicle			
Endgate Lower Lock Ajar Switch.....	In Endgate, near RH side.....	35.....	51	
Front Side Door Courtesy Lamp, LH.....	Lower left side of LH Front Door Trim.....	19.....	30	
Front Side Door Courtesy Lamp, RH	Lower right side of RH Front Door Trim	23.....	34	
Headlamp Switch	LH side of I/P part of Headlamp and I/P Lamp Dimmer and Accessory Switch	9.....	16	
I/P Compartment Lamp	Inside I/P Compartment, upper LH side			
I/P Compartment Lamp Switch.....	LH side of Instrument Panel Compartment accessed with door open			
I/P Courtesy Lamp, LH.....	LH side of Instrument Panel			
I/P Courtesy Lamp, RH.....	RH side of Instrument Panel			
Instrument Panel Lamp Dimmer.....	Attached to I/P Carrier Lower Reinforcement to RH side of Steering Column			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Inside Rear View Mirror	Mounted on Windshield			
Rear Compartment Courtesy Lamp.....	Under Package Shelf.....	30.....	43	
Rear Compartment Courtesy Lamp, LH.....	On LH "D" Pillar	34.....	49	
Rear Compartment Courtesy Lamp, RH	On RH "D" Pillar	36.....	52	
Rear Side Door Courtesy Lamp, LH.....	At back edge of LH Rear Door Trim			
Rear Side Door Courtesy Lamp, RH	At back edge of RH Rear Door Trim			
Roof Rail Courtesy and Reading Lamp, LH.....	LH Rear Roof Rail	26.....	37	
Roof Rail Courtesy and Reading Lamp, RH	RH Rear Roof Rail.....	26.....	38	

COMPONENT	LOCATION	201-PG	FIG.	CONN
Sunshade Illuminated Mirror, LH.....	LH Visor	26	37	
Sunshade Illuminated Mirror, RH	RH Visor	26	37	
Underhood Electrical Center.....	Engine Compartment, mounted to RH Wheelhouse.....	9	15	
Underhood Lamp.....	RH Rear of Hood			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C201 (6 cavities) (Base).....	Body Harn to I/P Harn, at RH side of Steering Column, above C200	11	19.....	202-5
C201 (6 cavities) (w/T61)	Body Harn to Daytime Running Lamps (DRL) Harn, at RH side of Steering Column, above C200.....	11	19.....	202-5
C201 (6 cavities) (w/T82)	Body Harn to Twilight Sentinel (TWS) Harn, At RH side of Steering Column, above C200.....	11	19.....	202-5
C202 (6 cavities) (w/T61)	I/P Harn to Daytime Running (DRL) Lamps Harn, RH side of Steering Column, above C200.....	11	19.....	202-5
C202 (6 cavities) (w/T82)	I/P Harn to Twilight Sentinel (TWS) Harn, RH side of Steering Column, above C200.....	11	19.....	202-5
C215 (10 cavities).....	Crossbody and Side Door Harn to Body Harn to I/P Harn, at base of RH "A" Pillar behind kickpad			
C309 (6 cavities).....	Body Harn to Roof Harn, near Dome Lamp.....	25	36.....	202-6
C405 (6 cavities).....	Body Harn to Endgate Harn, near center of LH "D" Pillar ..	34	49.....	202-7
C406 (8 cavities).....	RH Tailgate Harn to Body Harn, near center of LH "D" Pillar.....	34	49	
C407.....	Body Harn to Rear Compartment Courtesy Lamp			
C415 (6 cavities).....	Body Harn to Rear Header Harn, near center of LH "D" Pillar			
C501 (2 cavities).....	Crossbody and Side Door Harn to LH Front Side Door Courtesy Lamp Jumper, inside door			
C601.....	Crossbody and Side Door Harn to RH Front Side Door Courtesy Lamp Jumper, inside door			
C701.....	Crossbody and Side Door Harn to LH Rear Side Door Courtesy Lamp Jumper, inside door			
C801.....	Crossbody and Side Door Harn to RH Rear Side Door Courtesy Lamp Jumper, inside door			
G104.....	Engine Compartment on front of LH Cylinder Head	6	11	
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G201.....	Base of LH "A" Pillar, behind kickpad			
G400.....	Near center of RH "D" Pillar			
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment.....	31	46	
G401 (Wagon)	Near Center of LH "D" Pillar	34	49	
P403	Between Endgate and LH "D" Pillar			

INTERIOR LAMPS

COMPONENT	LOCATION	201-PG	FIG.	CONN
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	
P700	Between LH Rear Door and "B" Pillar	25	36	
P800	Between RH Rear Door and "B" Pillar	24	35	
S115	Engine Harness, approx 4 cm from fuel Injector #3			
S124	Engine Harn, Approx 7 cm from Underhood Electrical Center branch breakout in Underhood branch			
S201 (Buick)	I/P Harn, behind Instrument Cluster, approx 20 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S201 (Chev)	I/P Harn, approx 12 cm from C200 branch breakout			
S207 (w/T61)	Daytime Running Lamps (DRL) Harn, approx 20 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S207 (w/T82)	Headlamp Automatic Beam Control Harn approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout			
S213 (Buick)	I/P Harn, approx 4 cm from Instrument Cluster C2 Conn branch breakout, in spiral taping			
S213 (Chev)	I/P Harn, approx 12 cm from Heater-A/C Control Conn branch breakout			
S214 (Buick)	I/P Harn, approx 8 cm from C200 Conn branch breakout, in spiral taping			
S214 (Chev)	I/P Harn, approx 7 cm from Cigar Lighter Conn branch breakout			
S229 (Buick)	I/P Harn, behind Instrument Cluster approx 24 cm from Instrument Cluster Conn C2 branch breakout in spiral taping			
S229 (Chev)	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout			
S231	Body Harn, approx 16 cm from Convenience Center breakout			
S248	Crossbody Harn, approx 8 cm from C231 branch breakout			
S250	Body Harn, approx 20 cm from Convenience Center breakout			
S253	Body Harn, approx 4 cm from Convenience Center breakout			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			
S290 (Buick)	I/P Harn, approx 31 cm from C200 on branch			
S290 (Chev)	I/P Harn, approx 21 cm from C200 on branch			

COMPONENT	LOCATION	201-PG FIG. CONN
S306	Crossbody Harn, approx 8 cm forward of Power Seat crossover branch breakout	
S308	Body Harn, approx 11 cm from C309 branch breakout	
S319	Roof Harn, approx 40 cm from Dome Lamp breakout	
S320	Roof Harn, in C309 branch, approx 36 cm from breakout	
S402 (Wagon).....	Tailgate Harn, approx 12 cm from RH lower Tail/Turn/Stoplamp Conn branch breakout	
S402 (SEO Wagon).....	Tailgate Harn, approx 5 cm from High Mount Stoplamp Conn breakout	
S406	Roof Harn, in C309 branch, approx 32 cm from breakout	
S414 (Wagon).....	Body Harn, approx 26 from Remote Control Door Lock Module breakout	
S415 (Wagon).....	Body Rear Harn, approx 40 cm from C450 branch breakout	
S416 (Wagon).....	Body Rear Harn, approx 17 cm from C411 branch breakout	
S420 (Wagon).....	Body Harn, approx 12 cm from C400 breakout	
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse #33. If Fuse #33 is open, check for a short to ground in CKT 40.
2. Check I/P Fuse #35. If Fuse #35 is open, check for a short to ground in CKT 2040.
3. Check I/P Fuses 13, 27 and 28. If Fuses are open, check for short to ground in CKT's 1040, 740 and 2540.
4. Check that grounds G104, G200, G201, G400 and G401 are clean and tight.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system

malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Do the test listed, or make the necessary repairs, for your symptom in the Symptom Table.

INTERIOR LAMPS

SYMPTOM TABLE

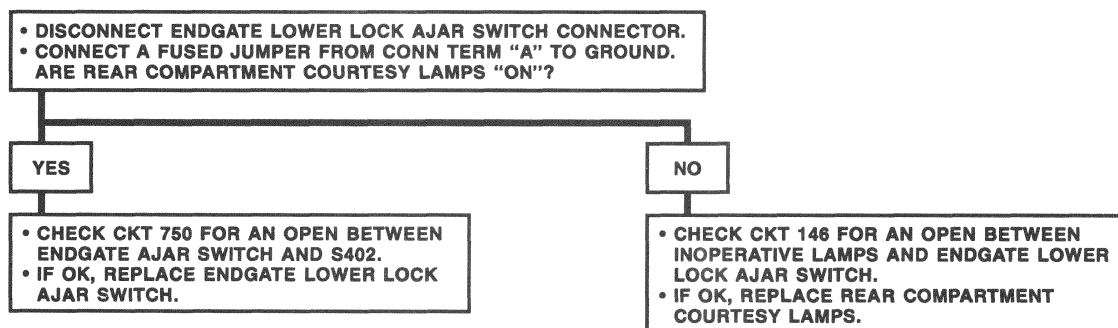
SYMPTOM	PROCEDURE
All Courtesy Lamps are inoperative with Door Jamb Switches (SEO).	Check for poor connection at Term "D" C302. If OK, repair open in CKT 149/156 between Warning Alarm Term "A11" and S341. Refer to "Audible Warnings," page 8A-76-0, for additional details.
All Courtesy Lamps are inoperative with one or more Door Jamb Switches (NON-SEO).	Check CKT 149 between S253 and Dome Courtesy Lamp Relay for an open. Check CKT 450 between Dome Courtesy Lamp Relay and G200 for an open. Refer to "Audible Warnings," page 8A-76-0, for additional details.
All Courtesy Lamps are inoperative with I/P Dimmer/Headlamp Switch only.	Check CKT 149 (between S229 and I/P Dimmer/Headlamp Switch) and CKT 450 (between I/P Dimmer/Headlamp Switch and G200) for an open. If OK, replace I/P Dimmer/Headlamp Switch.
Any or all of the Courtesy Lamps are on at all times.	Perform Lamp Short Test on page 8A-114-10. If OK, refer to "Audible Warnings," page 8A-76-0, for additional details.
Any or all the Courtesy Lamps are on at all times.	Perform Lamp Short Test on page 8A-114-10. If OK, refer to "Audible Warnings," page 8A-76-0, for additional details.
One or both Roof Rail Courtesy and Reading Lamps are inoperative with Door Jamb Switches or I/P Dimmer/Headlamp Switch.	Check bulb(s), CKT 2040 (between S318 and Lamps) and CKT 149 (between Lamps and S320) for an open. If OK, replace Roof Rail Courtesy and Reading Lamp(s).
One or both Roof Rail Courtesy and Reading Lamps are inoperative with Headlamp and I/P Dimmer Switch.	Check CKT 149 (between S320 and S253) for an open. If OK, replace Roof Rail Courtesy Lamp(s).
One or both I/P Courtesy Lamps are inoperative.	Check bulb(s), CKT 2040 (between S214 and Lamps) and CKT 149 (between Lamps, and I/P Dimmer/Headlamp Switch for an open.
One or more Door Courtesy Lamps are inoperative.	Check bulb(s), CKT 2040 (between S312 and Lamps) and CKT 149 (between Lamps and S306) for an open. If OK, replace Door Courtesy Lamp(s).
One or both Rear Compartment Courtesy Lamps are inoperative with Endgate Lower Lock Ajar Switch.	Perform Endgate Lower Lock Ajar Switch Test on page 8A-114-9.
One or both Rear Compartment Courtesy Lamps are inoperative with Lamp Switches.	Check CKT 750 (between Lamps and G400) for an open. If OK, replace Rear Courtesy Lamp(s).
Inside Rear View Mirror Lamps are inoperative with Door Jamb Switches or I/P Dimmer/Headlamp Switch.	Check bulbs, CKT 2040 (between S318 and Lamps) and CKT 149 (between Mirror and S320). If OK, replace Inside Mirror.
Inside Rear View Mirror Lamps are inoperative with Lamp Switches.	Check CKT 750 (between Lamps and S316) for an open. If OK, replace Inside Mirror.
Underhood Lamp is inoperative.	Check bulb, CKT 540 (between I/P Fuse and Lamp) and CKT 350 (between Lamp and G104) for an open. If OK, replace Underhood Lamp.
One or both Sunshade Lamps are inoperative.	Check bulbs and CKT 2040 (between S318 and Lamps) for an open. Also check Sunshade for a clean and tight ground connection. If OK, replace Sunshade.
I/P Compartment Lamp is inoperative.	Check bulb, CKT 40 (between I/P Fuse #33 and Lamp) and CKT 450 (between Lamp and G200) for an open. If OK, replace I/P Compartment Lamp. Check I/P Compartment Switch for open on Buick.

SYMPTOM TABLE (Continued)

SYMPTOM	PROCEDURE
Rear Compartment Courtesy Lamp is inoperative.	Check bulb, CKT 740 (between S240 and Lamp) and CKT 450 (between Lamp and G200) for an open. If OK, replace Rear Compartment Courtesy Lamp.
Cigar Lighter is inoperative.	Check for corrosion or element damage. Also check CKT 2540 (between I/P Fuse #28 and Lighter) and CKT 450 (between Lighter and G200) for an open. If OK, replace Cigar Lighter.
"DOOR OPEN" Indicator inoperative.	If Courtesy Lamps operate properly, check CKT 149 between S229 and Instrument Cluster Conn C2 Term "A8" for an open. If OK, service Instrument Cluster.
"DOOR OPEN" Indicator "ON" at all times.	Perform Lamp Short Test on page 8A-114-10.



ENDGATE LOWER LOCK AJAR SWITCH TEST



INTERIOR LAMPS

LAMP SHORT TEST

With all the doors closed and the Lamp Switch turned off, disconnect the Door Jamb Switches and the Lamp Switch one at a time.

- If the lamps go out when a particular switch is disconnected, replace that switch.
- If the lamps remain lit with all switches disconnected, check for short to ground in CKT 149 or 1393. If OK, refer to "Audible Warnings," page 8A-76-0, for additional details.

CIRCUIT OPERATION

DOOR COURTESY, INSIDE REAR VIEW MIRROR COURTESY, I/P COURTESY, REAR COURTESY AND READING AND ROOF RAIL COURTESY LAMPS

Voltage is applied through Fuse #35 at all times to the Door Courtesy Lamps, Inside Rear View Mirror, I/P Courtesy Lamps, Rear Courtesy Lamps and to the Roof Rail Courtesy and Reading Lamps will light whenever a door is opened or whenever the I/P Dimmer Courtesy Switch is turned to "ON." The Rear Courtesy Lamps will light whenever the Endgate is opened. The Inside Rear View Mirror Courtesy/Reading Lamps, the Rear Courtesy

Lamps and the Roof Rail Courtesy Lamps also have a separate switch in the circuit. When turned to "ON," this switch allows for individual operation of these Lamps. Refer to "Audible Warnings," page 8A-76-0, for additional information on Courtesy Lamps and Circuit Operation.

HEADLAMP SWITCH ILLUMINATION LAMP

Whenever the Ignition Switch is turned to "RUN," "BULB TEST" or "START," voltage is applied through Fuse #17 to the Headlamp Switch Illumination Lamp. The Lamp remains lit until the Ignition Switch is turned to "OFF."

SUNSHADE ILLUMINATED MIRROR

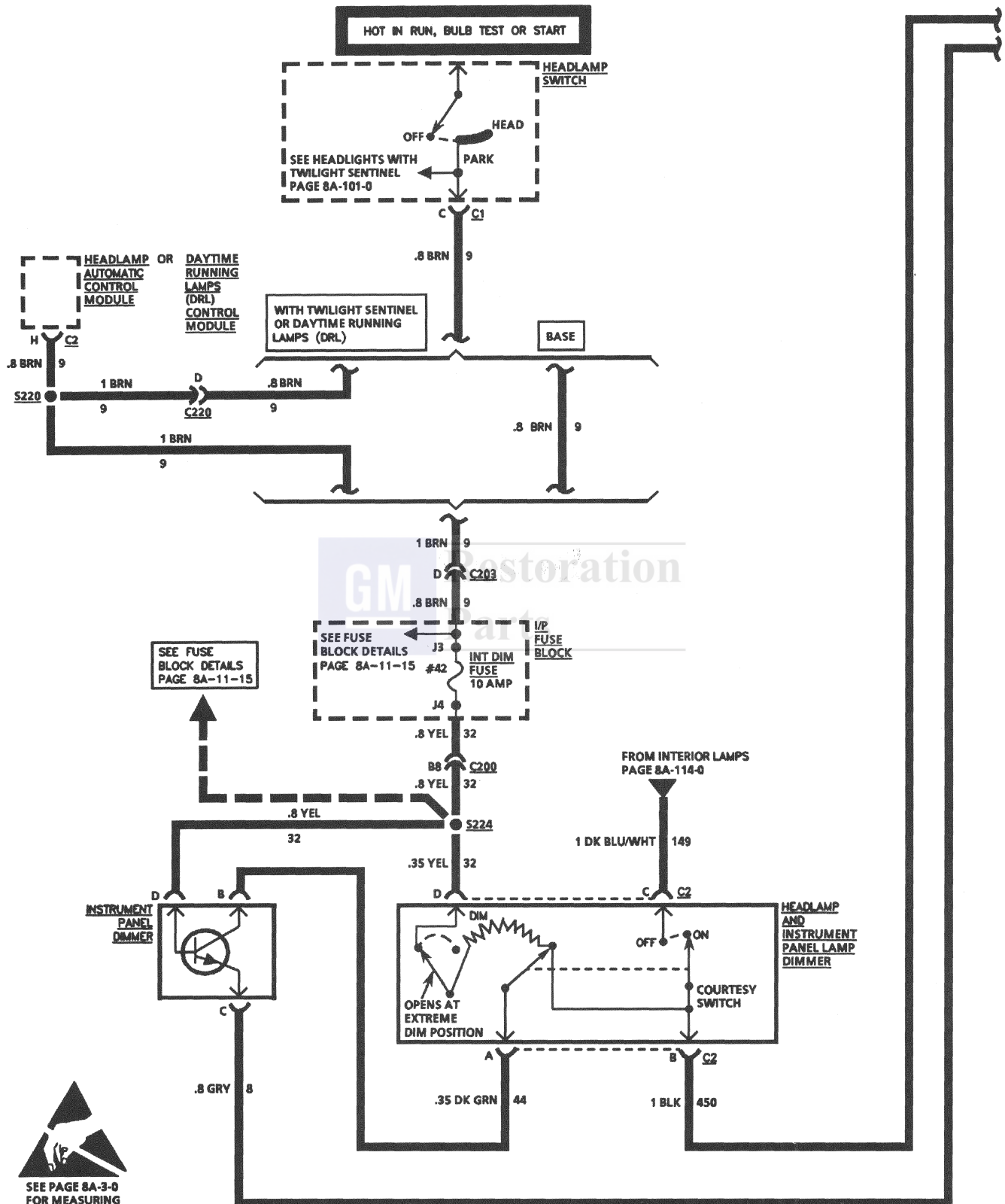
Voltage is applied through Fuse #35 at all times to the LH and RH Mirror. The LH and RH Mirror Lamps will light whenever the Visor is pulled down and the cover is opened.

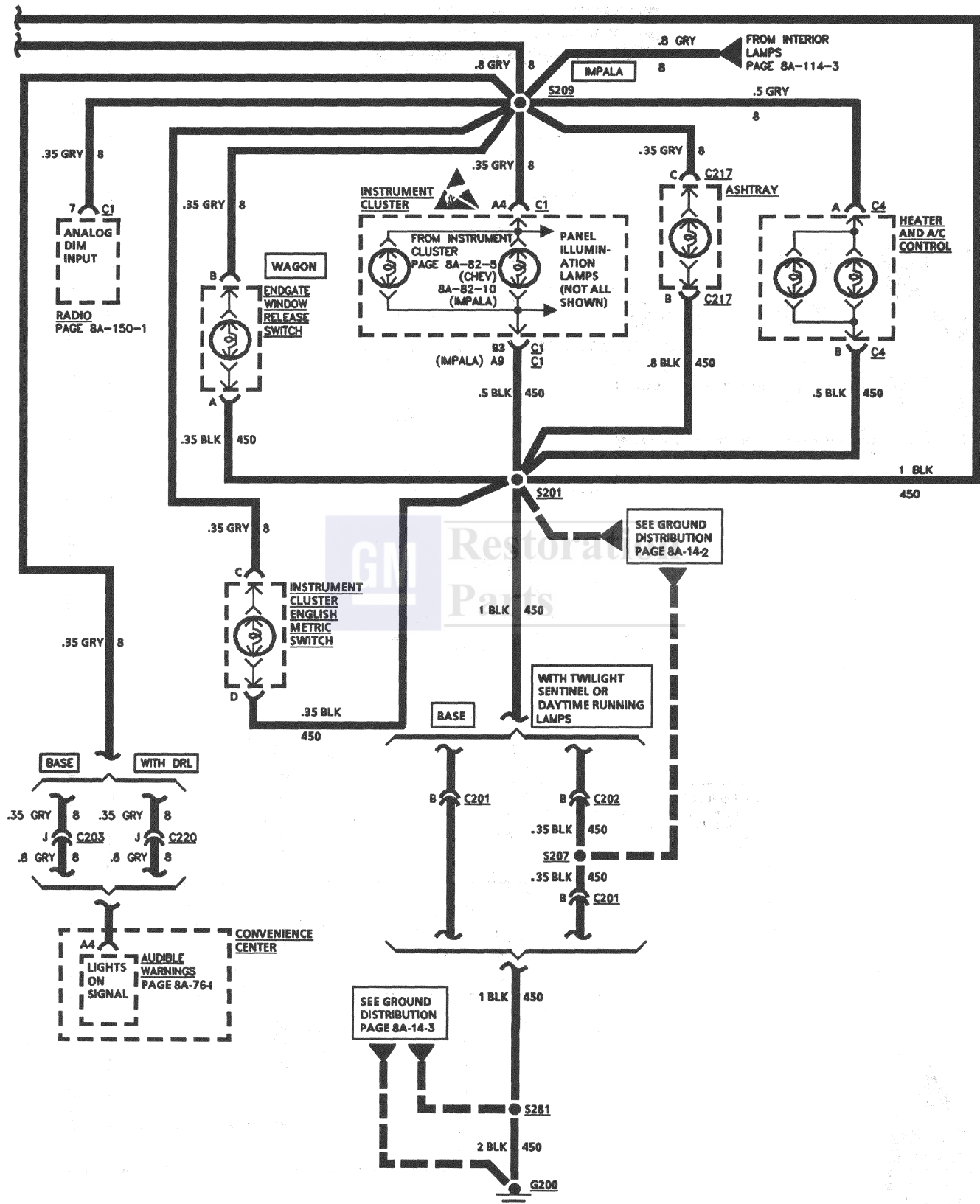
CIGAR LIGHTER

Voltage is applied through Fuse #28 at all times to the Cigar Lighter. The Cigar Lighter has a heating element that, when pushed in, completes the circuit and begins to heat up. When the element is sufficiently heated, the Cigar Lighter opens the circuit.

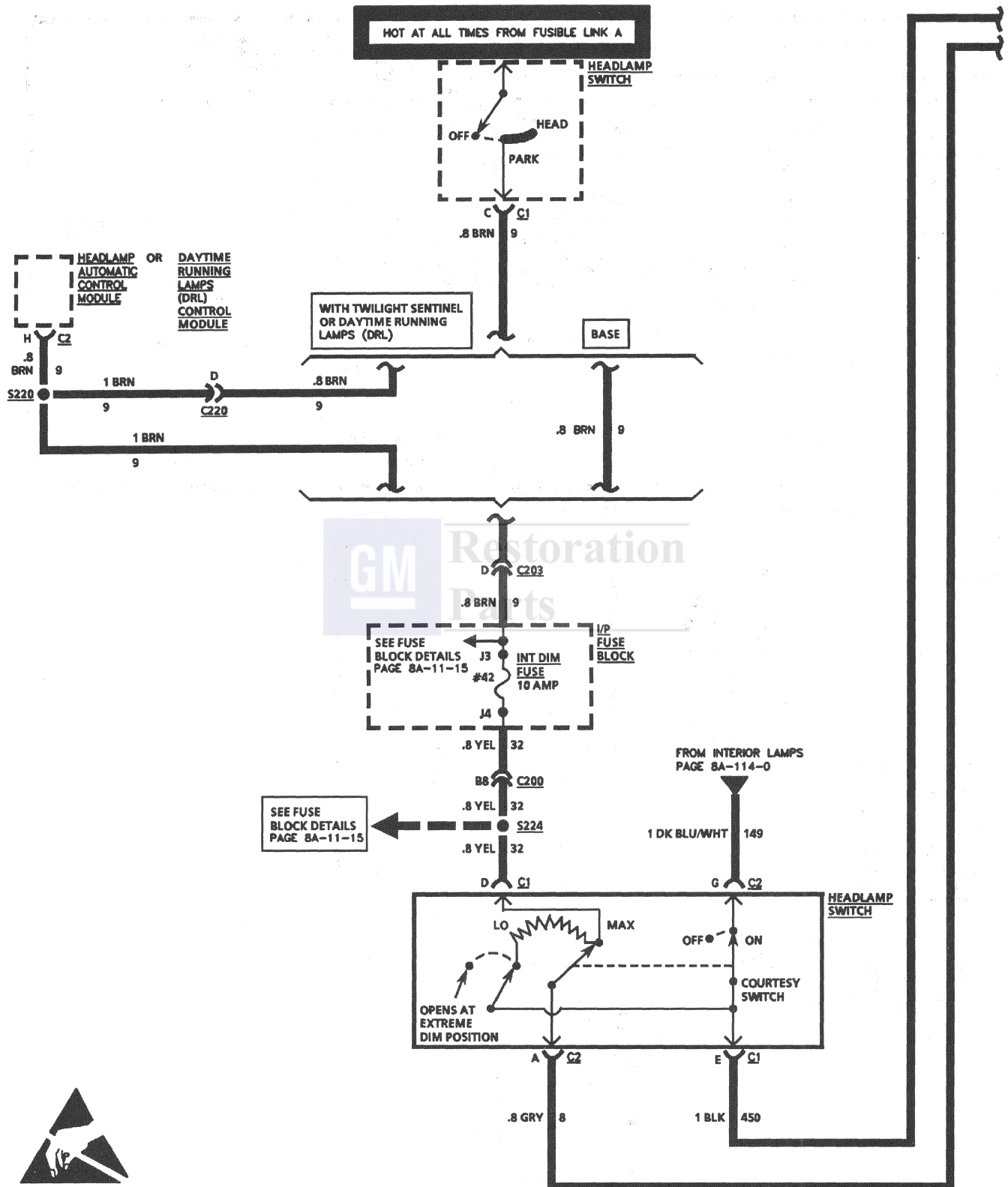


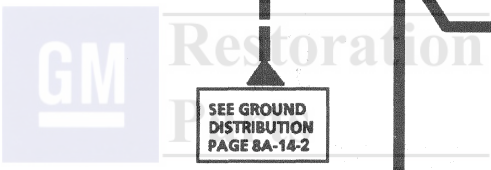
INSTRUMENT PANEL DIMMING (CHEV)





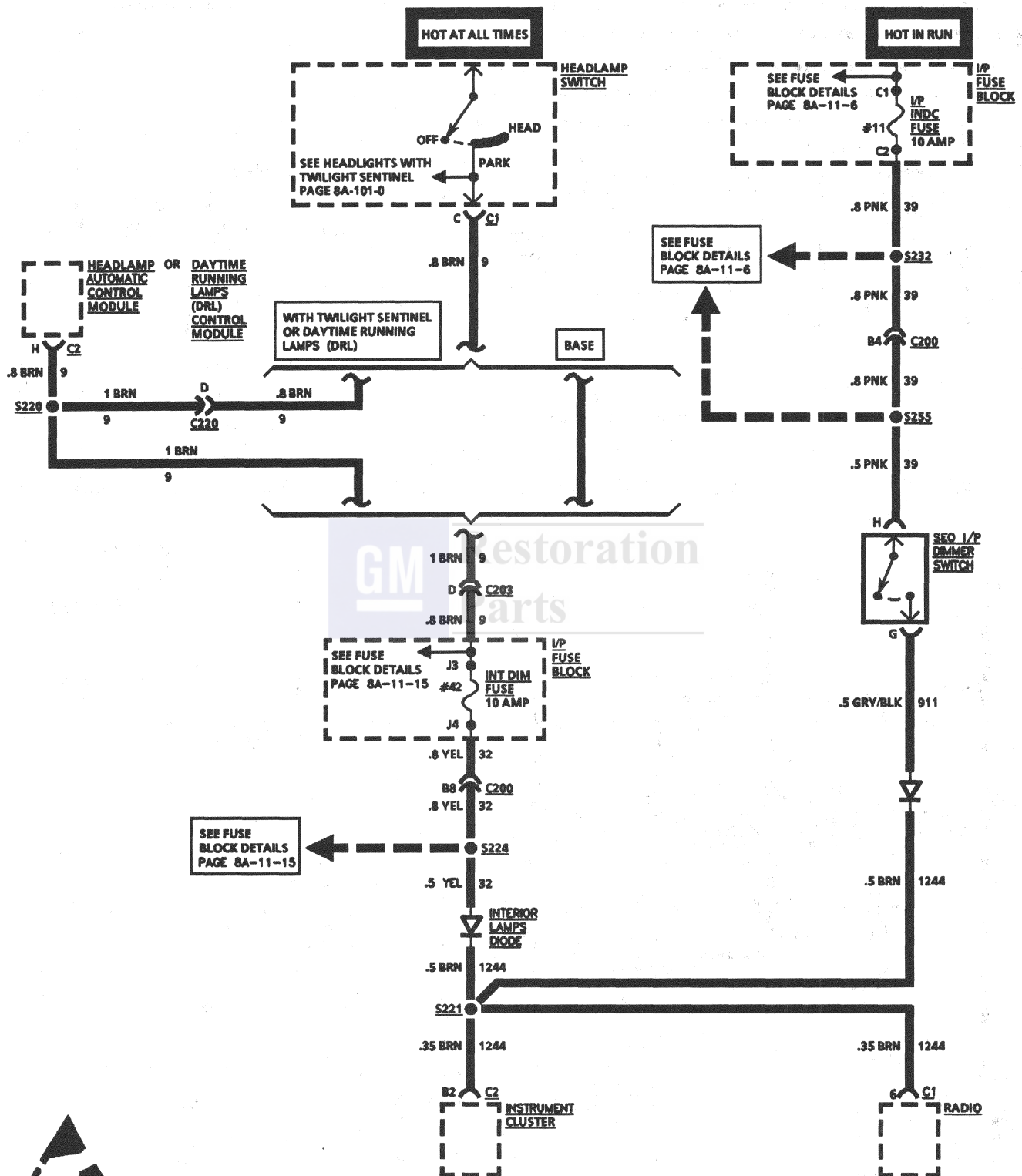
INSTRUMENT PANEL DIMMING (BUICK)





8A - 117 - 4 ELECTRICAL DIAGNOSIS

INSTRUMENT PANEL DIMMING (SEO)



SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES

INSTRUMENT PANEL DIMMING

COMPONENT	LOCATION	201-PG	FIG.	CONN
Ashtray	Front of Instrument Panel.....	17	28	
Ashtray Lamp	Front of Instrument Panel.....	17	28	
Headlamp Automatic Control Module.....	RH "A" Pillar, behind kickpad.....	18	29.....	202-7
Convenience Center	LH I/P, left of Steering Column	11	19	
Daytime Running Lamps (DRL) Control Module	RH "A" Pillar, behind kickpad.....	18	29.....	202-14
Endgate Window Release Switch.....	LH side of Instrument Panel part of Accessory Switch Panel			
Headlamp Switch	LH side of I/P part of Headlamp and I/P Lamp Dimmer and Accessory Switch	9	16.....	202-11
Headlamp and I/P Lamp Dimmer.....	LH side of I/P			
Heater and A/C Control	Center of I/P.....	17	28	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Instrument Cluster English Metric Switch.....	LH I/P			
Door Handle Lamp LH	LH Front Door			
Door Lock Switch Lamp LH....	LH Front Door			
Door Handle Lamp RH	RH Front Door			
Door Lock Switch Lamp RH....	RH Front Door			
Radio	Center I/P	17	28	
Rear Compartment Lid Ajar Indicator Lamp.....	LH side of Instrument Panel			
SEO I/P Dimmer Switch.....	RH Center I/P, near Radio			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C201 (6 cavities)(Base)	Body Harn to I/P Harn, at RH side of Steering Column, above C200	11	19.....	202-5
C202 (6 cavities).....	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, RH side of Steering Column, next to C200	11	19.....	202-5
C203 (10 cavities)(Base)	Body Harn to I/P Harn, at RH side of Steering Column.....	11	19.....	202-5
C215 (10 cavities).....	Cross Car Harn to Body Harn, behind RH kickpad at base of "A" Pillar.....	18	29.....	202-4
C217.....	I/P Harn to Ashtray Lamp Jumper, lower center of I/P			
C220 (10 cavities).....	I/P Harn to Twilight Sentinel or Daytime Running Lamps Harn, RH side of Steering Column.....	11	19.....	202-5
G200.....	Base of LH "A" Pillar, behind kickpad	11	19	
G201.....	Base of LH "A" Pillar, behind kickpad	11	19	
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	

INSTRUMENT PANEL DIMMING

COMPONENT	LOCATION	201-PG FIG. CONN
S201 (Buick)	I/P Harn, behind Instrument Cluster, approx 20cm from Instrument Cluster Conn C2 breakout in spiral taping	
S201 (Chev).....	I/P Harn, 12 cm from C200 branch breakout	
S207 (w/T82).....	Headlamp Automatic Beam Control Harn approx 15 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S209 (Buick)	I/P Harn behind Instrument Cluster, approx 12 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S209 (Chev).....	I/P Harn behind Instrument Cluster, approx 22 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S220 (w/T61).....	Daytime Running Lamps Harn, approx 13cm from Daytime Running Lamp Diode	
S220 (w/T82).....	Headlamp Automatic Beam Control Harn approx 2 cm from Headlamp Automatic Control Ambient Light Sensor Conn branch breakout	
S221	I/P Harn, approx 4 cm from C200 branch breakout	
S224	I/P Harn behind Instrument Cluster, approx 26 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S232	Body Harn, approx 10 cm from SDM breakout—	
S255 (Buick)	I/P Harn, behind Instrument Cluster 16 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping	
S255 (Chev).....	I/P Harn, approx 4 cm from Instrument Cluster Conn C2 branch breakout before spiral taping	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout	
S281	Body Harn, approx 24 cm from Convenience Center branch breakout	
S422	Body Harn, approx 27 cm from C408 branch breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Make sure Park Lamps turn "ON" and "OFF" normally before proceeding with System Diagnosis, refer to "Exterior Lamps," page 8A-110-0 for Park Lamp diagnosis.
2. Check I/P Fuse #42. If I/P Fuse #42 is open, check for a short to ground in CKT 44, CKT 8, or in CKT 32.
3. Check that G200 and G201 are clean and tight.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system

disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
None of the Panel Lamps will light with Headlamp Switch in "PARK" or "HEAD."	Chart #1 (BUICK) Chart #2 (CHEV)	8A-117-8 8A-117-9
All Panel Lamps remain lit at all times.	Check CKT 9, CKT 44, CKT 8 and CKT 32 for a short to B+.	
I/P Dimmer Switch will not change the brightness of the Panel Lamps.	Check for short to B+ in CKT 8. Check for short to B+ in CKT 44 (CHEV). If OK, replace I/P Dimmer/Headlamp Switch.	
Brightness of Panel Lamps changes erratically when I/P Lamp Dimmer Switch is turned.	Check for poor connections at I/P and Headlamp Dimmer Switch. If OK, replace I/P and Headlamp Dimmer Switch.	
One or more Panel Lamps will not illuminate or dim properly.	Check CKT 8 (between suspect Panel Lamp and S209) and CKT 450 (between suspect Panel Lamp and G200) for an open. If OK, replace suspect Panel Lamp bulb.	
SEO speedometer and Radio displays do not illuminate with Park Lamps "OFF."	Check for shorted SEO I/P Dimmer Switch. If OK, repair short to B+ in CKT 911 or CKT 1244.	
SEO speedometer and Radio displays will not dim to "OFF" when using the SEO I/P Dimmer Switch.	Check for defective SEO I/P Dimmer Switch. If OK, repair open in CKT 911 or CKT 1244.	



INSTRUMENT PANEL DIMMING

CHART #1 (BUICK)
NONE OF THE PANEL LAMPS WILL LIGHT WITH HEADLAMP SWITCH
IN "PARK" OR "HEAD"

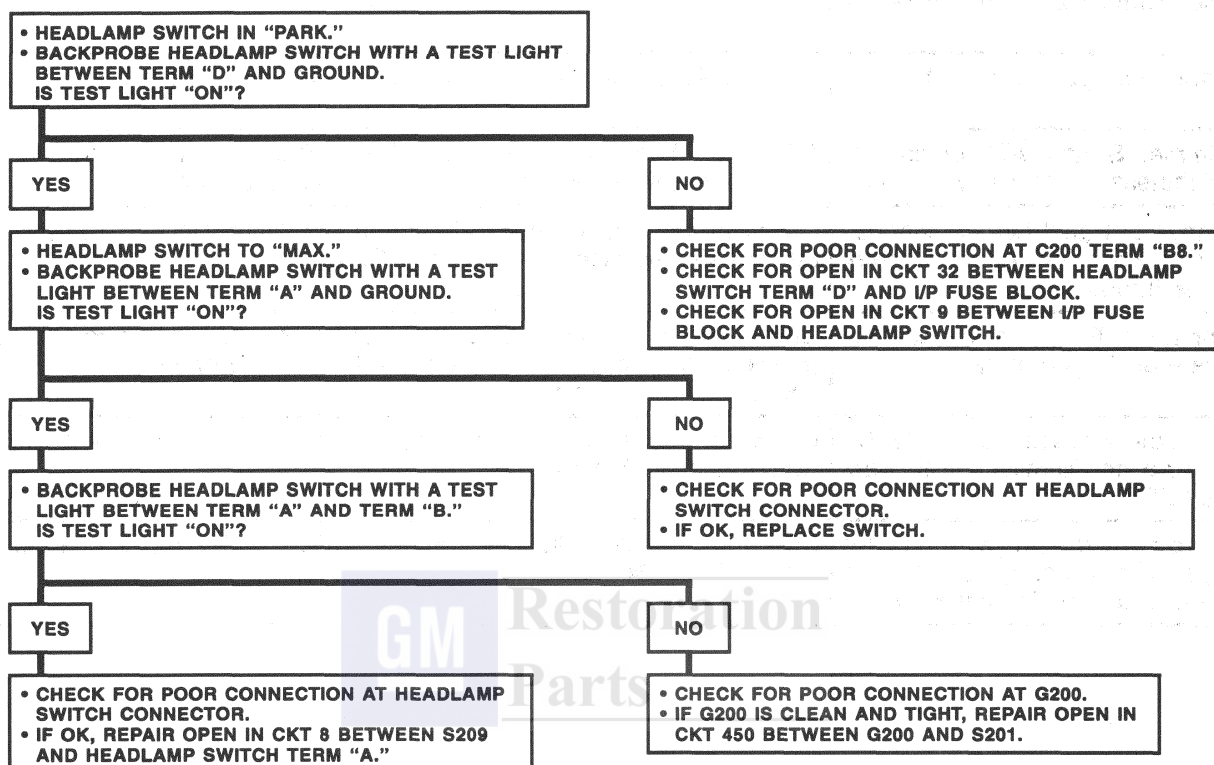
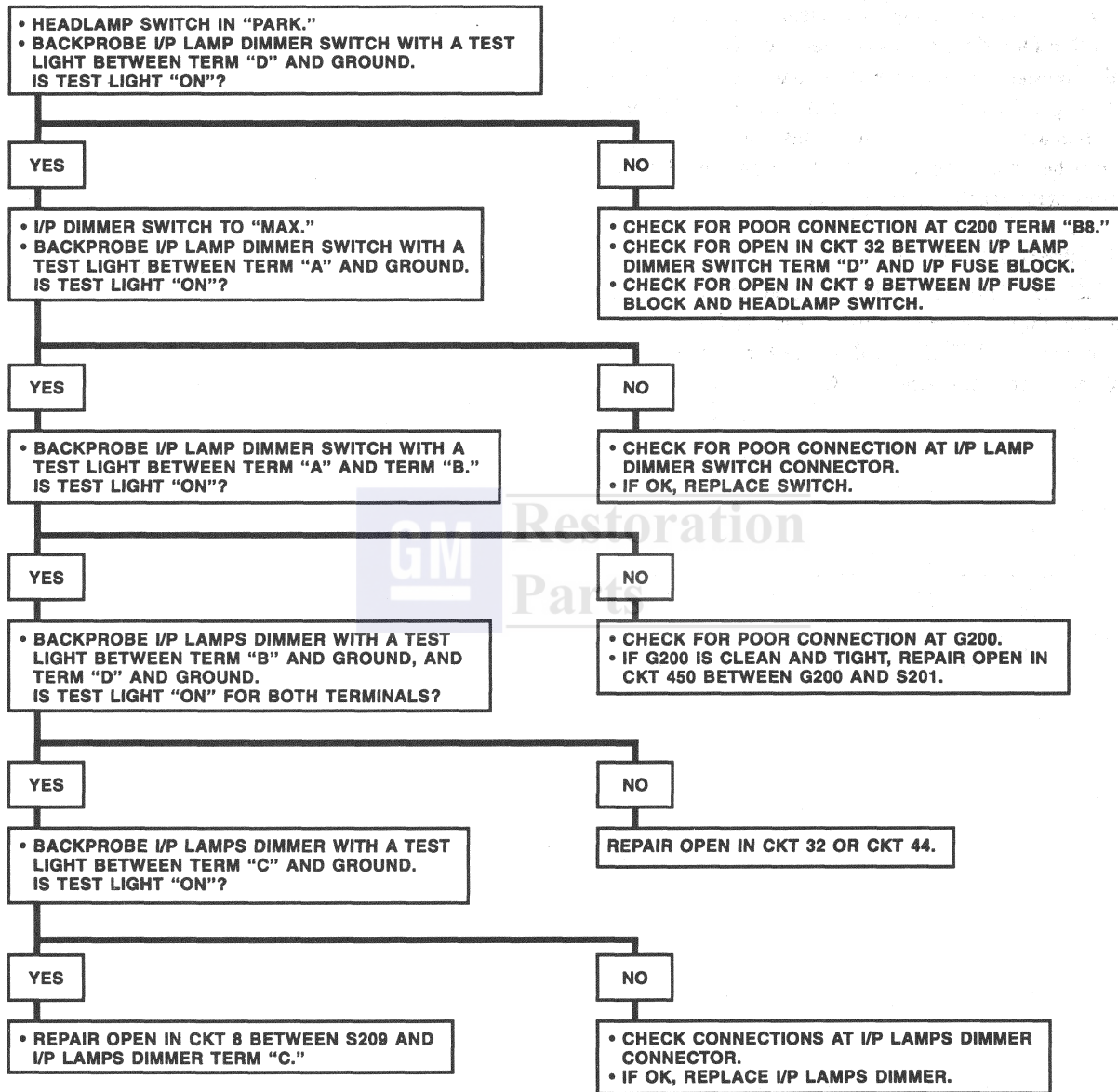


CHART #2 (CHEV)
NONE OF THE PANEL LAMPS WILL LIGHT WITH HEADLAMP SWITCH
IN "PARK" OR "HEAD"



INSTRUMENT PANEL DIMMING

CIRCUIT OPERATION

Battery voltage is applied at all times to the Headlamp Switch. When the Headlamp Switch is in "HEAD" or "PARK," voltage is applied through I/P Fuse #42 to the I/P and Headlamp Dimmer Switch.

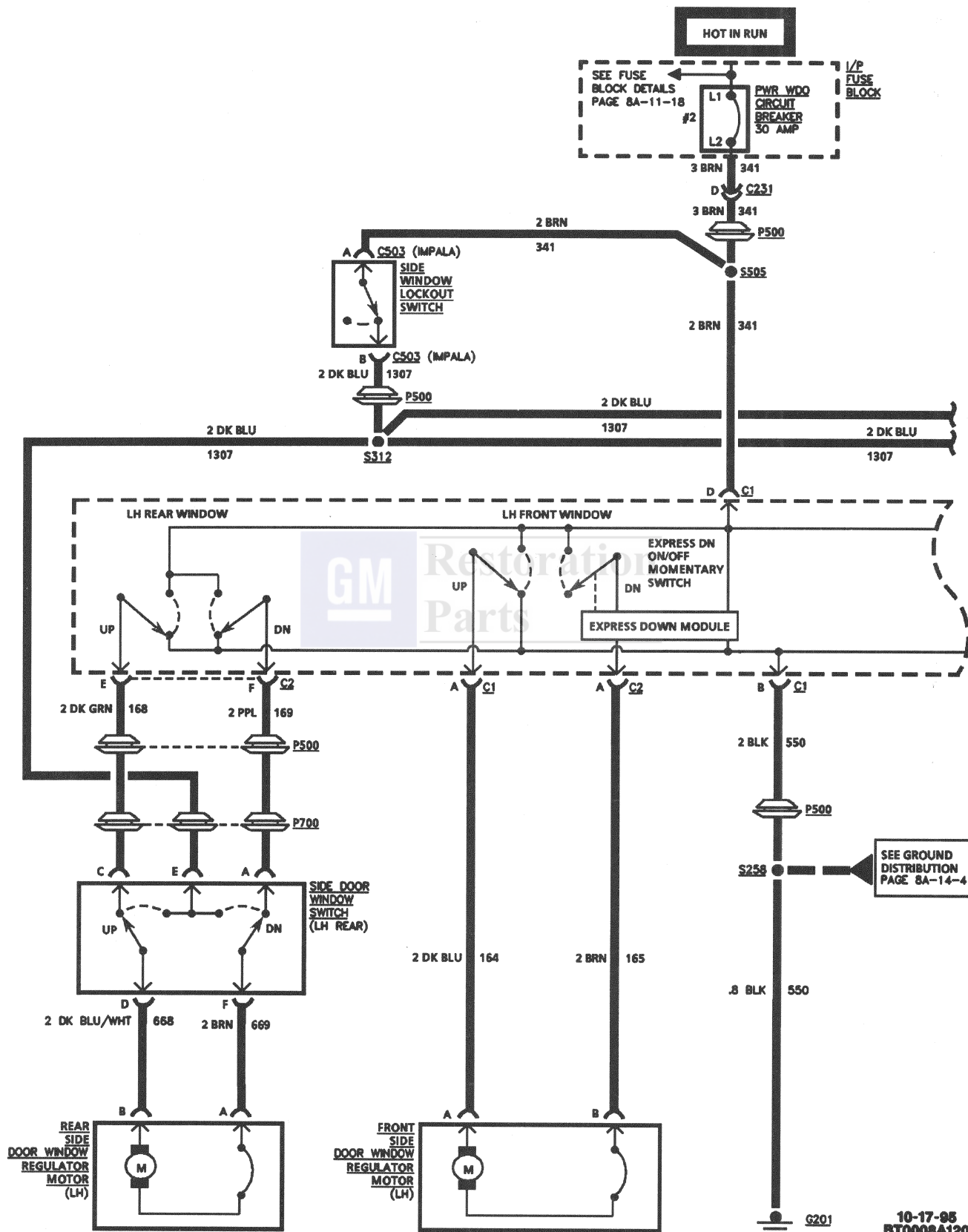
The I/P and Headlamp Dimmer Switch controls the brightness of the Panel Lamps by means of a rheostat. When the Dimmer Switch is turned to the "MAX" position, the resistance is reduced to 60 ohms and the Panel Lamps are bright. When the knob is turned to "LO," the resistance increases to about 190 ohms, and the Panel Lamps dim. Chevrolet models use an additional module to control Instrument Panel Lamp brilliance.

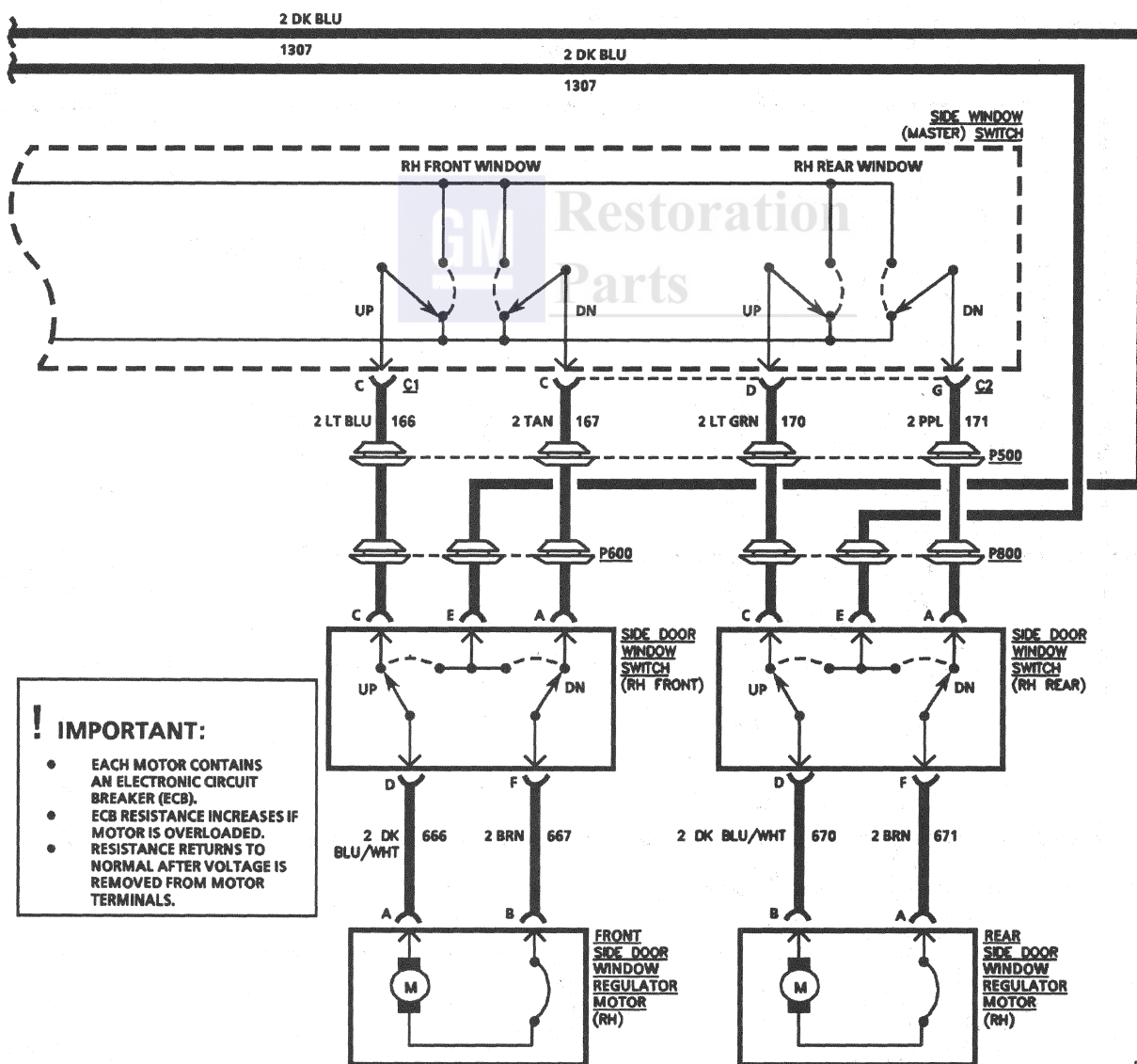
SEO I/P Dimmer Switch

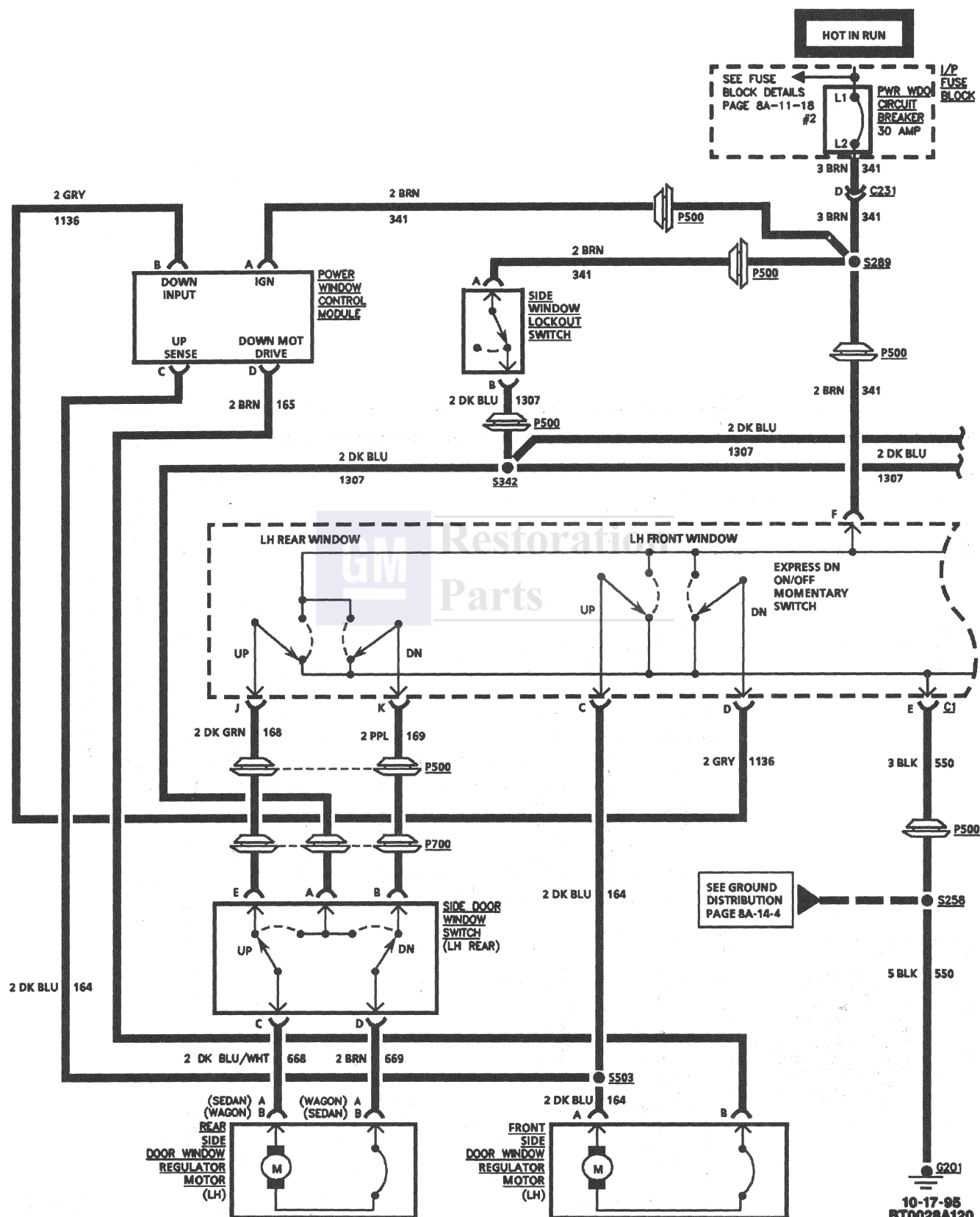
The SEO I/P Dimmer Switch is used to completely blank out the digital speedo cluster and Radio display. Applying voltage to CKT 1244 will cause the V/F displays to turn "OFF," with Park Lamps off.

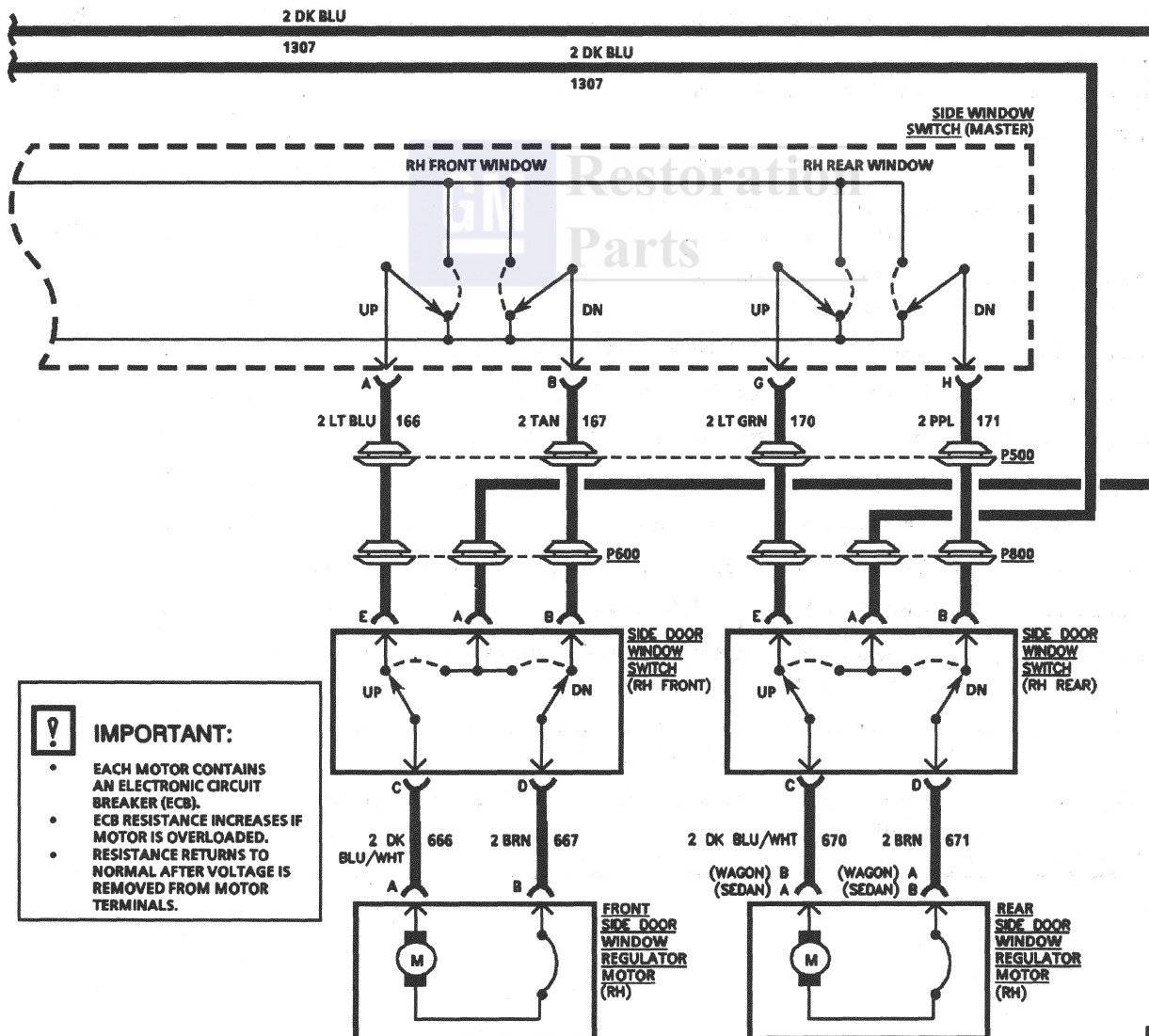












8A - 120 - 4 ELECTRICAL DIAGNOSIS

POWER WINDOWS

COMPONENT	LOCATION	201-PG	FIG.	CONN
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Side Door Window Regulator Motor, LH Front.....	LH Front Door	19	30	
Side Door Window Regulator Motor, RH Front.....	RH Front Door	23	34	
Side Window Switch, RH Front	RH Front Door Armrest	23	34.....	202-10
Side Window Master Switch.....	LH Front Door Armrest.....	19	30	
Rear Side Door Window Regulator Motor, LH.....	LH Rear Door	25	36	
Rear Side Door Window Regulator Motor, RH.....	RH Rear Door	24	35	
Rear Side Door Window Switch, LH.....	LH Rear Door Armrest.....	25	36.....	202-9
Rear Side Door Window Switch, RH.....	RH Rear Door Armrest	24	35.....	202-9
Side Door Window Lockout Switch.....	LH Front Side Door attached to Accessory Switch Panel	19	30	
C231 (6 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar behind kickpad.....	19	30.....	202-7
C503 (2 cavities).....	Crossbody and Side Door Harn to Side Door Window Lockout Switch			
G201.....	Base of LH "A" Pillar, behind kickpad	11	19	
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	
P700	Between LH Rear Door and "B" Pillar.....	25	36	
P800	Between RH Rear Door and "B" Pillar.....	24	35	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S289 (Buick)	Crossbody Harn, at C230 branch breakout			
S342	Crossbody Harn, approx 12 cm forward of Power Seat crossover branch breakout			
S503 (Buick)	Crossbody Harn, approx 7 cm from Door Lock Switch breakout inside LH Front Door			
S505 (Chev).....	Crossbody Harn, approx 34 cm from P500, inside LH Front Door			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. If all Power Windows are inoperative, check Circuit Breaker #2. If open, check for a short to ground in CKT 341.
2. If windows move slowly, check that:
 - Windows free of mechanical binding and pivot joints are greased.
 - Battery is fully charged.
 - Ground G201 is clean and tight.
3. If switches do not illuminate when Park Lamps are turned "ON," refer to "Interior Lamps," page 8A-114-0.
4. If the Express Down Feature does not work, but window moves down with each switch depression, replace the Side Window Master Switch (Chev) or Power Window Control Module (Buick).

5. If the Side Window Lockout Switch does not disable the windows, check CKT 1307 for a short to B+. If OK, replace the Side Window Lockout Switch.

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

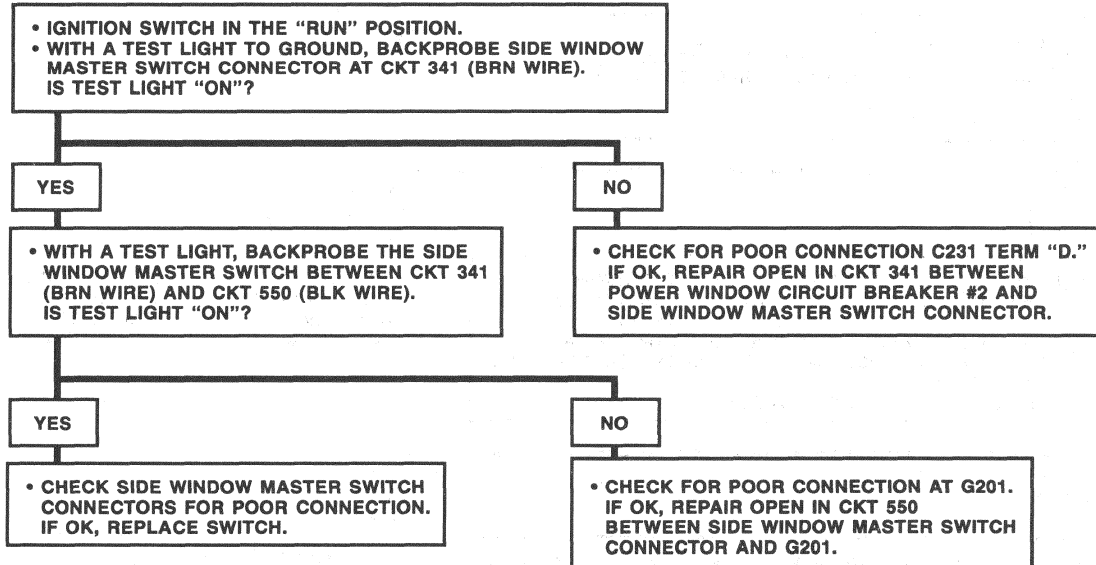
SYSTEM CHECK

ACTION	NORMAL RESULTS
[1] • Operate each window "UP" and "DOWN" from the Side Window Master Switch.	Each window operates quietly and smoothly, with no sticking. LH Front Window rolls down all the way without the switch being held (Express Down Feature).
[2] • Operate each window from its individual Side Window Switch, with the Side Window Lockout Switch in the "UNLOCK" position.	Each window operates quietly and smoothly, with no sticking.
[3] • Side Window Lockout Switch in the "LOCK" position. • Repeat steps 1 and 2.	Each window inoperative from individual switches, but they operate from the Side Window Master Switch.

8A - 120 - 6 ELECTRICAL DIAGNOSIS**POWER WINDOWS****SYMPTOM TABLE**

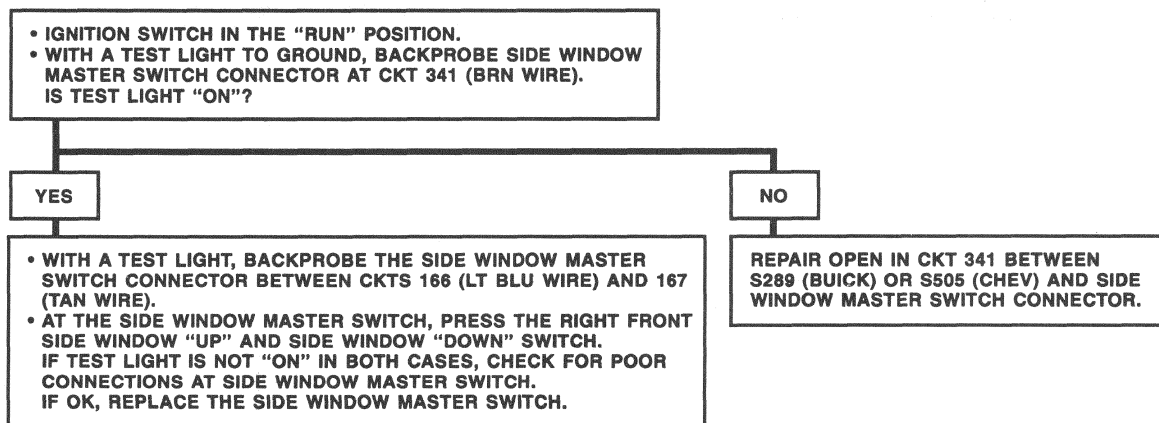
SYMPTOM	PROCEDURE	PAGE NUMBER
All Power Windows inoperative.	Chart #1	8A-120-7
Power Windows inoperative from Side Window Master Switch, with normal operation from individual Side Window Switches.	Chart #2	8A-120-7
LH Front Window inoperative, all others operate normally.	Chart #3	8A-120-8
RH Front, LH Rear or RH Rear Power Window is inoperative from the Side Window Master Switch, with normal operation from the individual Side Window Switches.	Chart #4	8A-120-9
RH Front, LH Rear or RH Rear Power Window is inoperative from individual Side Window Switch, but operates normally from Side Window Master Switch.	Chart #5	8A-120-9
One window (other than LH Front) is inoperative from both the Side Window Master Switch and individual Side Window Switch, all other windows operate normally.	Chart #6	8A-120-10
RH Front, LH Rear and RH Rear Power Windows are inoperative from individual switches, but operates from the Side Window Master Switch.	Chart #7	8A-120-11

CHART #1 ALL POWER WINDOWS INOPERATIVE



C9902

CHART #2 POWER WINDOWS INOPERATIVE FROM SIDE WINDOW MASTER SWITCH, WITH NORMAL OPERATION FROM INDIVIDUAL SIDE WINDOW SWITCHES



C9903

POWER WINDOWS

CHART #3
LH FRONT WINDOW INOPERATIVE, ALL OTHERS OPERATE NORMALLY

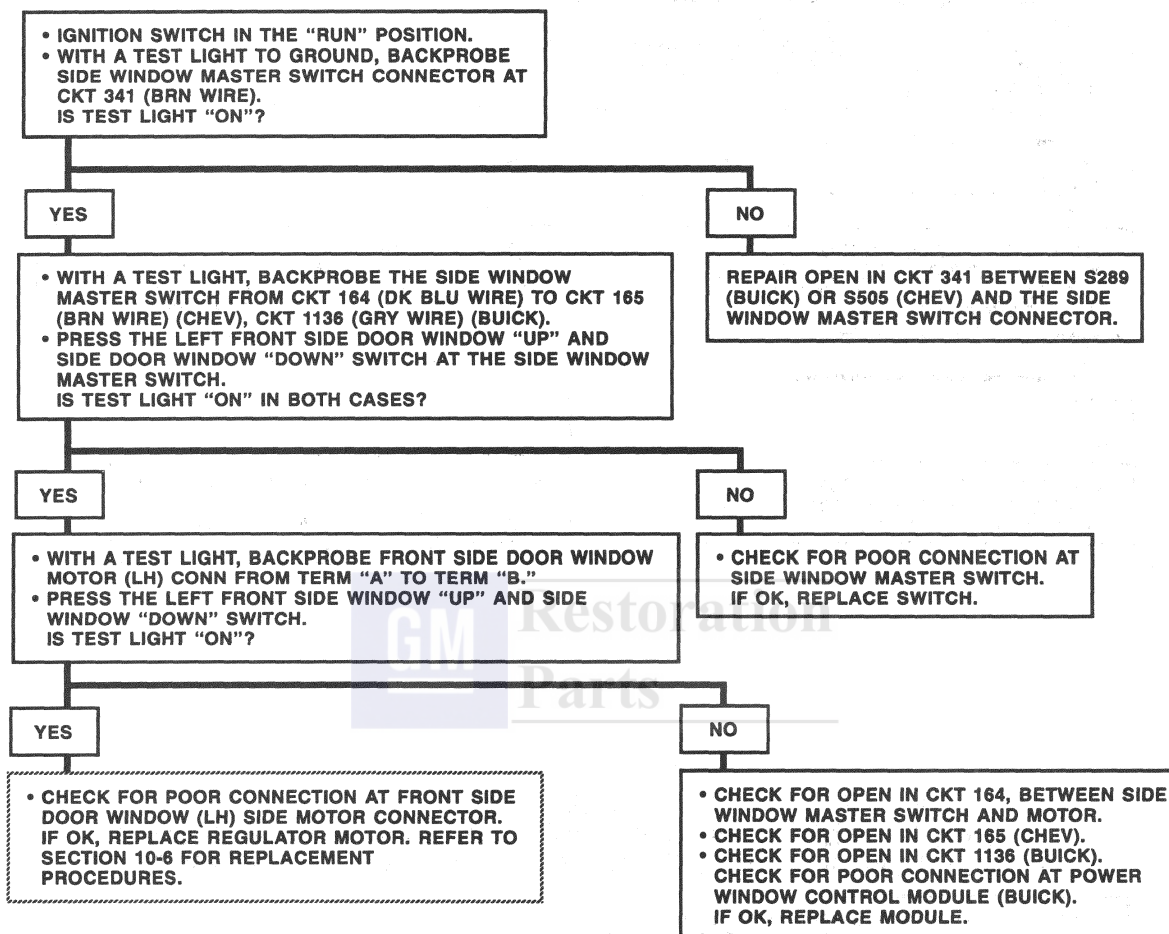
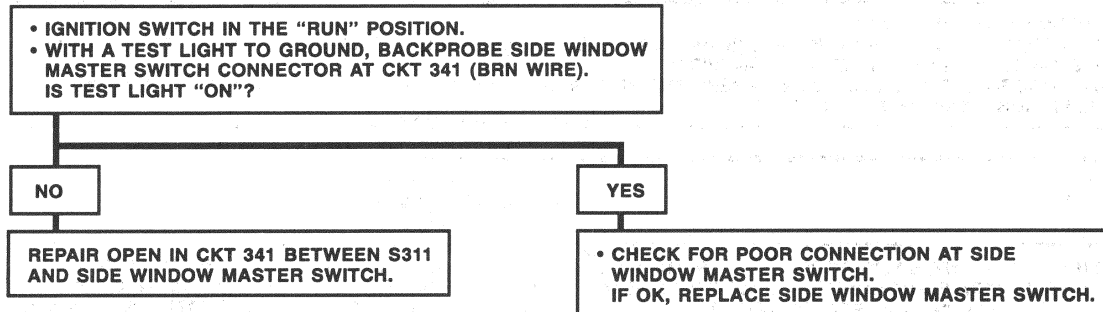


CHART #4

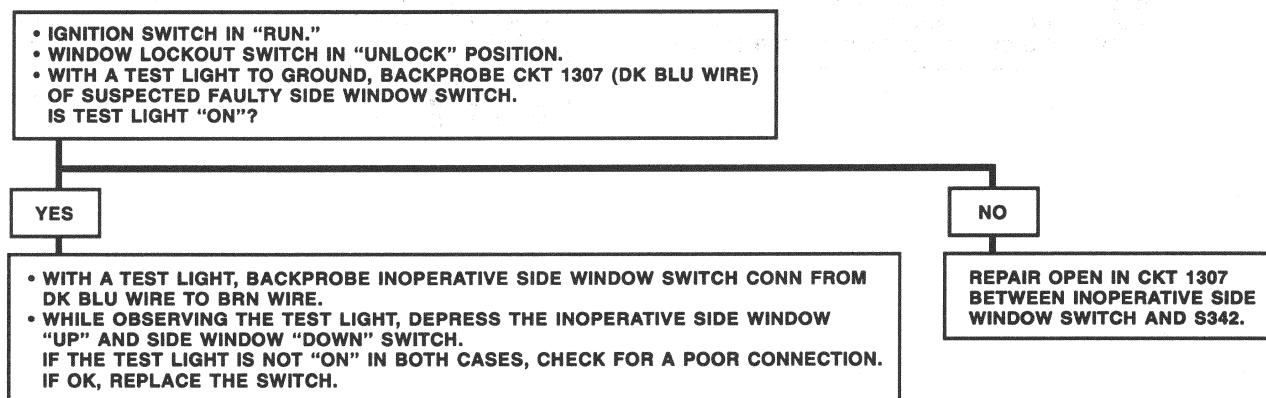
**RH FRONT, LH REAR OR RH REAR POWER WINDOW IS INOPERATIVE
FROM THE SIDE WINDOW MASTER SWITCH, WITH NORMAL
OPERATION FROM THE INDIVIDUAL SIDE WINDOW SWITCH**



C9905

CHART #5

**RH FRONT, LH REAR OR RH REAR POWER WINDOW IS
INOPERATIVE FROM INDIVIDUAL SIDE WINDOW SWITCH, BUT
OPERATES NORMALLY FROM SIDE WINDOW MASTER SWITCH**



C9906

POWER WINDOWS

CHART #6
ONE WINDOW (OTHER THAN LH FRONT) IS INOPERATIVE FROM
BOTH THE SIDE WINDOW MASTER SWITCH AND INDIVIDUAL SIDE
WINDOW SWITCH, ALL OTHER WINDOWS OPERATE NORMALLY

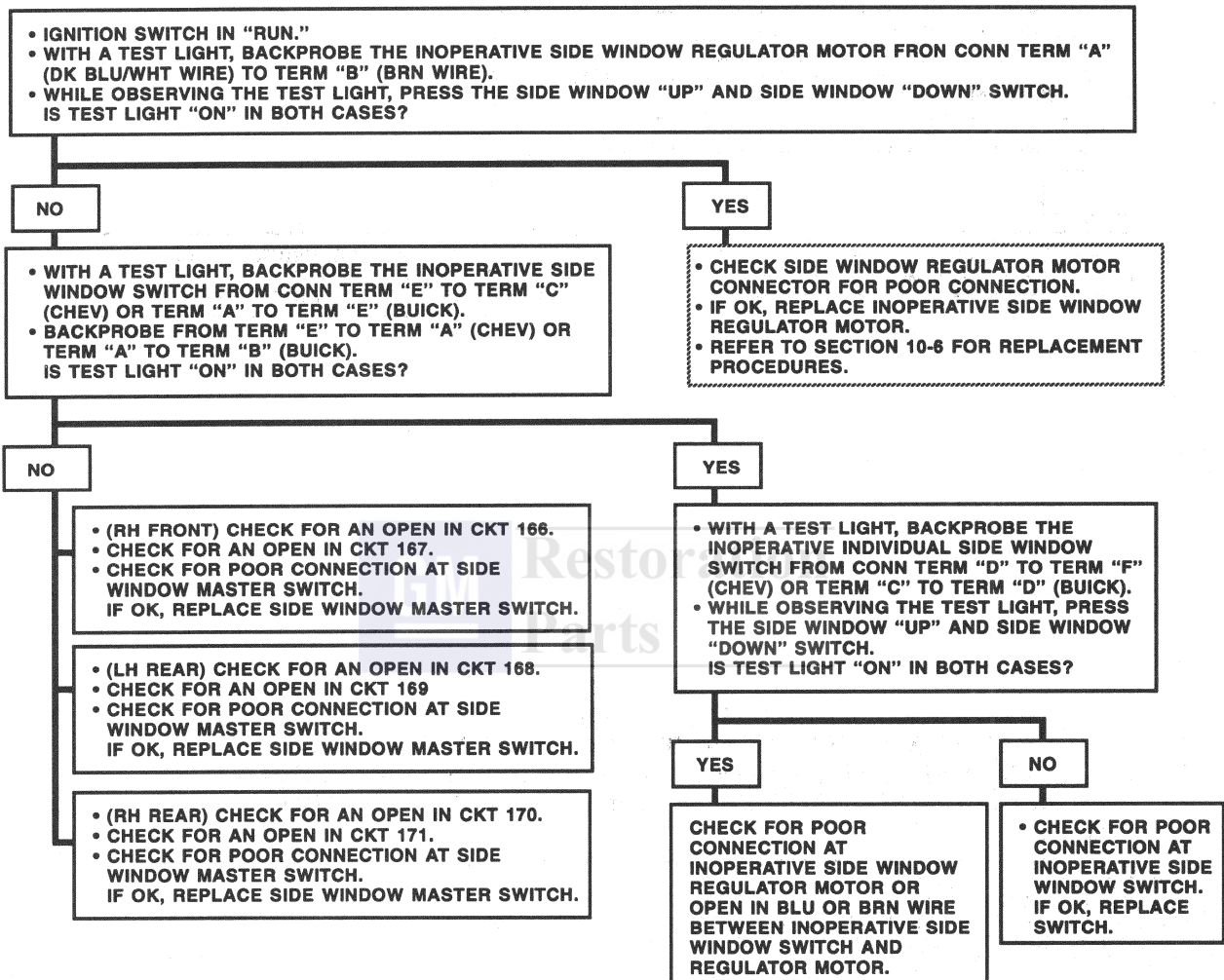
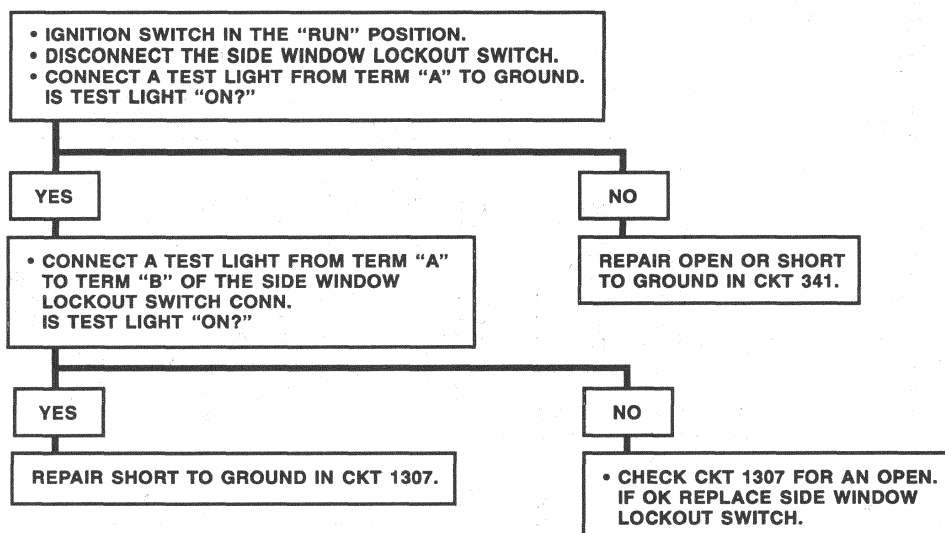


CHART #7

**RH FRONT, LH REAR AND RH REAR POWER WINDOWS ARE
INOPERATIVE FROM INDIVIDUAL SIDE WINDOW SWITCHES,
BUT OPERATE FROM SIDE WINDOW MASTER SWITCH**



C9907

CIRCUIT OPERATION

With the Ignition Switch in the "RUN" position, voltage from Circuit Breaker #2 is applied to the Side Window Master Switch through CKT 341 and the individual Side Window Switches through the Side Window Lockout Switch that connects CKT 1307 and CKT 341. The Side Door Window Regulator Motors and Side Window Switches receive ground through the Side Window Master Switch, which is grounded at G201. When a window other than the LH Front Window is operated from the Side Window Master Switch, battery voltage will be sent to the Side Door Window Regulator Motor through the individual Side Window Switch. The LH Front Window is operated directly from the Side Window Master Switch.

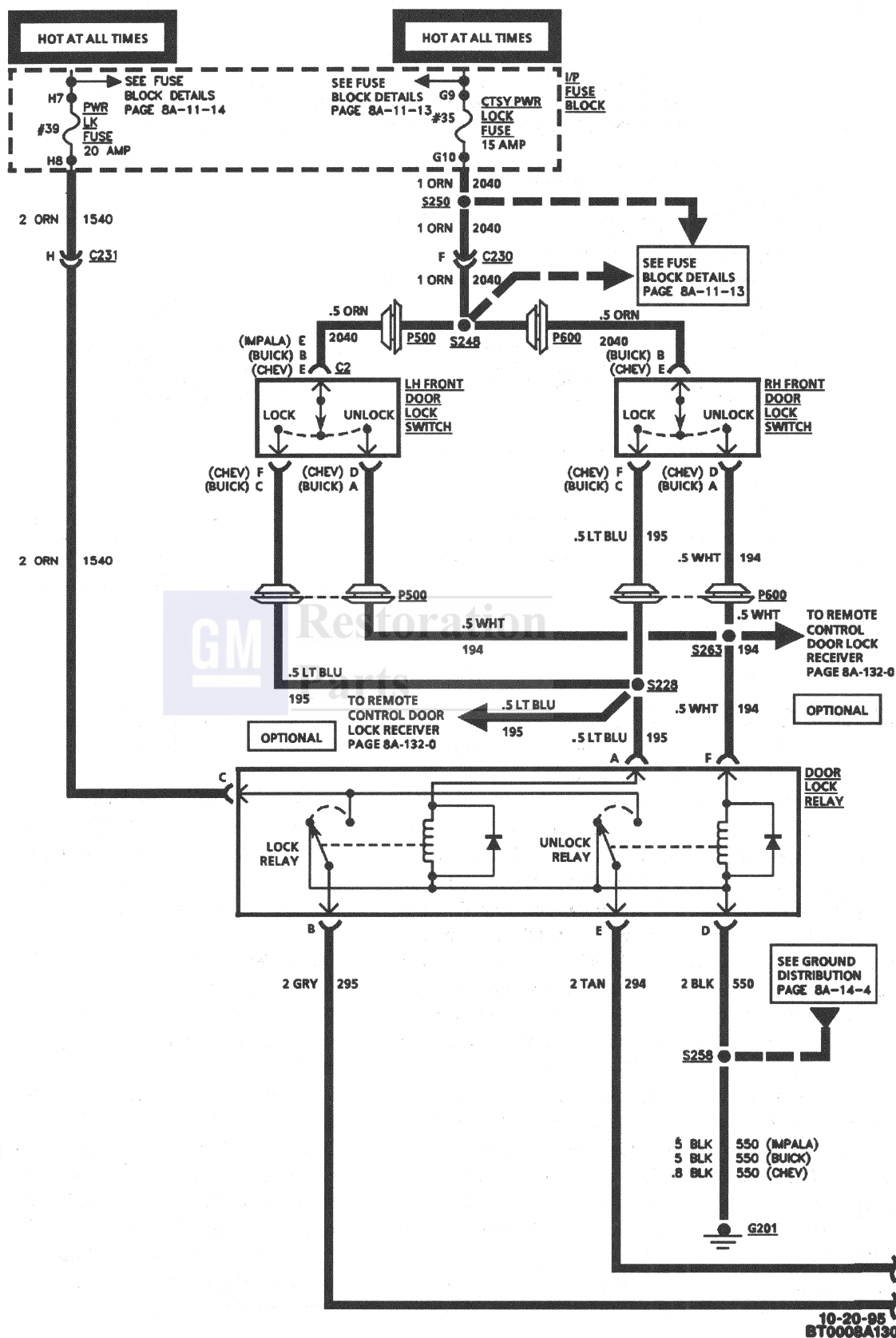
The Power Windows are driven by reversible, permanent magnet motors. Each motor is controlled by a set of two switches, which are normally closed to ground. When any Side Window Switch is moved to the "UP" position, the "UP" switch will provide battery voltage to the Side Door Window Regulator Motor through the DK BLU/WHT wire. The Side Door Window Regulator Motor will receive ground through the BRN wire, the "DOWN" switch, and the Side Window Master Switch and drive the

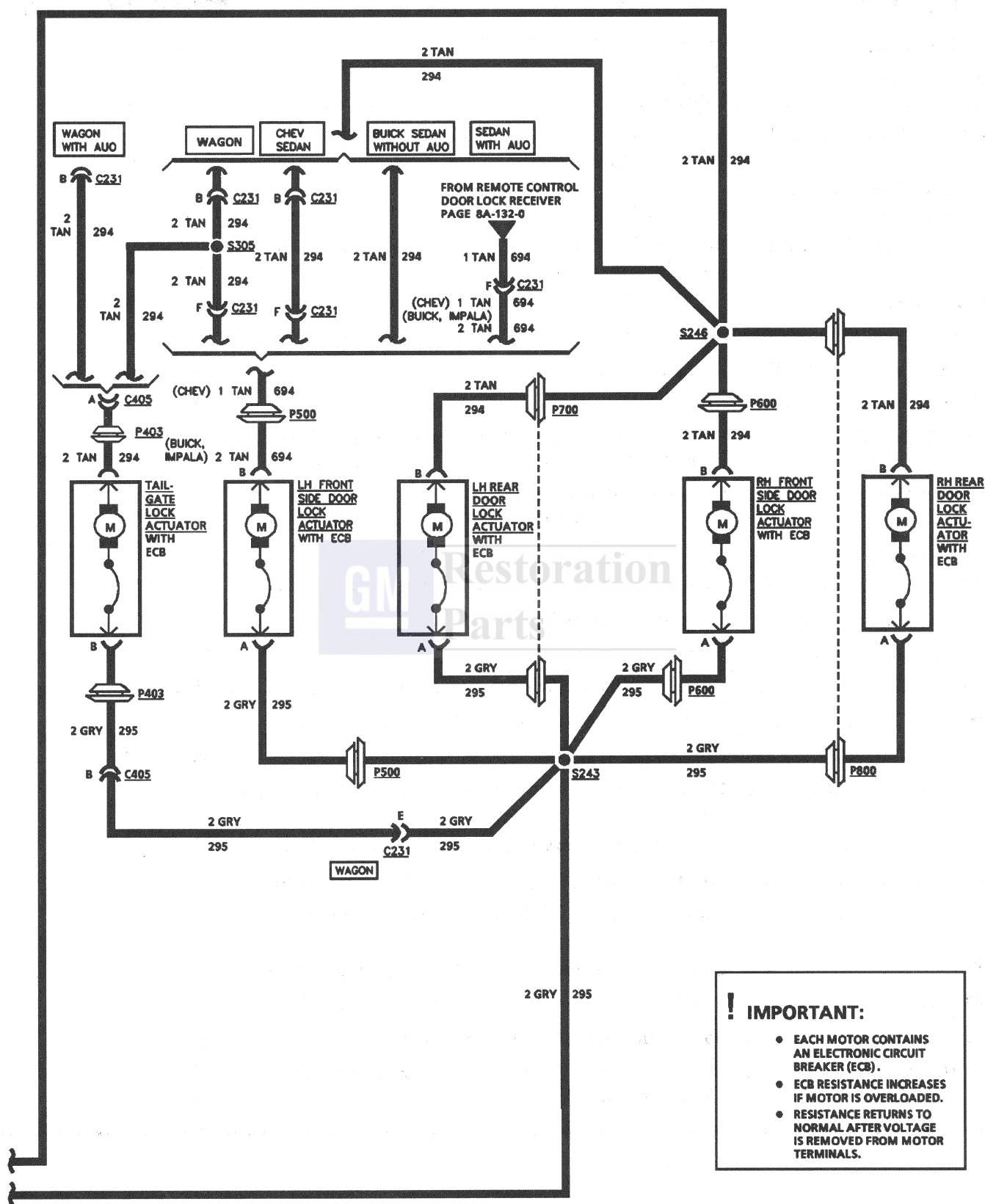
window up. When the switch is released, the switch contacts will return to their normal grounded position.

To lower the window, the "DOWN" switch will connect the BRN wire to battery voltage. Ground will be provided to the DK BLU/WHT wire through the "UP" switch and the Side Window Master Switch. The polarity across the motor will be reversed, causing the motor to rotate in the opposite direction and lower the window.

The Power Windows System also includes an Express Down Feature for the LH Front Window. This allows the LH Front Window to open fully when the LH Front Side Window Switch is pressed momentarily. All of the solid state circuitry controlling this feature is contained within the Side Window Master Switch.

Each motor is protected by an Electronic Circuit Breaker (ECB). If a Side Window Switch is held in the "UP" or "DOWN" position too long with the window obstructed, or after the window is fully up or down, the ECB will increase its resistance. By increasing its resistance, the ECB will prevent the Side Door Window Regulator Motor from overloading. The ECB will reset to normal resistance when voltage to the Side Door Window Regulator Motor is interrupted.





POWER DOOR LOCKS AND ENDGATE LOCK

COMPONENT	LOCATION	201-PG	FIG.	CONN
Door Lock Relay.....	At base of LH "A" Pillar, behind kickpad	11	19	
Front Door Lock Actuator LH.....	LH Front Door	19	30	
Front Door Lock Switch LH	LH Front Side Door attached to Front Side Door inside Handle Bezel.....	19	30	
Front Door Lock Actuator RH	RH Front Door	23	34	
Front Door Lock Switch RH	RH Front Side Door attached to Front Side Door inside Handle Bezel.....	23	34	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Rear Door Lock Actuator LH...	LH Rear Door	25	36	
Rear Door Lock Actuator RH...	RH Rear Door	24	35	
Endgate Lock Actuator	RH Endgate	35	51	
C230 (10 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar behind kickpad.....	11	19	202-5
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar behind kickpad.....	11	19	202-6
C405 (6 cavities).....	Body Harn to Endgate Harn, near center of LH "D" Pillar ..	34	49	202-7
G201.....	Base of LH "A" Pillar, behind kickpad	11	19	
P403	Between Tailgate and LH "D" Pillar			
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	
P700	Between LH Rear Door and "B" Pillar	25	36	
P800	Between RH Rear Door and "B" Pillar	24	35	
S212	I/P Harn, approx 4 cm from C200 branch breakout in spiral taping			
S246	Crossbody Harn, approx 4 cm from C231 branch breakout			
S248	Crossbody Harn, approx 8 cm from C231 branch breakout			
S250	Body Harn, approx 20 cm from Convenience Center breakout			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S263	Crossbody Harn, approx 16 cm from C231 branch breakout			
S305	Body Harn, approx 12 cm from C309 breakout			
S333 (Buick)	Crossbody Harn, 4 cm forward of Power Seat Crossover branch breakout			

TROUBLESHOOTING HINTS**(Perform before beginning System Diagnosis)**

1. Check I/P Fuse #35. If open, check for a short to ground in CKT 2040.
2. Check for a poor connection at G201.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system failure but prove "GOOD" in a continuity/voltage check (see "Troubleshooting Procedures," page 8A-4-0).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Power Door Locks inoperative from both Power Door Lock Switches.	Chart #1	8A-130-4
Power Door Locks operate from one Door Lock Switch only.	Chart #2	8A-130-5
Lock function inoperative (unlock function operative) from both Door Lock Switches.	Chart #3	8A-130-5
Unlock function inoperative (lock function operative) from both Door Lock Switches.	Chart #4	8A-130-6
Lock function inoperative (unlock function operative) from one Door Lock Switch.	Chart #5	8A-130-6
Unlock function inoperative (lock function operative) from one Door Lock Switch.	Chart #6	8A-130-7
One or more Lock Actuators inoperative from both switches.	Chart #7	8A-130-7

POWER DOOR LOCKS AND ENDGATE LOCK

CHART #1
POWER DOOR LOCKS INOPERATIVE FROM BOTH DOOR LOCK SWITCHES

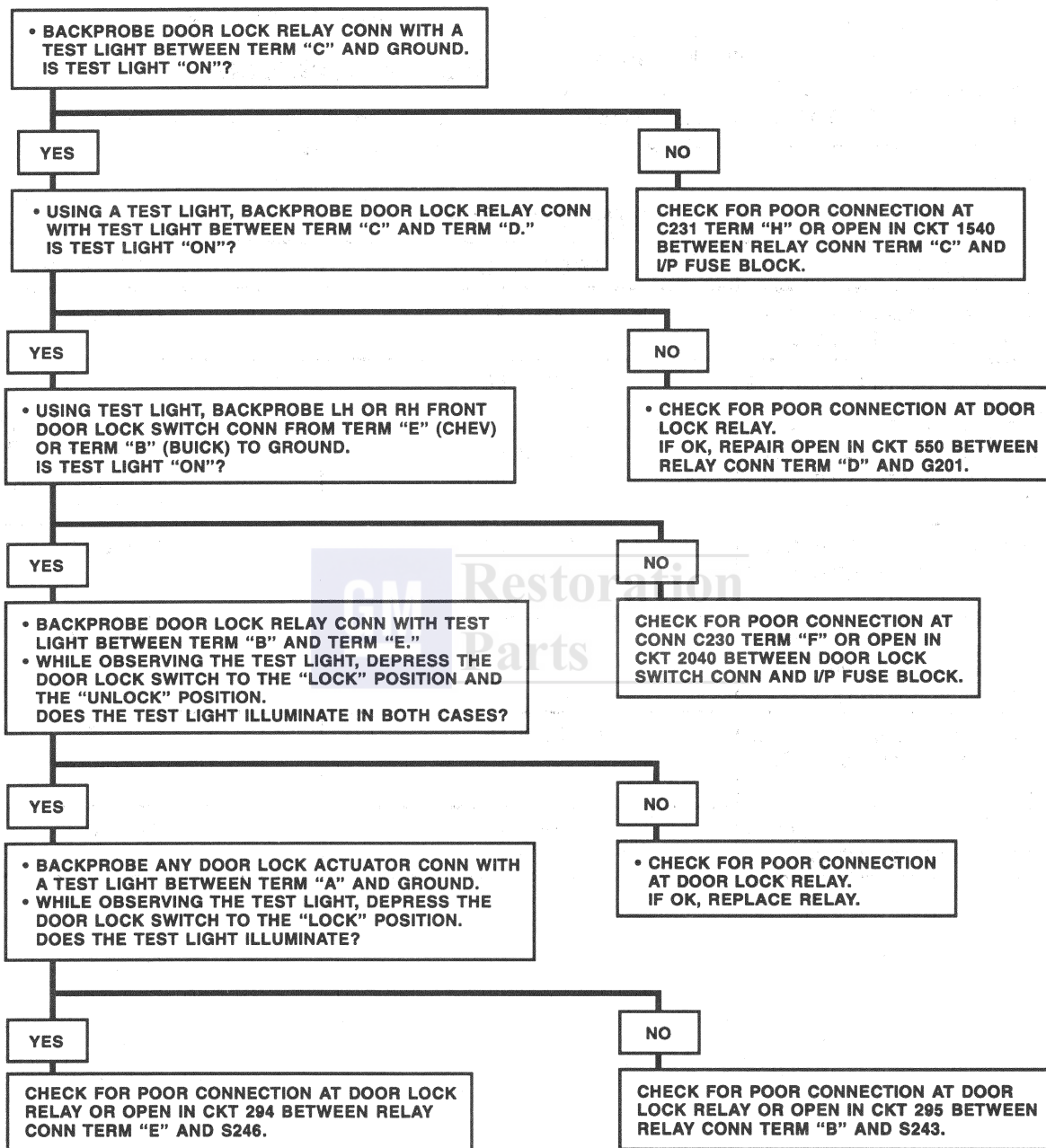
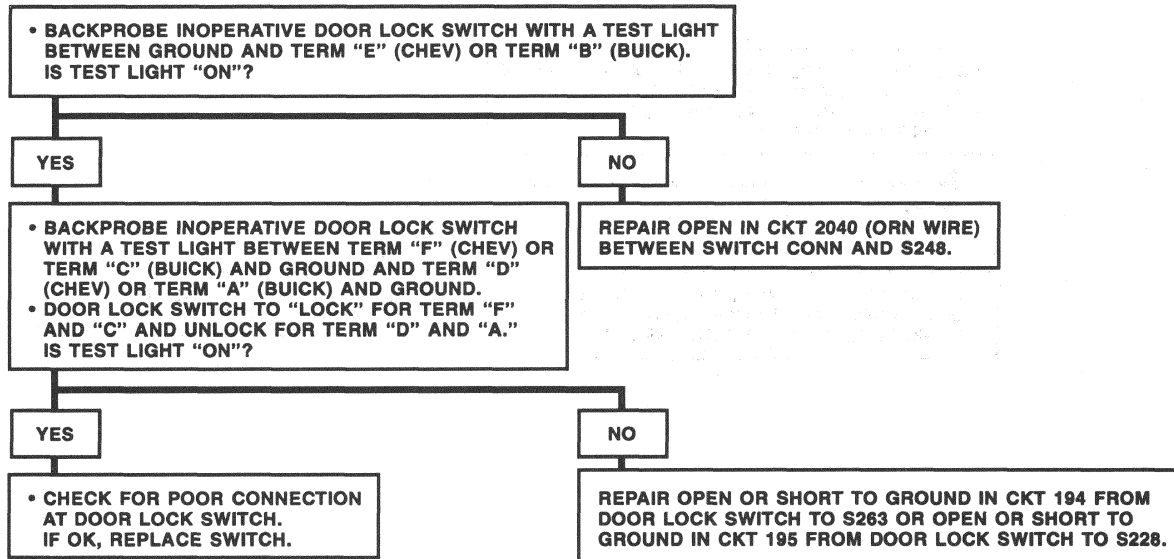


CHART #2

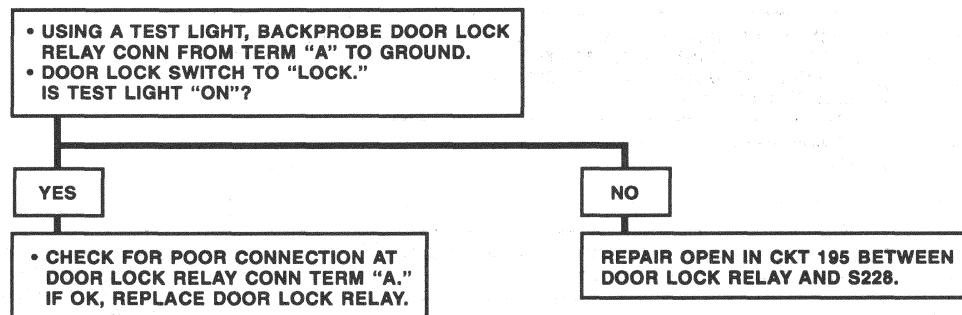
POWER DOOR LOCKS OPERATE FROM ONE DOOR LOCK SWITCH ONLY



C9896

CHART #3

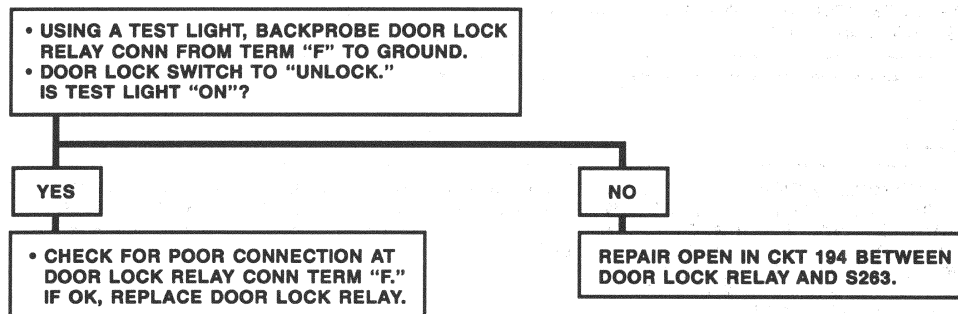
LOCK FUNCTION INOPERATIVE (UNLOCK FUNCTION OPERATIVE) FROM BOTH DOOR LOCK SWITCHES



C9897

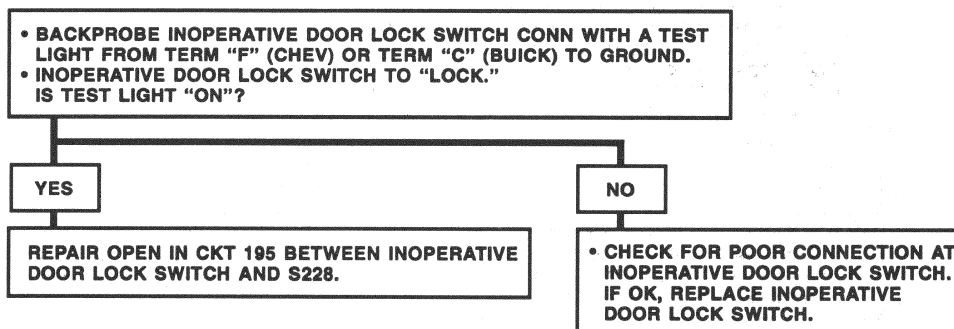
POWER DOOR LOCKS AND ENDGATE LOCK

CHART #4
UNLOCK FUNCTION INOPERATIVE (LOCK FUNCTION OPERATIVE)
FROM BOTH DOOR LOCK SWITCHES



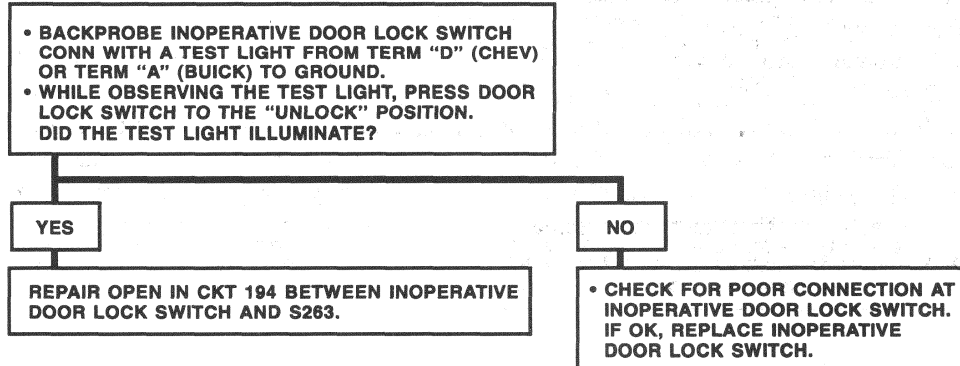
C9898

CHART #5
LOCK FUNCTION INOPERATIVE (UNLOCK FUNCTION OPERATIVE)
FROM ONE DOOR LOCK SWITCH



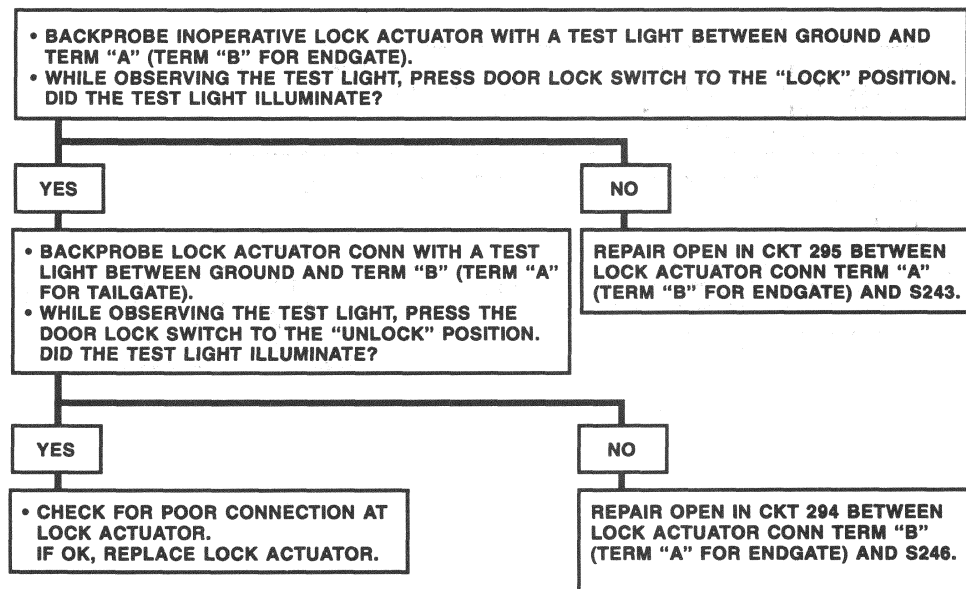
C9899

CHART #6
UNLOCK FUNCTION INOPERATIVE (LOCK FUNCTION OPERATIVE)
FROM ONE DOOR LOCK SWITCH



C9900

CHART #7
ONE OR MORE LOCK ACTUATORS ARE INOPERATIVE FROM BOTH SWITCHES



C9901

POWER DOOR LOCKS AND ENDGATE LOCK

CIRCUIT OPERATION

POWER DOOR LOCKS AND ENDGATE LOCK

Battery voltage from I/P Fuse #39 is applied at all times to the Door Lock Relay through CKT 1740. Battery voltage from I/P Fuse #35 is applied at all times to the Door Lock Switches through CKT 2040. The Door Lock Relay is permanently grounded at G201.

When either Door Lock Switch is pushed to the "LOCK" position, battery voltage is applied to the Door Lock Relay through CKT 195. This energizes the relay, which then applies battery voltage from I/P Fuse #39 to the Door Lock Actuators and the Endgate Lock Actuator through CKT 295. Ground is provided to the Door Lock

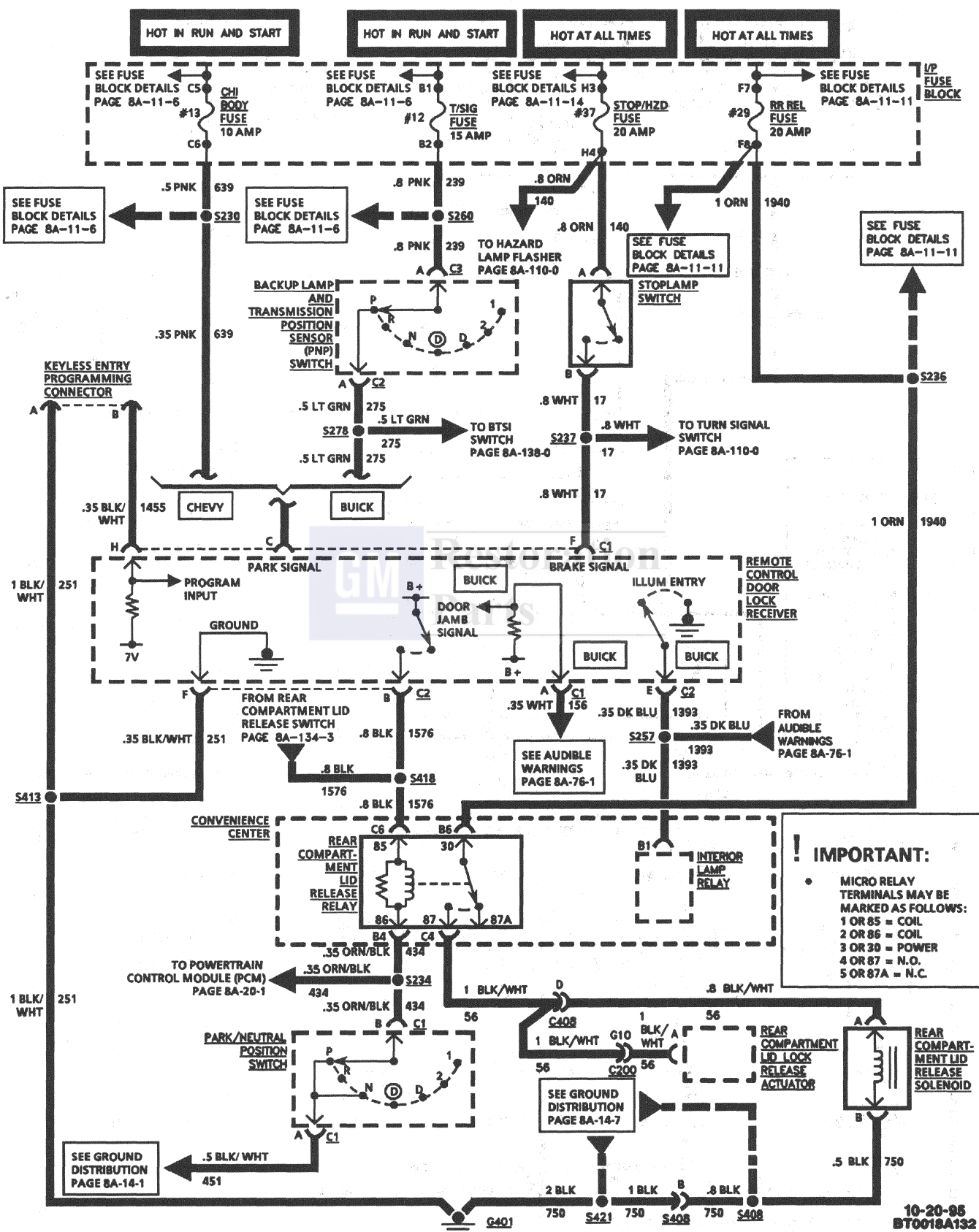
Actuators and the Endgate Lock Actuator through CKT 294 and the Door Lock Relay. The Door Lock Actuators will lock the Endgate and doors.

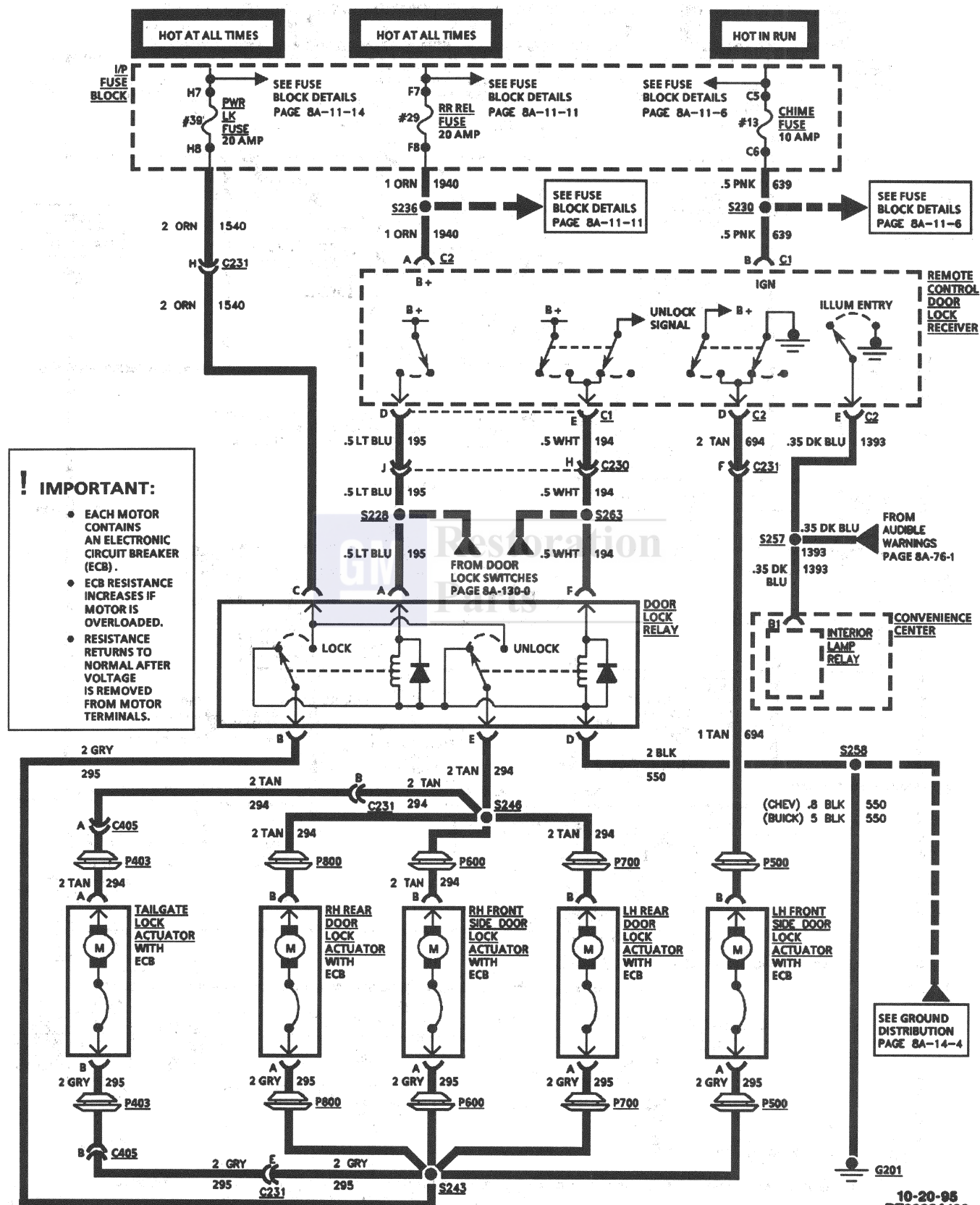
When either Door Lock Switch is pushed to the "UNLOCK" position, battery voltage is applied to the Door Lock Relay through CKT 194. This energizes the relay, which then applies battery voltage from I/P Fuse #39 to the Door Lock Actuators and the Endgate Lock Actuator through CKT 294. Ground is provided to the Door Lock Actuators and the Endgate Lock Actuator through CKT 295 and the Door Lock Relay. The Door Lock Actuators will rotate in the opposite direction and unlock the Endgate and doors.













REMOTE KEYLESS ENTRY

COMPONENT	LOCATION	201-PG	FIG.	CONN
Accessory Switch Panel.....	Right of Radio, near Center I/P			
Backup Lamp and Transmission Position Sensor (PNP) Switch.....	Near base of Steering Column, on Column			
Convenience Center	LH I/P, left of Steering Column.....	12.....	20	
Door Lock Relay.....	At base of LH "A" Pillar, behind kickpad	11.....	19	
Endgate Lock Actuator.....	RH Endgate	35.....	51	
Endgate Lock Switch.....	RH Endgate	35.....	51	
Endgate Upper Latch Switch	Near center of Endgate.....	35.....	51	
Endgate Window Release Relay.....	Located in Convenience Center	12.....	20	
Endgate Window Release Switch.....	LH side of I/P, part of Accessory Switch Panel			
Front Side Door Lock Actuator LH.....	LH Front Door	19.....	30	
Front Side Door Lock Actuator RH	RH Front Door	23.....	34	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Interior Lamp Relay.....	Located in Convenience Center	12.....	20	
Keyless Entry Programming Conn (Sedan).....	LH side of Rear Compartment.....	31.....	46	
Keyless Entry Programming Conn (Wagon).....	Clipped to Rear Header Harn, on LH "D" Pillar	34.....	50	
Park/Neutral Position Switch....	Under Floor Console, attached to Automatic Transmission Control			
Rear Compartment Lid Release Relay.....	Located in Convenience Center	12.....	20	
Rear Compartment Lid Release Solenoid.....	Bolted to Rear Compartment Lid	30.....	43	
Rear Door Lock Actuator LH...	LH Rear Door	25.....	36	
Rear Door Lock Actuator RH...	RH Rear Door	24.....	35	
Remote Control Door Lock Receiver (Sedan).....	Front of Luggage Compartment, attached to Rear Shelf.....	29.....	42	
Remote Control Door Lock Receiver (Wagon).....	Mounted on bracket above LH Rear Wheelhouse, under Trim Panel			
Stoplamp Switch	Attached to Brake Pedal Bracket (bottom switch)			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14.....	22.....	202-1
C230 (10 cavities).....	Crossbody and Side Door Harn to Body Harn, at Base of LH "A" Pillar, behind kickpad			

COMPONENT	LOCATION	201-PG	FIG.	CONN
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad			
C405 (6 cavities).....	Body Harn to Endgate Harn, center of LH "D" Pillar.....	34.....	49.....	202-7
C406 (8 cavities).....	Tailgate Harn to Body Harn, near center of LH "D" Pillar...	34.....	49.....	202-7
C408 (4 cavities).....	Body Harn to Rear Compartment Courtesy Lamp Harn	30.....	43.....	202-7
C450 (6 cavities).....	Body Rear Harn to Body Harn, near center of LH "D" Pillar.....	34.....	49.....	202-5
G201.....	Base of LH "A" Pillar, behind kickpad	11.....	19	
G400.....	Near center of RH "D" Pillar	36.....	52	
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment.....	31.....	46	
G401 (Wagon)	Near center of LH "D" Pillar	34.....	49	
P403 (Wagon).....	Between Endgate and LH "D" Pillar			
P500	Between LH Front Door and "A" Pillar	19.....	30	
P600	Between RH Front Door and "A" Pillar	23.....	34	
P700	Between LH Rear Door and "B" Pillar	25.....	36	
P800	Between RH Rear Door and "B" Pillar.....	24.....	35	
S228	Crossbody Harn, approx 4 cm from Door Lock Relay branch breakout			
S230	Body Harn, approx 4 cm from BTSI Conn breakout			
S234	Body Harn, approx 4 cm from C201 breakout			
S236	Body Harn, approx 4 cm from Starter Motor Theft Deterrent Relay breakout			
S237	Body Harn, approx 11 cm from Starter Motor Theft Deterrent Relay breakout			
S243	Crossbody Harn, at C230 branch breakout			
S246	Crossbody Harn, approx 4 cm from C231 branch breakout			
S247	Body Harn, approx 7 cm from Starter Motor Theft Deterrent Relay breakout			
S257	Body Harn, approx 8 cm from breakout on Convenience Center branch			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S263	Crossbody Harn, approx 16 cm from C231 branch breakout			
S278	Body Harn, approx 4 cm from Convenience Center branch breakout			
S406	Body Rear Harn, approx 17 cm from C412 breakout			
S408	Deck Lid Harn, approx 4 cm from Rear License Lamp breakout			
S413	Body Harn, approx 7 cm from G401 breakout			

REMOTE KEYLESS ENTRY

COMPONENT	LOCATION	201-PG	FIG.	CONN
S418	Body Harn, approx 11 cm from High Mounted Stoplamp (HMSL) breakout			
S421	Body Harn, approx 14 cm from High Mount Stoplamp (HMSL) breakout			

SYSTEM DIAGNOSIS

- Refer to SECTION 9K.





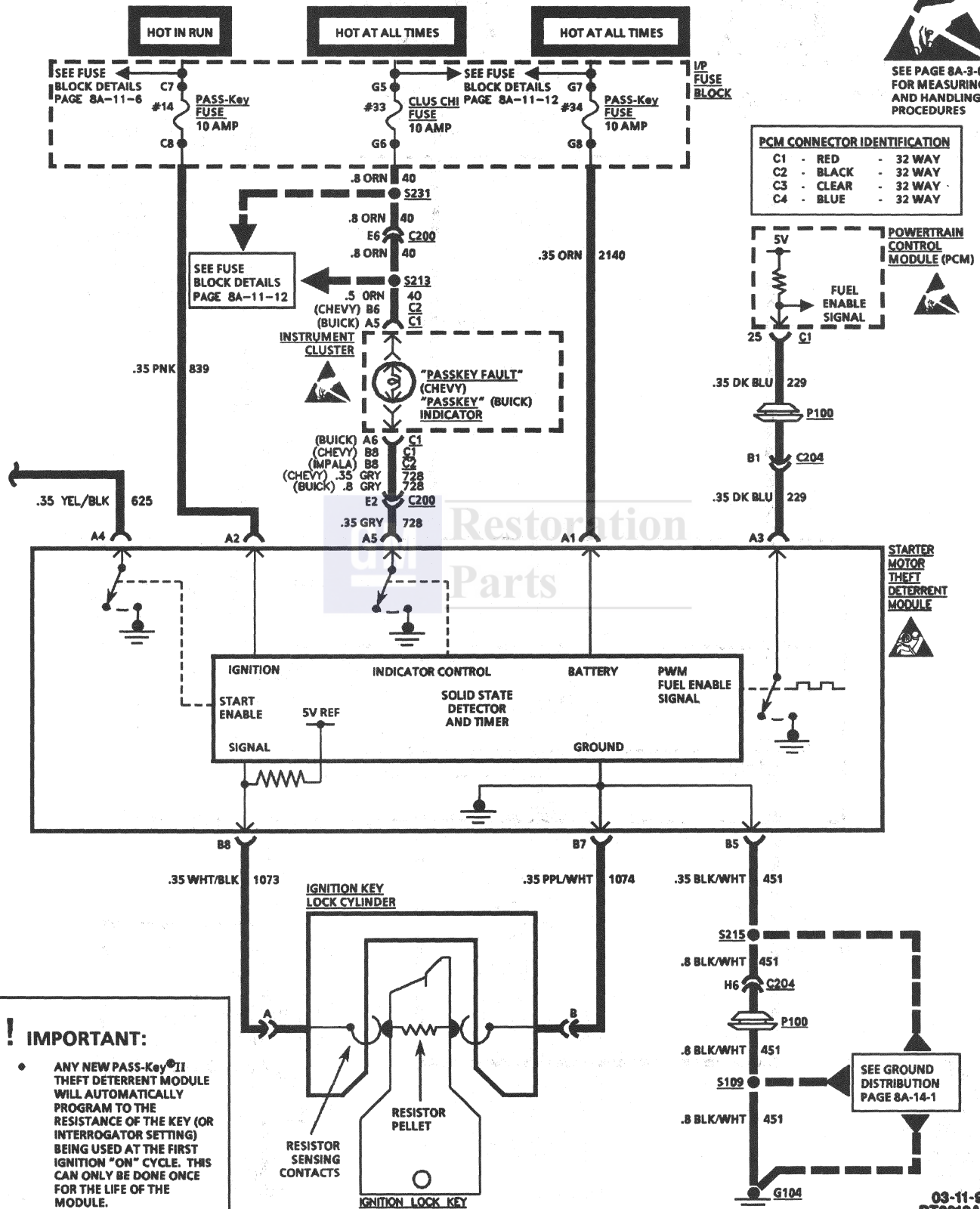


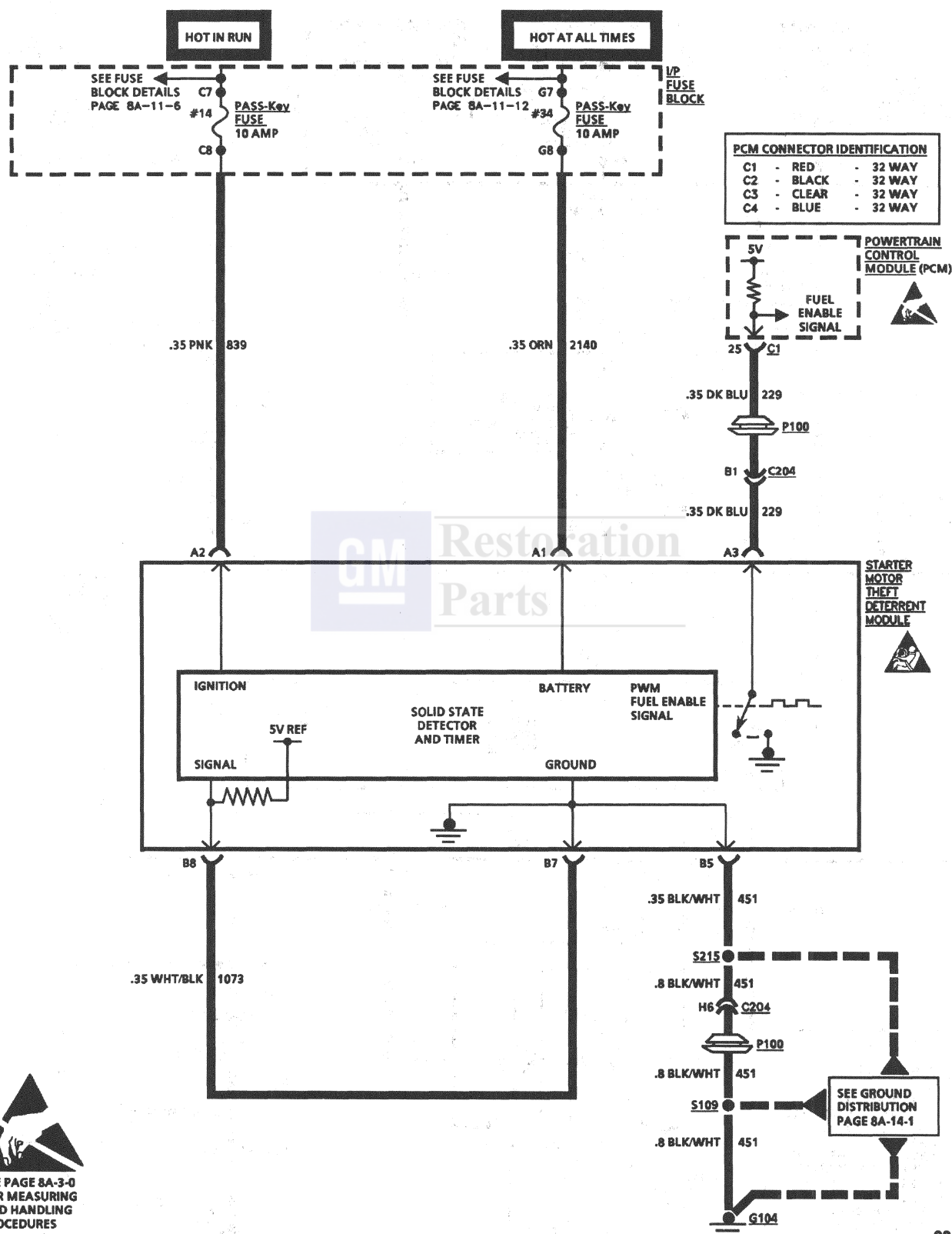
CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

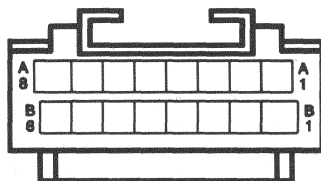
PASS-KEY® II WITHOUT SEO



SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES



PASS-KEY® II
SEO

**12110259****16 - WAY F MICRO - PACK 100 SERIES****GRN****PASS - KEY II THEFT DETERRENT MODULE****06-08-95
BT0038A133**

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A1	ORN	2140	B+ POWER FEED FROM I/P FUSE #34 PASS-KEY® II	8A-11-12
A2	PNK	839	IGN POWER FEED FROM I/P FUSE #14 PASS-KEY® II	8A-11-6
A3	DK BLU	229	FUEL ENABLE SIGNAL	8A-133-1
A4	YEL/BLK	625	THEFT DETERRENT RELAY CONTROL (NOT USED ON SEO VEHICLES)	8A-133-1
A5	GRY	728	PASS-KEY® II INDICATOR LAMP CONTROL (NOT USED ON SEO VEHICLES)	8A-133-1
B5	BLK/WHT	451	GROUND	8A-14-1
B7	PPL/WHT	1074	IGNITION KEY RESISTOR RETURN	8A-133-1
B8	WHT/BLK	1073	IGNITION KEY RESISTOR FEED	8A-133-1

COMPONENT	LOCATION	201-PG	FIG.	CONN
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
Ignition Key Lock Cylinder	Top RH side of Steering Column			
Ignition Switch	Mounted on upper RH side of Steering Column	13	.....	21
Instrument Cluster	LH side of I/P, centered above Steering Column.....	9	.....	16
Powertrain Control Module (PCM).....	In Engine Compartment, forward of LH Wheelhouse under Air Cleaner	4	.....	8
Starter Motor Theft Deterrent Relay.....	RH "A" Pillar behind kickpad	11	.....	19
Starter Solenoid	Bottom of RH side of Engine, above Starter Motor			
Theft Deterrent Module	Behind LH I/P, left of Brake Pedal Bracket.....	11	.....	19
Underhood Electrical Center.....	Engine Compartment, mounted on RH Wheelhouse	9	.....	15
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	.....	22..... 202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment.....	16	.....	26..... 202-3
C207 (6 cavities).....	Engine Harn to Body Harn, near base of RH "A" Pillar, behind kickpad	18	.....	29
C207B (3 cavities)	Body Harn to Engine Harn, near base of RH "A" Pillar, behind kickpad	18	.....	29

8A - 133 - 4 ELECTRICAL DIAGNOSIS

PASS-KEY® II

COMPONENT	LOCATION	201-PG	FIG.	CONN
G104.....	Engine Compartment on front of LH Cylinder Head	6	11	
P100	RH I/P, forward of Blower Motor	18	29	
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S213 (Buick)	I/P Harn, approx 4 cm from I/P Cluster C2 Conn breakout, in spiral taping			
S213 (Chev).....	I/P Harn, approx 12 cm from Heater-A/C Control Conn branch breakout			
S215	Body Harn, approx 4 cm from SDM Conn breakout			
S227	Body Harn, approx 8 cm from Convenience Center breakout			
S231	Body Harn, approx 16 cm from Convenience Center breakout			
S276	Body Harn, approx 13 cm from SDM breakout			

SYSTEM DIAGNOSIS

- Refer to SECTION 9D for further System Diagnosis and Service Procedures.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Engine does not crank; PASS-Key illuminates for approximately 5 seconds (bulb check) and then goes out.	Chart #1	8A-133-5
Engine cranks but won't start; PASS-Key Indicator illuminates for approx 5 seconds (bulb check) and then goes out.	Chart #2	8A-133-6
PASS-Key Indicator "ON" steady (not flashing); Engine starts.	Chart #3	8A-133-6
PASS-Key indicator never illuminates; Engine starts	Chart #4	8A-133-7
Lock Cylinder and Harness Test	Chart #5	8A-133-7

CHART #1

ENGINE DOES NOT "CRANK;" "PASSKEY" INDICATOR ILLUMINATES FOR APPROXIMATELY 5 SECONDS (BULB CHECK) THEN GOES OUT

! IMPORTANT:

- TO AVOID MISDIAGNOSIS, CHECK FOR DIAGNOSTIC TROUBLE CODES. SEE SECTION 6E3.
- "PASSKEY" INDICATOR WILL STAY "ON" FOR 1 MINUTE AFTER PASSKEY FAULT HAS BEEN REPAIRED.

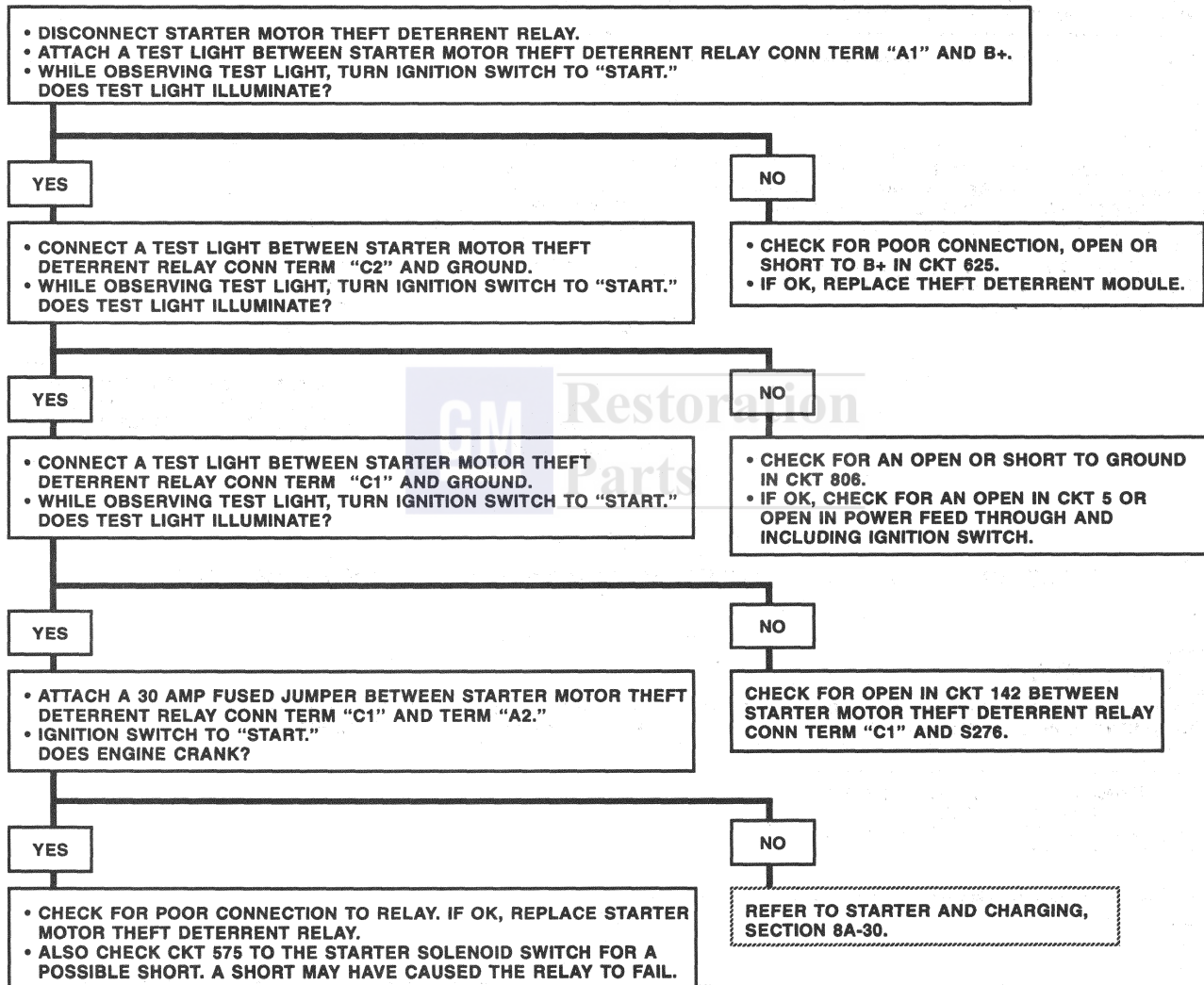


CHART #2

ENGINE CRANKS BUT WON'T START; "PASSKEY" INDICATOR ILLUMINATES FOR APPROX 5 SECONDS (BULB CHECK) THEN GOES OUT

! IMPORTANT:

- TO AVOID MISDIAGNOSIS, CHECK FOR DIAGNOSTIC TROUBLE CODES. REFER TO ENGINE CONTROLS.
- "PASSKEY" INDICATOR WILL STAY "ON" FOR 1 MINUTE AFTER PASSKEY FAULT HAS BEEN REPAIRED.

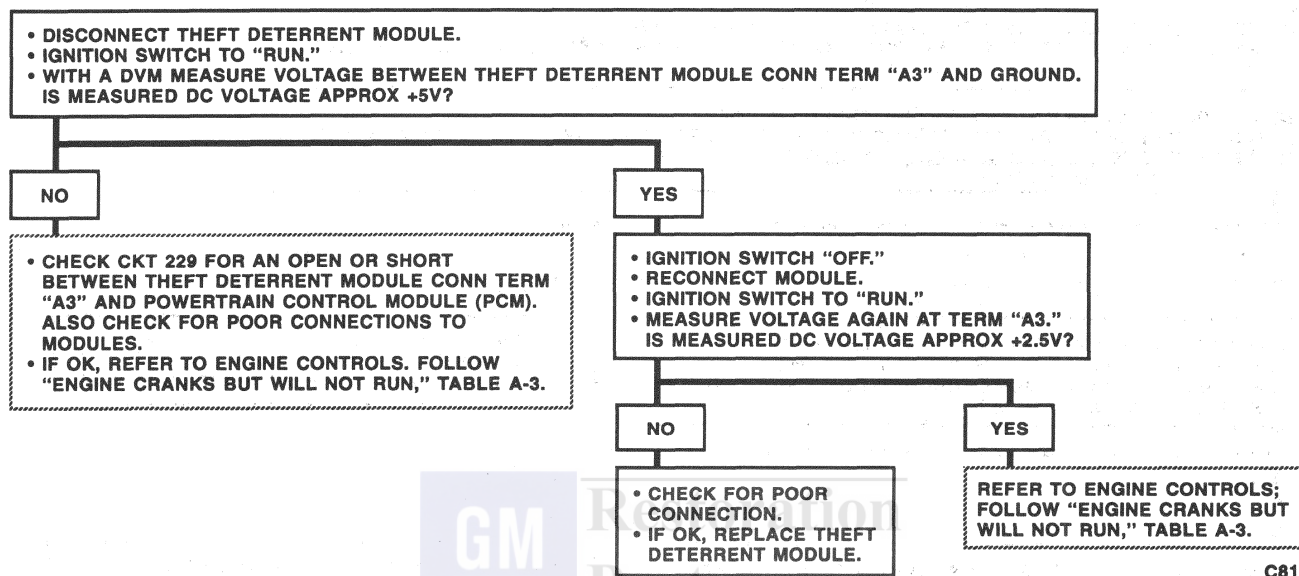


CHART #3

"PASSKEY" INDICATOR "ON" STEADY (NOT FLASHING); ENGINE STARTS

! IMPORTANT:

- TO AVOID MISDIAGNOSIS, CHECK FOR DIAGNOSTIC TROUBLE CODES. REFER TO ENGINE CONTROLS.
- "PASSKEY" INDICATOR WILL STAY "ON" FOR 1 MINUTE AFTER PASSKEY FAULT HAS BEEN REPAIRED.

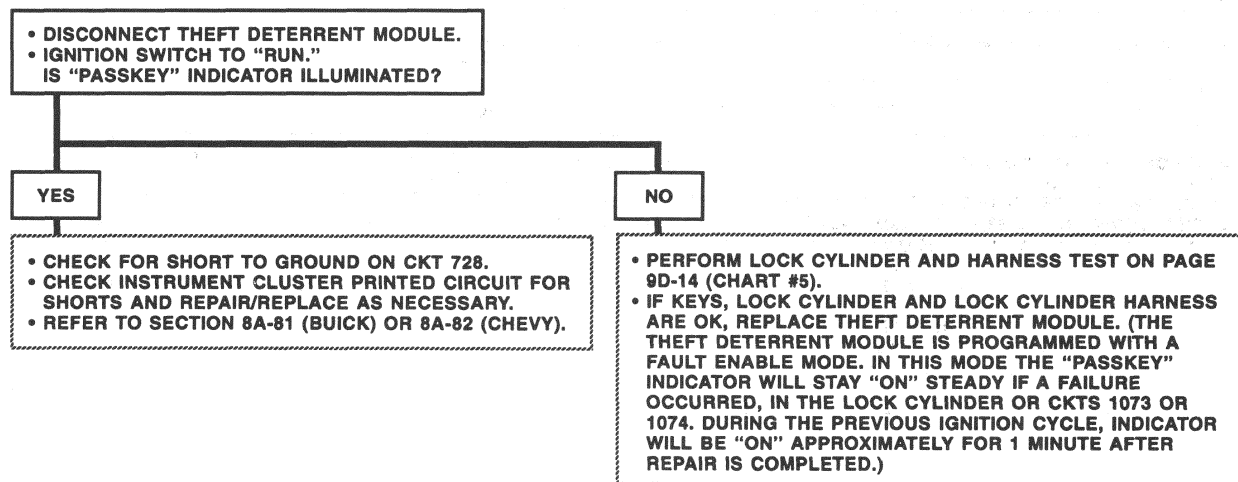
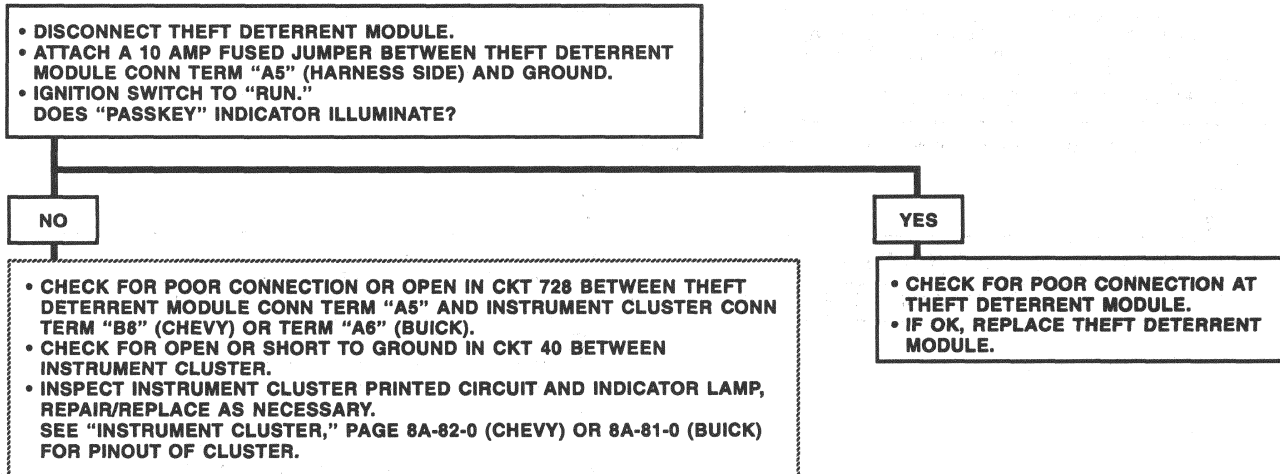


CHART #4**"PASSKEY" INDICATOR NEVER ILLUMINATES; ENGINE STARTS****! IMPORTANT:**

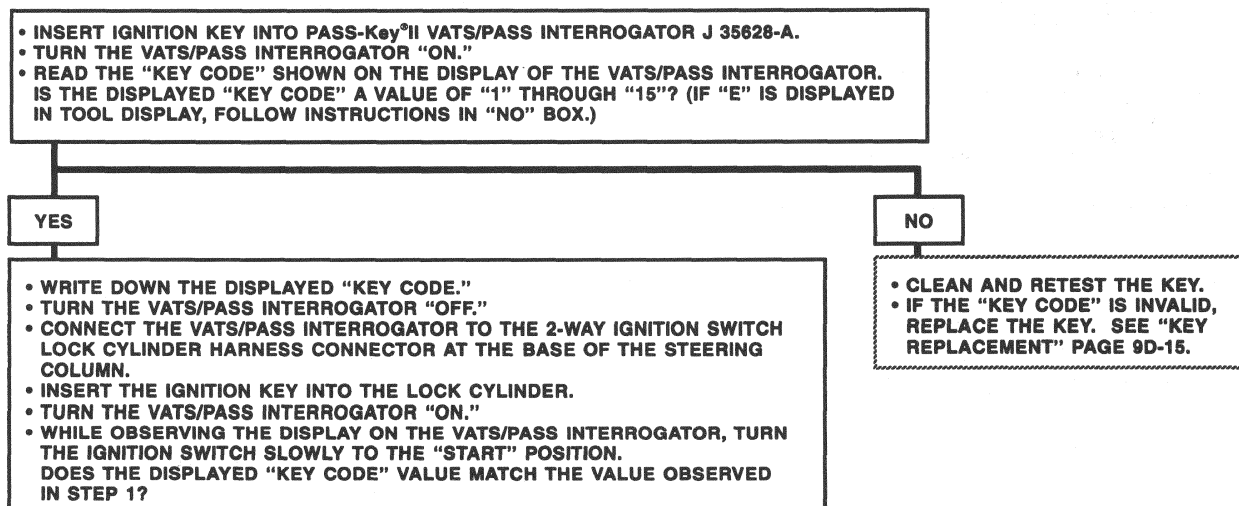
- TO AVOID MISDIAGNOSIS, CHECK FOR DIAGNOSTIC TROUBLE CODES. REFER TO ENGINE CONTROLS.
- "PASSKEY" INDICATOR WILL STAY "ON" FOR 1 MINUTE AFTER PASSKEY FAULT HAS BEEN REPAIRED.



C8141

CHART #5**LOCK CYLINDER AND HARNESS TEST****! IMPORTANT:**

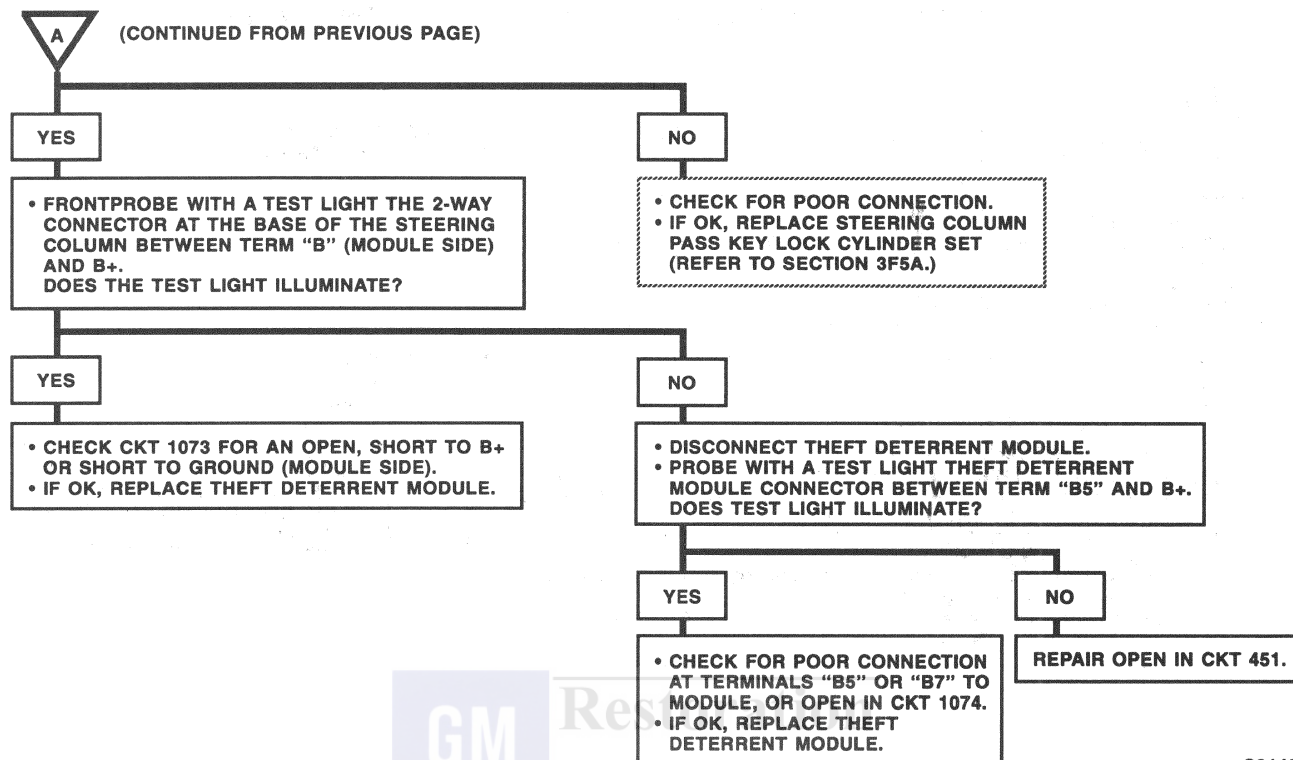
- TO AVOID MISDIAGNOSIS, DO NOT PERFORM THIS TEST UNLESS DIRECTED BY SYMPTOM TABLE OR CHART.
- AFTER REPAIR TO LOCK CYLINDER/HARNESS, "PASSKEY" INDICATOR WILL STAY "ON" FOR 1 MINUTE.



A (CONTINUED ON NEXT PAGE)

C8142

PASS-KEY® II

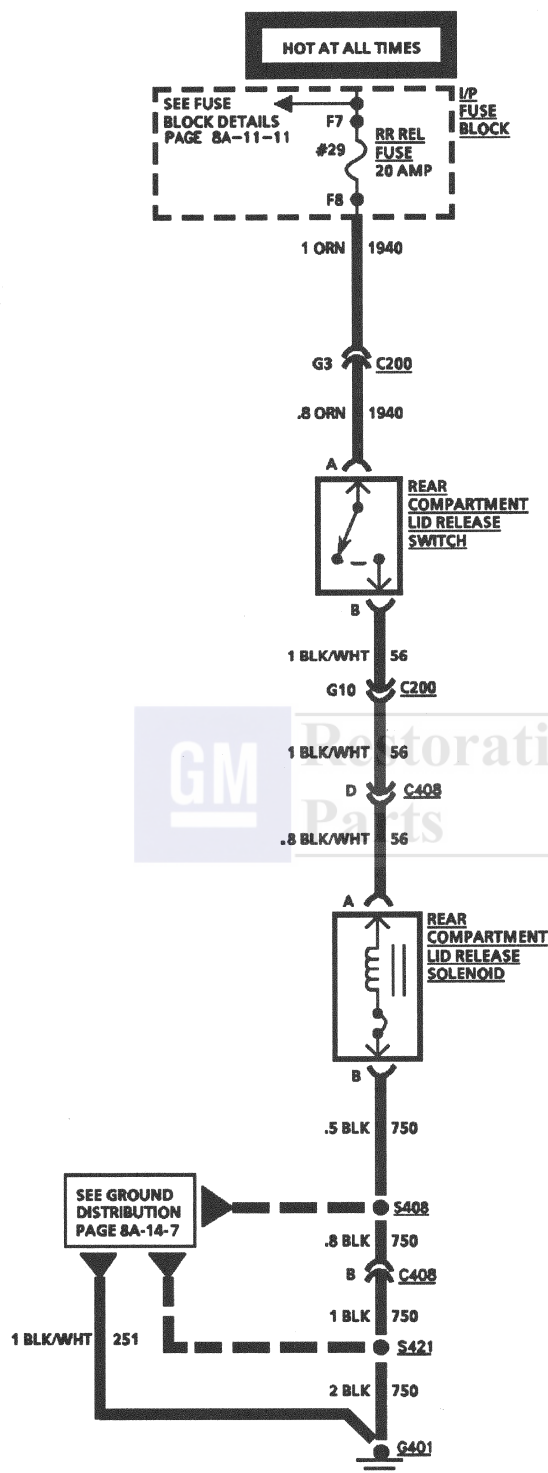


C8143



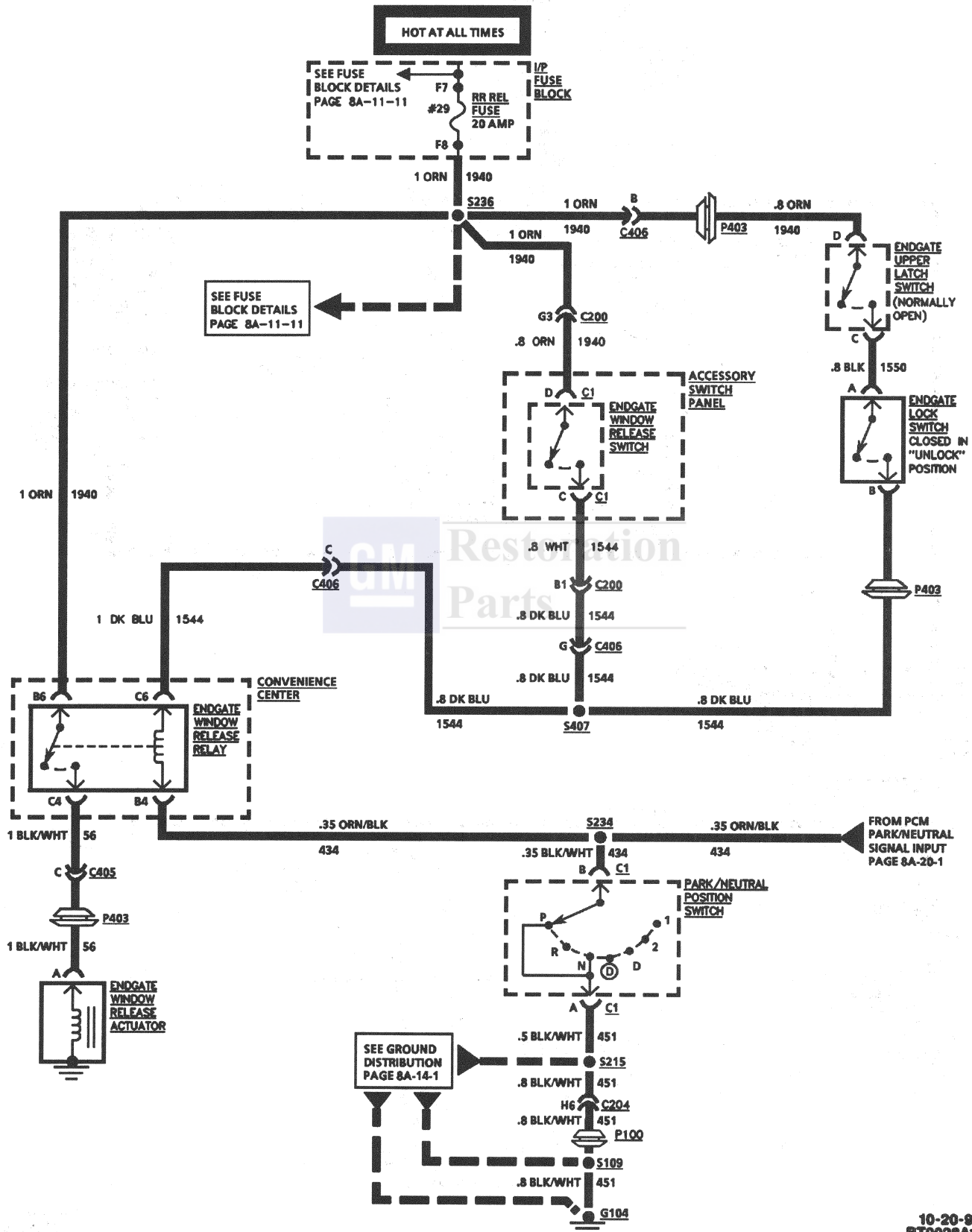
TRUNK/REAR WINDOW RELEASE

REAR COMPARTMENT WITHOUT KEYLESS ENTRY AND WITHOUT SEO (CHEV)



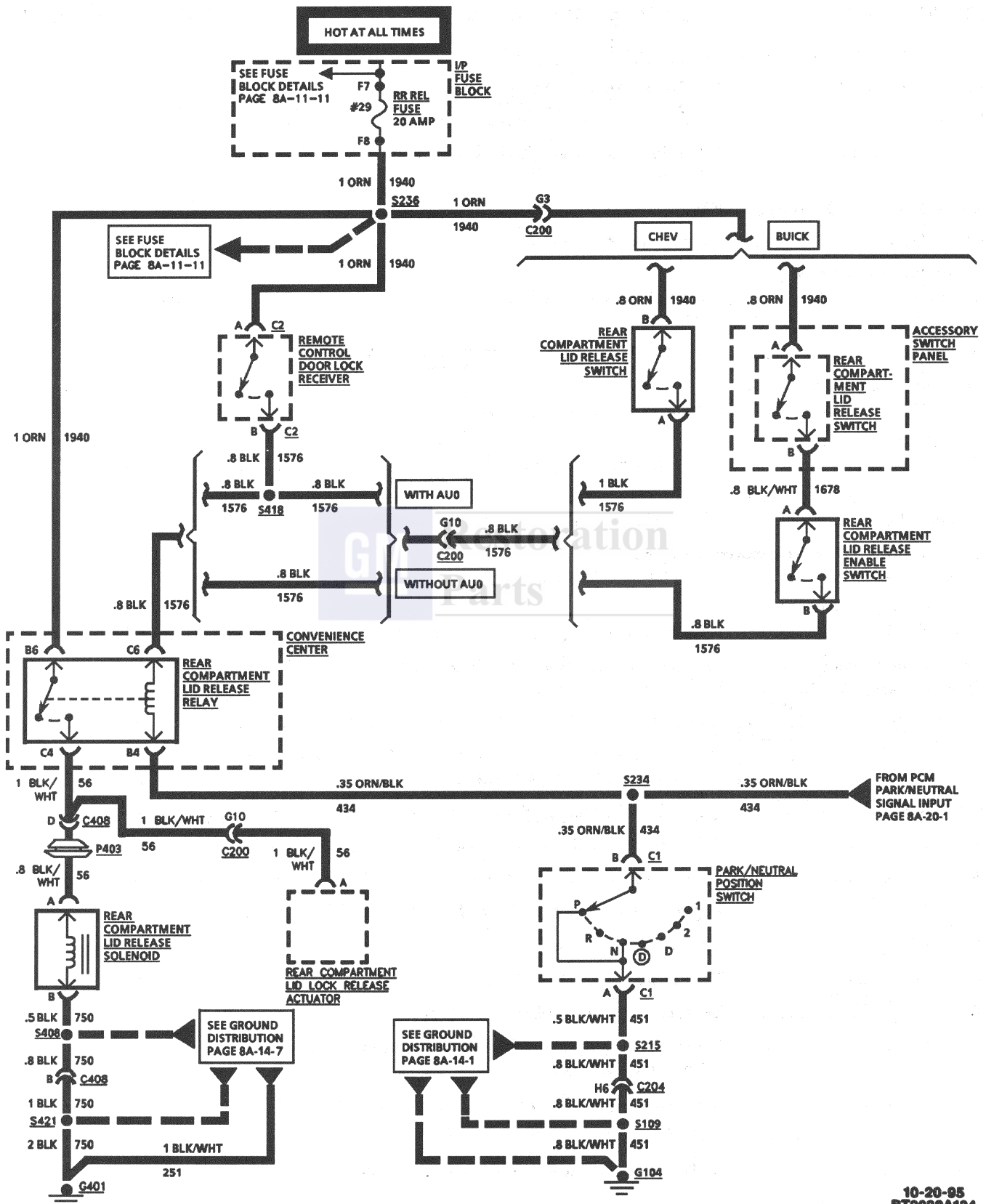


TRUNK/REAR WINDOW RELEASE ENDGATE WINDOW WITHOUT KEYLESS ENTRY (CHEV)



TRUNK/REAR WINDOW RELEASE

REAR COMPARTMENT LID RELEASE (CHEVY WITH KEYLESS ENTRY, SEO, ALL BUICK)



TRUNK/REAR WINDOW RELEASE

COMPONENT	LOCATION	201-PG	FIG.	CONN
Accessory Switch Panel.....	LH side of I/P			
Convenience Center	LH I/P, left of Steering Column.....	11	19	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Park/Neutral Position Switch....	Under Floor Console, attached to Automatic Transmission Control			
Endgate Lock Switch.....	RH Endgate	35	51	
Endgate Upper Latch Switch	Near center of Endgate	35	51	
Endgate Window Release Actuator.....	Center of Endgate	35	51	
Endgate Window Release Switch.....	LH side of I/P, part of Accessory Switch Panel			
Rear Compartment Lid Release Enable Switch.....	Mounted on I/P Compartment			
Rear Compartment Lid Release Solenoid.....	Bolted to Rear Compartment Lid	30	43	
Rear Compartment Lid Release Switch (Buick).....	LH I/P Carrier, left of Steering Column			
Rear Compartment Lid Release Switch (Chev)	In I/P Compartment LH side			
Remote Control Door Lock Receiver (Sedan).....	Front of Luggage Compartment attached to Rear Shelf.....	29	42	
Remote Control Door Lock Receiver (Wagon)	Mounted on bracket above LH Rear Wheelhouse, under Trim Panel			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P between Blower Motor and I/P Compartment.....	16	26	
C405 (6 cavities).....	Body Harn to Endgate Harn, near center of LH "D" Pillar ..	34	49	202-7
C406.....	Tailgate Harn to Body Harn, near center of LH "D" Pillar ..	34	49	
C408 (6 cavities).....	Body Harn to Rear Compartment Courtesy Lamp Harn	30	43	202-7
G104.....	Engine Compartment on front of LH Cylinder Head	6	11	
G401 (Sedan).....	LH Rear Wheelhouse in Luggage Compartment			
G401 (Wagon).....	Near center of LH "D" Pillar	34	49	
P403 (Wagon).....	Between Tailgate and LH "D" Pillar			
S109	Engine Harn, left side, approx 4 cm from Fuel Injector #5 Conn branch breakout			
S215	Body Harn, approx 4 cm from SDM Conn breakout			
S234	Body Harn, approx 4 cm from C201 breakout			
S236	Body Harn, approx 4 cm from Starter Motor Theft Deterrent Relay			

COMPONENT	LOCATION	201-PG FIG. CONN
S247	Body Harn, approx 7 cm from Theft Deterrent Relay breakout	
S407 (SEO Wagon).....	Rear Compartment Wiring Harn, approx 38 cm from P403, in Endgate	
S407 (Wagon).....	Tailgate Harn, approx 15 cm from C405 breakout	
S408	Deck Lid Harn, approx 4 cm from Rear License Lamp breakout	
S418	Body Harn, approx 11 cm from High Mount Stoplamp breakout	
S421 (Sedan)	Body Harn, approx 14 cm from High Mount Stoplamp breakout	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse #29. If open, check for a short to ground in CKT 1940.
2. Check that G104 and G401 are clean and tight.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).

- Refer to System Diagnosis for Rear Compartment Lid Release (Sedan) or Endgate Window Release (Wagon).

SYSTEM DIAGNOSIS

Rear Compartment Lid Release (Sedan)

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYSTEM CHECK

ACTION	NORMAL RESULTS
Press Rear Compartment Lid Release Switch (with Rear Compartment Lid Release Enable Switch "CLOSED," Buick only).	Rear Compartment Lid releases.
Press Rear Compartment Lid Release Switch (with Rear Compartment Lid Release Enable Switch "OPEN," Buick only).	Rear Compartment Lid does not release.
Press Rear Compartment Lid Release Button on Keyless Entry Remote.	Rear Compartment Lid releases.

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TRUNK/REAR WINDOW RELEASE

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Rear Compartment Lid will not release (Buick or Chev with Remote Keyless Entry or SEO).	Chart #1	8A-134-7
Rear Compartment Lid will not release (Chev without Remote Keyless Entry or SEO).	Chart #2	8A-134-9
Rear Compartment Lid will not release using Keyless Entry Remote, releases normally from switch.	Refer to SECTION 9K.	
Rear Compartment Lid does not latch.	Chart #3	8A-134-10
Rear Compartment Lid Release is operational with Ignition Switch "ON" and vehicle not in "PARK."	Check CKT 434 for a short to ground. If OK, check for misaligned Backup Lamp and Park/Neutral Position Switch. If OK, replace switch.	

SYSTEM DIAGNOSIS

Endgate Window Release (Wagon)

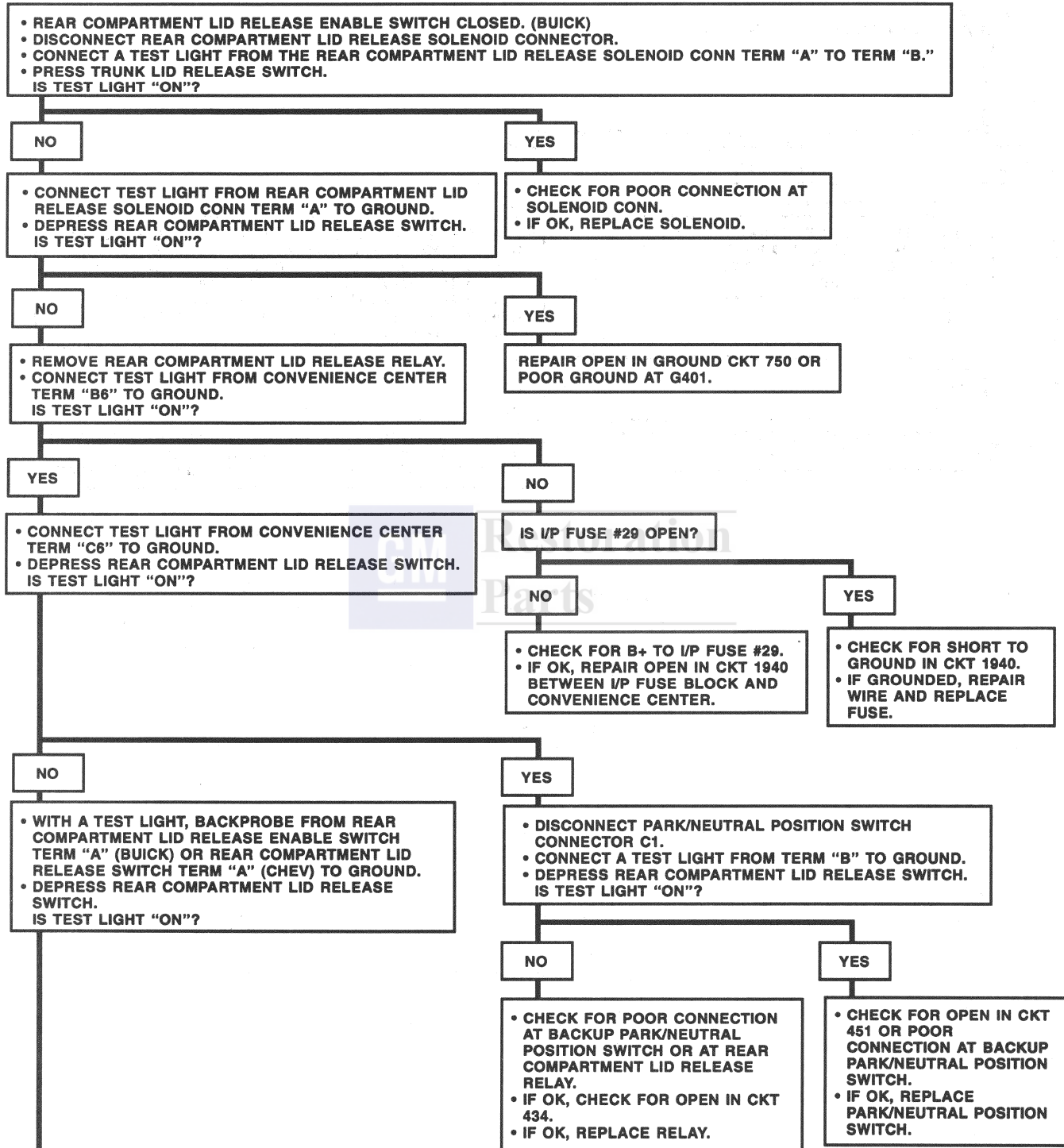
- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Endgate Window Release inoperative from both switches.	Chart #4	8A-134-11
Endgate Window Release inoperative from Endgate Window Release Switch only (with Power Door Locks).	Chart #5	8A-134-11
Endgate Window Release inoperative from the Endgate Upper Latch Switch only.	Chart #6	8A-134-12
Endgate Window will not latch.	Chart #7	8A-134-13
Endgate Lock inoperative.	• Without Remote Keyless Entry: Refer to "Power Door Locks and Endgate Lock," page 8A-130-0. • With Remote Keyless Entry: Refer to "Remote Keyless Entry," page 8A-132-0.	

CHART #1

REAR COMPARTMENT LID WILL NOT RELEASE (BUICK), OR (CHEV WITH KEYLESS ENTRY OR SEO)



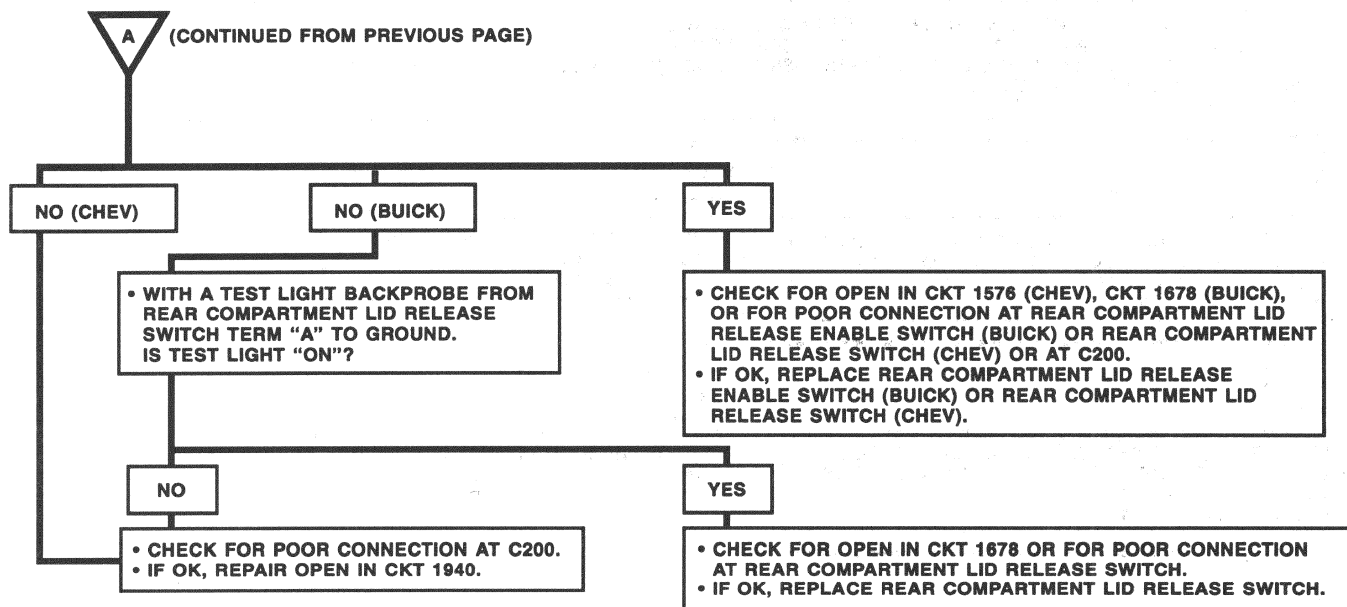
A

(CONTINUED ON NEXT PAGE)

TRUNK/REAR WINDOW RELEASE

CHART #1 (continued)

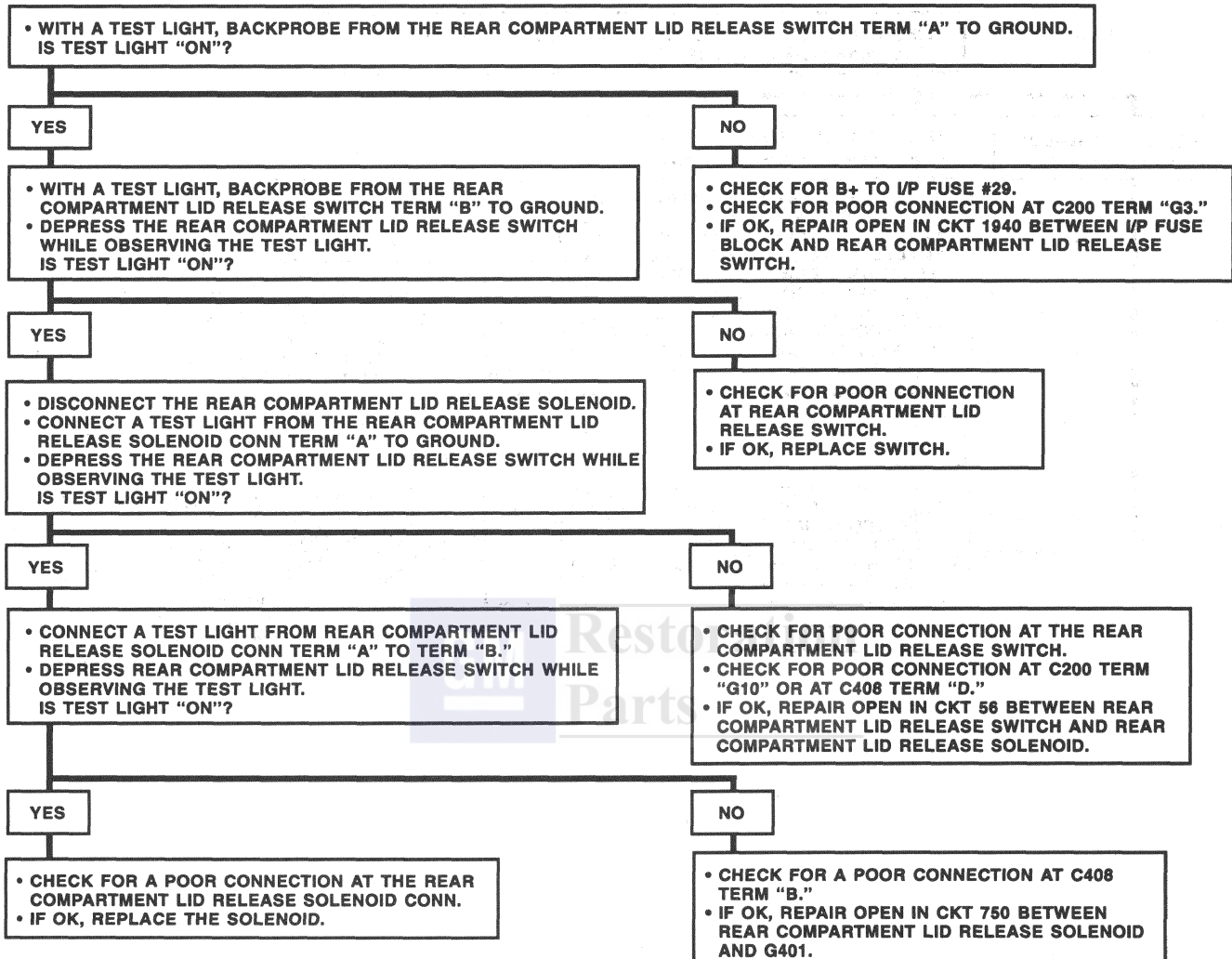
REAR COMPARTMENT LID WILL NOT RELEASE (BUICK), OR (CHEV WITH KEYLESS ENTRY OR SEO)



C9887

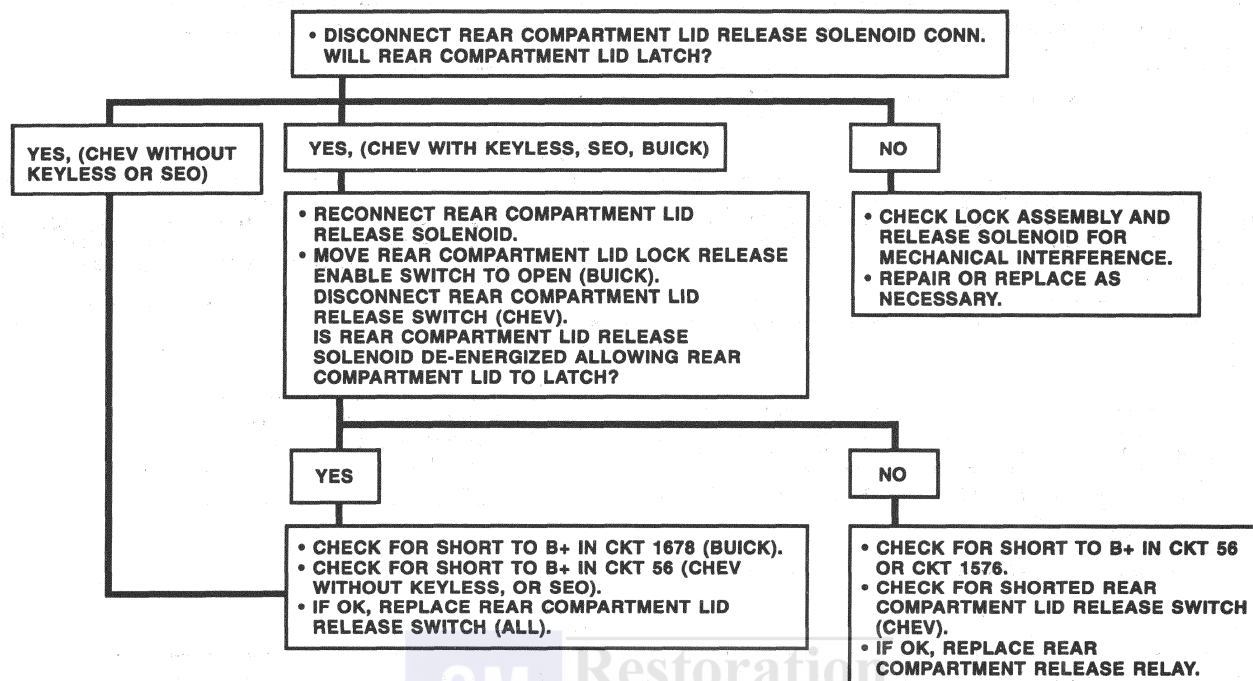
CHART #2

REAR COMPARTMENT LID WILL NOT RELEASE (CHEV, WITHOUT KEYLESS ENTRY OR SEO)



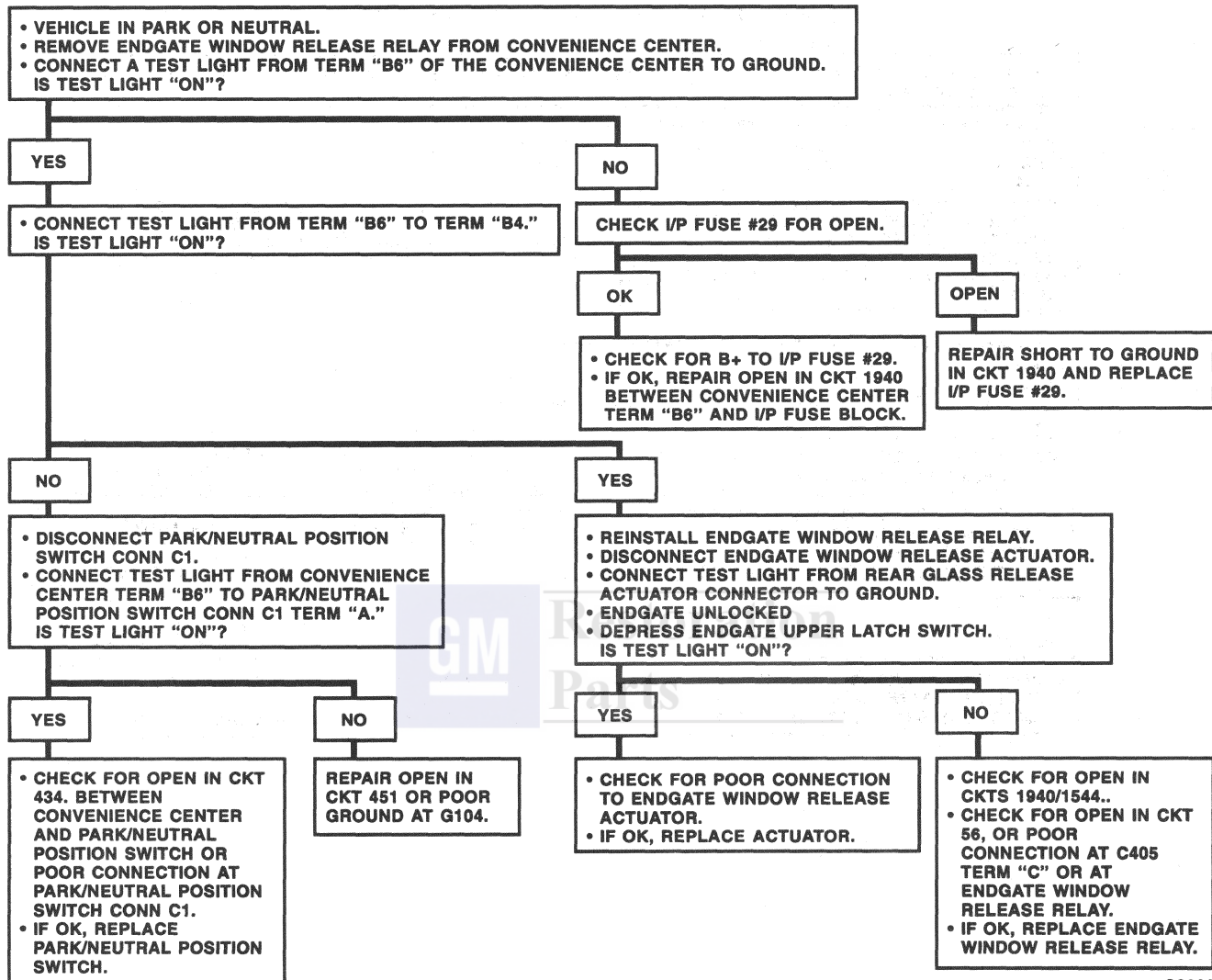
TRUNK/REAR WINDOW RELEASE

CHART #3
REAR COMPARTMENT LID DOES NOT LATCH



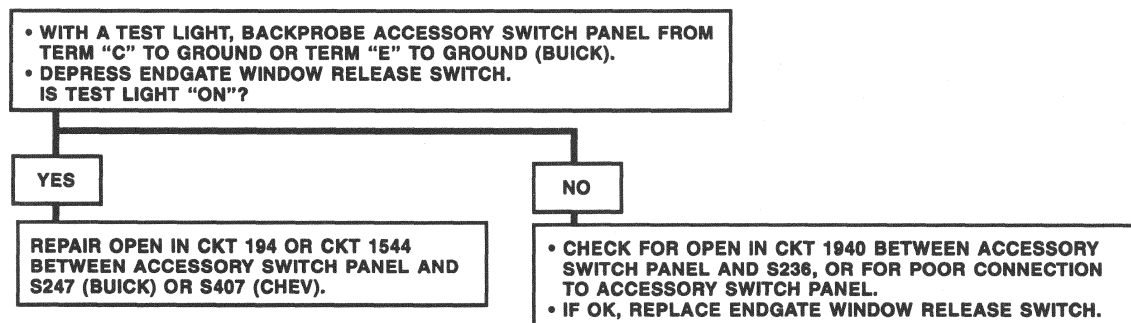
C9889

CHART #4
ENDGATE WINDOW RELEASE INOPERATIVE FROM BOTH SWITCHES



C9890

CHART #5
ENDGATE WINDOW RELEASE INOPERATIVE FROM ENDGATE WINDOW RELEASE SWITCH ONLY (WITH POWER DOOR LOCKS)



C9892

TRUNK/REAR WINDOW RELEASE

CHART #6
ENDGATE WINDOW RELEASE INOPERATIVE FROM THE
ENDGATE UPPER LATCH SWITCH ONLY

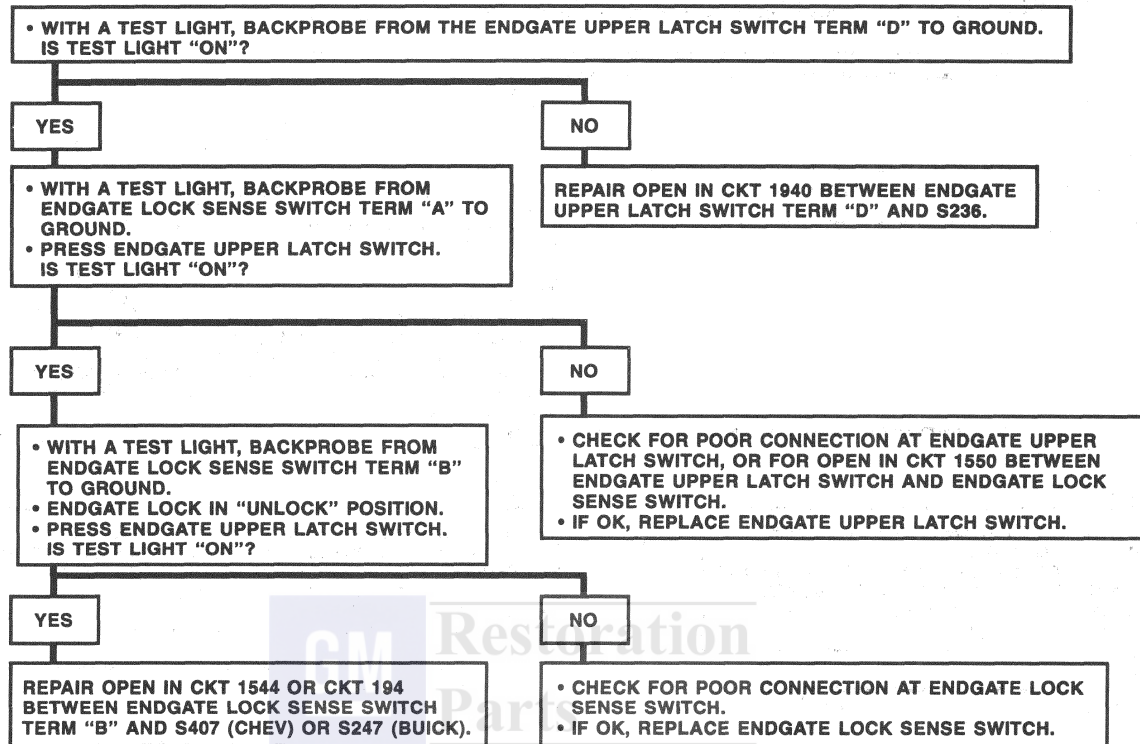
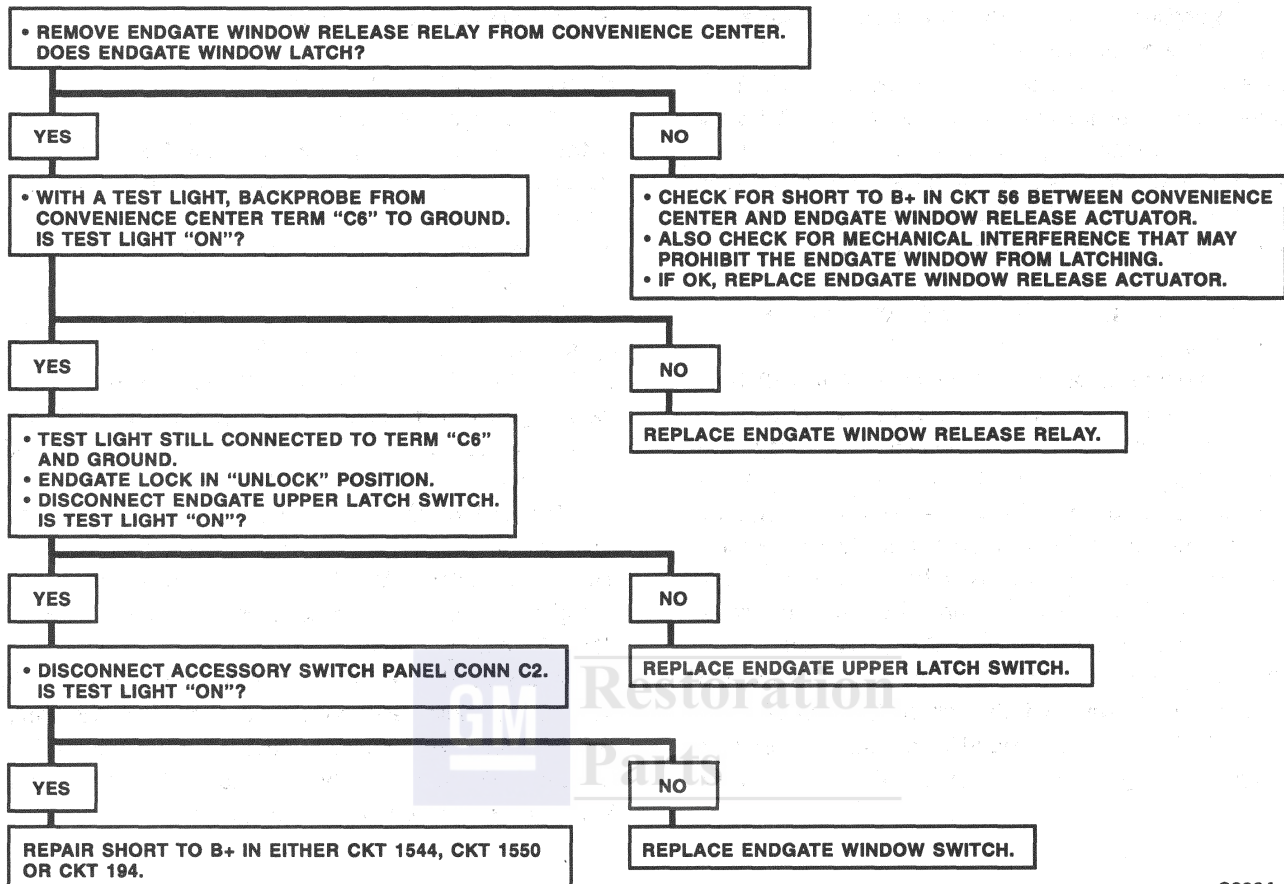


CHART #7 ENDGATE WINDOW WILL NOT LATCH



C9894

TRUNK/REAR WINDOW RELEASE

CIRCUIT OPERATION

Rear Compartment Lid Release (SEO, and Chev without Remote Keyless Entry)

Battery voltage is applied at all times from I/P Fuse #29 to the Rear Compartment Lid Release Switch. With the Switch closed, voltage is applied to the Rear Compartment Lid Release Actuator which is grounded at G401. When the Rear Compartment Lid Release Actuator is activated it will release the Rear Compartment Lid Latch.

Rear Compartment Lid Release (with Remote Keyless Entry)

Battery voltage is applied at all times from I/P Fuse #29 to the Rear Compartment Lid Release Relay and the Rear Compartment Lid Release Switch. The relay will receive voltage on the coil side when the Rear Compartment Lid Release Switch is depressed (closed). With Buick, the Rear Compartment Lid Release Enable Switch must also be closed for the relay to receive voltage on the coil side. Once voltage is applied to the coil side of the Rear Compartment Lid Release Relay, the Relay must then see a ground through the Backup Lamp and Park/Neutral Position Switch, when in "PARK" or "NEUTRAL," which is grounded at G104, therefore energizing the Relay which then sends voltage to the Rear

Compartment Lid Lock Release Actuator which receives its ground through G401 and activates the actuator and releases the Rear Compartment.

Endgate Window Release

The Endgate Window Release can be activated from within the vehicle by pressing the Endgate Window Release Switch in the Accessory Switch Panel. The Endgate Window can also be released from outside the vehicle by using the Endgate Upper Latch Switch when the Endgate is unlocked.

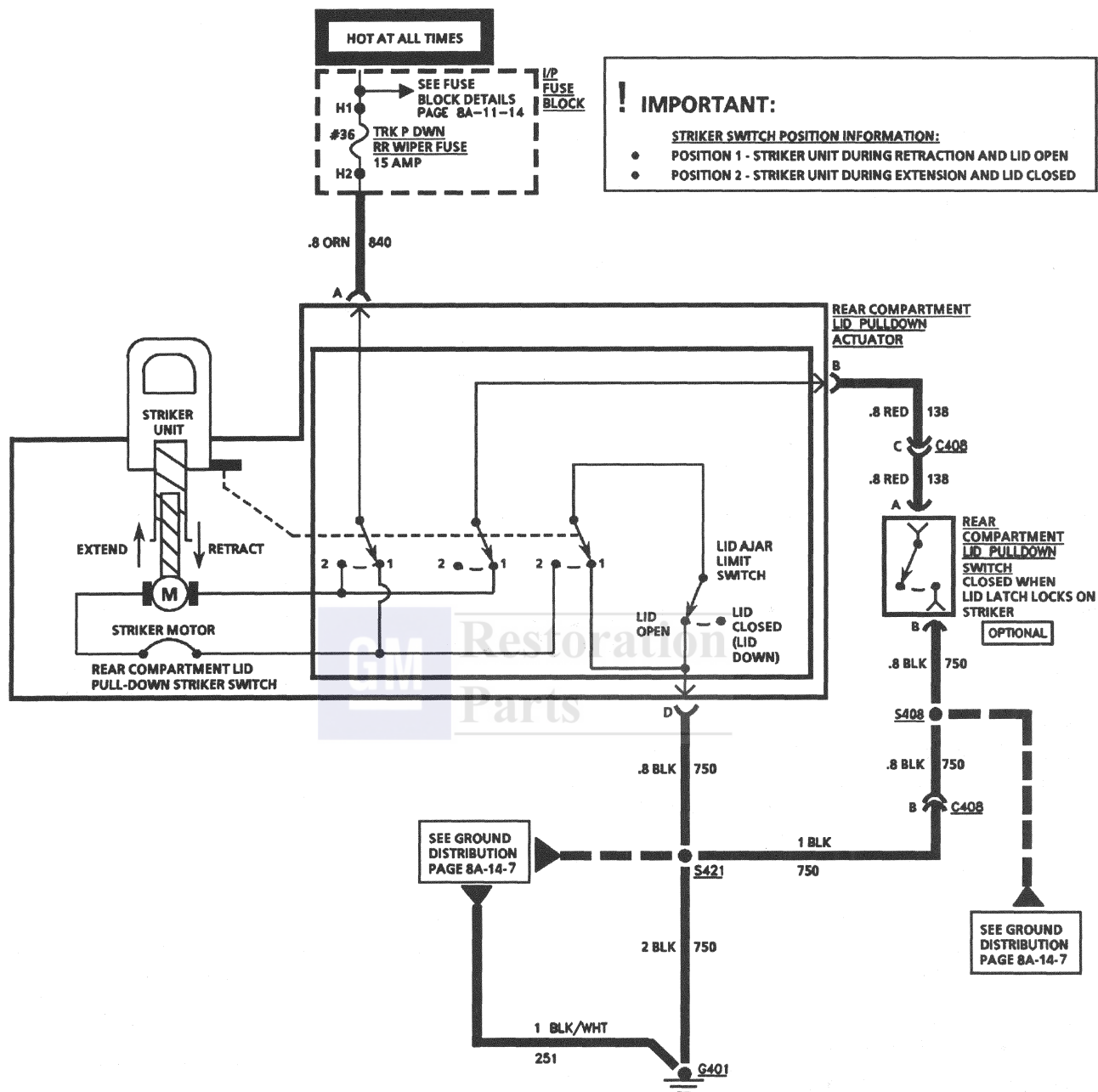
Battery voltage is applied, at all times, to the normally open contacts of the Endgate Window Release Relay from I/P Fuse #29. With the Endgate Window Release Switch or the Endgate Upper Latch Switch and Endgate Lock Switch closed, voltage from I/P Fuse #29 is applied to the coil of the Endgate Window Release Relay.

The coil of the relay receives a ground through the Backup Lamp and Park/Neutral Position Switch at G104. Thus, the Endgate Window Release Relay can only be energized when the gear selector is in the "PARK" or "NEUTRAL" position.

When the Endgate Window Release Relay is energized, its contacts close, and voltage is applied to the Endgate Window Release Actuator, which is case grounded. The Endgate Window will be released when the Endgate Window Release Actuator is energized.



TRUNK LID PULL-DOWN (BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
Rear Compartment Lid Pull-Down Actuator.....	Mounted in rear of Rear Compartment.....	31	.....	45
Rear Compartment Lid Pull-Down Striker Switch	Attached to Rear Compartment Lid Pull-Down Actuator			
Rear Compartment Lid Pull-Down Switch.....	Part of Rear Compartment Lid Lock.....	31	.....	45
C408 (4 cavities).....	Body Harn to Rear Compartment Courtesy Lamp Harn	30	.....	43..... 202-7
G401.....	LH Rear Wheelhouse in Luggage Compartment.....	31	.....	46
S408	Deck Lid Harn, approx 4 cm from Rear License Lamp breakout			
S421	Body Harn, approx 14 cm from high mount Stoplamp breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

This Section assumes mechanical operation is normal, with no interference. For mechanical repair, refer to SECTION 10-8.

- Rear Compartment Lid Lock must securely lock to Striker for proper operation of Pull-Down Unit.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be

intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

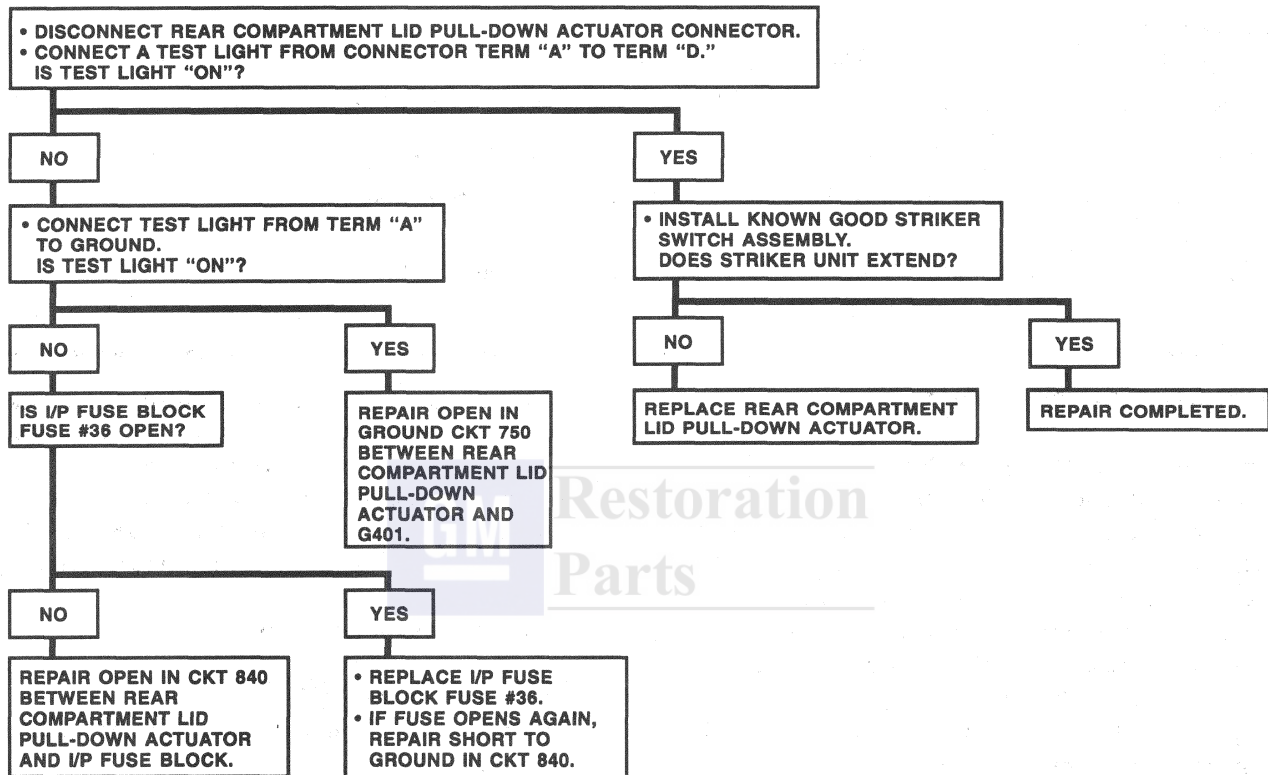
- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Striker Unit does not extend when Rear Compartment Lid is unlatched.	Chart #1	8A-135-2
Striker Unit does not retract when Rear Compartment Lid is closed.	Chart #2	8A-135-3

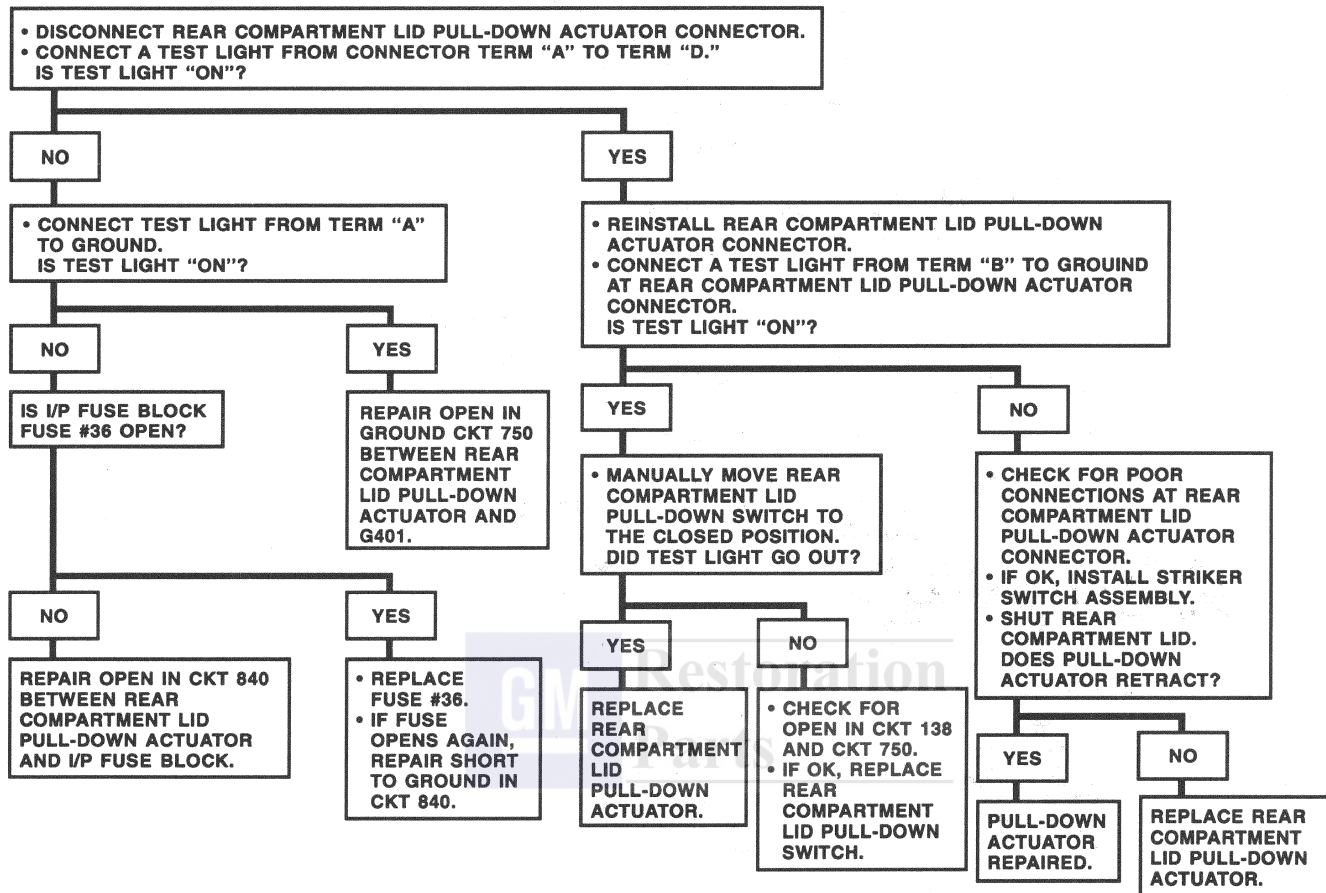
TRUNK LID PULL-DOWN

CHART #1
STRIKER UNIT DOES NOT EXTEND WHEN REAR COMPARTMENT LID IS UNLATCHED



C9891

CHART #2
STRIKER UNIT DOES NOT RETRACT WHEN REAR COMPARTMENT LID IS CLOSED

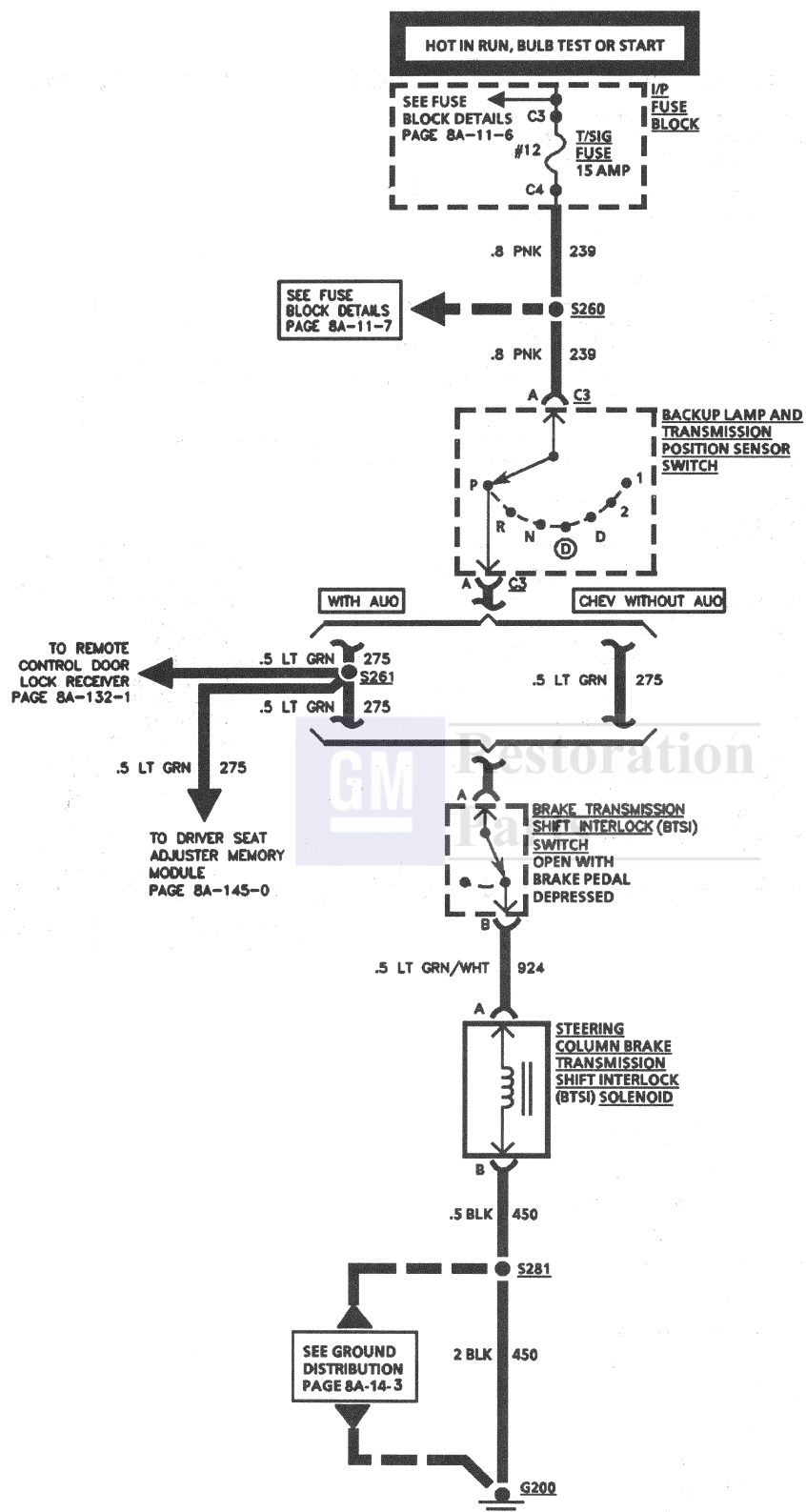


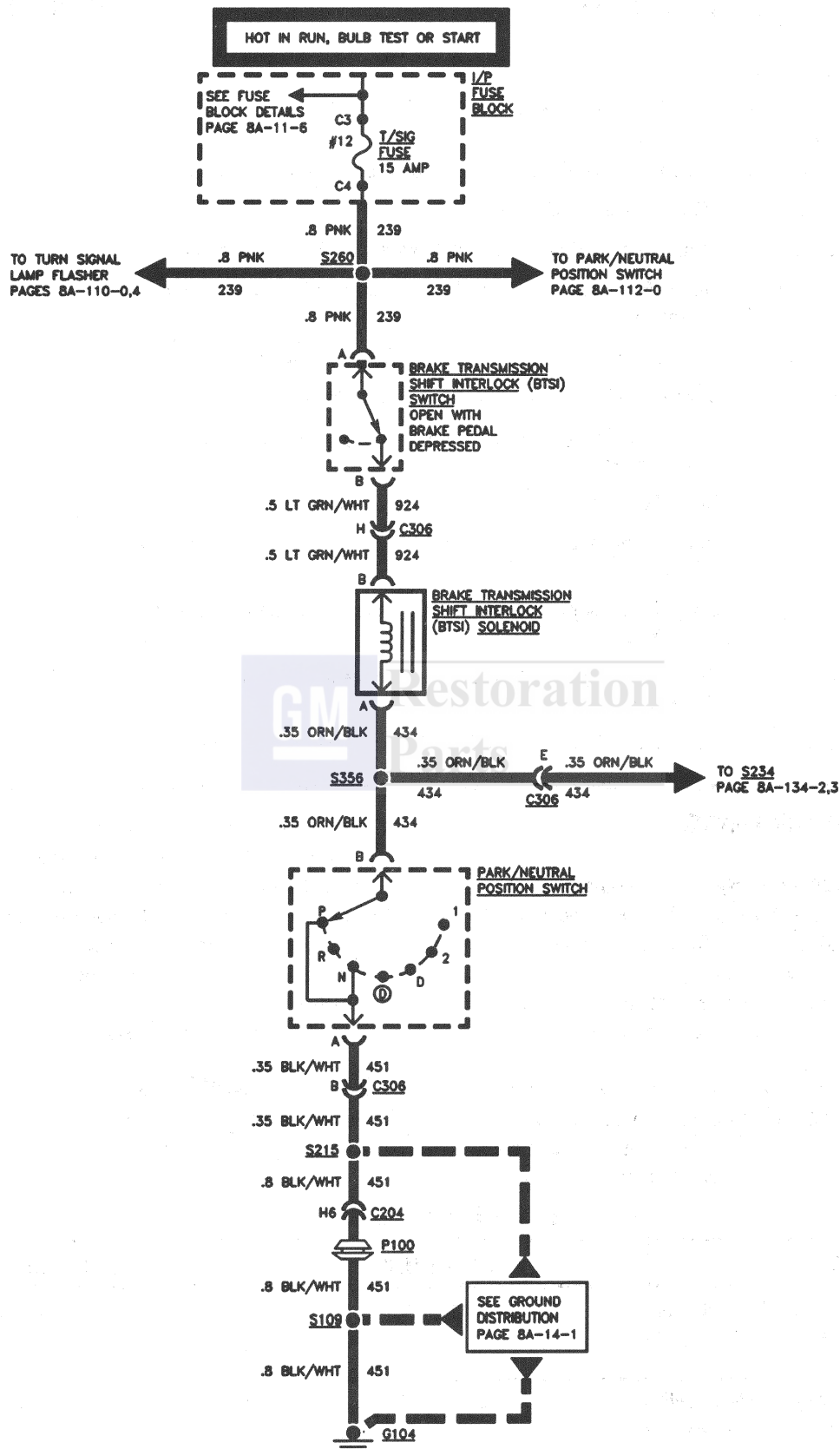
C10033

CIRCUIT OPERATION

Battery voltage is applied at all times to the Striker Motor within the Rear Compartment Lid Pull-Down Actuator. The polarity to the Striker Motor is determined by the position of the Striker Switches. In position "1," ground will be available through the Rear Compartment Lid Pull-Down Switch whenever the Deck Lid is shut. With the Rear Compartment Lid Pull-Down Switch closed, the Striker Motor retracts the Striker Unit until the Striker Switches are moved to position "2." In position "2," ground will be available through the Rear Compartment Limit Switch once the Rear Compartment Lid is opened. When the Rear Compartment Lid is opened, the Striker Motor extends the Striker Unit until the Striker Switches are moved to Position "1."

BRAKE TRANSMISSION SHIFT INTERLOCK





BRAKE TRANSMISSION SHIFT INTERLOCK

COMPONENT	LOCATION	201-PG	FIG.	CONN
Backup Lamp and Transmission Position Sensor Switch.....	Near base of Steering Column, on Column			
Brake Transmission Shift Interlock (BTSI) Switch.....	Attached to Brake Pedal Bracket (bottom switch)	14.....	22	
BTSI Solenoid.....	Upper LH side of Steering Column			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11.....	19	
Park/Neutral Position Switch.....	Under Floor Console, attached to Automatic Transmission Control			
G104.....	Engine Compartment on front of LH Cylinder Head			
G200.....	Base of LH "A" Pillar, behind LH kickpad	11.....	19	
C340 (4 cavities).....	Electronic Brake Control Harn to Body Harn, bottom LH Rear Floor Pan			
S215	Body Harn, approx 4 cm from SDM Conn breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S278	Body Harn, approx 4 cm from Convenience Center branch breakout			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			
S356	Crossbody Harn, at Seat Belt Switch Conn branch breakout			

TROUBLESHOOTING HINTS**(Perform before beginning System Diagnosis)**

1. Check I/P Fuse Block Fuse #12. If open, check CKT 239, CKT 275 and CKT 924 for a short to ground.
 2. Make sure G200 is clean and tight.
 3. If Transmission Shift Lever does not shift out of Park, make sure the linkage is properly adjusted. Refer to SECTION 7A.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be

intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

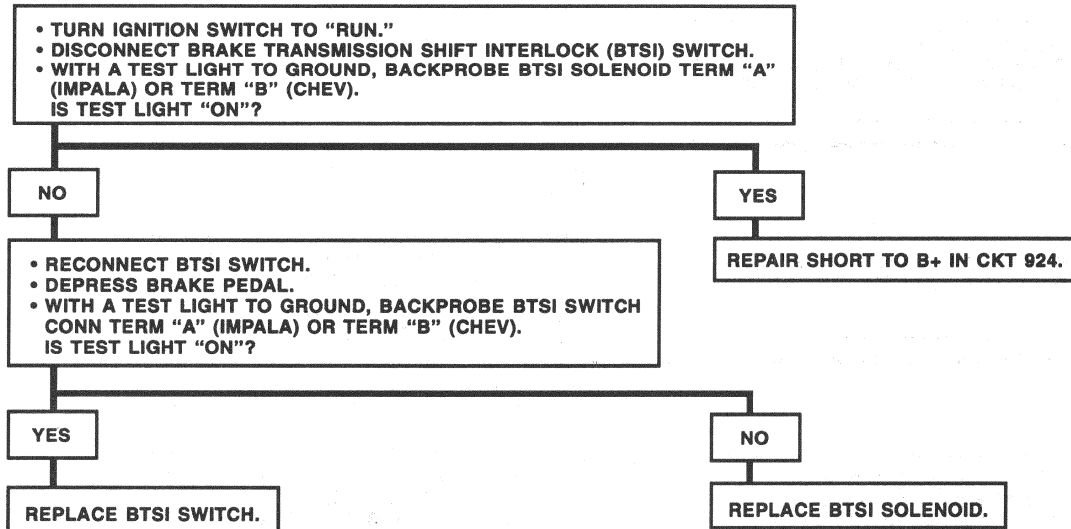
SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Transmission does not shift out of Park with brake pedal depressed and Ignition Switch in "RUN."	Chart #1	8A-138-3
Transmission shifts out of Park with Ignition Switch in "RUN" and Brake Pedal not depressed.	Chart #2	8A-138-4

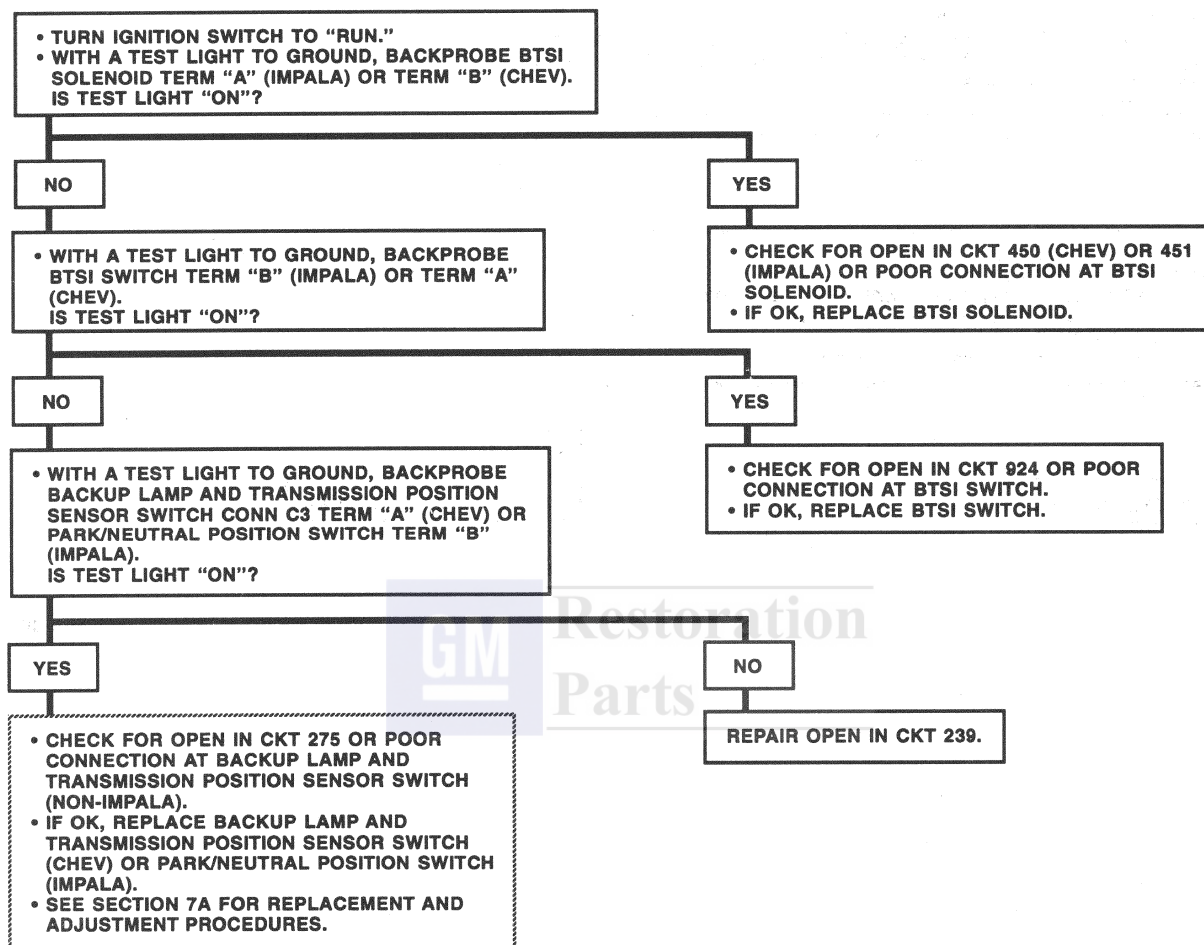
CHART #1
TRANSMISSION DOES NOT SHIFT OUT OF PARK WITH BRAKE
PEDAL DEPRESSED AND IGNITION SWITCH IN "RUN"



C9944

BRAKE TRANSMISSION SHIFT INTERLOCK

CHART #2
TRANSMISSION SHIFTS OUT OF PARK WITH IGNITION
SWITCH IN "RUN" AND BRAKE PEDAL NOT DEPRESSED

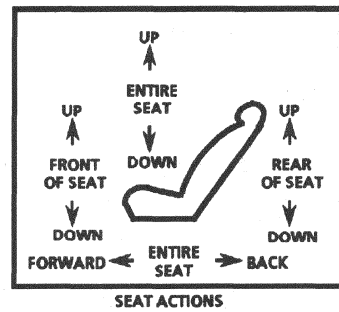
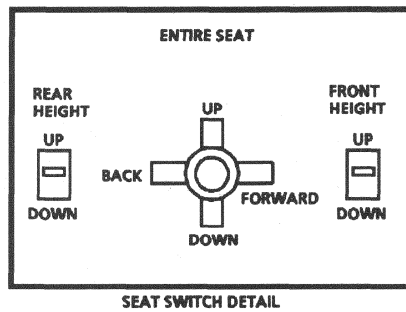


CIRCUIT OPERATION

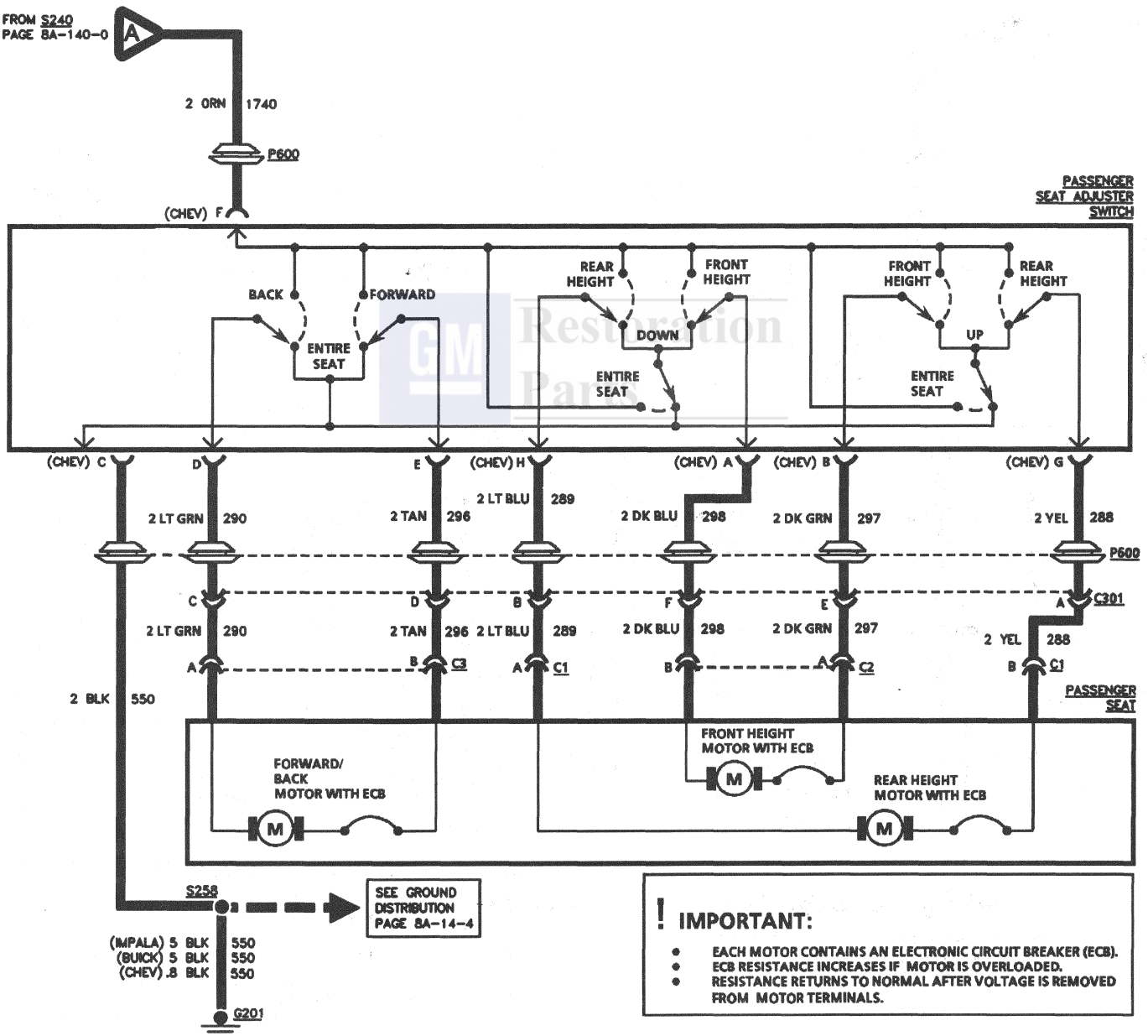
The Backup Lamp and Transmission Position Sensor Switch or Park/Neutral Position Switch receives Ignition voltage from I/P Fuse #12 in "RUN," "BULB TEST" and "START." When the Transmission Shift Lever is in "PARK," the switch relays voltage to the BTSI Switch. The BTSI Switch is normally closed, providing voltage to the BTSI Solenoid, which is permanently grounded at G200. When the BTSI Solenoid receives voltage, it is energized and prevents the Transmission Shift Lever from being moved out of "PARK." When the Brake Pedal is depressed, the BTSI Switch opens, removing voltage from the BTSI Solenoid. This de-energizes the Solenoid, allowing operation of the Shift Lever.



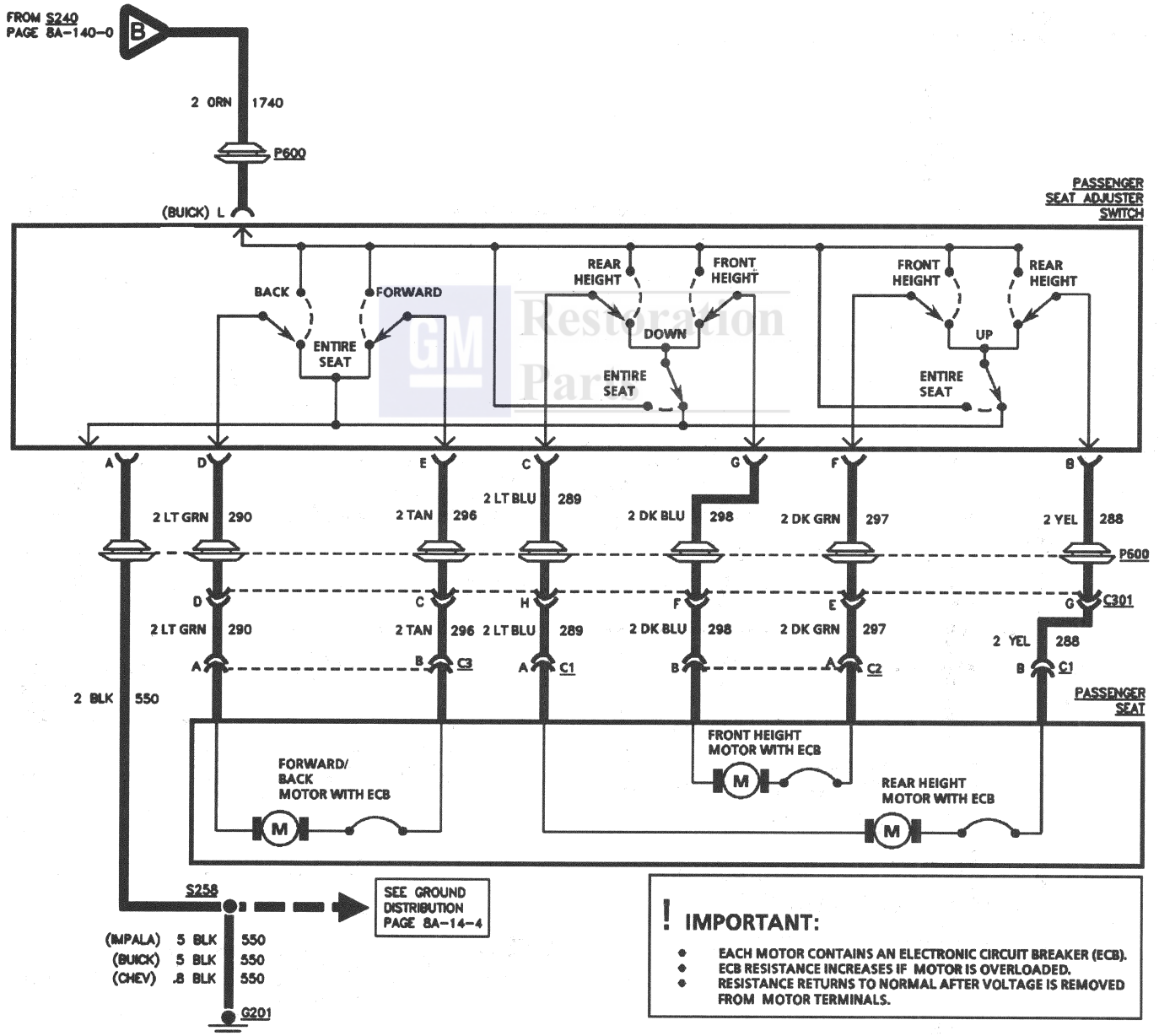
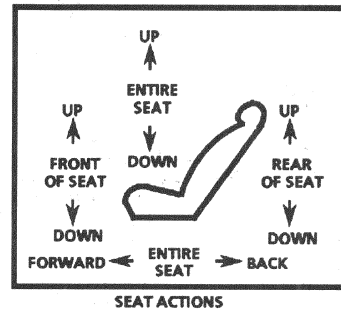
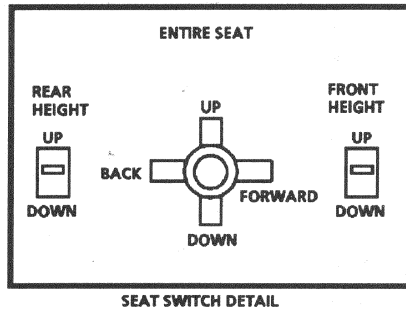




FROM S240
PAGE 8A-140-0



POWER SEATS



COMPONENT	LOCATION	201-PG	FIG.	CONN
Driver Forward/Back Motor	Under Driver Seat	22	33	
Driver Front Height Seat Motor	Under Driver Seat	22	33	
Driver Seat Adjuster Switch.....	LH Front Door Armrest			
Driver Rear Height Seat Motor	Under Driver Seat	22	33	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Passenger Forward/Back Motor	Under Passenger Seat			
Passenger Front Height Seat Motor	Under Passenger Seat			
Passenger Seat Adjuster Switch.....	RH Front Door Armrest	23	34	
Passenger Rear Height Seat Motor	Under Passenger Seat			
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad	19	30	202-6
C300 (6 cavities).....	Cross Car Harn to Driver Seat Motor Harn, under Driver Seat			
C301 (6 cavities).....	Crossbody Harn to Passenger Seat Motor Harn, under Passenger Seat			
G200.....	Base of LH "A" Pillar, behind kickpad	19	30	
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar.....	23	34	
S240	Crossbody Harn, approx 8 cm from Door Lock Relay branch breakout			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check Circuit Breaker #3 by noting Power Seat operation. If Circuit Breaker #3 is open, check for short to ground in CKT 1740.
2. If the Rear or Front Height does not function, but entire seat moves up and down, replace the Driver or Passenger Seat Adjuster Switch.
3. Make sure G201 is clean and tight.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system

disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

POWER SEATS

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
All positions do not operate.	Chart #1	8A-140-4
Entire seat will not move "FORWARD" and/or "BACK" (Chev).	Chart #2	8A-140-5
Front Height will not move "UP" and/or "DOWN" (Chev).	Chart #3	8A-140-6
Rear Height will not move "UP" and/or "DOWN" (Chev).	Chart #4	8A-140-7
Entire seat will not move "UP" and/or "DOWN" (Chev).	Chart #3 Chart #4	8A-140-6 8A-140-7
Entire seat will not move "FORWARD" and/or "BACK" (Buick).	Chart #5	8A-140-8
Front Height will not move "UP" and/or "DOWN" (Buick).	Chart #6	8A-140-9
Rear Height will not move "UP" and/or "DOWN" (Buick).	Chart #7	8A-140-10
Entire seat will not move "UP" and/or "DOWN" (Buick).	Chart #6 Chart #7	8A-140-9 8A-140-10

CHART #1 ALL POSITIONS DO NOT OPERATE

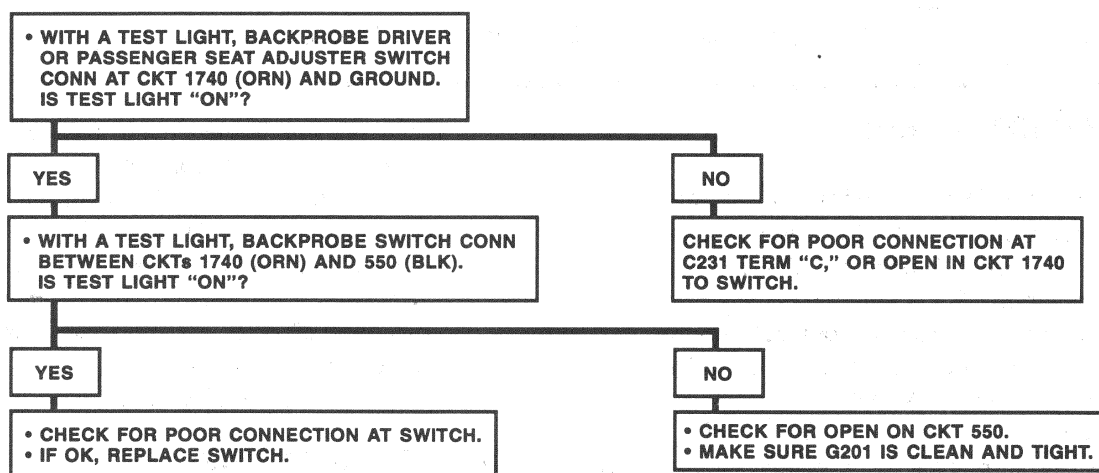
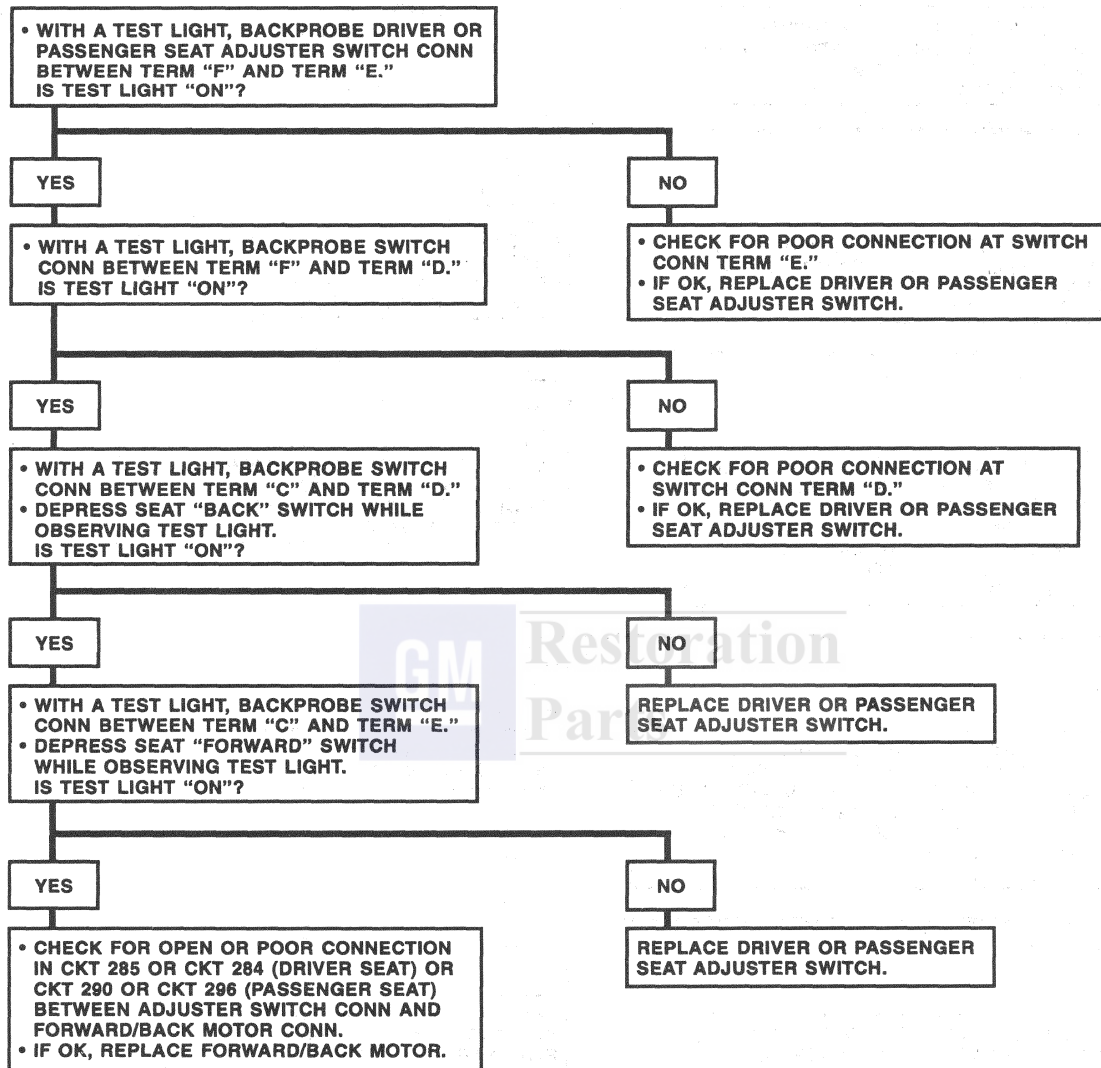


CHART #2
ENTIRE SEAT WILL NOT MOVE "FORWARD" AND/OR "BACK" (CHEV)



POWER SEATS

CHART #3
FRONT HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN" (CHEV)

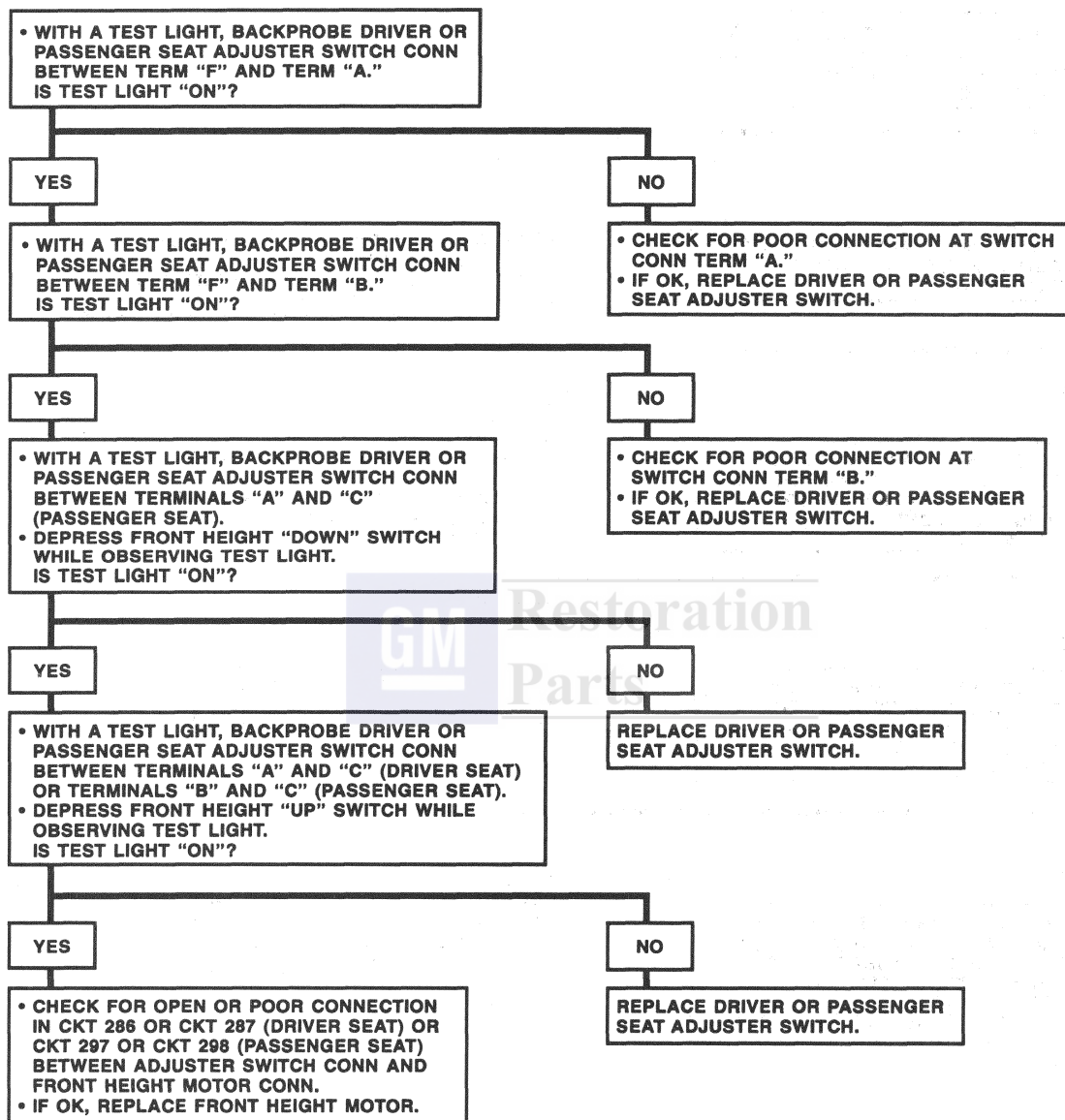
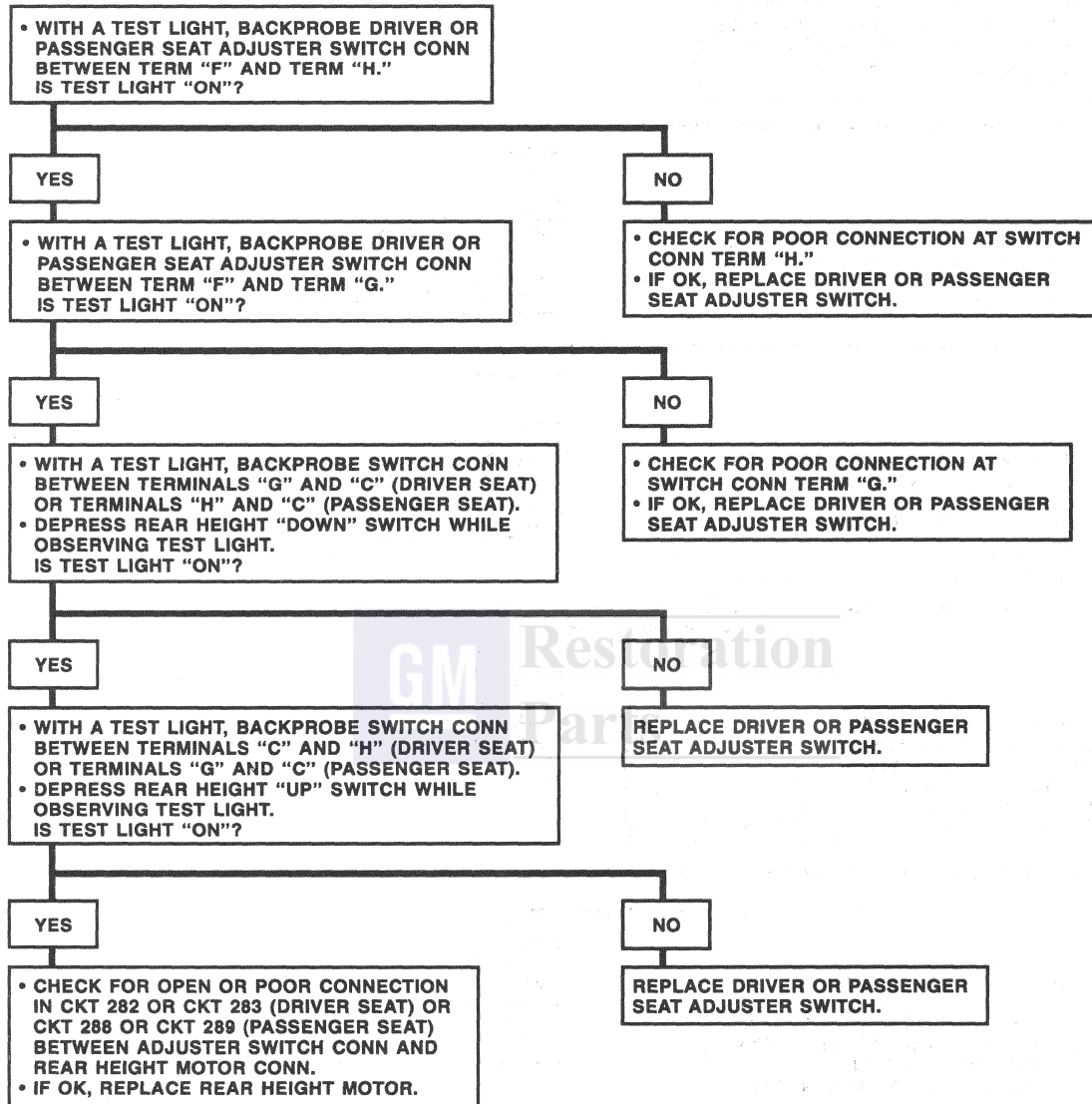


CHART #4
REAR HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN" (CHEV)



POWER SEATS

CHART #5
ENTIRE SEAT WILL NOT MOVE "FORWARD" AND/OR "BACK" (BUICK)

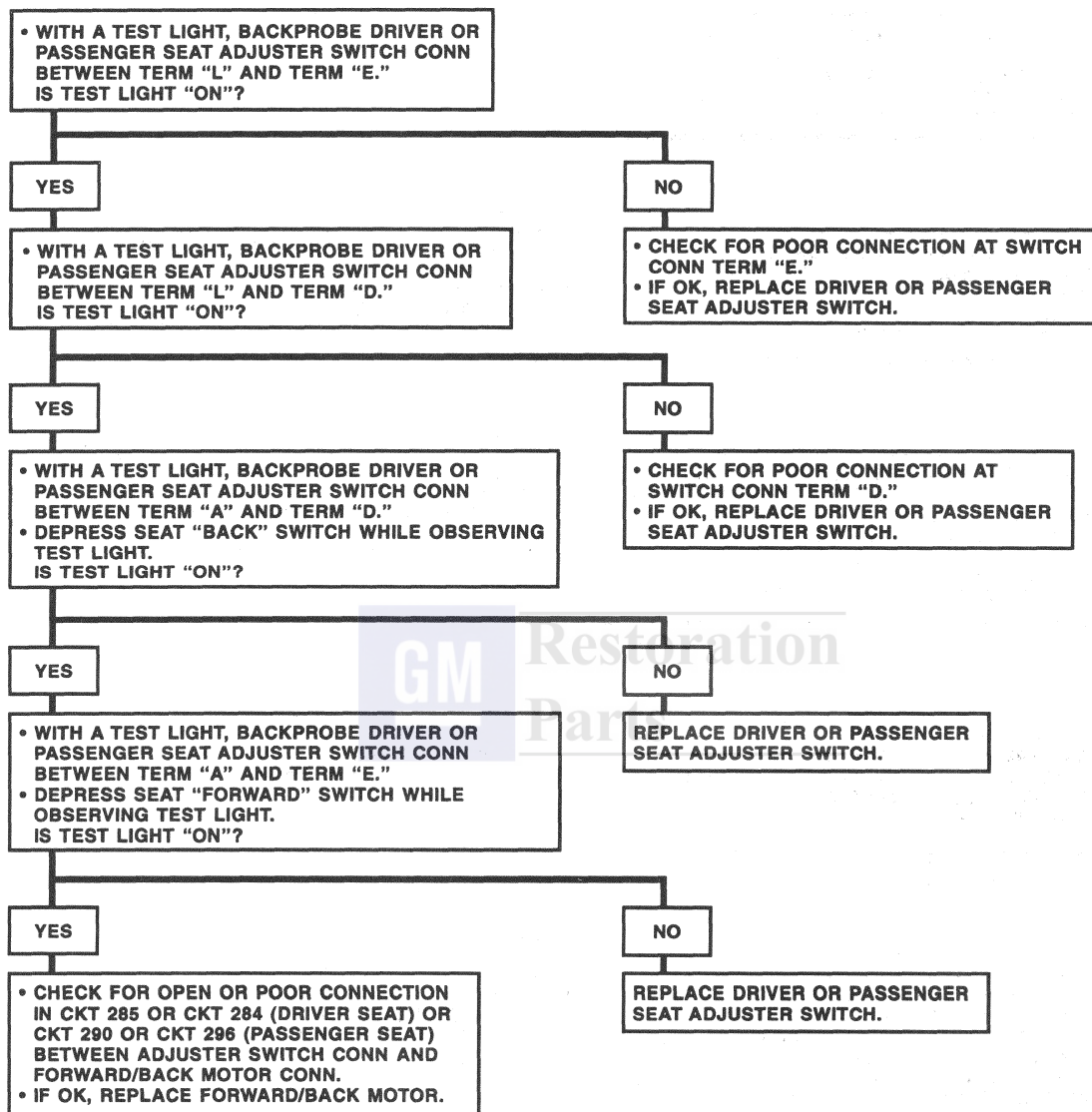
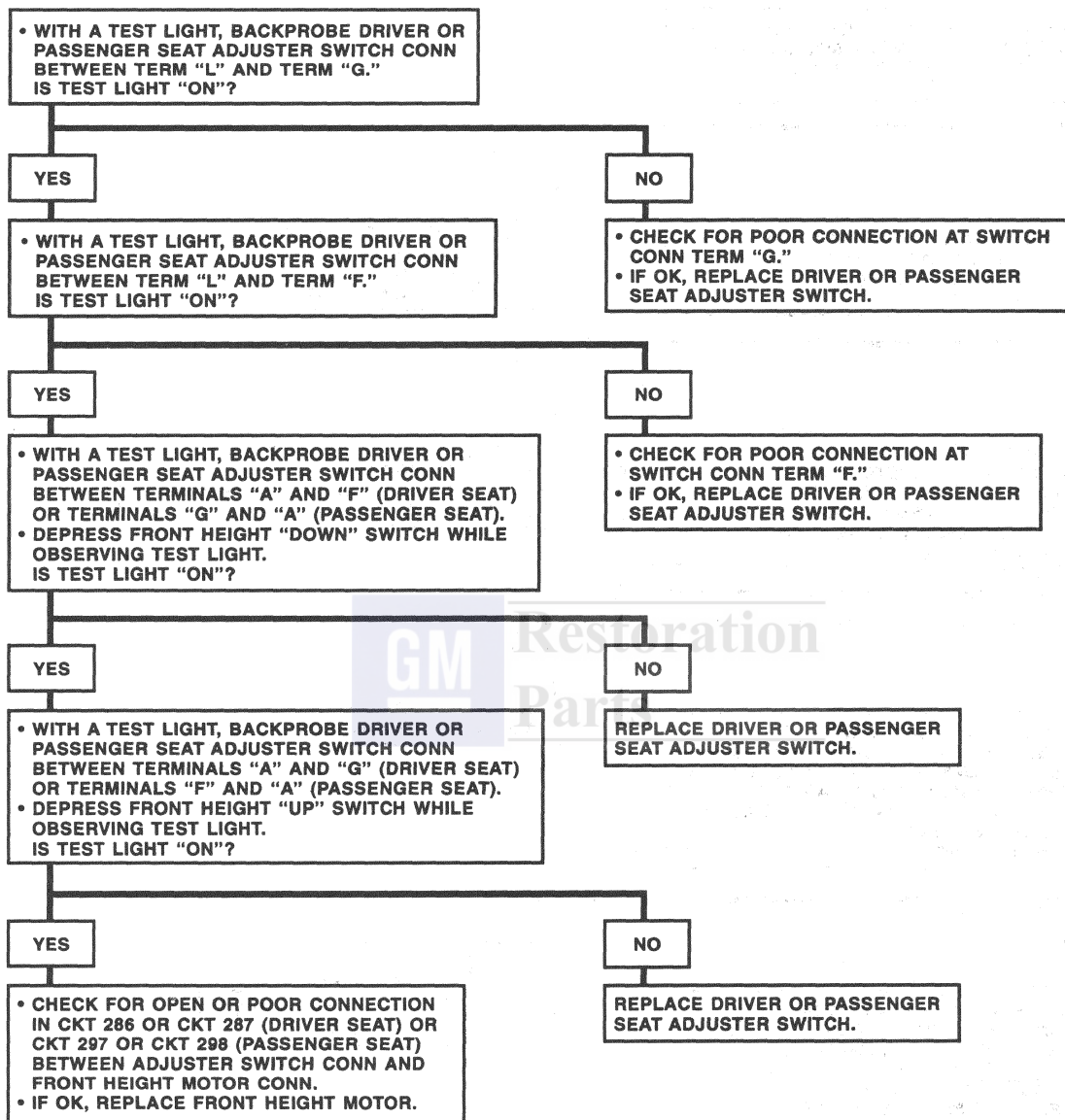
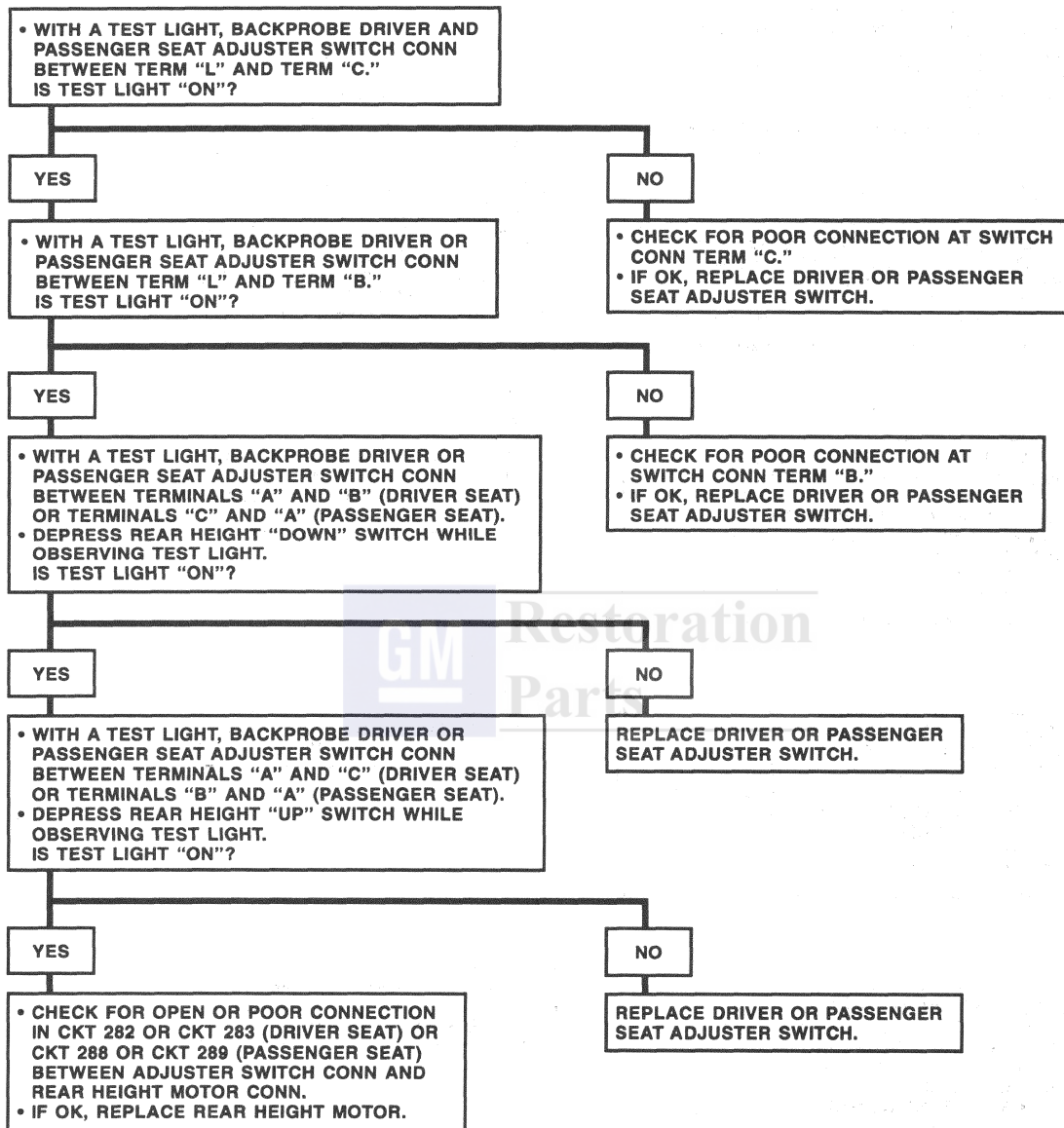


CHART #6
FRONT HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN" (BUICK)



POWER SEATS

CHART #7
REAR HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN" (BUICK)



CIRCUIT OPERATION

There are three reversible motors that operate the power seats. The front and rear height of the seat are operated by different motors. They can be raised or lowered independently of each other. When the Entire Seat Switch is pushed to the "UP" or "DOWN" position, both motors run to move the front and rear of the seat at the same time.

Ground is applied at all times to both sides of each motor. When a switch is depressed, battery voltage is applied to the appropriate side of the motor.

The Forward/Back Motor is operated by the Entire Seat Switch. When it is held in the "FORWARD" position, battery voltage is applied from the Switch contacts through the TAN wire to the Forward/Back Motor. Ground applied

to the motor through the LT GRN wire. The motor runs to drive the seat forward until the switch is released.

In the "BACK" position, the LT GRN wire receives battery voltage and the TAN wire has ground. This reversed polarity causes the motor to run in the opposite direction and drive the seat backward.

The Front and Rear Height Motors work in a similar way when the Front or Rear Height Switch is operated.

To lower the entire seat, the Entire Seat Switch is held in the "DOWN" position. This applies battery voltage to both the DK BLU and LT BLU wires. Both motors run to drive the entire seat down. A similar action occurs to move the entire seat up.

Each motor contains a solid state self-resetting circuit breaker to protect it from overload.





COMPONENT	LOCATION	201-PG	FIG.	CONN
Driver Seat Switch Pod	Bottom of Driver Seat, Outboard Side			
Driver Seat Recliner Motor.....	Part of bottom Driver Seat.....	22	33	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Passenger Seat Switch Pod.....	Bottom of Passenger Seat, Outboard Side			
Passenger Seat Recliner Motor	Part of bottom Passenger Seat			
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad	19	30	202-6
C316 (23 cavities).....	Driver Seat Harn to Cross-Car Harn, under Driver Seat.....	21	32	202-6
C317 (23 cavities).....	Passenger Seat Harn to Cross-Car Harn, under Passenger Seat	21	32	202-6
G201	Base of LH "A" Pillar, behind kickpad	19	30	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S343	Cross Car Harn, 28 cm from Power Seat breakout			
S344	Driver Seat Harn, approx 10 cm from Driver Seat Switch Conn breakout			
S346	Driver Seat Harn, approx 2 cm from Driver Switch Conn breakout			
S348	Passenger Seat Harn, approx 16 cm from C301			
S350	Passenger Seat Harn, approx 39 cm from C301			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

! Important:

- To avoid misdiagnosis, inspect mechanical linkage for binding which would prevent smooth operation or cause system failure.
- Substitute I/P Circuit Breaker #1 with one of equal value (20 amp) known to be operational.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to "System Diagnosis."

SYSTEM DIAGNOSIS

Perform the "System Check" in the order shown. When a fault is found, refer to the Symptom Table for the appropriate diagnostic procedure(s). If a normal result is found at each and every step of the "System Check," the fault may be intermittent.

To help isolate an intermittent fault, first examine the mating terminals at each component and connector for a poor connection. Also check that each terminal of mating connectors is properly seated in the connector body. If the connections appear to be reliable, try the "System Check" again while moving the wiring harness from side to side at each component and in-line connector, to try and induce the intermittent fault.

Once a fault has been corrected, perform the "System Check" to verify the diagnosis.

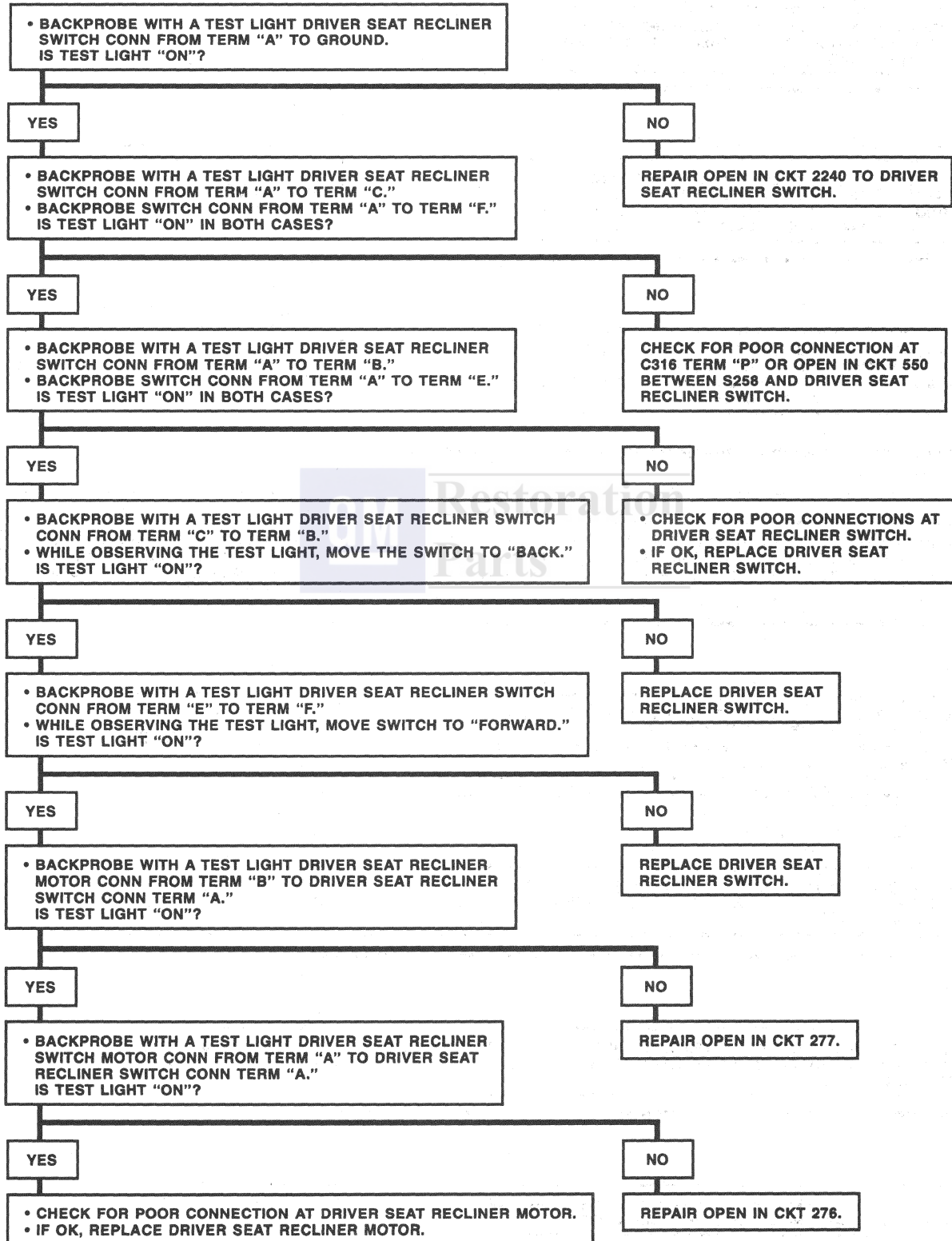
8A - 141 - 2 ELECTRICAL DIAGNOSIS**POWER RECLINING SEAT(S)****SYSTEM CHECK**

ACTION	NORMAL RESULTS
[1] • Move Driver Seat Switch to "BACK."	Driver Seatback moves back.
[2] • Move Driver Seat Switch to "FORWARD."	Driver Seatback moves forward.
[3] • Move Passenger Seat Recliner Switch to "BACK."	Passenger Seatback moves back.
[4] • Move Passenger Seat Recliner Switch to "FORWARD."	Passenger Seatback moves forward.

SYMPTOM TABLE

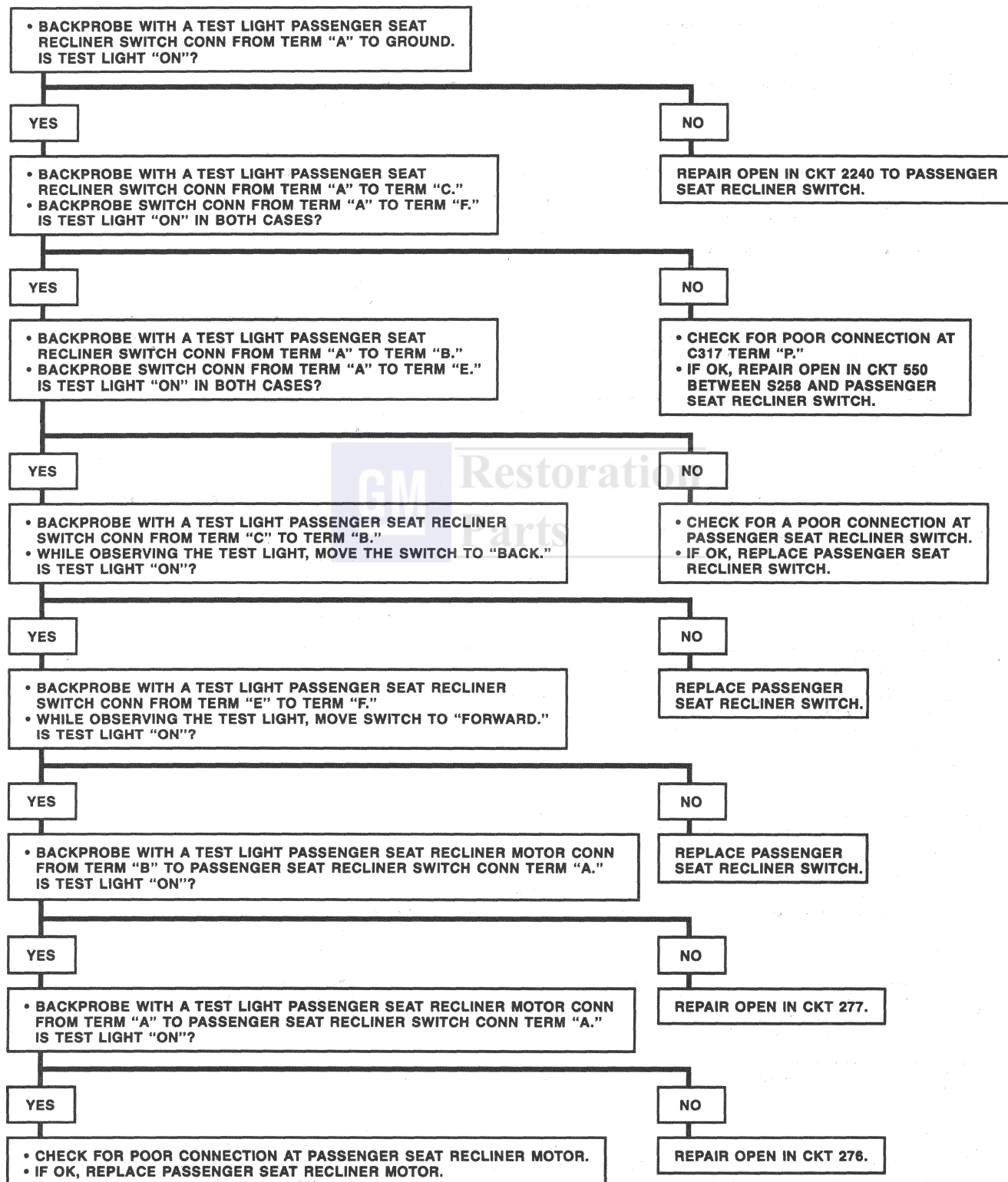
SYMPTOM	PROCEDURE	PAGE NUMBER
Driver Seat Recliner inoperative, Passenger Seat Recliner operates normally.	Chart #1	8A-141-3
Passenger Seat Recliner inoperative, Driver Seat Recliner operates normally.	Chart #2	8A-141-4
Driver Seat and Passenger Seat Recliner inoperative.	Check for an open in CKT 2240 between I/P Circuit Breaker #1 and S343 or poor connection at C231 terminal "A." Check for an open in CKT 550 between S258 and ground G201. Check that ground G201 is clean and tight.	
Driver Seat Recliner "FORWARD" mode inoperative, "BACK" mode operates normally.	Replace Driver Seat Recliner Switch.	
Driver Seat Recliner "BACK" mode inoperative, "FORWARD" mode operates normally.	Replace Driver Seat Recliner Switch.	
Passenger Seat Recliner "FORWARD" mode inoperative, "BACK" mode operates normally.	Replace Passenger Seat Recliner Switch.	
Passenger Seat Recliner "BACK" mode inoperative, "FORWARD" mode operates normally.	Replace Passenger Seat Recliner Switch.	

CHART #1
DRIVER SEAT RECLINER INOPERATIVE
PASSENGER SEAT RECLINER OPERATES NORMALLY



POWER RECLINING SEAT(S)

CHART #2
PASSENGER SEAT RECLINER INOPERATIVE
DRIVER SEAT RECLINER OPERATES NORMALLY



CIRCUIT OPERATION

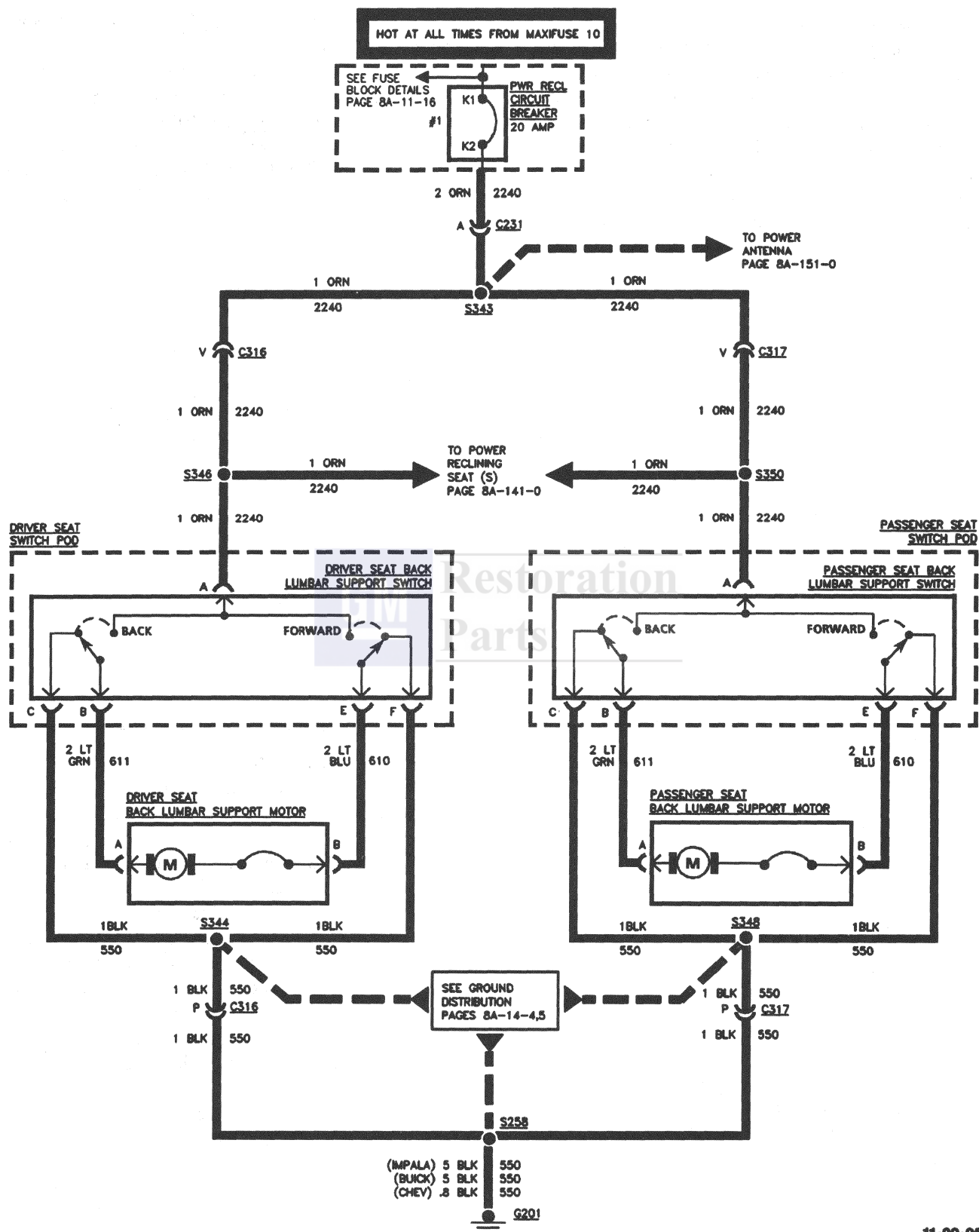
Battery voltage from I/P Circuit Breaker #1 is applied to the Driver Seat Recliner Switch and the Passenger Seat Recliner Switch through CKT 2240. The Recliner Switches, which are grounded at G201, normally ground both sides of the Recliner Motors. When the Recliner Switch is moved to the "BACK" position, battery voltage is applied to the Recliner Motor through the LT BLU wire and the Recliner Switch. The motor will rotate to move the

seatback back. The Recliner Motor will be grounded through the LT GRN wire.

When the Recliner Switch is moved to the "FORWARD" position, battery voltage is applied to the Recliner Motor through the LT GRN wire. The Recliner Motor will be grounded through the LT BLU wire and the Recliner Switch. The Recliner Motor will rotate in the opposite direction and move the seatback forward.



LUMBAR SUPPORTS (BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Driver Seat Switch Pod.....	Bottom of Driver Seat, Outboard Side			
Driver Seatback Lumbar Support Motor.....	Part of Driver Seat bottom.....	22	33	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Passenger Seat Switch Pod.....	Bottom of Passenger Seat, Outboard Side			
Passenger Seatback Lumbar Support Motor.....	Part of Passenger Seat bottom			
C231 (8 cavities).....	Crossbody Harn and Side Door Harn to Body Harn, at base of "A" Pillar, behind kickpad	19	30	202-6
C316 (23 cavities).....	Driver Seat Harn to Cross Car Harn under Driver Seat.....	21	32	202-6
C317 (23 cavities).....	Passenger Seat Harn to Cross Car Harn under Passenger Seat	21	32	202-6
G201.....	Base of LH "A" Pillar, behind kickpad	19	30	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S343	Cross Car Harn, 28 cm from Power Seat breakout			
S344	Driver Seat Harn, approx 10 cm from Driver Seat Switch Conn breakout			
S346	Driver Seat Harn, approx 25 cm from Driver Switch Conn breakout			
S348	Passenger Seat Harn, approx 16 cm from C301			
S350	Passenger Seat Harn, approx 39 cm from C301			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

! Important:

- To avoid misdiagnosis, inspect cable for binding which would prevent smooth operation or cause system failure.
- Substitute I/P Circuit Breaker #1 with one of equal value (20 amp) known to be operational.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

Perform the System Check in the order shown. When a fault is found, refer to the Symptom Table for the appropriate diagnostic procedure(s). If a normal result is found at each and every step of the System Check, the fault may be intermittent.

To help isolate an intermittent fault, first examine the mating terminals at each component and connector for a poor connection. Also, check that each terminal of the mating connector is properly seated in the connector body. If the connections appear to be reliable, try the System Check again while moving the wiring harness from side to side at each component and in-line connector, to try and induce the intermittent fault.

Once a fault has been corrected, perform the System Check to verify the diagnosis.

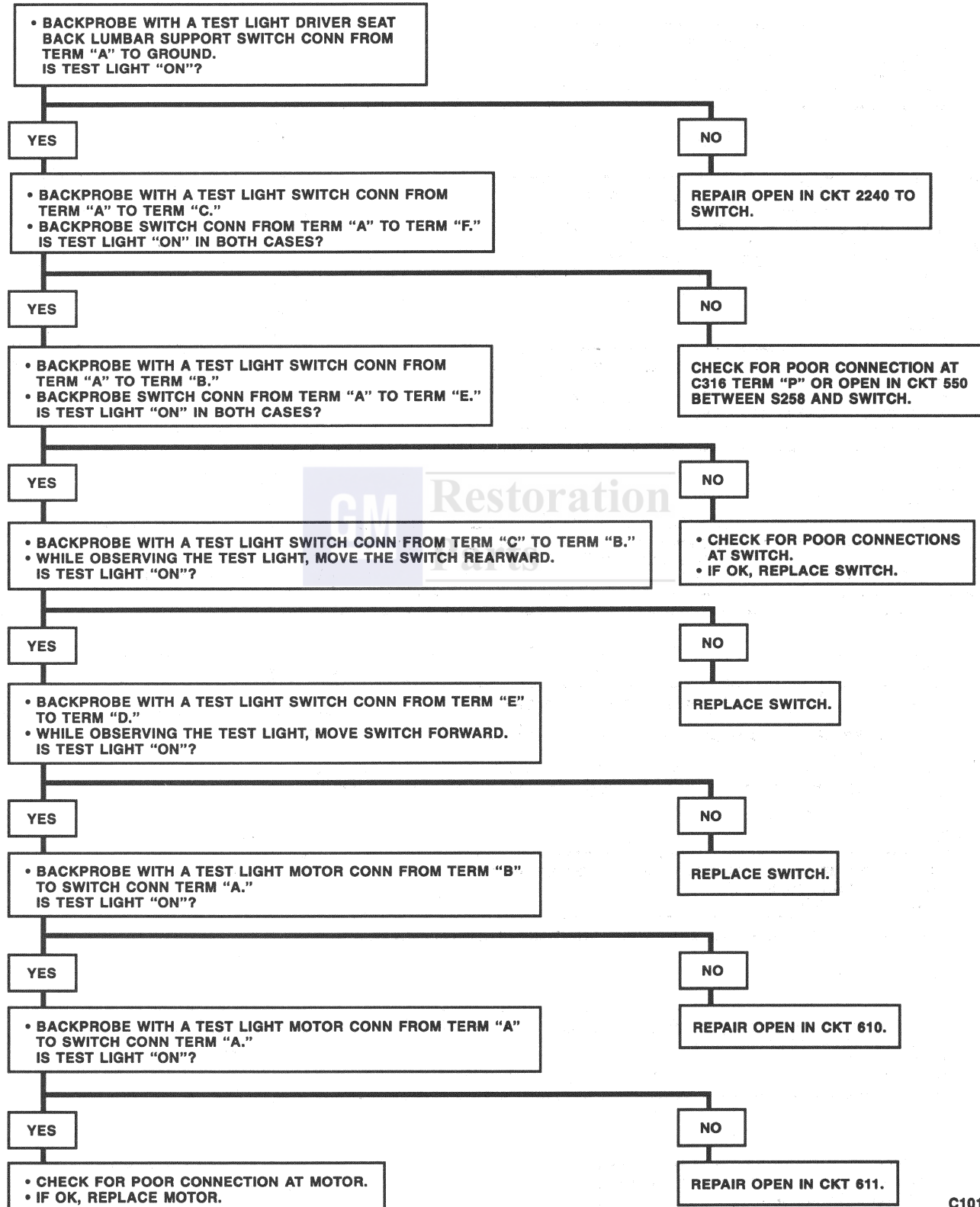
LUMBAR SUPPORTS**SYSTEM CHECK**

ACTION	NORMAL RESULTS
[1] • Move Driver Seat Back Lumbar Support Switch rearward.	Driver Seatback Lumbar Support increases.
[2] • Move Driver Seat Back Lumbar Support Switch forward.	Driver Seatback Lumbar Support decreases.
[3] • Move Passenger Seat Back Lumbar Support rearward.	Passenger Seatback Lumbar Support increases.
[4] • Move Passenger Seat Back Lumbar Support forward.	Passenger Seatback Lumbar Support decreases.

SYMPTOM TABLE

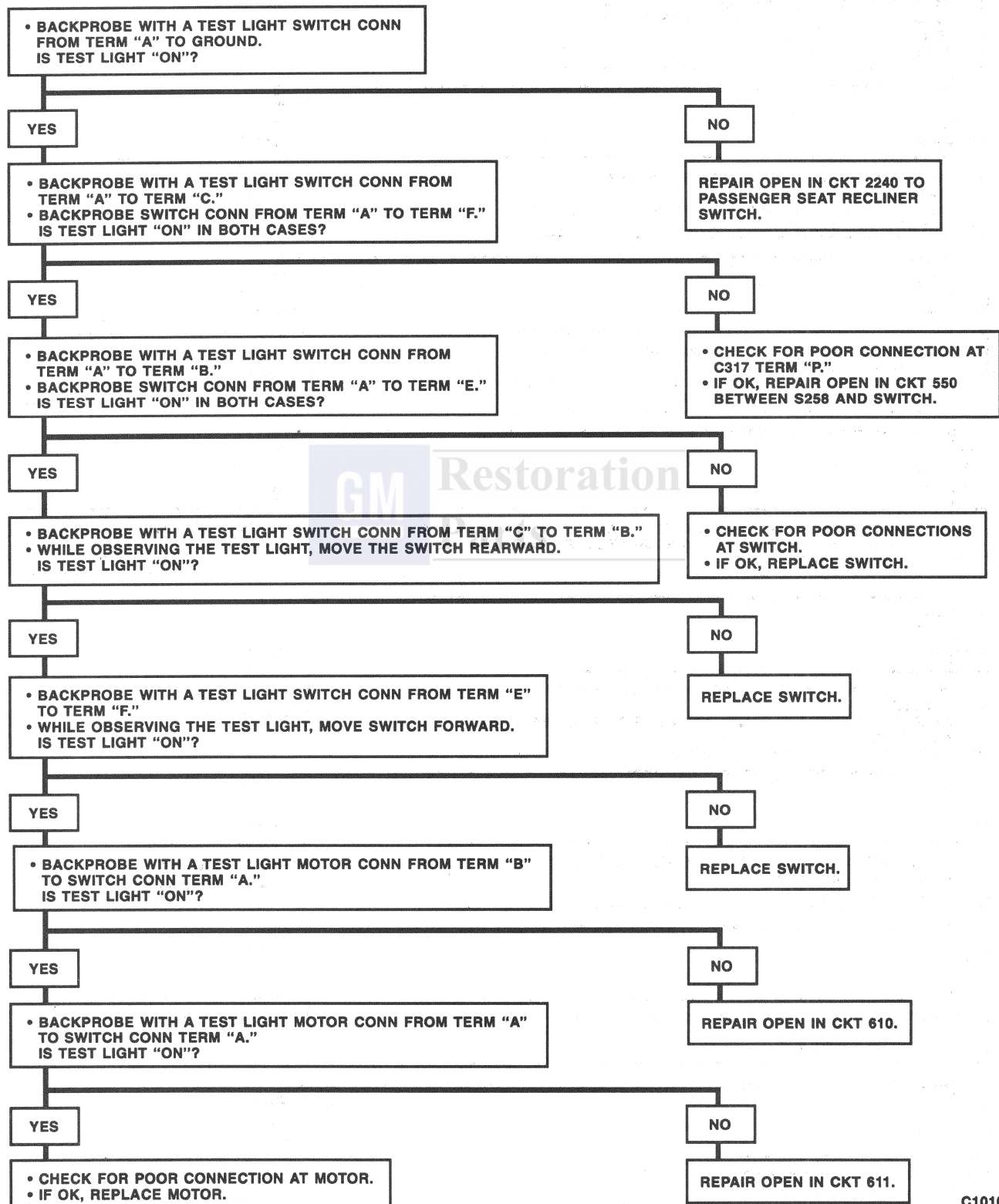
SYMPTOM	PROCEDURE	PAGE NUMBER
Driver Lumbar Support inoperative, Passenger Lumbar Support operates normally.	Chart #1	8A-142-3
Passenger Lumbar Support inoperative, Driver Lumbar Support operates normally.	Chart #2	8A-142-4
Driver and Passenger Lumbar Support inoperative.	Check for an open in CKT 2240 between I/P Circuit Breaker #1 and S343 or poor connection at C231 terminal "A". Check for an open in CKT 550 between S258 and ground G201. Check that ground G201 is clean and tight.	
Driver Seatback Lumbar Support decreases but will not increase.	Replace Driver Seatback Lumbar Support Switch.	
Driver Seatback Lumbar Support increases but will not decrease.	Replace Driver Seatback Lumbar Support Switch.	
Passenger Seatback Lumbar Support decreases but will not increase.	Replace Passenger Seatback Lumbar Support Switch.	
Passenger Seatback Lumbar Support increases but will not decrease.	Replace Passenger Seatback Lumbar Support Switch.	

CHART #1
DRIVER LUMBAR SUPPORT INOPERATIVE PASSENGER
LUMBAR SUPPORT OPERATES NORMALLY



LUMBAR SUPPORTS

CHART #2
PASSENGER LUMBAR SUPPORT INOPERATIVE
DRIVER LUMBAR SUPPORT OPERATES NORMALLY



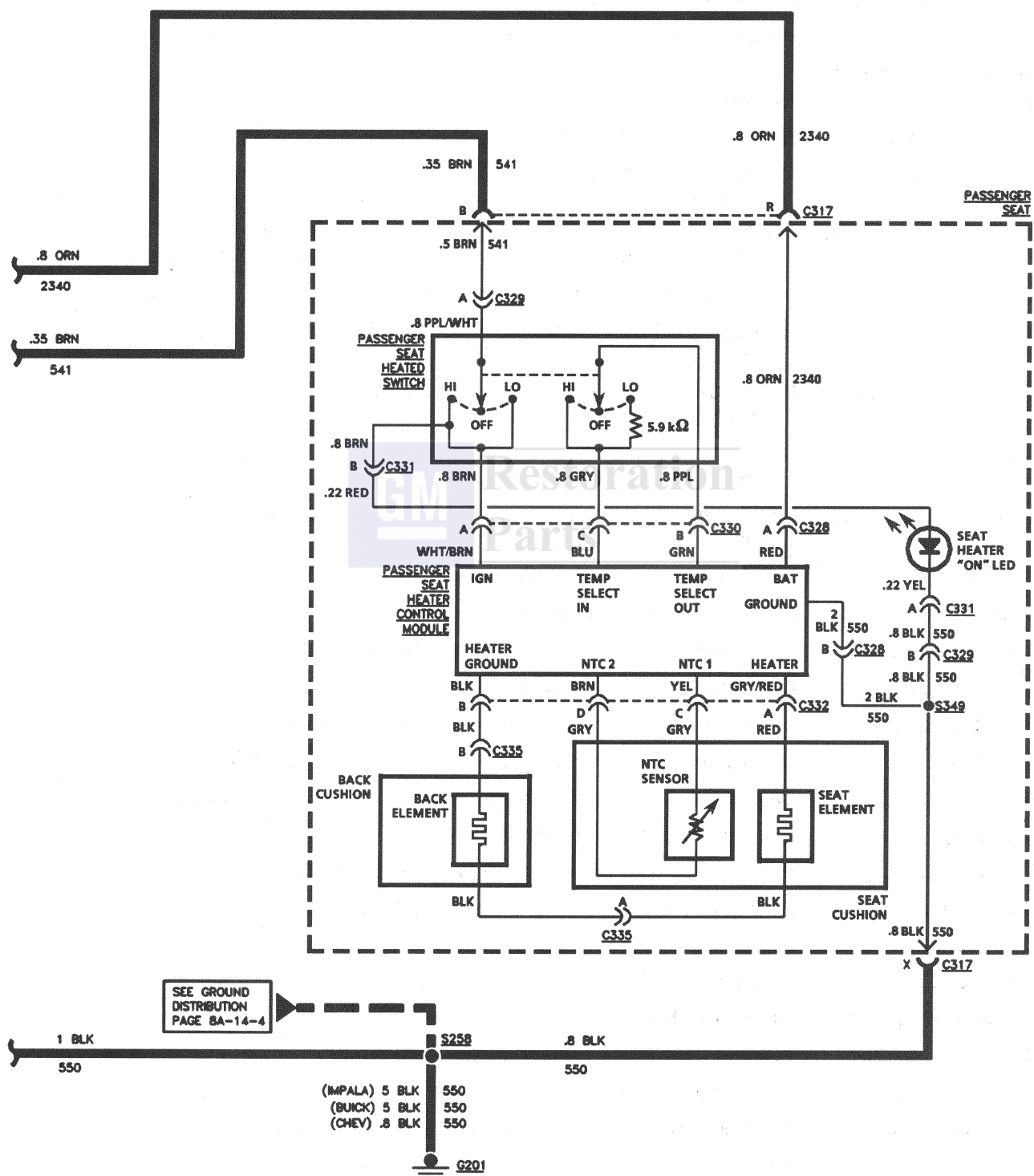
CIRCUIT OPERATION

Battery voltage from I/P Circuit Breaker #1 is applied to the Driver Seatback Lumbar Support Switch and the Passenger Seatback Lumbar Support Switch through CKT 2240. The Switches, which are grounded at G201, normally ground both sides of the Adjuster Actuator Motors. When the switch is moved to rearward position, battery voltage is applied to the motor through the LT BLU wire and the switch. The motor will rotate to increase the seatback. The Lumbar Support Motor will be grounded through the LT GRN wire.

When the switch is moved to the forward position, battery voltage is applied to the motor through the LT GRN wire. The motor will be grounded through the LT BLU wire and the switch. The motor will rotate in the opposite direction and decrease the Seatback Lumbar Support.







8A - 143 - 2 ELECTRICAL DIAGNOSIS

HEATED SEATS

COMPONENT	LOCATION	201-PG	FIG.	CONN
Driver Seat Heater Control Module	Attached to seat support, under LH Seat			
Driver Seat Heater Switch.....	LH side of Driver's Seat Cushion			
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Passenger Seat Heater Control Module	Attached to seat support, under RH Seat			
Passenger Seat Heater Switch...	RH side of Passenger Seat Cushion			
C230 (10 cavities).....	Crossbody and Side Door Harn to Body Harn at base of LH "A" Pillar behind kickpad.....	19	30	202-5
C231 (8 cavities).....	Crossbody and side Door Harn to Body Harn at base of LH "A" Pillar behind kickpad.....	19	30	202-6
C316 (23 cavities).....	Driver Seat Harn to Crossbody Harn, under Driver Seat.....	21	32	202-6
C317 (23 cavities).....	Passenger Seat Harn to Crossbody Harn under Passenger Seat	21	32	202-6
C318 (6 cavities).....	Driver's Seat Jumper Harn, to Driver's Seat Adjuster Memory Module Pigtail	21	32	202-6
C319 (6 cavities).....	Driver's Seat Jumper Harn, to Driver's Seat Adjuster Memory Module	21	32	202-6
C320 (3 cavities).....	Driver Seat Jumper Harn, to Driver's Seat Adjuster Memory Module			
C321 (2 cavities).....	Driver Seat Jumper Harn, to Heated Seat Module.....	21	32	
C322 (2 cavities).....	Driver Seat Jumper Harn, to Driver Seat Harn			
C323 (3 cavities).....	Driver Seat Heater Switch to Heated Seat Module			
C324 (2 cavities).....	Driver Seat Heater Switch to Indicator Conn			
C325 (4 cavities).....	Driver Seat Heater Module to Upper Seat Heater Conn			
C326 (2 cavities).....	Driver's Seat Jumper to Seat Belt Switch	22	33	
C327 (6 cavities).....	Crossbody to Passenger Power Seat Jumper	22	33	
C328 (2 cavities).....	Passenger Seat Jumper to Heated Seat Module			
C329 (2 cavities).....	Passenger Seat Jumper to Passenger Seat Heater Switch			
C330 (3 cavities).....	Passenger Seat Heater Switch to Heated Seat Module			
C331 (2 cavities).....	Passenger Seat Heater Switch to Indicator			
C332 (4 cavities).....	Passenger Seat Heater Module to Upper Seat Heater			
C334 (2 cavities).....	Driver Seat Heater Element, to Seat Back Harn			
C335 (2 cavities).....	Passenger Seat Heater Element, to Seat Back Harn			
G201.....	Base of LH "A" Pillar, behind kickpad	19	30	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S325	Cross Car Harn, approx 32 cm forward of Power Seat Crossover breakout, Driver's Side			

COMPONENT	LOCATION	201-PG FIG. CONN
S345	Driver's Seat Harn, approx 14 cm from Seat Control Switch breakout	
S347	Driver's Seat Harn, approx 6 cm from Memory Module breakout	
S349	Passenger Seat Harn, approx 22 cm from C301	

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse #18. If open, repair short to ground in CKT 541.
2. Check I/P Fuse #40. If open, repair short to ground in CKT 2340.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or

resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Heated Seat inoperative.	Chart #1	8A-143-4


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graph TD
    Start([START]) --> Q1{• WITH A TEST LIGHT TO GROUND, BACKPROBE C321 TERM "A" (LH) OR C328 TERM "A" (RH). IS TEST LIGHT "ON"?}
    Q1 -- YES --> Q2{• TURN IGNITION SWITCH TO "RUN."  
• PLACE HEATED SEAT SWITCH TO "HIGH."  
• BACKPROBE C323 TERM "A" (LH) OR C330 TERM "A" (RH) WITH A TEST LIGHT TO GROUND. IS TEST LIGHT "ON"?}
    Q1 -- NO --> Q3{• CHECK I/P FUSE #40.  
• IF OPEN, REPAIR SHORT TO GROUND IN CKT 2340 AND REPLACE FUSE.  
• IF OK, CHECK FOR POOR CONNECTION AT C230 TERM "B."  
• IF OK, REPAIR OPEN IN CKT 2340.}
    Q2 -- YES --> Q4{• DISCONNECT HEATED SEAT SWITCH.  
• WITH A DVM, MEASURE RESISTANCE AT C323 (LH) SIDE OR C330 (RH) SIDE BETWEEN TERMINALS "B" AND "C" SWITCH SIDE, WITH SWITCH IN "HIGH." RESISTANCE SHOULD BE 0 OHMS; SWITCH IN "LOW" POSITION, RESISTANCE SHOULD BE 5900 OHMS. IS THE RESISTANCE CORRECT?}
    Q2 -- NO --> Q5{• WITH A TEST LIGHT TO GROUND, BACKPROBE C322 TERM "B" (LH) OR C329 TERM "A" (RH). IS TEST LIGHT "ON"?}
    Q4 -- YES --> Q6{• DISCONNECT C325 (LH) SIDE OR C332 (RH) SIDE.  
• WITH A DVM, MEASURE THE RESISTANCE BETWEEN TERM "C" AND TERM "D" ON SEAT CUSHION SIDE OF CONNECTOR. IS RESISTANCE APPROX 3000 TO 5000 OHMS?}
    Q4 -- NO --> R1[REPLACE HEATED SEAT SWITCH.]
    Q5 -- YES --> Q7{• WITH A TEST LIGHT TO B+, BACKPROBE C324 TERM "B" (LH) OR C331 TERM "B" (RH). IS TEST LIGHT "ON"?}
    Q5 -- NO --> Q8{• CHECK I/P FUSE #18.  
• IF OPEN, REPAIR SHORT TO GROUND IN CKT 541.  
• IF OK, CHECK C230 TERM "B" FOR POOR CONNECTION.  
• IF OK, REPAIR OPEN IN CKT 541.}
    Q6 -- YES --> Q9{• C325 (LH) SIDE OR C332 (RH) SIDE STILL DISCONNECTED.  
• DISCONNECT C334 (LH) OR C335 (RH).  
• WITH A DVM, MEASURE RESISTANCE FROM C325 (LH) OR C332 (RH) TERM "A" AND C334 (LH) OR C335 (RH) TERM "A" OF SEAT CUSHION SIDE. IS RESISTANCE APPROX 1 OHM?}
    Q6 -- NO --> R2[REPLACE SEAT CUSHION ELEMENT.]
    Q7 -- YES --> Q10{• CHECK G201.  
• IF OK, REPAIR OPEN IN CKT 550.}
    Q7 -- NO --> R3[REPLACE HEATED SEAT SWITCH.]
    Q9 -- YES --> Q11{• C334 (LH) OR C335 (RH) STILL DISCONNECTED.  
• WITH A DVM, MEASURE RESISTANCE BETWEEN TERMINALS "A" AND "B" OF BACK CUSHION SIDE. IS RESISTANCE APPROX 1 OHM?}
    Q9 -- NO --> R4[REPLACE SEAT CUSHION ELEMENT.]
    Q11 -- YES --> R5[REPLACE HEATED SEAT MODULE.]
    Q11 -- NO --> R6[REPLACE BACK CUSHION ELEMENT.]

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CIRCUIT OPERATION

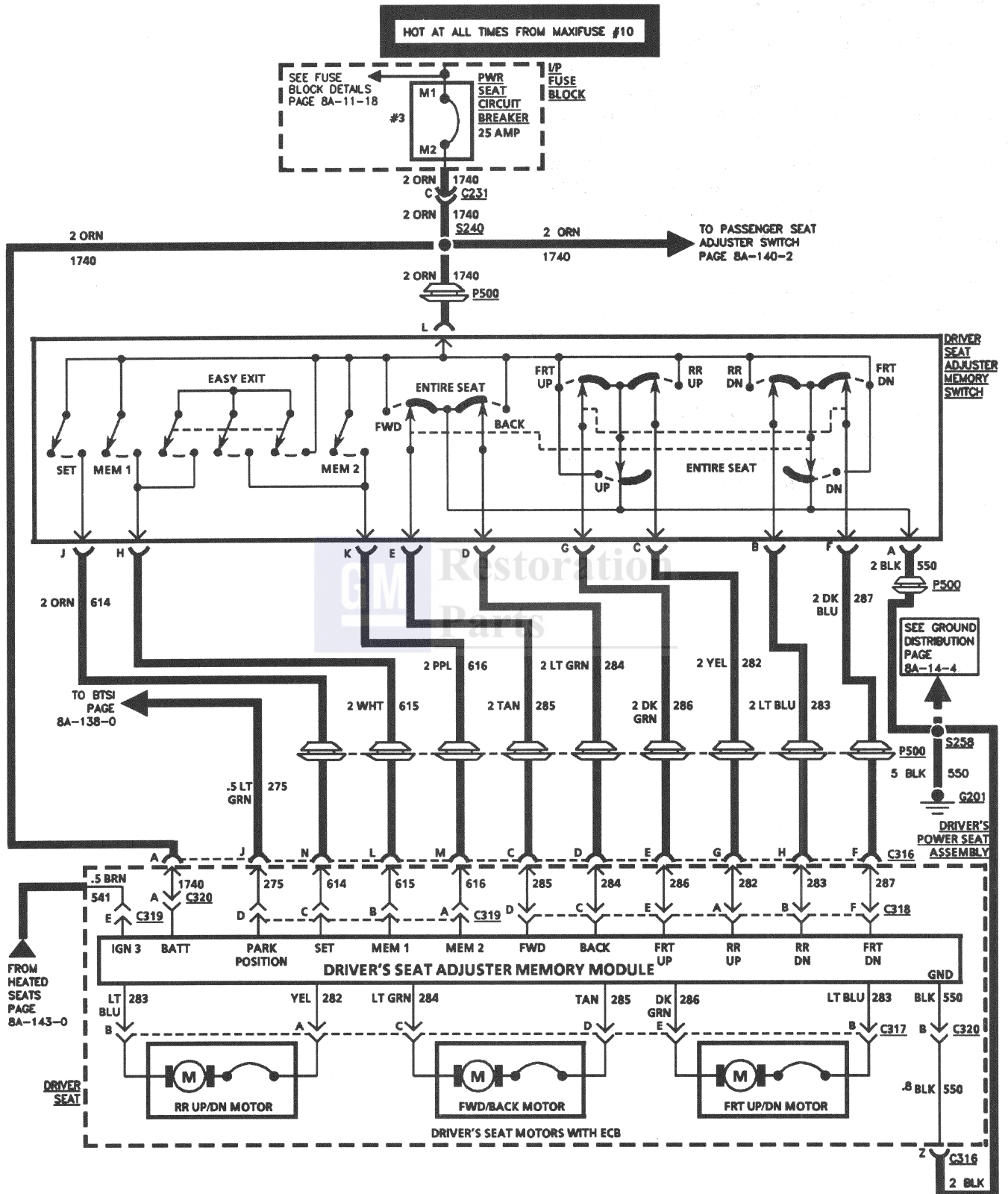
When "LO" is pressed on the Heated Seat Switch and the Ignition Switch is in "RUN," the Heated Seat Control Module LO input terminal is momentarily grounded. This causes the Seat Control Module to turn on the Heater LED Indicator and apply voltage to the Seat Heaters. The Heated Seat Control Module monitors the seat surface temperature through a thermistor located in the Center Seat Bottom. The Heated Seat Control Module will maintain the seat surface temperature at approximately 37.5° C (98.5° F) when "LO" has been selected.

Operation of the Heated Seat in the HI mode is similar to LO operation except the Heater LED Indicator will be lit and seat surface temperature will be maintained at approximately 42.5° C (107.5° F).

When the "OFF" Switch is pressed, the Heated Seat Control Module's "OFF" input is grounded momentarily. The module will react by turning off the voltage applied to the Seat Heaters. The module will also turn off the Heated Seats whenever the Ignition Switch has been cycled "OFF" and then back to "RUN."



MEMORY SEATS (BUICK)



COMPONENT	LOCATION	201-PG	FIG.	CONN
Driver's Seat Adjuster Memory Module.....	Below center of Driver's Seat.....	22	.....	33
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
C231 (8 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad	19	.....	30..... 202-6
C316 (6 cavities).....	Driver's Seat Harn to Cross-Car Harn, under Driver's Seat ...	21	.....	32
C317 (6 cavities).....	Passenger Seat Harn to Cross-Car Harn, under Passenger Seat	21	.....	32
C318 (6 cavities).....	Driver's Seat Jumper Harn to Driver's Seat Adjuster Memory Module			
C319 (6 cavities).....	Driver's Seat Jumper Harn to Driver's Seat Adjuster Memory Module			
C320 (3 cavities).....	Driver's Seat Jumper Harn to Driver's Seat Adjuster Memory Module			
G201.....	Base of LH "A" Pillar, behind kickpad	19	.....	30
P500	Between LH Front Door and "A" Pillar	19	.....	30
S240	Crossbody Harn, approx 8 cm from Door Lock Relay branch breakout			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse Block Circuit Breaker #3. If open, repair short to ground in CKT 1740.
- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to the "Symptom Table" for the appropriate diagnostic procedure(s).

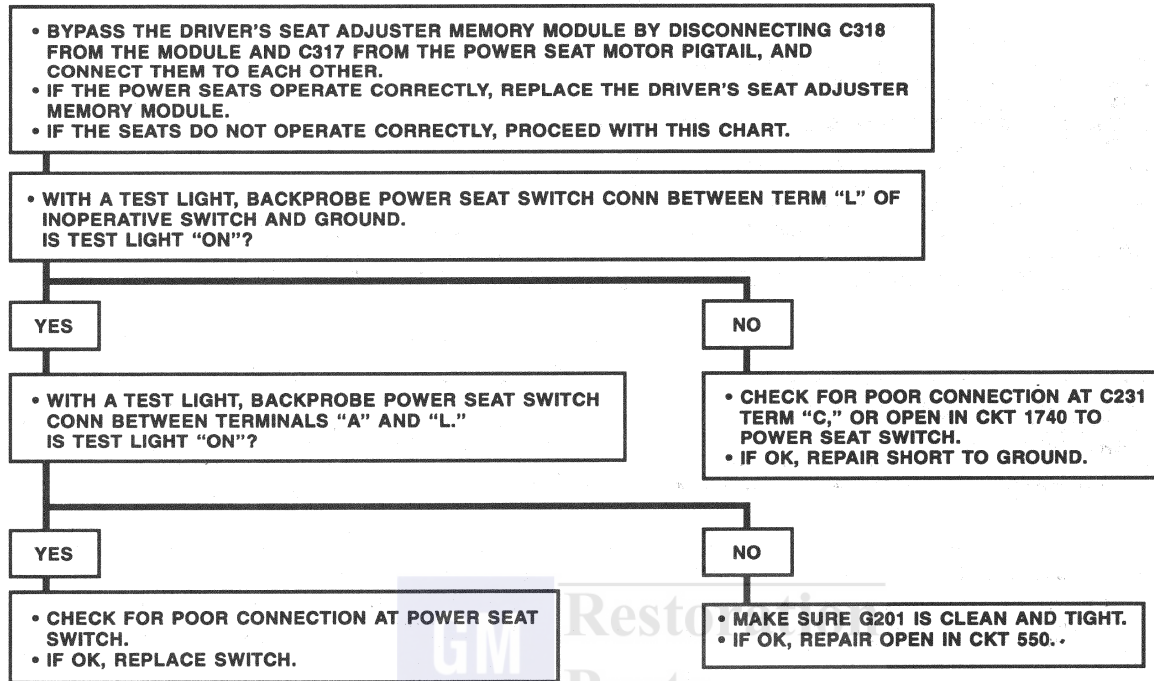
SYSTEM DIAGNOSIS

- Refer to the "Symptom Table" for the appropriate diagnostic procedure(s).

8A - 145 - 2 ELECTRICAL DIAGNOSIS**MEMORY SEATS****SYMPTOM TABLE**

SYMPTOM	PROCEDURE	PAGE NUMBER
All positions do not operate	Chart #1	8A-145-3
Seat will not move "FORWARD" and/or "BACK"	Chart #2	8A-145-4
Front Height will not move "UP" and/or "DOWN"	Chart #3	8A-145-5
Rear Height will not move "UP" and/or "DOWN."	Chart #4	8A-145-6
Memory Seat inoperative, Power Seats operate normally	Ignition "ON," Transmission in "PARK." With a test light to ground, backprobe C319 terminal "D." If test light illuminates, replace Driver's Seat Adjuster Memory Module. If test light does not illuminate, check CKT 275 for an open or short to ground. IF OK, adjust or replace Park Gear Switch.	
Power Seats do not retain memory	With a test light to ground, backprobe C319 terminal "C." If test light is not "ON," connect test light between C319 terminal "C" and C320 terminal "B." If light is "ON," replace Driver's Seat Adjuster Memory Module. If test light is "OFF," repair open in CKT 550.	
Unable to set memory for Power Seats	With a test light to ground, backprobe C319 terminal "C." Note light while depressing Set Switch. If test light is "ON," replace Driver's Seat Adjuster Memory Module. If test light is "OFF," check CKT 614 for an open. If OK, replace the Power Seat Switch.	
Memory 1 is inoperative, Memory 2 operates normally	With a test light to ground, backprobe C319 terminal "B." If a test light is "ON," replace Driver's Seat Adjuster Memory Module. If test light is "OFF," check CKT 615 for an open. If OK, replace the Memory Switch.	
Memory 2 is inoperative, Memory 1 operates normally.	With a test light to ground, backprobe C319 terminal "A." If test light is "ON," replace Driver's Seat Adjuster Memory Module. If test light is "OFF," check CKT 616 for an open. If OK, replace the Driver's Seat Adjuster Memory Switch	
Easy exit is inoperative, Memory 1 and Memory 2 operate normally.	Replace Driver's Seat Adjuster Memory Switch	

CHART #1
ALL POSITIONS DO NOT OPERATE



C10098

MEMORY SEATS

CHART #2
SEAT WILL NOT MOVE "FORWARD" AND/OR "BACK"

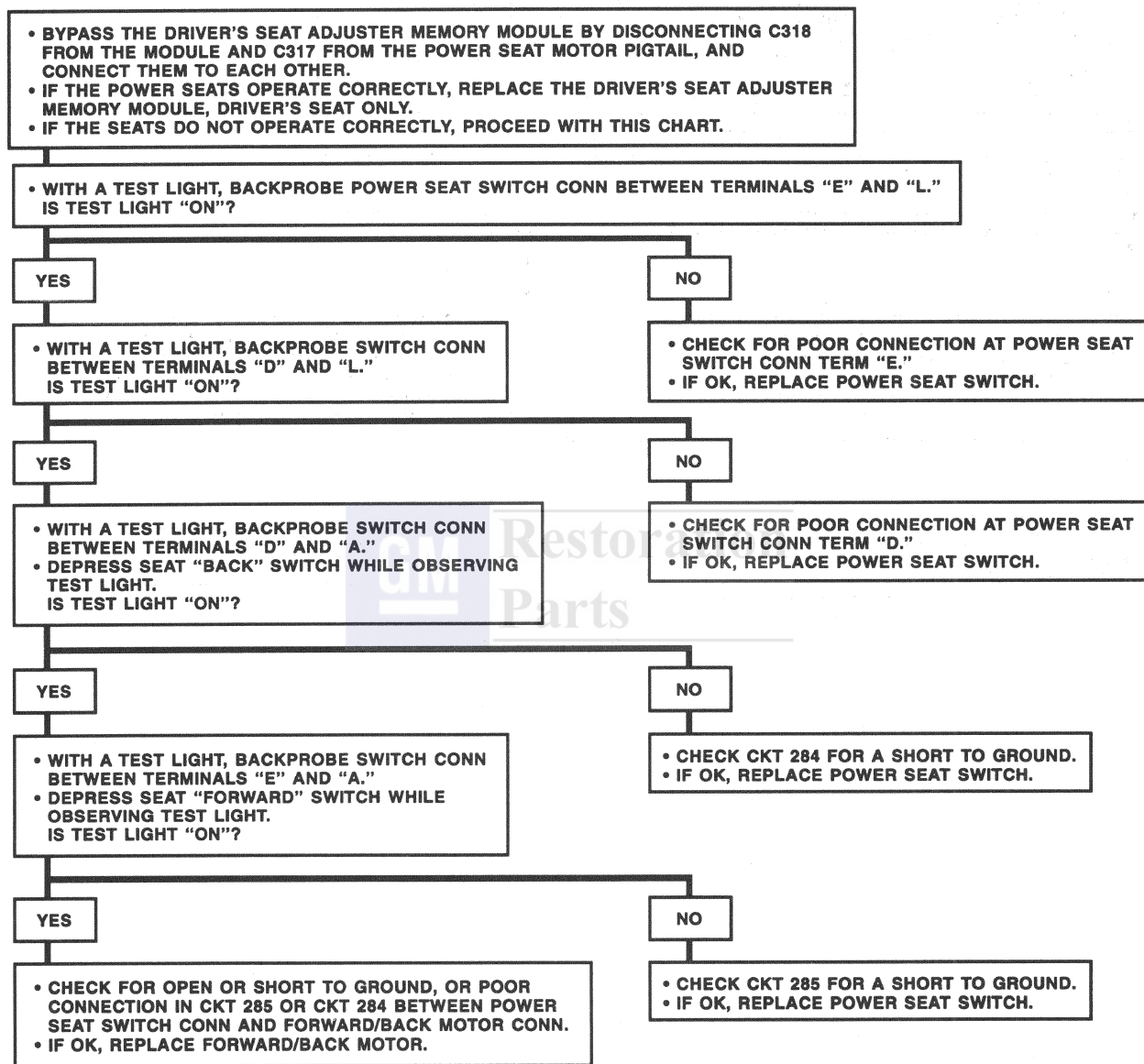
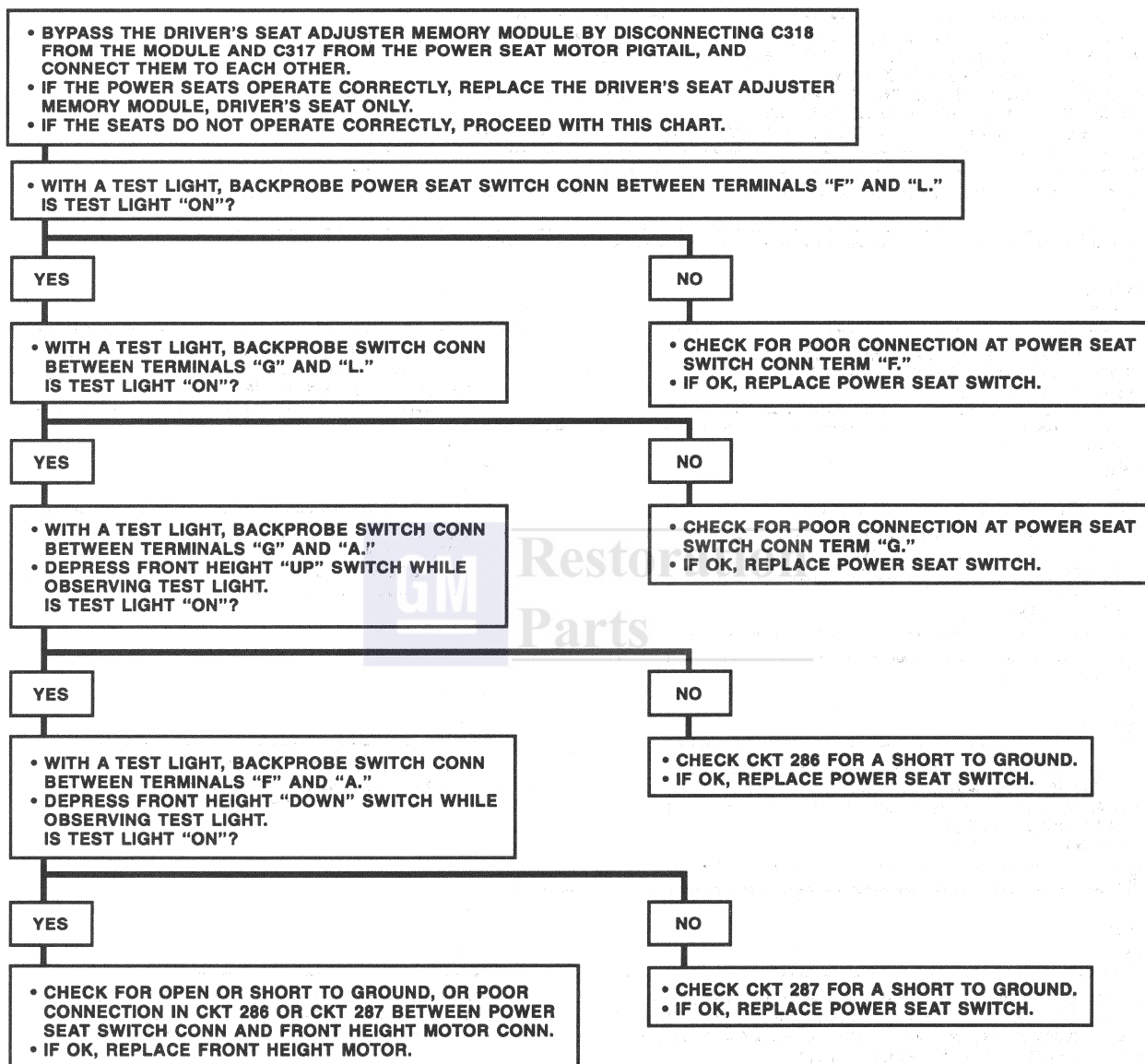


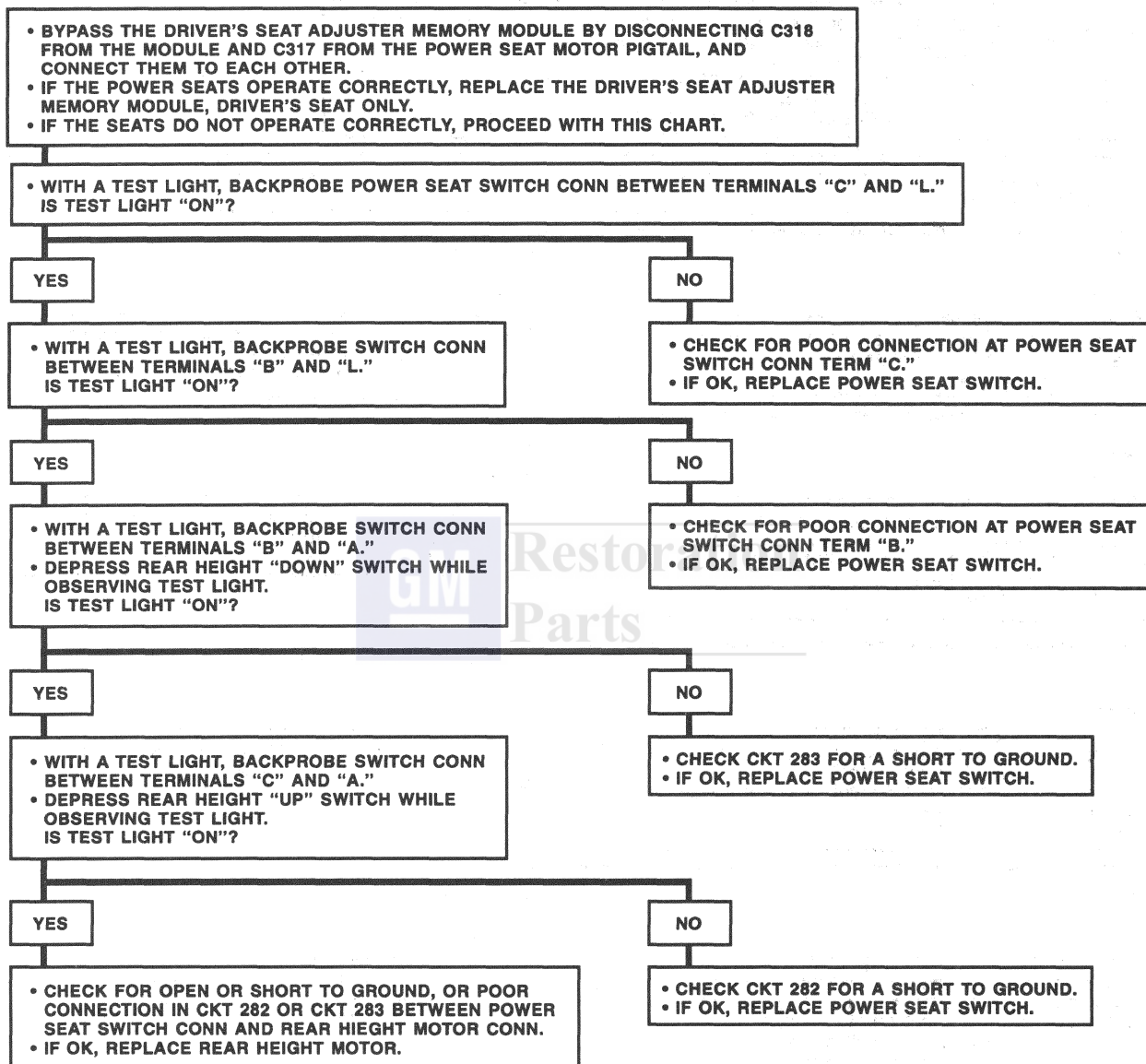
CHART #3

FRONT HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN"



MEMORY SEATS

CHART #4
REAR HEIGHT WILL NOT MOVE "UP" AND/OR "DOWN"



CIRCUIT OPERATION

The six-way power seats move when voltage is applied to one or more of the three Seat Motors. The direction the motor turns depends on the polarity of the supply voltage which is set by the control switches and sent to the motors by the Seat Memory Module. Note that control power only, not motor power, comes from the LH Seat Switch.

The three Seat Motors directly operate the three seat movements: Front Height, Rear Height, and Forward/Back.

The Driver's Seat Adjuster Memory Module must see 12 volts at terminal "D," from the Park/Neutral Position and Backup Lamp Switch Assembly. Voltage will be present if the gear selector is in the "PARK" position. Once the gear selector is moved out of the "PARK" position, voltage will not be present at terminal "D" of the Driver's Seat Adjuster Memory Module, therefore disabling the Memory Seats.

Voltage from the I/P Fuse Block Circuit Breaker is first applied to the Driver's Seat Adjuster Memory Module, which then operates the motors, depending on the switch inputs received.

The Driver's Seat Adjuster Memory Module controls the three Seat Motors by turning them off and on by using their selected directions. These selections are made by counting motor pulses produced when the seat is moved to the desired position for the first time.

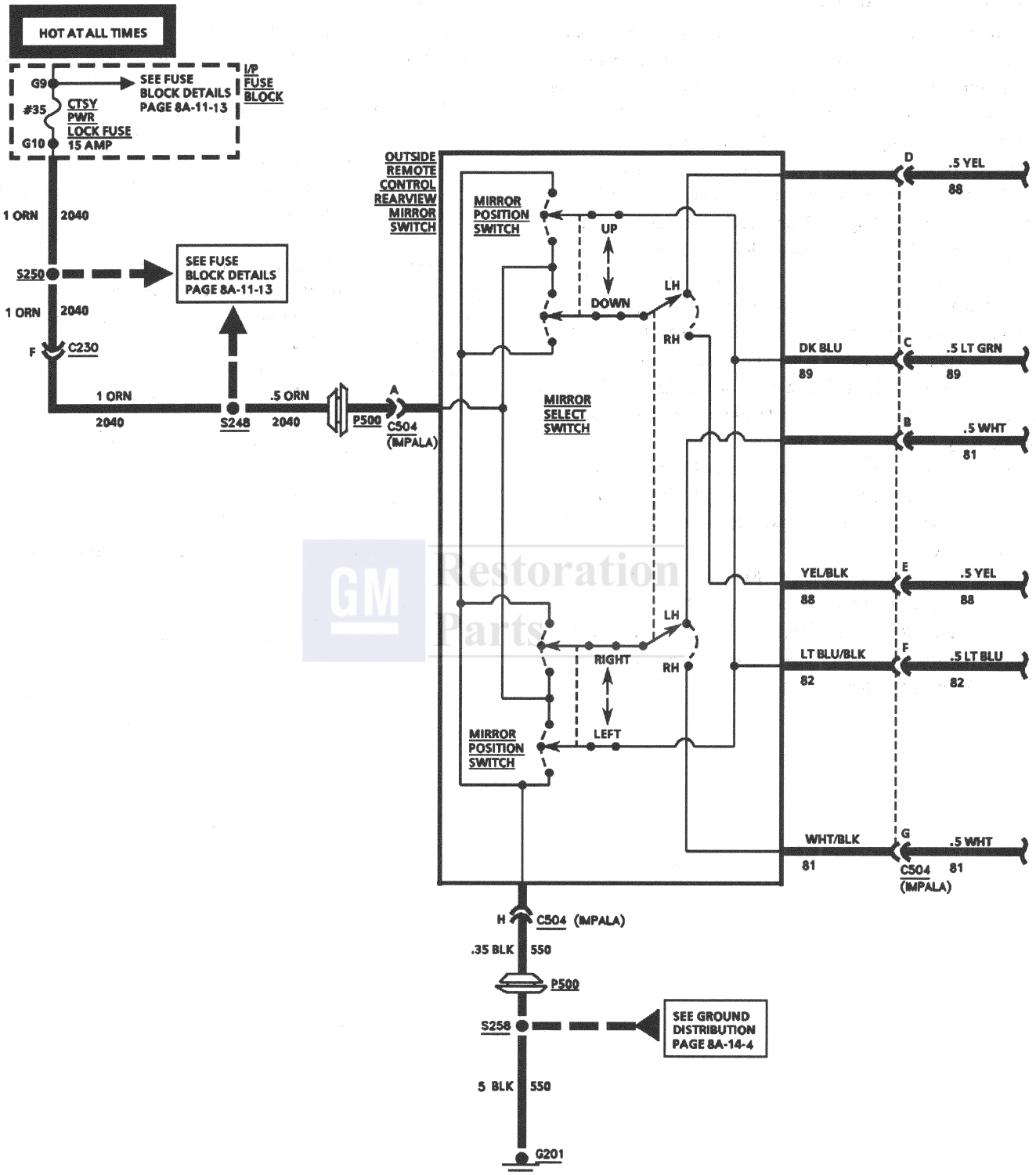
The Memory Seat System provides an automatic return of the Driver's Seat to one of two reset positions. When a switch is closed to operate the Power Seat, the Driver's Seat Adjuster Memory Module transmits the voltage applied from the switch to the Seat Motors. In addition, the Driver's Seat Adjuster Memory Module counts the pulses that are produced by the operation of each motor. The Solid State unit in the module stores this pulse count in its memory, and is able to remember the seat location.

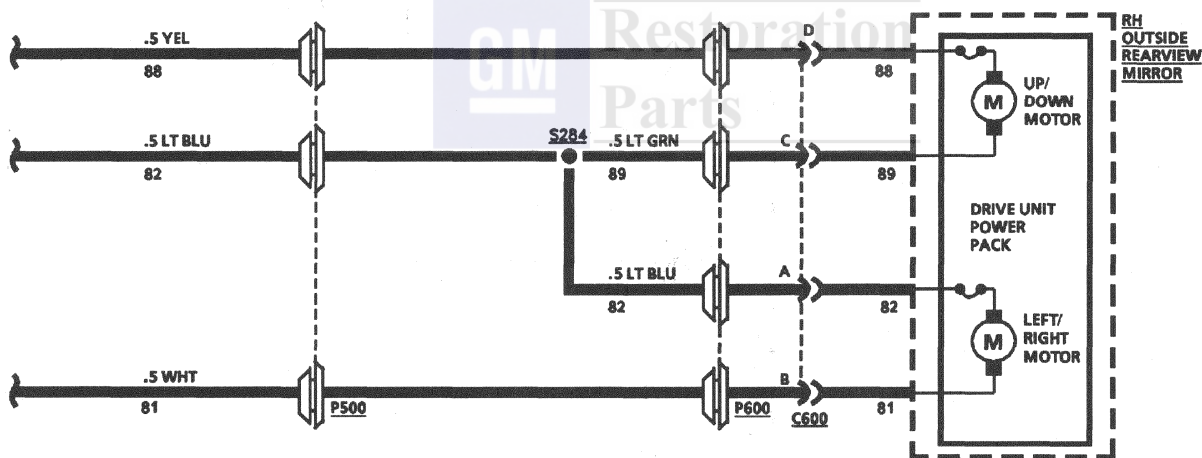
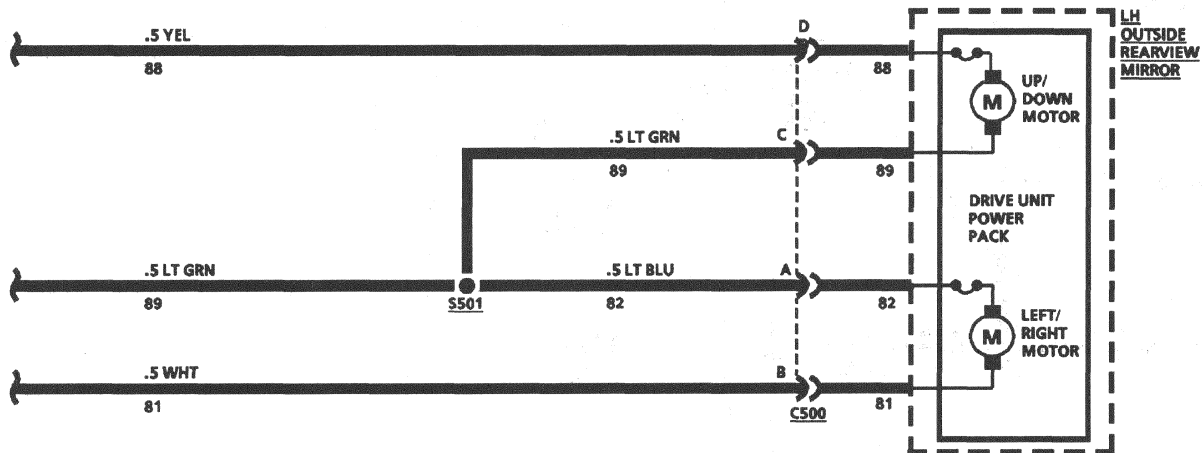
If the "SET MEMORY BUTTOM" is pushed, and the Memory Select Switch is moved to either the Memory 1 position or Memory 2 position, then the pulse count for each of the three motors are stored. When that memory position is selected at a later time, the seat will return to that set position.

With the Easy Exit Switch closed, voltage is applied simultaneously to the Memory 1 and Memory 2 inputs of the Driver's Seat Adjuster Memory Module. The module takes this as a signal to move the seat to a fully down and fully back position. The module applies voltage to all three LH seat motors until the seat is fully back and down. The Easy Exit function will operate the Ignition Switch I "OFF."

Each motor contains an electronic circuit breaker (ECB). It resets only after voltage is removed from the motor.

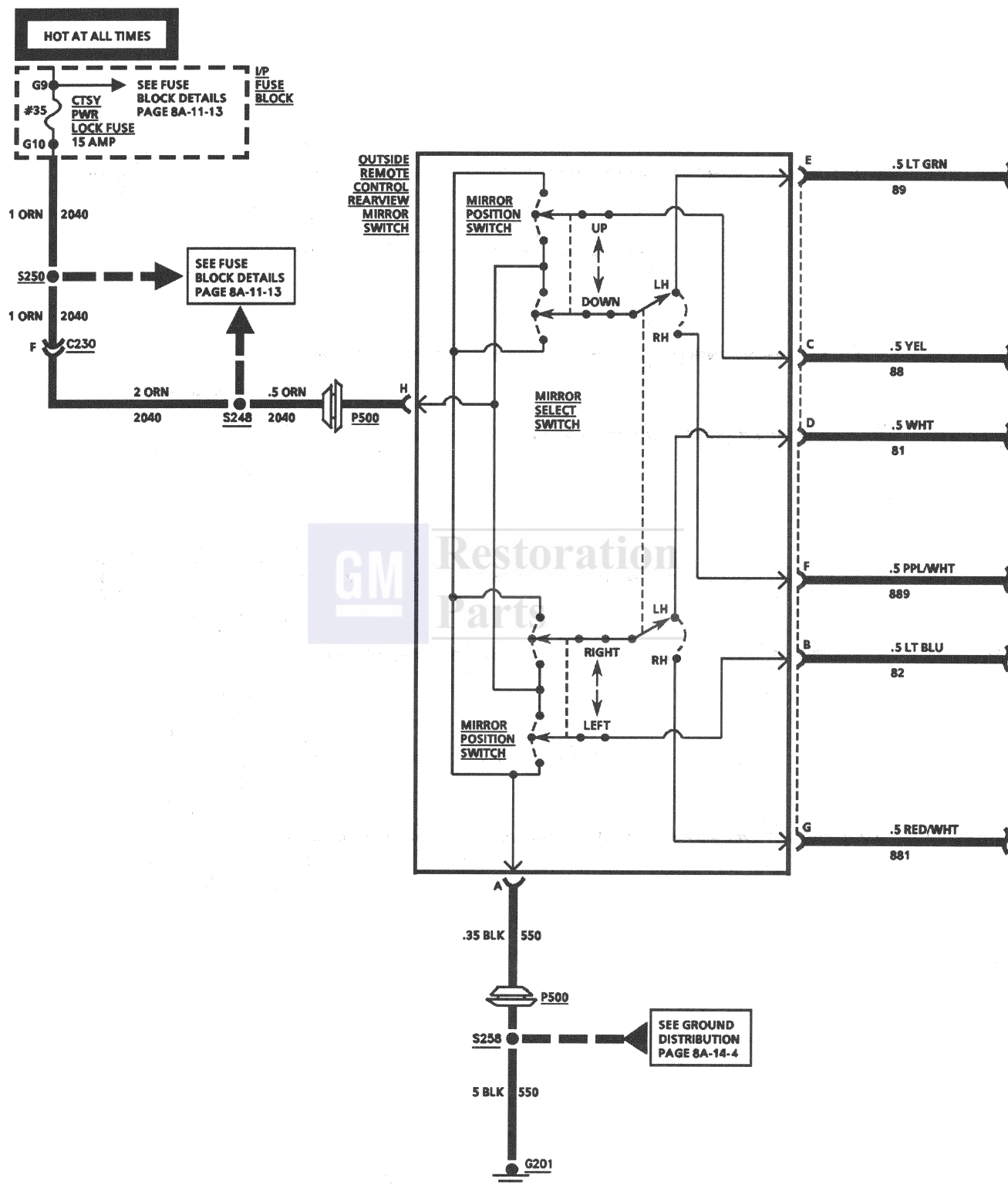
POWER MIRRORS (CHEV)

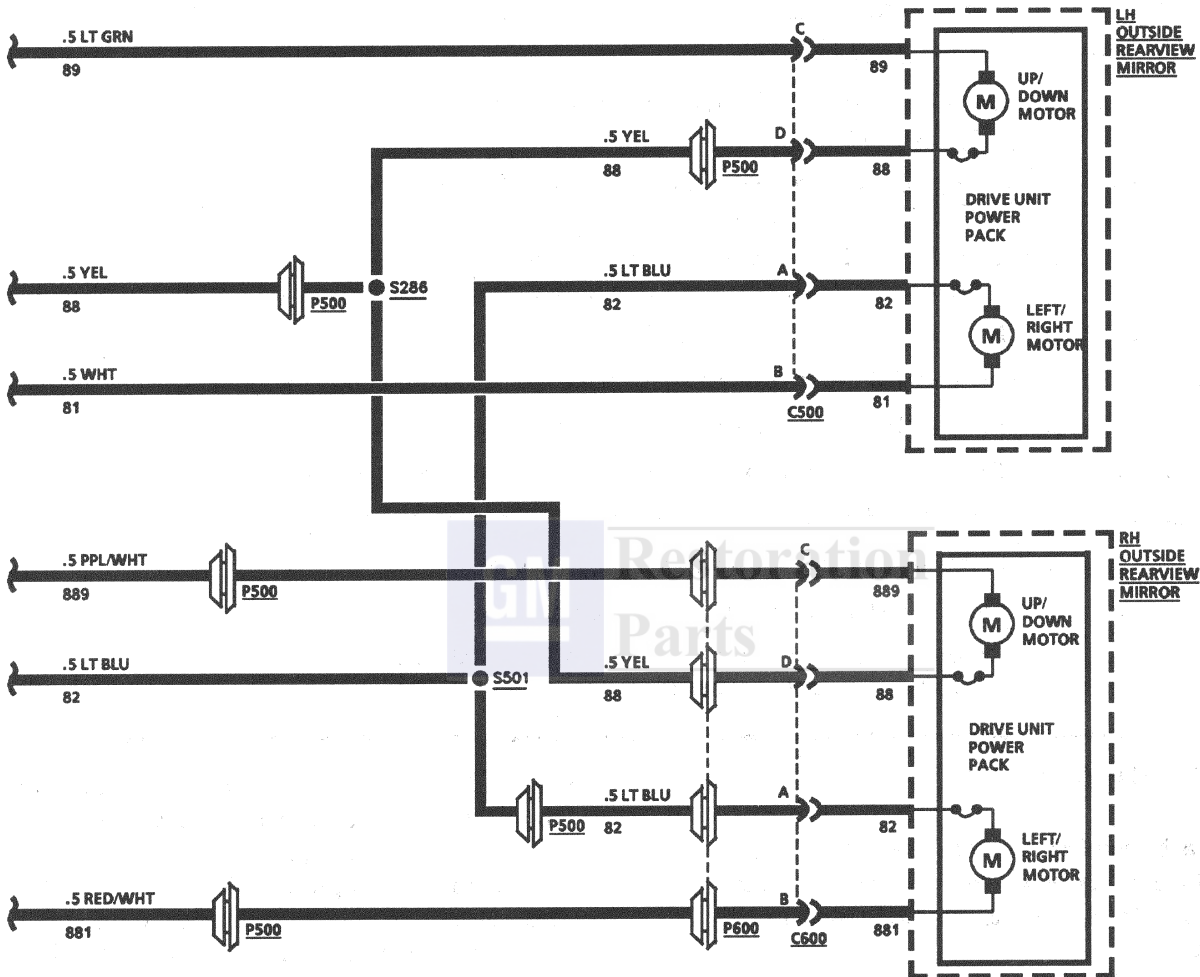




8A - 147 - 2 ELECTRICAL DIAGNOSIS

POWER MIRRORS (BUICK)





8A - 147 - 4 ELECTRICAL DIAGNOSIS

POWER MIRRORS

COMPONENT	LOCATION	201-PG	FIG.	CONN
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
LH Outside Rearview Mirror....	LH Front Door			
Outside Remote Control Rearview Mirror Switch.....	LH Front Side Door, attached to Front Side Door inside Handle Bezel.....	19	.....	30
RH Outside Rearview Mirror....	RH Front Door			
C302 (10 cavities).....	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" Pillar			
C500 (8 cavities).....	Crossbody and Side Door Harn to LH Outside Rear View Mirror	19	.....	30..... 202-8
C600 (8 cavities).....	Crossbody and Side Door Harn to RH Outside Rearview Mirror	23	.....	34..... 202-8
G200.....	Base of LH "A" Pillar, behind kickpad	19	.....	30
P500	Between LH Front Door and "A" Pillar	19	.....	30
P600	Between RH Front Door and "A" Pillar	23	.....	34
S248	Crossbody Harn, approx 8 cm from C231 branch breakout			
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S307	Body Harn, approx 17 cm from C309 breakout			
S312	Cross Car Harn, approx 8 cm from C302 breakout			
S501	Crossbody Harn, approx 4 cm from LH Front Side Window Regulator Motor Conn breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check I/P Fuse Block Fuse #35 by operating door locks. If Fuse #35 is open, check CKT 2040 for a short to ground.
2. Check that ground G200 is clean and tight.
3. If both mirrors are inoperative, check for poor connection at Outside Remote Control Rearview Mirror Switch.
4. If only one mirror operates properly, check for poor connection at C500 (LH Outside Mirror) or C600 (RH Outside Mirror).
 - Refer to SECTION 10-6 for Outside Rearview Mirror replacement.

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedure(s).

SYSTEM CHECK

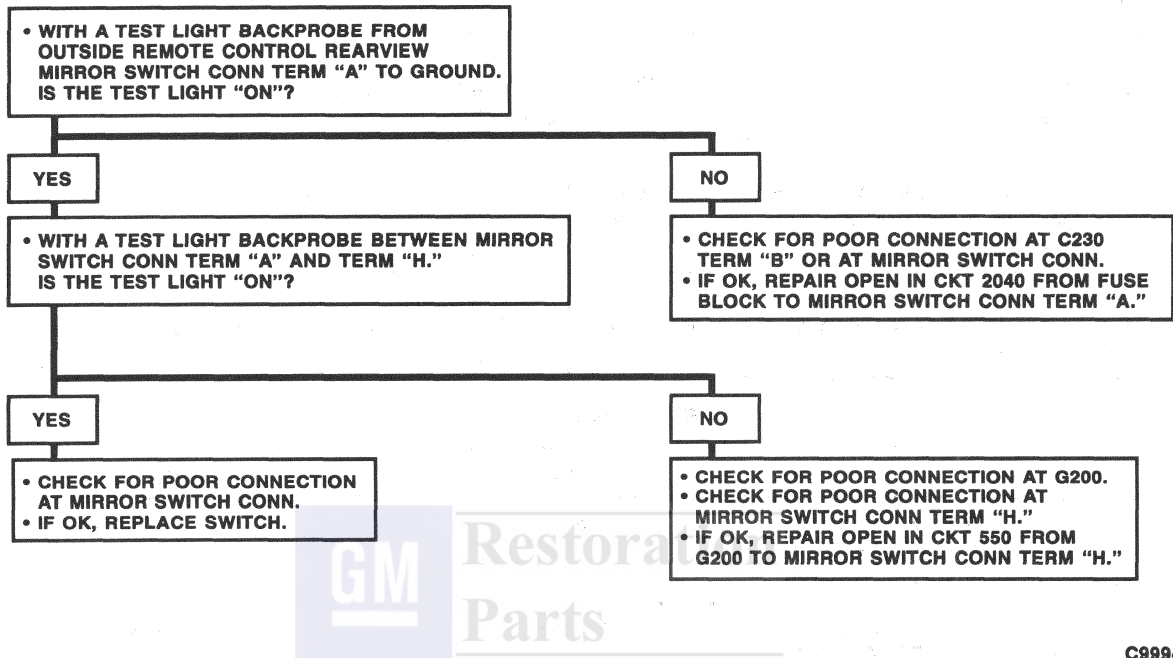
ACTION	NORMAL RESULTS
[1] • Move Mirror Select Switch to "LEFT" position. Operate Mirror Position Switch in "UP" and "DOWN" positions.	LH Outside Rearview Mirror moves smoothly upward and downward.
[2] • Operate Mirror Position Switch in the "LEFT" and "RIGHT" positions.	LH Outside Rearview Mirror moves smoothly to the left and right.
[3] • Move Mirror Select Switch to "RIGHT" position. Operate Mirror Position Switch in "UP" and "DOWN" positions.	RH Outside Rearview Mirror moves smoothly upward and downward.
[4] • Operate Mirror Position Switch in the "LEFT" and "RIGHT" positions.	RH Outside Rearview Mirror moves smoothly to the left and right.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Both mirrors do not operate in either ("UP/DOWN" or "LEFT/RIGHT") mode (Chev).	Chart #1	8A-147-6
One mirror does not operate in the "UP/DOWN" mode ("LEFT/RIGHT" mode operates normally)(Chev).	Chart #2	8A-147-6
One mirror will not operate in the "LEFT/RIGHT" mode ("UP/DOWN" mode operates normally)(Chev).	Chart #3	8A-147-7
One mirror will not operate in either ("UP/DOWN" or "LEFT/RIGHT") mode (Chev).	Chart #4	8A-147-7
Both mirrors do not operate in either ("UP/DOWN" or "LEFT/RIGHT") mode (Buick).	Chart #5	8A-147-8
One mirror does not operate in the "UP/DOWN" mode ("LEFT/RIGHT" mode operates normally)(Buick).	Chart #6	8A-147-8
One mirror will not operate in the "LEFT/RIGHT" mode ("UP/DOWN" mode operates normally)(Buick).	Chart #7	8A-147-9
One mirror will not operate in either ("UP/DOWN" or "LEFT/RIGHT") mode (Buick).	Chart #8	8A-147-9

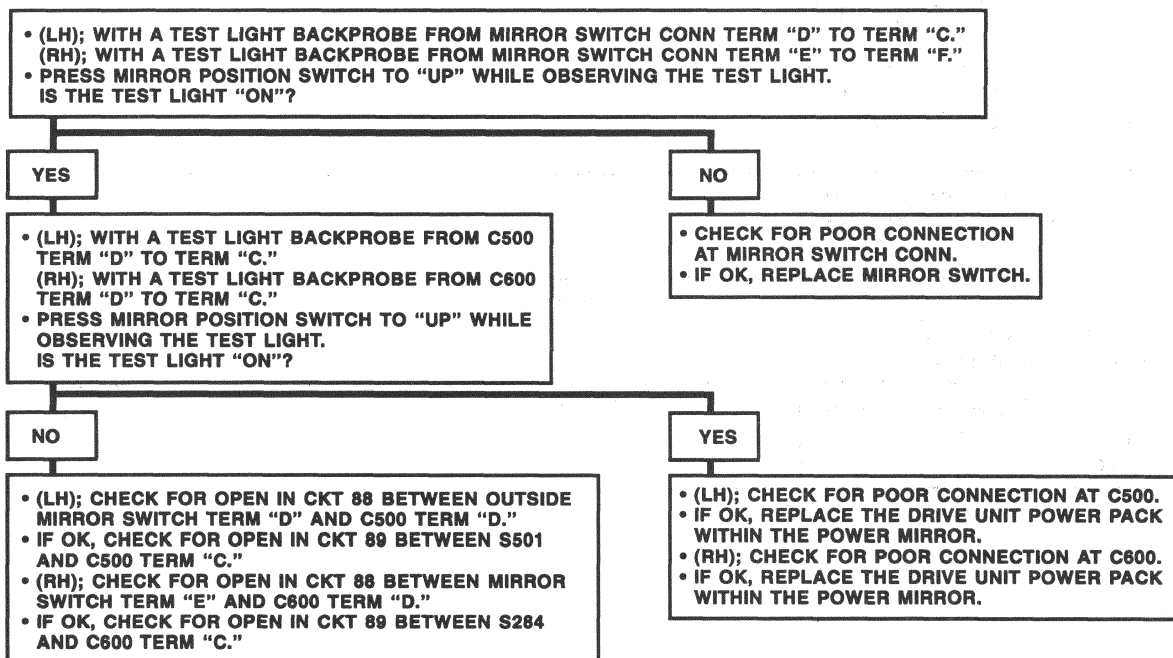
POWER MIRRORS

CHART #1
BOTH MIRRORS DO NOT OPERATE IN EITHER
("UP/DOWN" OR "LEFT/RIGHT") MODE



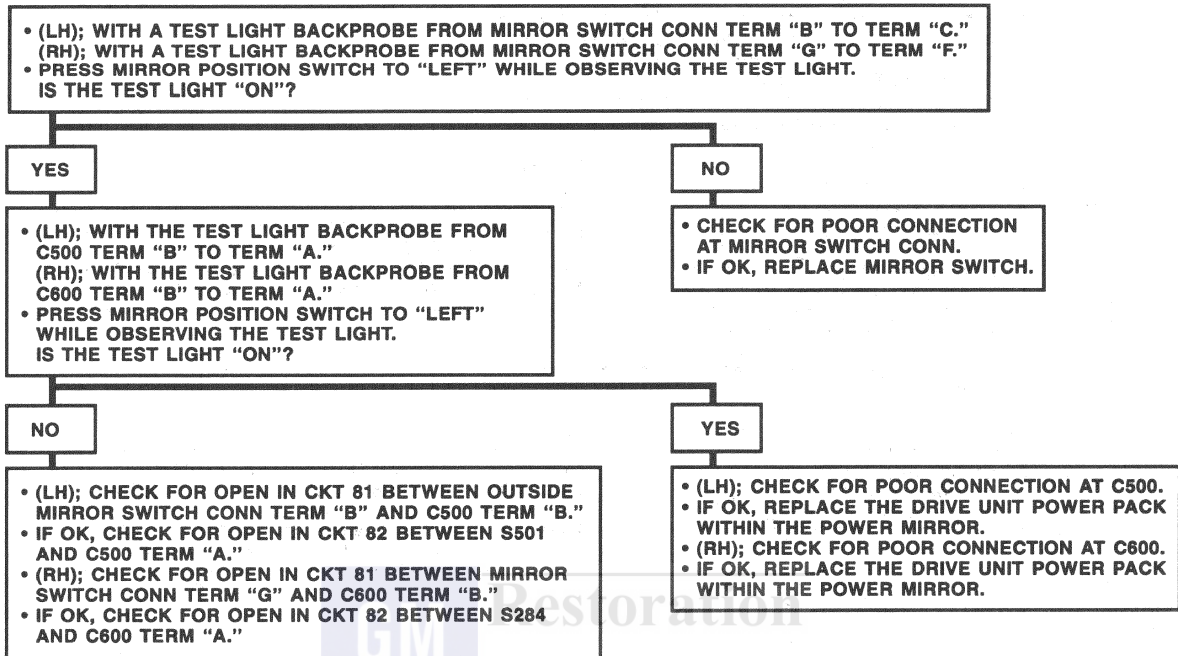
C9994

CHART #2
ONE MIRROR DOES NOT OPERATE IN THE "UP/DOWN" MODE
("LEFT/RIGHT" MODE OPERATES NORMALLY)



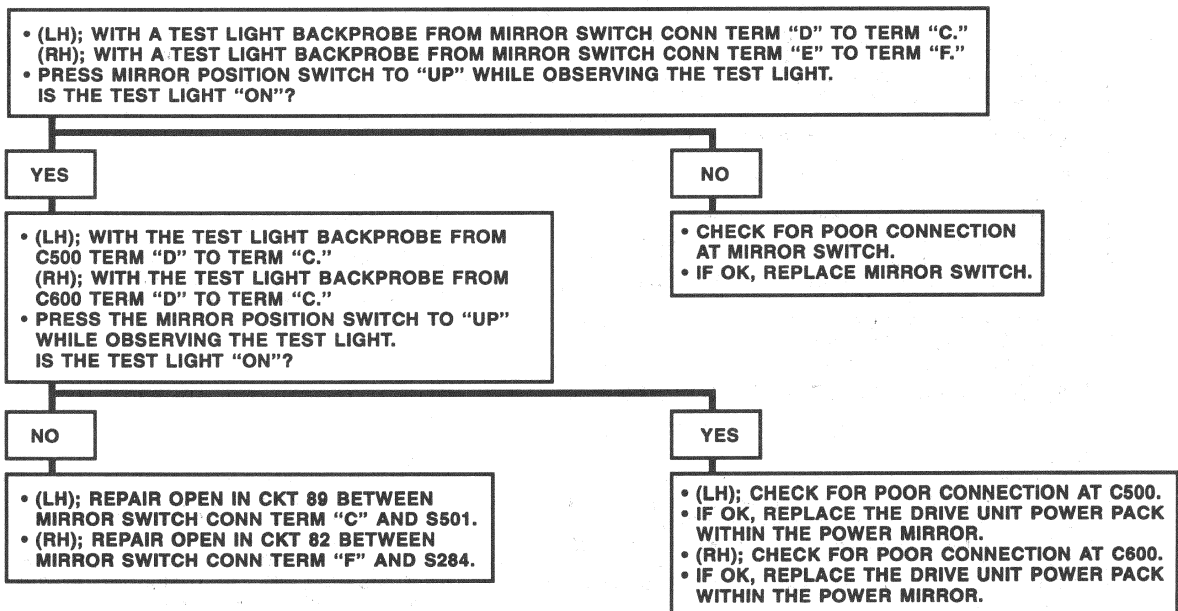
C9995

CHART #3
ONE MIRROR WILL NOT OPERATE IN THE "LEFT/RIGHT" MODE
("UP/DOWN" MODE OPERATES NORMALLY)



C9996

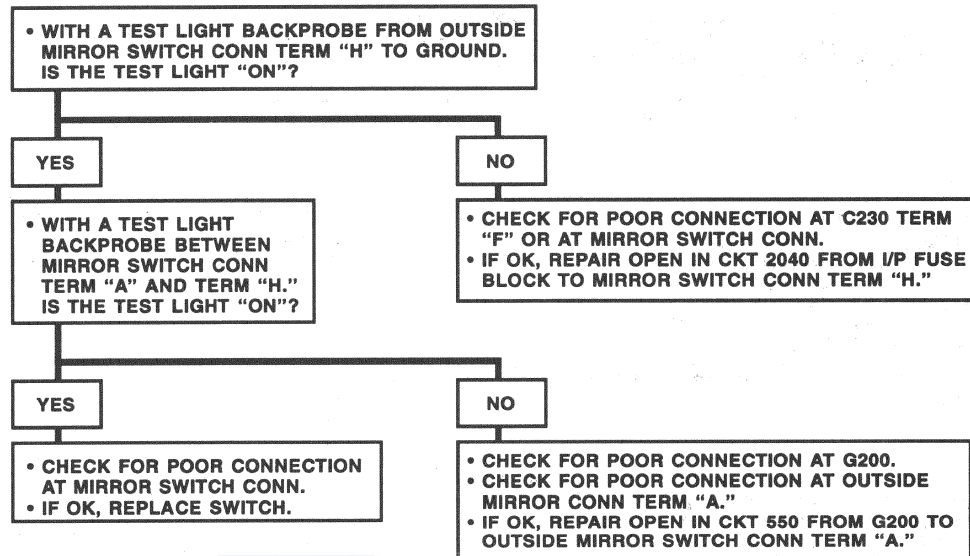
CHART #4
ONE MIRROR WILL NOT OPERATE IN EITHER
("UP/DOWN" OR "LEFT/RIGHT") MODE



C9997

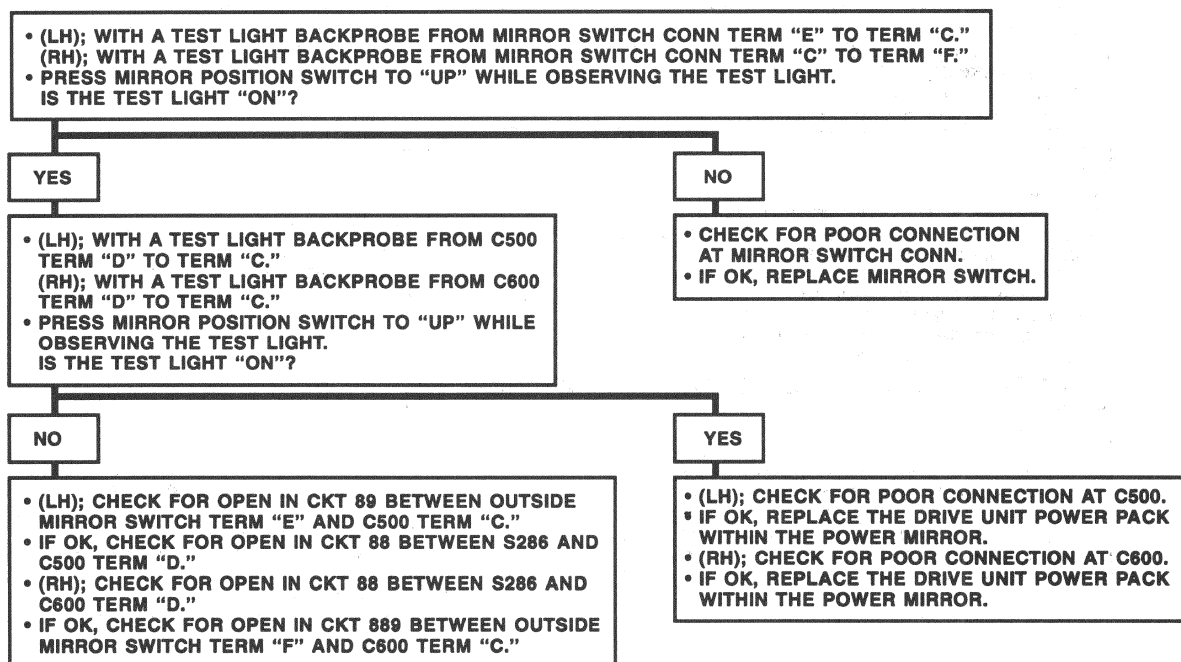
POWER MIRRORS

CHART #5
BOTH MIRRORS DO NOT OPERATE IN EITHER
("UP/DOWN" OR "LEFT/RIGHT") MODE



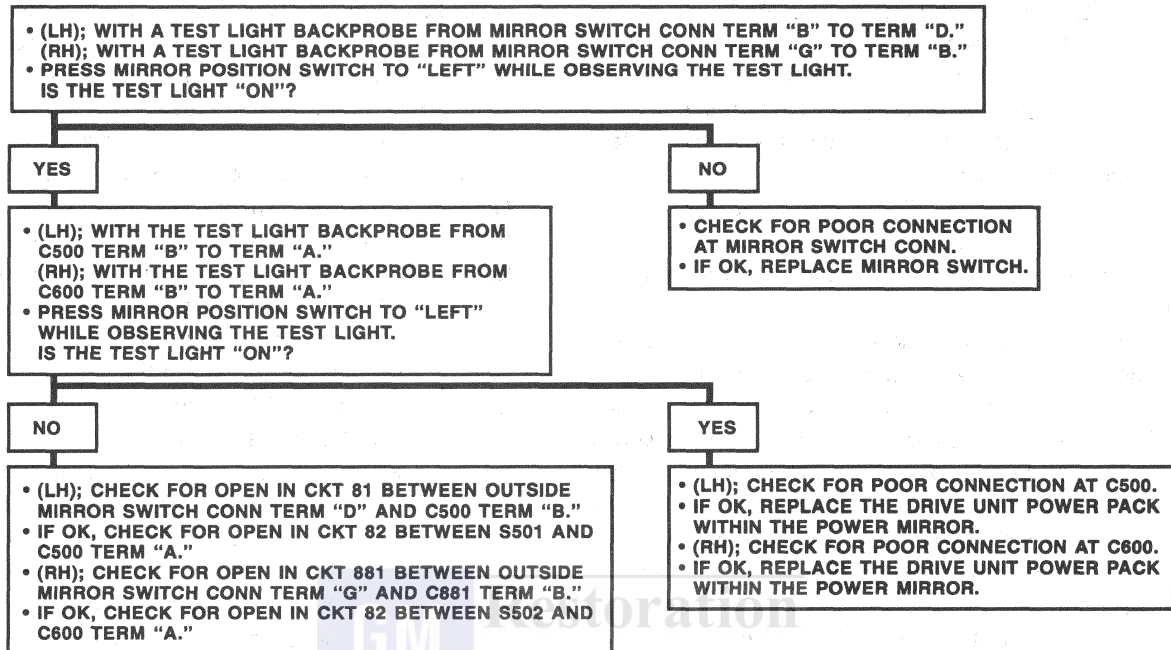
C9999

CHART #6
ONE MIRROR DOES NOT OPERATE IN THE "UP/DOWN" MODE
("LEFT/RIGHT" MODE OPERATES NORMALLY)



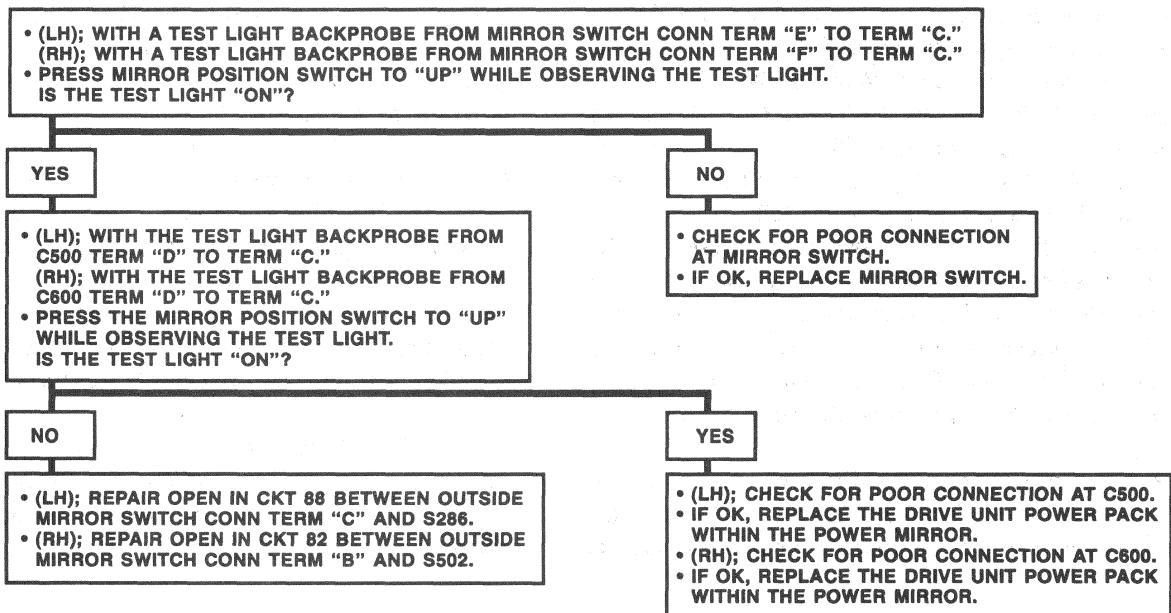
C10000

CHART #7
ONE MIRROR WILL NOT OPERATE IN THE "LEFT/RIGHT" MODE
("UP/DOWN" MODE OPERATES NORMALLY)



C9998

CHART #8
ONE MIRROR WILL NOT OPERATE IN EITHER ("UP/DOWN" OR
"LEFT/RIGHT") MODE



C10001

POWER MIRRORS**CIRCUIT OPERATION (CHEV)**

Each Outside Rearview Mirror has two reversible motors. One adjusts the mirror up and down, and the other adjusts the mirror right and left. These motors are controlled by the Outside Remote Control Rearview Mirror Switch. The Mirror Switch contains a Mirror Position Switch. The Mirror Position Switch is a five-position switch that controls the polarity of the voltage to the motors. The Mirror Switch also contains a Mirror Select Switch, which directs the voltage to either the RH or LH Outside Rearview Mirror. The Outside Mirror Switch receives battery voltage at all times from I/P Fuse Block Fuse #35 through CKT 2040 and is permanently grounded at G200.

When the LH Outside Rearview Mirror is selected, the Mirror Position Switch will control the motors of the LH Outside Mirror. When the Mirror Position Switch is pressed to the "UP" position, voltage is applied to the Up/Down Motor of the LH Outside Rearview Mirror through CKT 88. Ground will be provided to the Up/Down Motor by the Mirror Switch through CKT 89. The Up/Down Motor in the LH Outside Rearview Mirror will run and turn the LH Outside Rearview Mirror up.

When the Mirror Position Switch is pressed to the "DOWN" position, voltage is applied to the Up/Down Motor of the LH Outside Rearview Mirror through CKT 89, and ground is provided through CKT 88. This will cause the Up/Down Motor to rotate in the opposite direction, and turn the LH Outside Rearview Mirror down.

The Left/Right Motor of the LH Outside Rearview Mirror operates in a similar manner. When the Mirror Position Switch is pressed to the "LEFT" position, voltage is applied to the Left/Right Motor of the LH Outside Rearview Mirror through the CKT 81. Ground will be provided to the Left/Right Motor by the Mirror Switch through CKT 89. The Left/Right Motor will run and turn the LH Outside Rearview Mirror to the left.

When the Mirror Position Switch is pressed to the "RIGHT" position, voltage is applied to the Left/Right Motor of the LH Outside Rearview Mirror through the CKT 89, and ground is provided through CKT 81. This will cause the Left/Right Motor to rotate in the opposite direction, and turn the LH Outside Rearview Mirror to the right.

The RH Outside Rearview Mirror is adjusted in the same way when the Mirror Select Switch is moved to the "RH" position and the appropriate position switch is operated.

CIRCUIT OPERATION (BUICK)

Each Outside Rearview Mirror has two reversible motors. One adjusts the mirror up and down, and the other adjusts the mirror right and left. These motors are controlled by the Outside Remote Control Rearview Mirror Switch. The Mirror Switch contains a Mirror Position Switch. The Mirror Position Switch is a five-position switch that controls the polarity of the voltage to the motors. The Mirror Switch also contains a Mirror Select Switch, which directs the voltage to either the RH or LH Outside Rearview Mirror. The Mirror Switch receives battery voltage at all times from I/P Fuse Block Fuse #35 through CKT 2040 and is permanently grounded at G200.

When the LH Outside Rearview Mirror is selected, the Mirror Position Switch will control the motors of the LH Outside Rearview Mirror. When the Mirror Position Switch is pressed to the "UP" position, voltage is applied to the Up/Down Motor of the LH Outside Rearview Mirror through CKT 89. Ground will be provided to the Up/Down Motor by the Mirror Switch through CKT 88. The Up/Down Motor in the LH Outside Rearview Mirror will run and turn the LH Outside Rearview Mirror up.

When the Mirror Position Switch is pressed to the "DOWN" position, voltage is applied to the Up/Down Motor of the LH Outside Rearview Mirror through CKT 88 and ground is provided through CKT 89. This will cause the Up/Down Motor to rotate in the opposite direction, and turn the LH Outside Rearview Mirror down.

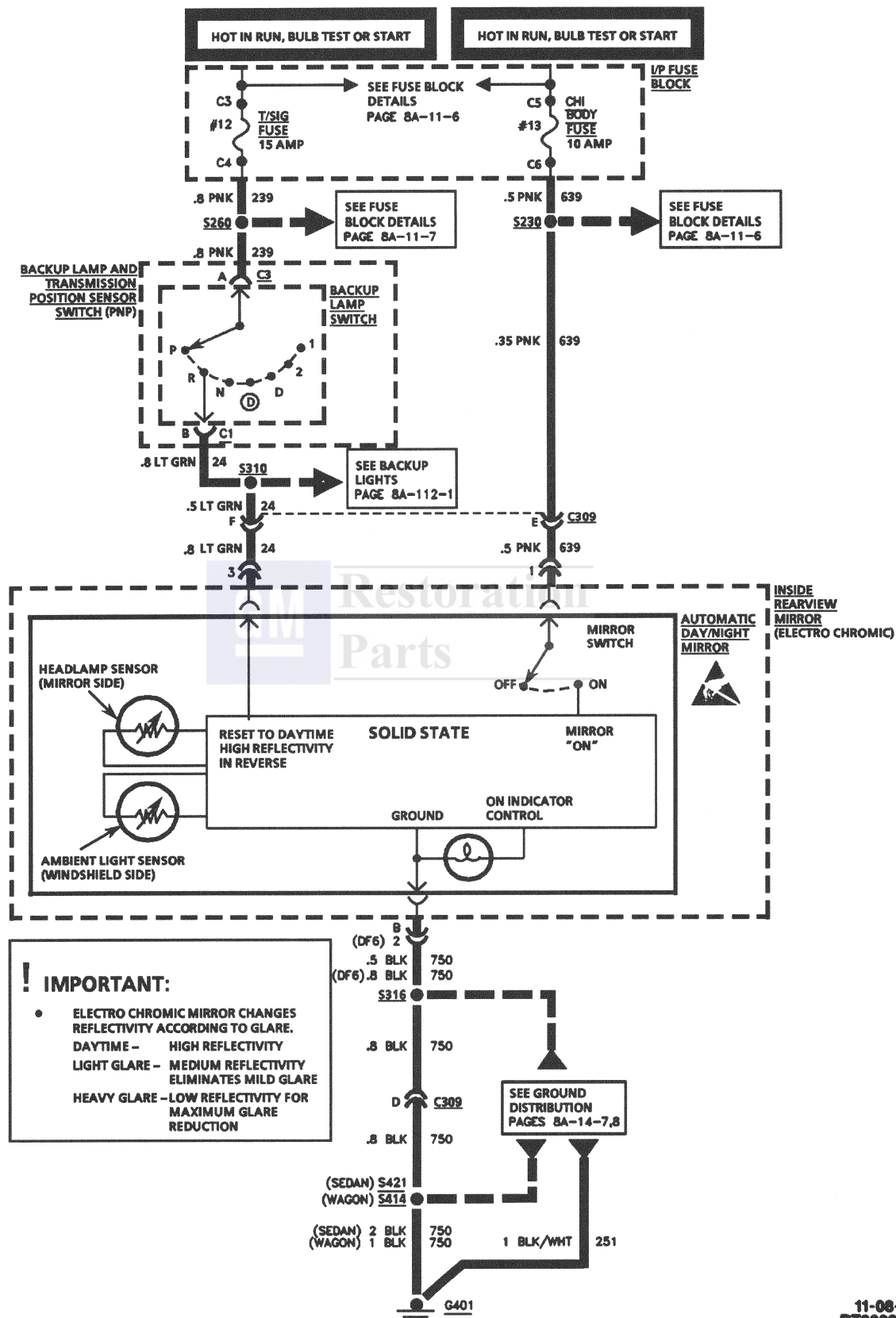
The Left/Right Motor of the LH Outside Rearview Mirror operates in a similar manner. When the Mirror Position Switch is pressed to the "LEFT" position, voltage is applied to the Left/Right Motor of the LH Outside Rearview Mirror through the CKT 81. Ground will be provided to the Left/Right Motor by the Mirror Switch through CKT 82. The Left/Right Motor will run and turn the LH Outside Rearview Mirror to the left.

When the Mirror Position Switch is pressed to the "RIGHT" position, voltage is applied to the Left/Right Motor of the LH Outside Rearview Mirror through the CKT 82 and ground is provided through CKT 81. This will cause the Left/Right Motor to rotate in the opposite direction, and turn the LH Outside Rearview Mirror to the right.

The RH Outside Rearview Mirror is adjusted in the same way when the Mirror Select Switch is moved to the "RH" position and the appropriate position switch is operated.



AUTOMATIC DAY/NIGHT MIRROR



SEE PAGE 8A-3-0
FOR MEASURING
AND HANDLING
PROCEDURES

COMPONENT	LOCATION	201-PG	FIG.	CONN
Backup Lamp and Transmission Position Sensor Switch (PNP)	Near base of Steering Column, on column			
Inside Rearview Mirror.....	Mounted on Windshield			
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	.....	19
C309 (6 cavities).....	Body Harn to Roof Harn, near Dome Lamp.....	25	.....	36..... 202-6
G401.....	LH Rear Wheelhouse in Luggage Compartment			
S230	Body Harn, approx 4 cm from BTSI Conn breakout			
S260	Body Harn, approx 12 cm from Convenience Center branch breakout			
S310	Body Harn, approx 4 cm from C309 breakout			
S316	Roof Harn, in C309 branch, approx 32 cm from breakout			
S414	Body Harn, approx 26 cm from Remote Control Door Lock Module breakout			
S421	Body Harn, approx 14 cm from High Mount Stoplamp breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

1. Check that the mirror is getting power from I/P Fuse Block Fuse #13 by observing that the label on the mirror "ON" indicator is illuminated.
2. Check the Backup Lamp Switch and I/P Fuse Block Fuse #12 by checking operation of the Backup Lamps.
3. Be sure photocells are not dirty or obstructed.
 - Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system

disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System Check and refer to the Symptom Table for the appropriate diagnostic procedures.

8A - 148 - 2 ELECTRICAL DIAGNOSIS

AUTOMATIC DAY/NIGHT MIRROR

SYSTEM CHECK

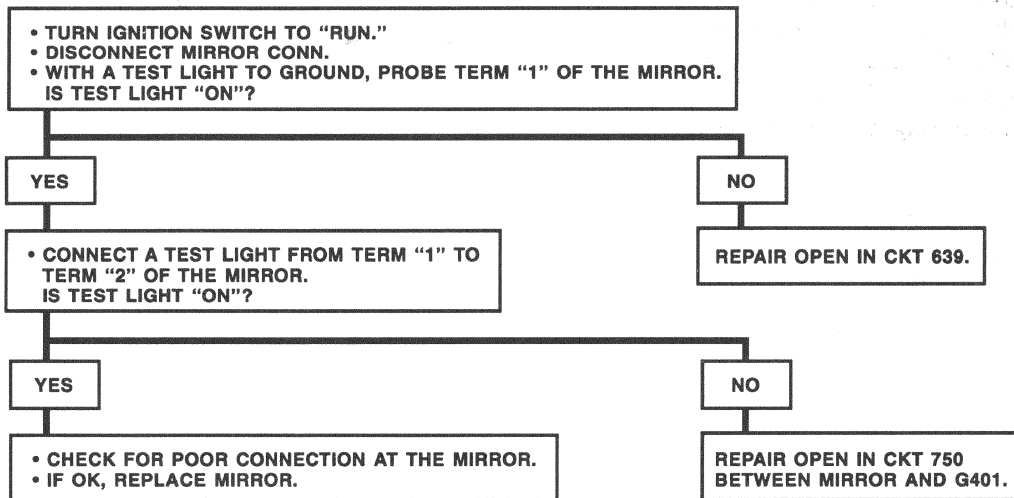
ACTION	NORMAL RESULTS
[1] • Cover Ambient Light Sensor (windshield side) with dark cloth. • Shine light on Headlamp Sensor (mirror side).	Mirror gradually darkens.
[2] • Gear Selector Lever: "REVERSE."	Mirror gradually lightens to clear state.
[3] • Gear Selector Lever: "PARK."	Mirror gradually darkens.
[4] • Remove cloth and light.	Mirror gradually lightens to clear state.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Mirror does not darken at night with lights shining on mirror.	Chart #1	8A-148-3
Mirror does not lighten to clear state with Gear Selector Lever in "REVERSE."	Chart #2	8A-148-3

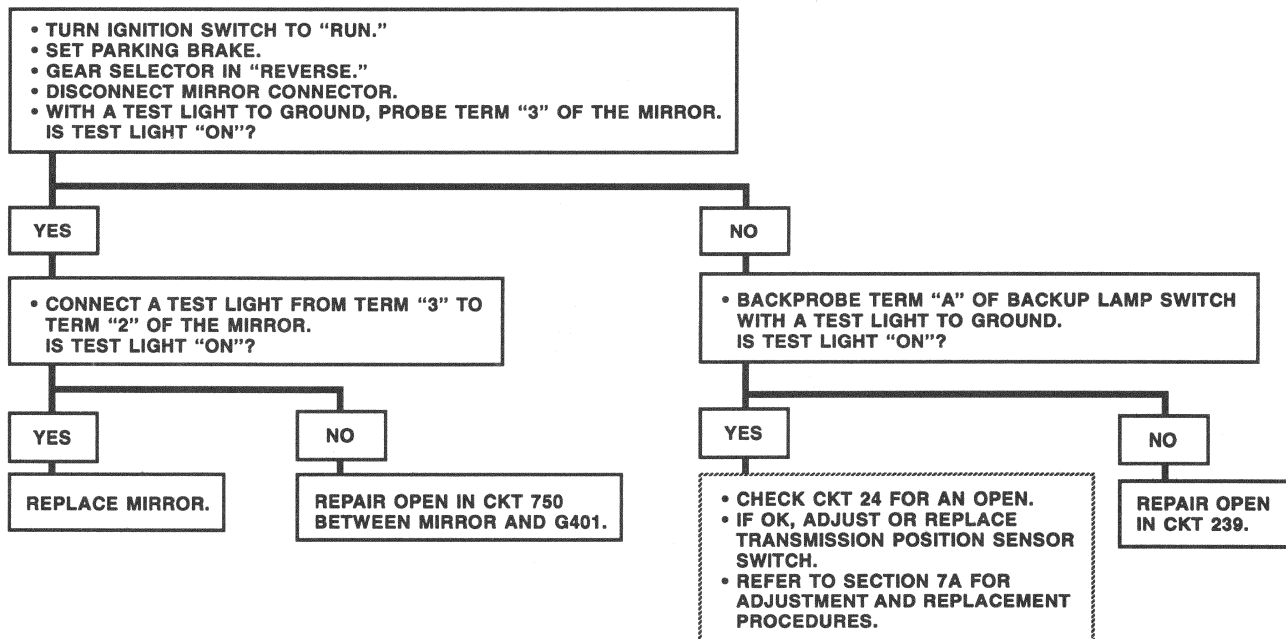


CHART #1
AUTOMATIC DAY/NIGHT MIRROR DOES NOT DARKEN AT NIGHT WITH A LIGHT SHINING ON THE MIRROR SIDE



C10094

CHART #2
AUTOMATIC DAY/NIGHT MIRROR DOES NOT LIGHTEN WITH GEAR SELECTOR LEVER IN "REVERSE"



C10095

AUTOMATIC DAY/NIGHT MIRROR

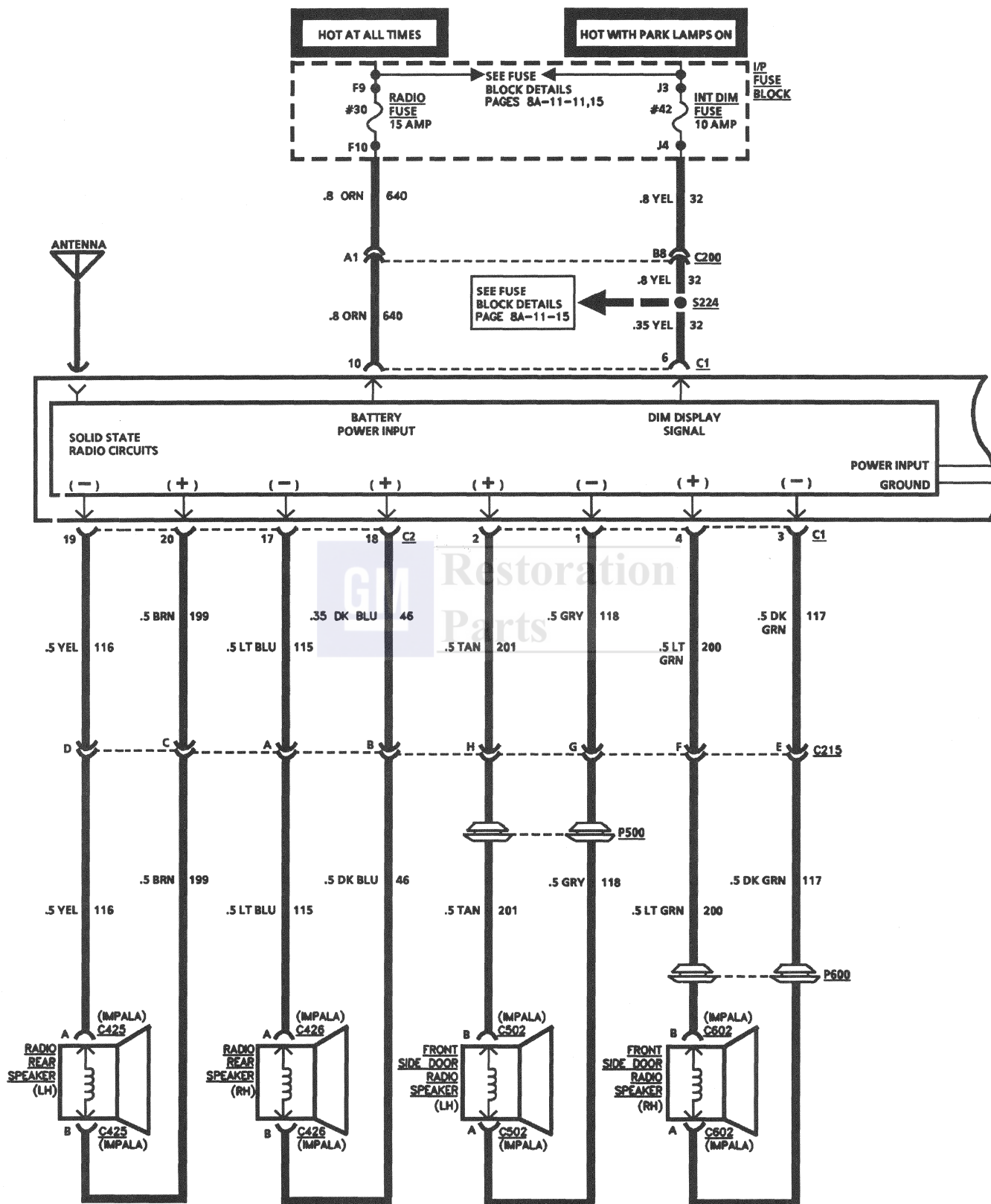
CIRCUIT OPERATION

The Electrochromic Inside Rearview Mirror uses two photocell sensors to determine light conditions in the front and back of the vehicle. At night, as the glare of headlamps from behind increases, the mirror gradually becomes darker to absorb the glare. In the daytime, the mirror is in a clear state. With the Ignition Switch in "RUN," battery voltage is applied to terminal "A." With the Gear Selector Lever in "REVERSE," battery voltage is applied to terminal "3" of the mirror. The mirror then gradually changes to a clear state.





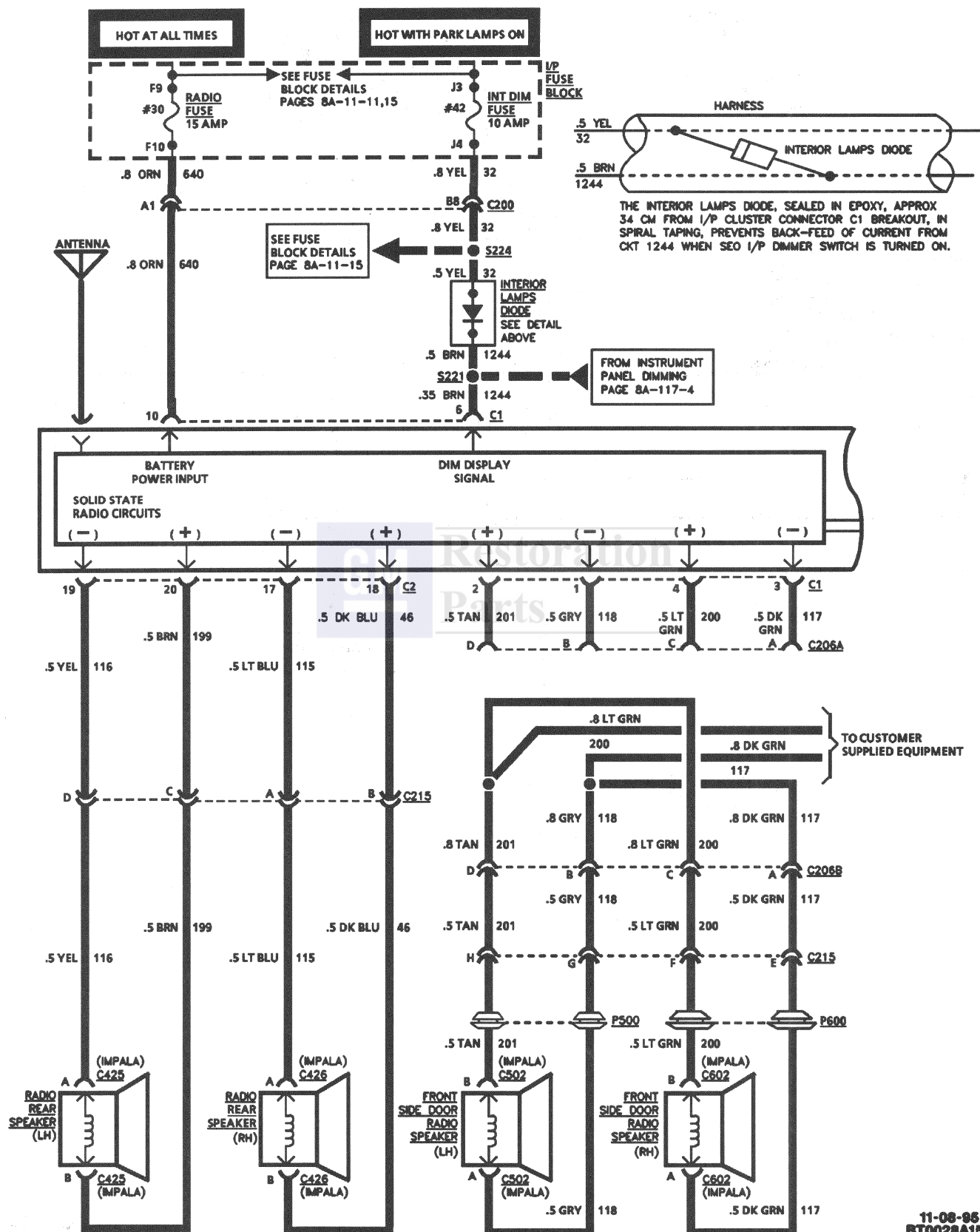
RADIO/AUDIO SYSTEMS CHEV

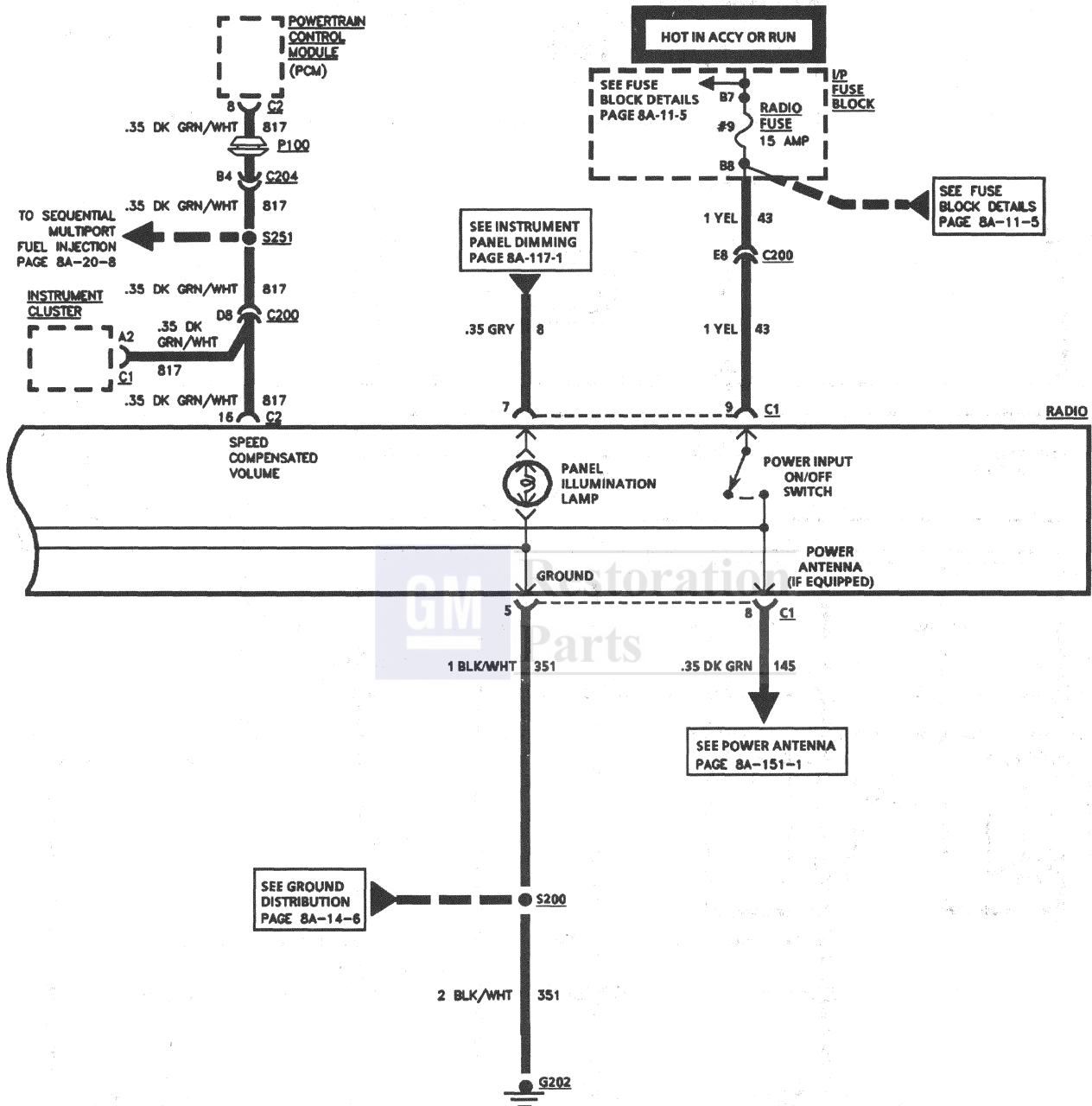




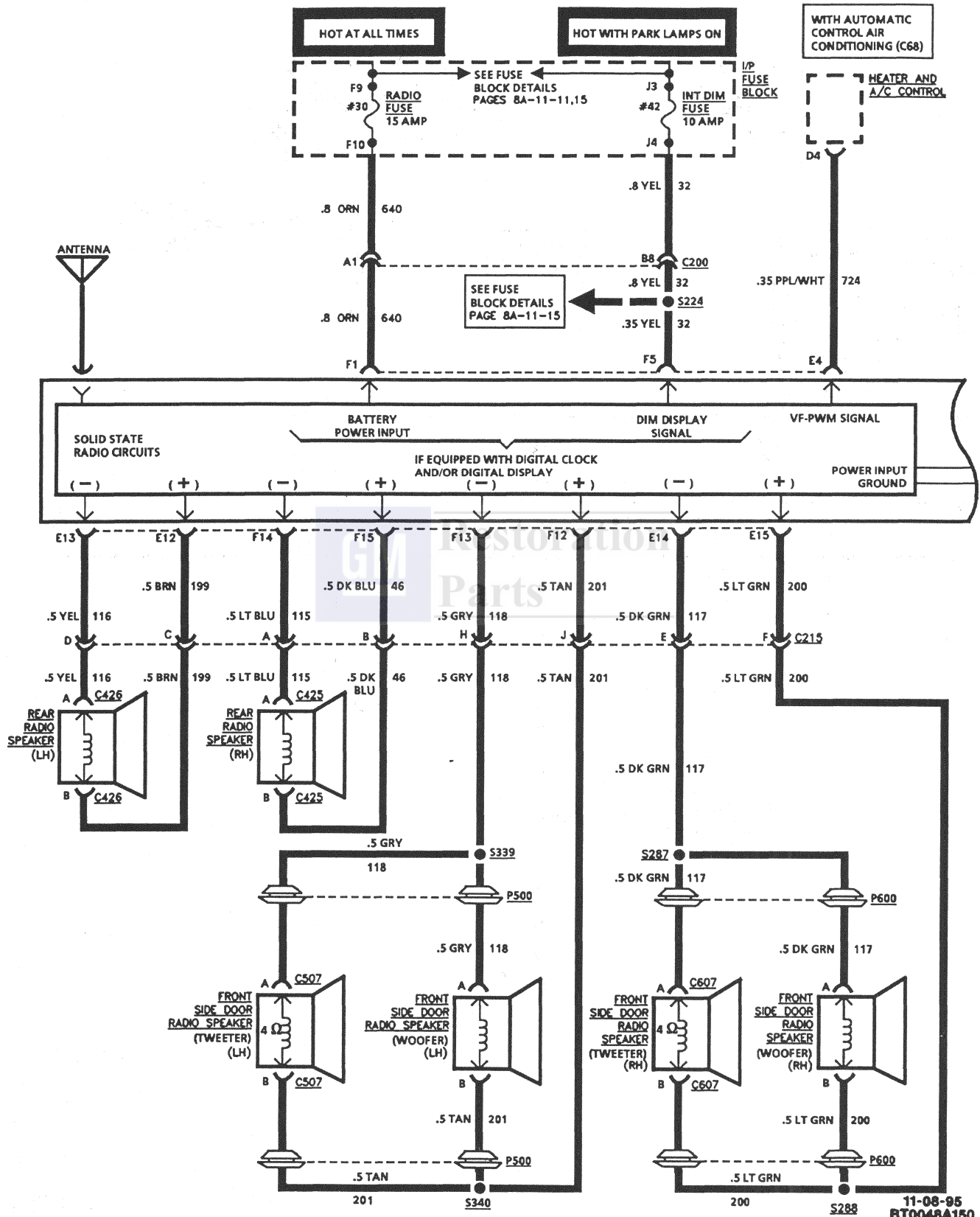
RADIO/AUDIO SYSTEMS

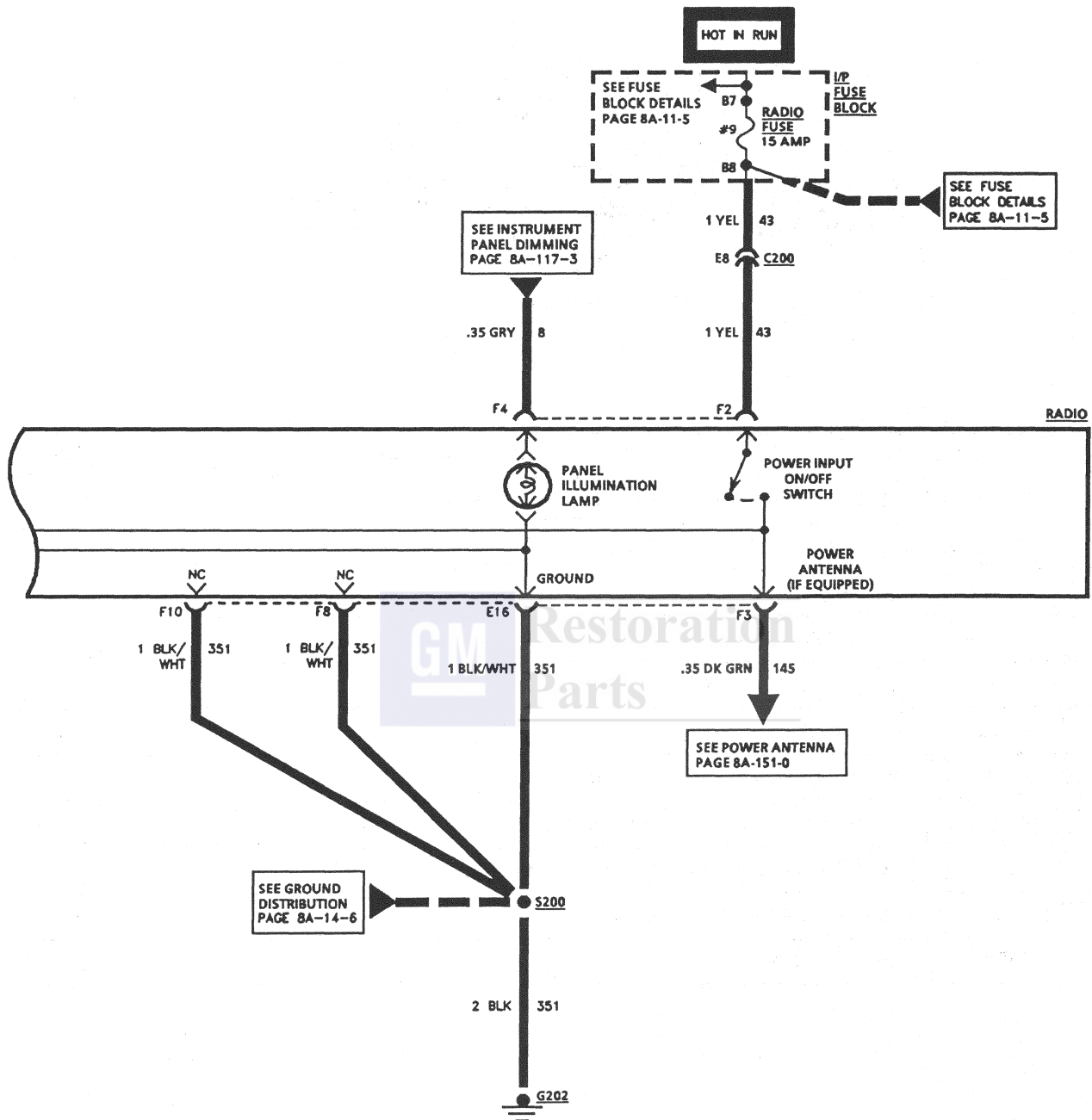
SEO





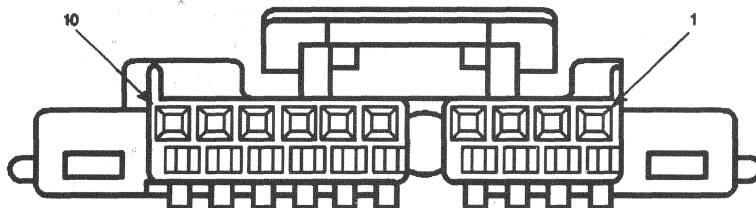
RADIO/AUDIO SYSTEMS BUICK





8A - 150 - 6 ELECTRICAL DIAGNOSIS

RADIO/AUDIO SYSTEMS (CHEV)



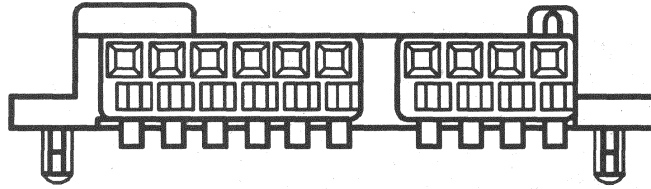
12047531

10 - WAY F MICRO - PACK

BLK

RADIO RECEIVER (C1)

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
1	GRY	118	FRONT SPEAKERS, LH RETURN	8A-150-0
2	TAN	201	FRONT SPEAKERS, LH FEED	8A-150-0
3	DK GRN	117	FRONT SPEAKERS, RH RETURN	8A-150-0
4	LT GRN	200	FRONT SPEAKERS, RH FEED	8A-150-0
5	BLK/WHT	351	GROUND TO G202	8A-150-1
6	YEL	32	DIM DISPLAY SIGNAL	8A-150-0
7	GRY	8	ILLUMINATION LAMP CONTROL	8A-150-1
8	DK GRN	145	RADIO "ON" SIGNAL TO POWER ANTENNA/MOTOR RELAY	8A-150-1
9	YEL	43	IGNITION CONTROLLED FEED FROM I/P #9, RADIO FUSE	8A-150-1
10	ORN	640	INPUT FROM I/P #30, RADIO FUSE	8A-150-0
6	BRN	1244	DIM DISPLAY SIGNAL (SEO)	8A-150-2

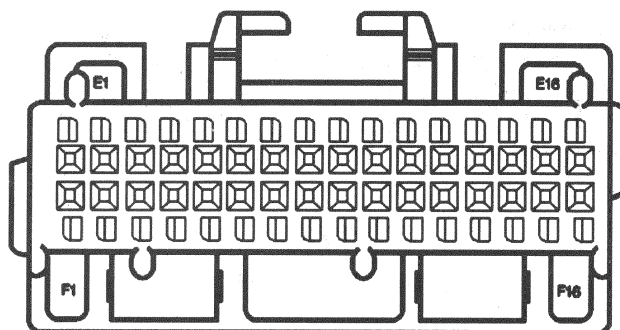
**12065785****10 - WAY F MICRO - PACK
GRY
RADIO (C2)****04-26-95
BT0078A150**

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
16	DK GRN/WHT	817	SPEED COMPENSATED VOLUME	8A-150-1,3
17	LT BLU	115	REAR RADIO SPEAKER, RH RETURN	8A-150-0
18	DK BLU	46	REAR RADIO SPEAKER, RH FEED	8A-150-0
19	YEL	116	REAR RADIO SPEAKER, LH RETURN	8A-150-0
20	BRN	199	REAR RADIO SPEAKER, LH FEED	8A-150-0



8A - 150 - 8 ELECTRICAL DIAGNOSIS

RADIO/AUDIO SYSTEMS (BUICK)



12110115

32 - WAY F MICRO - PACK 100 SERIES

**DK BLU
RADIO RECEIVER**

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
E4	PPL/WHT	724	DIMMING SIGNAL FOR VACUUM FLUORESCENT DISPLAY TO HEATER-A/C CONTROL (C68)	8A-150-4
E12	BRN	199	REAR RADIO SPEAKER, LH FEED	8A-150-4
E13	YEL	116	REAR RADIO SPEAKER, LH RETURN	8A-150-4
E14	DK GRN	117	FRONT SIDE DOOR RADIO SPEAKERS, RH RETURN	8A-150-4
E15	LT GRN	200	FRONT SIDE DOOR RADIO SPEAKERS, RH FEED	8A-150-4
E16	BLK/WHT	351	TO S200 THEN TO G202	8A-150-5
F1	ORN	640	BATTERY FEED TO RADIO FOR MEMORY	8A-150-4
F2	YEL	43	RADIO POWER	8A-150-5
F3	DK GRN	145	POWER FEED TO POWER ANTENNA RELAY	8A-150-5
F4	GRY	8	ILLUMINATION LAMP	8A-150-5
F5	YEL	32	DIM DISPLAY SIGNAL	8A-150-4
F8	BLK/WHT	351	TO S200 THEN TO G202	8A-150-5
F10	BLK/WHT	351	TO S200 THEN TO G202	8A-150-5
F12	TAN	201	FRONT SIDE DOOR RADIO SPEAKERS, LH RETURN	8A-150-4
F13	GRY	118	FRONT SIDE DOOR RADIO SPEAKERS, LH FEED	8A-150-4
F14	LT BLU	115	REAR RADIO SPEAKER, RH RETURN	8A-150-4
F15	DK BLU	46	REAR RADIO SPEAKER, RH RETURN	8A-150-4

COMPONENT	LOCATION	201-PG	FIG.	CONN
Front Speakers, LH.....	LH Front Door			
Front Speakers, RH.....	RH Front Door			
Heater and A/C Control	Center I/P.....	17	28	
I/P Fuse Block.....	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Radio	Center I/P.....	17	28	
Rear Speaker, LH (Sedan).....	In Rear of Vehicle			
Rear Speaker, LH (Wagon)	In Rear of Vehicle			
Rear Speaker, RH (Sedan).....	RH side of Rear Shelf			
Rear Speaker, RH (Wagon)	In Rear of Vehicle			
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C206 (4 cavities).....	I/P Harn, near C200			
C215 (2 cavities).....	I/P Harn to Cross Car Harn, Floor line behind RH "A" Pillar.....	18	29	
C218 (4 cavities).....	I/P Harn, near C200			
G202.....	Base of RH "A" Pillar, behind kickpad	18	29	
P100	RH I/P, forward of Blower Motor	18	29	
P500	Between LH Front Door and "A" Pillar	19	30	
P600	Between RH Front Door and "A" Pillar	23	34	
S200 (Buick).....	I/P Harn, approx 4 cm from Ashtray Lamp Conn breakout, in spiral taping			
S200 (Chev).....	I/P Harn, approx 8 cm from Heater-A/C Control Conn branch breakout			
S221 (w/WX7)	I/P Harn, approx 4 cm from C200 branch breakout			
S224 (Buick).....	I/P Harn, approx 27 cm from C200 branch breakout			
S224 (Chev).....	I/P Harn, behind Instrument Cluster approx 26 cm from Instrument Cluster Conn C2 branch breakout, in spiral taping			
S251	Body Harn, approx 7 cm from SDM breakout			
S287	Crossbody Harn, approx 17 cm from P600 at RH "A" Pillar			
S288	Crossbody Harn, approx 21 cm from P600 at RH "A" Pillar			
S339 (Buick).....	Crossbody Harn, approx 20 cm forward of Power Seat crossover branch breakout			
S340 (Buick).....	Crossbody Harn, approx 16 cm forward of Power Seat crossover branch breakout			

RADIO/AUDIO SYSTEMS**TROUBLESHOOTING HINTS****Radio Inoperative**

1. For checking a speaker, use a "C" or "D" cell battery and momentarily connect and disconnect it across the circuits to that speaker while listening for a slight popping sound or watching for the cone of the speaker to move in and out. If either happens, the speaker and circuitry are usually OK.
2. Check Fuse #30. If open, check for a short to ground through CKT 640.
3. Check Fuse #9. If open, check for a short to ground through CKT43.
4. Make sure ground G202 is clean and tight.

Radio Noise

A noise "sniffer" may be used to aid in troubleshooting radio noise. See details on page 8A-150-20.

General

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

1. Verify customer complaint.
2. Refer to: Delco Sound Service Guide (DE SSG) and Dealer Service Manuals; fill out the Service Writer Form provided in the Delco Sound Service Guide (DE SSG).
3. Follow radio service procedures.
4. If technical assistance is required, have all the pertinent information available before placing the call.
5. For a more complete diagnostic overview, consult the DE SSG.

IDENTIFYING CONCERNS

- CHECK for technical service bulletins. Check the Dealer Communication System for any applicable Preliminary Information (P/I) for customer concerns.
- CHECK for stored diagnostic trouble codes. Refer to Engine Controls.

- For reception concerns, determine if the station is obtainable in the customer's listening area.
- For an FM reception concern, refer to the FM reception section in the DE SSG.
- For an AM reception concern, refer to the AM reception section in the DE SSG.
- To test for audio reception/noise, position the vehicle outside of the building with the hood down.
- Duplicate the customer's complaint before trying to diagnose the system. Have the customer demonstrate the condition. Test drive the vehicle with the customer and then test drive another similar model vehicle (with a similar audio system) to do a comparison of the two vehicles to determine if the condition is abnormal.
- Before diagnosing, identify components, their features and the customer's complaint.
- Determine if any aftermarket equipment is installed on the vehicle. Disconnect the aftermarket equipment and determine if the customer's complaint still exists. Follow GM guidelines for installation of aftermarket components. Refer to the DE SSG.
- Perform the following steps to identify a noisy component:
 1. Identify ignition key switch position in which the noise appears, such as: accessory, key ON engine not running, and key ON engine running.
 2. REMOVE fuses one at a time until the complaint condition has been eliminated.
 3. Mark the complaint fuse(s) and reinstall all fuses and circuit breakers.
 4. Refer to SECTION 8A-10 and SECTION 8A-11 to identify all systems and components powered by the complaint fuse(s).
 5. Disconnect the components powered by the complaint fuse(s) one at a time until the complaint condition has been eliminated and the noisy component is identified.
 6. CHECK the ground integrity of the complaint causing component.
- An interference condition is NOT necessarily an audible noise.
- Most noises can be found on weak stations near the low end of the band and are considered to be a normal condition.
- Ignition noise on FM could indicate a possible defective ignition system.
- Malfunctioning and marginal components, relays, and solenoids may induce noise and/or poor reception.

CORRECTIVE ACTION

- Use proper tools for diagnostics and repairs.
- Follow ESD guidelines.
- Use available noise suppression devices:
 - 220 mF (50V) capacitor GM P/N 1227895
 - 0.47 mF capacitor GM P/N 1227894
 - Fuse block capacitor GM P/N 469328
 - Feed through capacitor GM P/N 477371
 - Filter package GM P/N 1224205
 - Turn signal suppression GM P/N 3861565
 - Fuel pump suppresser GM P/N 25027405
 - 21 inch braided ground strap GM P/N 8910791
 - 19 inch braided ground strap GM P/N 6286800
 - 10.5 inch braided ground strap GM P/N 6287160
 - 8.5 inch braided ground strap GM P/N 12091511
- Utilize the test tape/CD Diagnostic Kit GM P/N J39916-A to optimize proper audio diagnostics.
- If the condition requires the radio to be sent to the service center, describe the symptoms on the warranty form accurately. Along with the warranty form, send a copy of the Service Writer Check List with the unit.
- Do not leave a CD or tape in the car. Extreme heat could cause permanent damage.
- Cassette tapes could be damaged if not stored in the case. The vibration in the vehicle can cause the tape to unwind inside the cartridge.
- Use the trouble trees/noise charts in the DE SSG.
- Before removing speaker(s), check all connectors and wiring to the speaker(s). Examine the connectors for bent or loose pins. Refer to Troubleshooting Procedures in SECTION 8A-4.
- If a test antenna is used in diagnostics, ground the antenna base to the vehicle body and do not hold the mast.

Important:

- CHECK the antenna coax connectors for corrosion or bad connections/crimps. Route coax separately from the other wires. Shield antenna coax interconnections with aluminum or nickel tape as described in the DE SSG.
- CHECK all vehicle grounds, NOT just radio and antenna grounds. Refer to the antenna diagnostic section.
- Coated screws or bolts can act as poor grounds.
- Always use a braided ground strap when applying grounds. Keep the ground strap as short as possible. The shorter the ground strap the better.
- When shielding the dash, wires, hoses (most hoses are conductive unless they have a white stripe), etc., use aluminum foil tape or nickel tape to shield against magnetically induced interference. For optimum results, try varying the following ground techniques:
 - Add a ground at both ends of the tape.
 - Add a ground to just one end of the tape.
 - Do not add ground to the tape.
- When shielding a harness with tape, attach a ground strap to the end of the tape and then wrap the strap 360° around the tape securing the other end of the strap to a known good chassis ground.
- Any interference is best corrected by suppression at the source of the interference, if possible.
- Care should be used when applying suppression. Signal wires (such as sensor outputs, clock, and communication circuits) CANNOT be suppressed. Battery and ignition wires can be suppressed. After adding any suppression, all vehicle systems (even those not related to the audio system) should be checked for proper operation and function.
- Interference can usually be eliminated by shielding/grounding or suppressing.
- Capacitors work best on switch pops and low frequency noise. Filters work best on high frequency whines and static.
- Whenever possible, make a test harness that includes filters and capacitors. Always check the effectiveness and operation before permanently installing a FIX.
- Recommended capacitor application for an audible pop induced from a switching operation is:
 - Add a capacitor across the contacts of the switch.
 - Add a capacitor from the hot side of the switch to ground.
 - Add a capacitor to each side of the switch to ground.
- If a complaint condition is only present with the ignition key in the RUN position and the engine running, perform the following checks:
 - CHECK the integrity of the ignition system (proper spark plug wire routing, no misfiring, etc.). Refer to SECTION 6D-4.
 - CHECK the integrity of the engine compartment grounds.
 - CHECK for malfunctioning relays, solenoids, or other components which may be inducing "noise" or poor reception.
 - CHECK the ground integrity of the complaint causing component.
- For noise and/or poor reception, perform the Antenna System Test and make the necessary repairs.

RADIO/AUDIO SYSTEMS

GENERATOR WHINE CONCERNS



Inspect:

- CHECK the ground terminal on the battery.
- CHECK for coated mounting bolts on the generator bracket.
- CHECK for a faulty mounting of the generator to the engine.
- Make sure all ground straps between the engine and the frame are clean and tight.
- Try the following fixes:
 1. If noise is still present, check the charging system. Refer to SECTION 6D-3.
 2. If the charging system is functioning normally, check for technical service bulletins on generator whine.
 3. Install a filter, GM P/N 1224205, in the battery feed to the radio.
 4. Try installing the filter with the following variations if noise is not eliminated.
 - INSTALL the filter with the single wire side toward the radio and the ground wire attached to a good ground.

- REMOVE the ground to the filter.
- REVERSE the filter so the two wire side is toward the radio with the ground wire attached to a good ground.

- REMOVE the ground from the filter.

5. If noise is still present, install another filter, GM P/N 1224205, in the ignition feed to the radio. Install using the same variations as the first filter. If the installation of this filter causes turn ON or turn OFF delays or other noticeable performance concerns, REMOVE it and INSTALL a 0.47 mF capacitor to ground in its place.
6. REMOVE any unneeded filters after REPAIR, before reassembling the vehicle.

NOTICE TO TECHNICIANS:

Electromagnetic interference (EMI) can cause a fewer number of stations to be received in one of the three ignition suited modes. The EMI can be caused by various vehicle components. This may eliminate engine running components, ignition on components, etc. For example, if the same number of stations are received with the engine running as when the engine was off, the components that are active with the engine running are not causing the interference.

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Display is inoperative, no sound from any speaker	Chart #1	8A-150-14
No sound from one speaker	Chart #2	8A-150-15
Compact Disc Player does not operate properly	Chart #3	8A-150-16
Tape Player does not operate properly	Chart #4	8A-150-17
Speed Compensated Volume (Chev up level Radios) does not operate properly	Check for PCM diagnostic trouble code (DTC P1652.) If set, refer to "Driveability and Emissions," Engine Controls for diagnosis. (All other systems that use the Vehicle Speed Signal should be checked for proper operation as well.) Check for open in CKT 817 between splice and radio. If OK, service radio.	
Radio memory (clock and station presets) is inoperative.	Check CKT 640 for an open or high resistance between Radio and I/P Fuse #30. If OK, service Radio.	
Radio does not "MUTE" or Radio is always muted if equipped with (UV8) cellular phone option.	Refer to Motorola Cellular Telephone Diagnostic Manual.	
Radio display is inoperative; speakers are OK. (Buick with C68)	Check CKT 724 for a short to B+. If OK, service Radio.	
Radio controls are inoperative.	Service Radio.	
Radio will not shut "OFF."	Service Radio.	
Radio display does not dim with I/P Dimmer Switch. (Buick with C68)	Check CKT 724 for an open or high resistance between Radio and Heater-A/C control. If OK, service Radio.	
Radio display does not dim with I/P Dimmer Switch. (Chev and Buick with C67)	Check CKT 8 for an open. If OK, service radio.	
Radio displays "LOC."	Remove Fuse #9 and Fuse #30 for one minute then reinstall fuses. If Radio still displays "LOC," refer to SECTION 9A.	
Radio display does not dim and/or Radio face and buttons do not illuminate with Park Lamps "ON."	Check CKT 32 for an open or high resistance between Radio and I/P Fuse #42. If OK, service Radio.	
Radio face and buttons do not dim with I/P Dimmer Switch; display dims normally.	Refer to "Instrument Panel Dimming."	8A-117-0

RADIO/AUDIO SYSTEMS

CHART #1
DISPLAY IS INOPERATIVE, NO SOUND FROM ANY SPEAKER

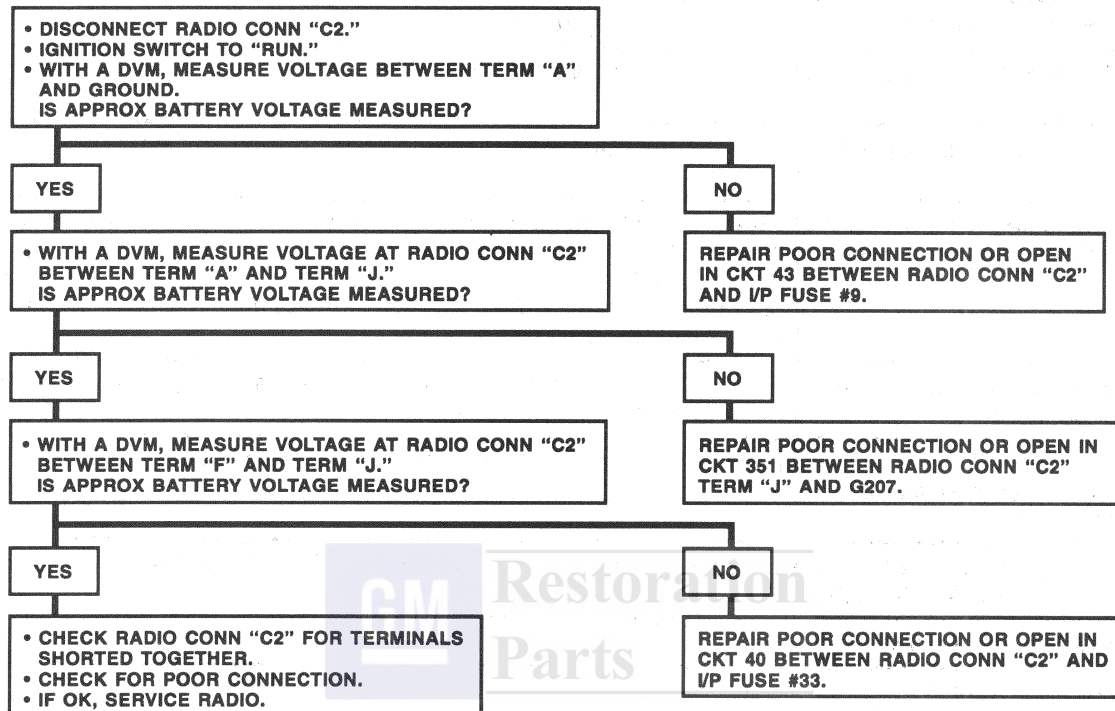
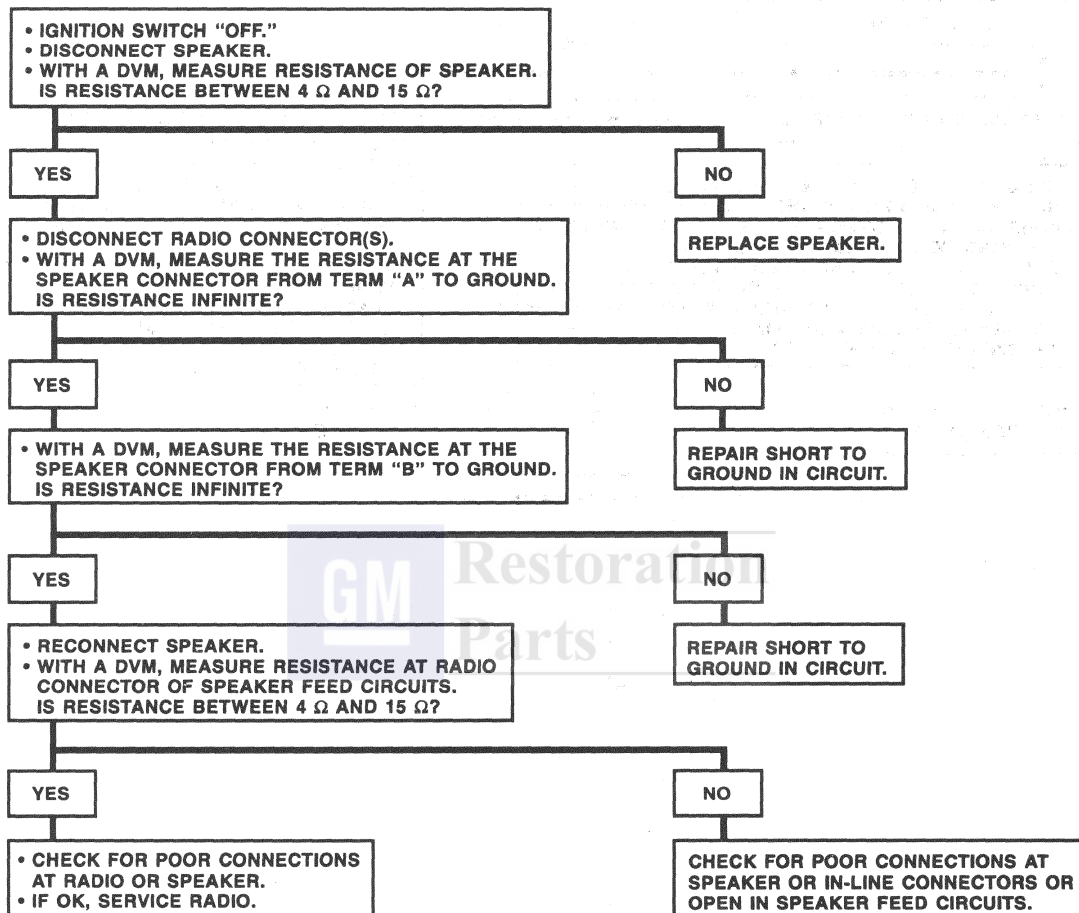


CHART #2
NO SOUND FROM ONE SPEAKER



RADIO/AUDIO SYSTEMS

CHART #3
COMPACT DISC PLAYER DOES NOT OPERATE PROPERLY

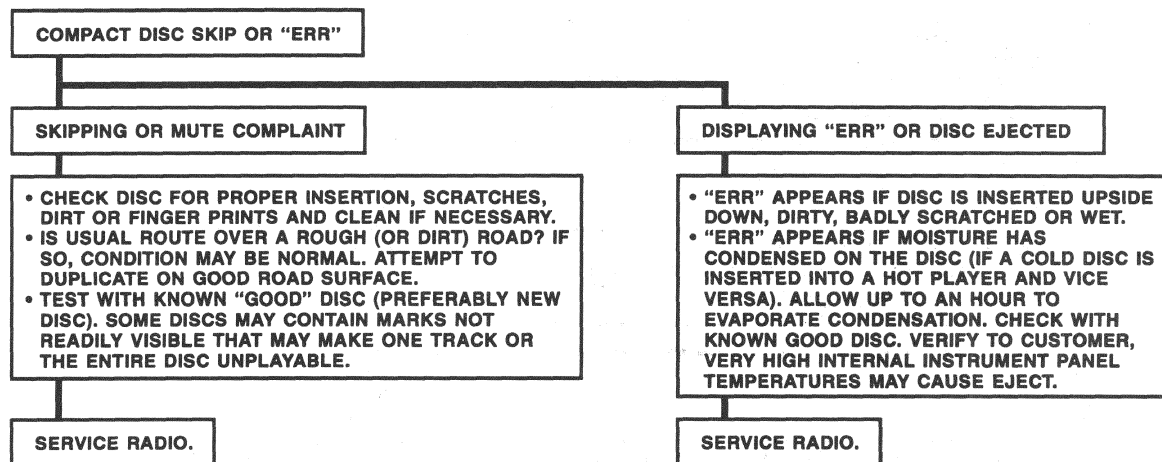
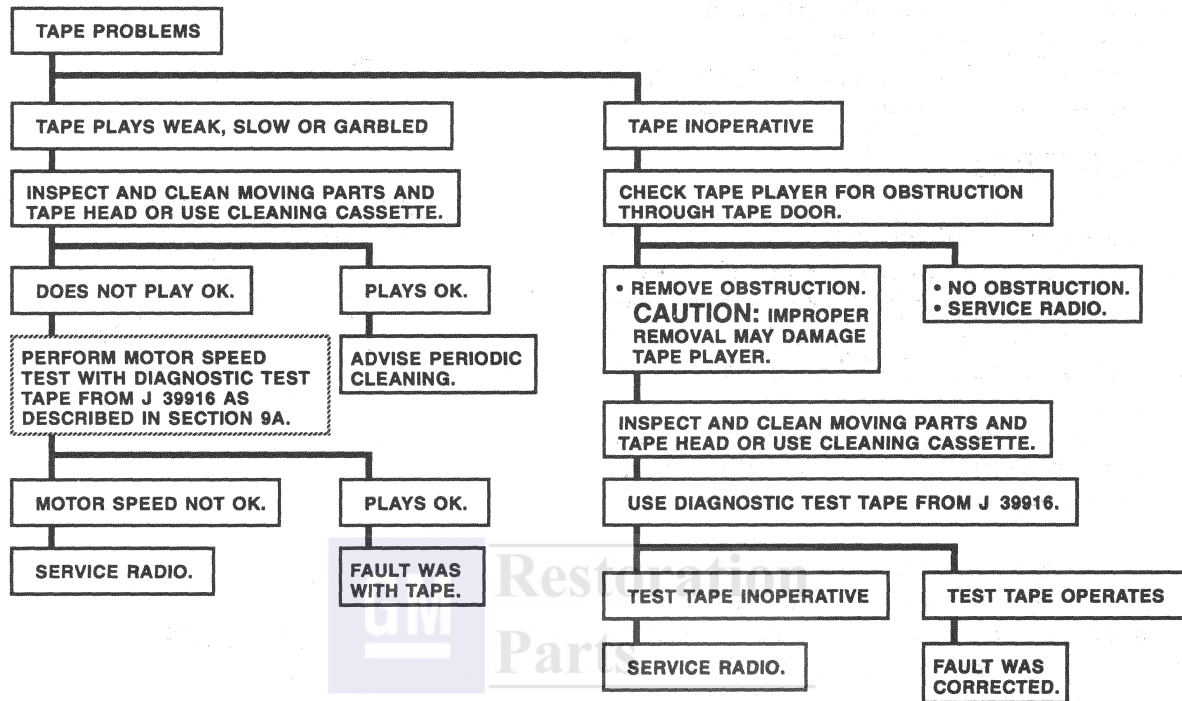


CHART #4
TAPE PLAYER DOES NOT OPERATE PROPERLY



RADIO/AUDIO SYSTEMS

! Important:

- Before measuring the resistance of the Antenna, remove the negative lead of the Battery and "zero" the meter before taking measurements. When checking resistance, cautiously wiggle the antenna mast, the lead-in tip, and the cable. The readings below should always be obtained. If not, some portion of the lead-in is intermittent and the lead-in should be replaced.

CUSTOMER'S TIPS

HOW TO ENJOY FM STEREO

- A. Select Stations Within Range - The best FM fidelity will be obtained from stations within a 10-40 mile range. Beyond that "noise" or "flutter" may begin to appear due to the "line of sight" range limitations of FM signals.

- SOLUTION: Reduce treble response by moving the treble control down (or to the left) in fringe areas. On EQ Radios, slowly slide the 10K control down.

- B. Realize Tall Structures Can Interfere - Tall buildings or hills may cause "shadows" or cancellation of FM signals (this is similar to the "ghost" or "flutter" effect seen on television sometimes when airplanes are flying in the vicinity). It will sound like a "pop" or momentary "hiss."

- SOLUTION: Reduce the treble or 10K setting to a lower volume.

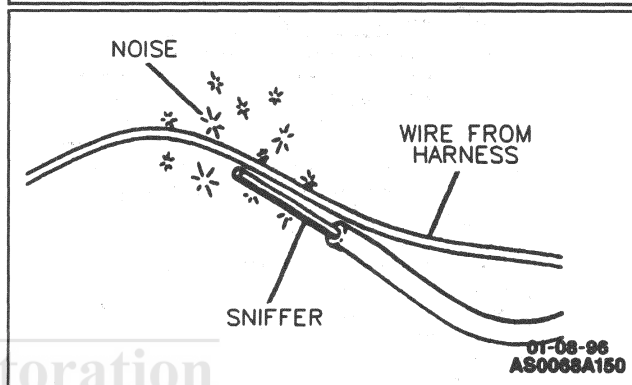
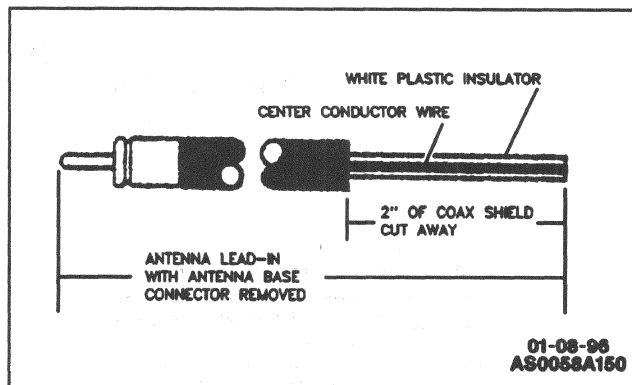
- C. Interference From Another Station - Although the circuits in Delco receivers are the most advanced available, there are rare instances where a station being listened to will be interfered with by another station. This only happens when the stations are on almost the same frequency and certain geographical criteria are present.

- SOLUTION: Select another station or switch to tape.

HOW TO ENJOY AM

Reception Characteristics

AM does not have the flutter characteristics of FM (caused by tall buildings, hills, etc.). However, it is subject to interference from power lines, neon signs, atmospheric conditions, and unwanted stations.



WAYS TO REDUCE NOISE

1. Move treble control down.
2. Tune to a stronger station.

CIRCUIT OPERATION

The Radio receives battery voltage at all times on CKT 640 through I/P Fuse #30 to keep clock and preset station memory alive when the Ignition is "OFF." With the Ignition Switch in "ACCY" or "RUN," voltage is applied to CKT 43 through I/P Fuse #9 to enable Radio operation.

When the Park Lamps or Headlamps are turned "ON," voltage is applied to the Radio on CKT 32 from the Headlamp Switch. When voltage is applied to CKT 32 at the Radio, the Radio will dim the display a preset amount (Step Dim). With the Headlamps or Park Lamps "ON," the Radio display may be dimmed manually using the I/P Dimmer Switch. The I/P Dimmer Switch varies the voltage on CKT 8 to the Radio to control the radio face display dimming.

The Heater and A/C Control on Buicks with Automatic Control Air Conditioning (C68) will also supply the Radio with a Pulse Width Modulated signal on CKT 724. This signal (voltage) is used to dim the VF display of the Radio when the I/P Dimmer switch is dimmed manually.

ANTENNA SYSTEM TEST

- DISCONNECT NEGATIVE BATTERY CABLE.
- DISCONNECT ANTENNA LEAD-IN CONNECTOR AT THE RADIO RECEIVER.
- WITH A DVM, MEASURE RESISTANCE BETWEEN THE COAX (OUTER CONDUCTOR) CONNECTOR AND THE NEGATIVE BATTERY CABLE.


IMPORTANT:

- TO AVOID MISDIAGNOSIS BE SURE TO "ZERO" METER BEFORE TAKING MEASUREMENTS. IS RESISTANCE VALUE GREATER THAN .15 OHMS?

NO

YES

- GRASP THE ANTENNA MAST.
- WHILE OBSERVING THE DVM, WIGGLE THE ANTENNA. DOES THE METER INDICATE INTERMITTENT CONTINUITY?

- CHECK THE BASE OF THE ANTENNA FOR A GOOD CONNECTION TO BODY GROUND.
- CHECK THE COAXIAL CABLE INTERCONNECTS FOR A POOR CONNECTION OR CORROSION.
- CHECK THE GROUND CONNECTION FROM THE BATTERY NEGATIVE CABLE TO THE BODY. REPAIR THE ANTENNA GROUND CIRCUIT AS NECESSARY.

NO

YES

- WITH A DVM, MEASURE RESISTANCE BETWEEN THE RADIO COAX LEAD-IN CONNECTOR (CENTER CONDUCTOR) AND THE ANTENNA MAST.


IMPORTANT:

- TO AVOID MISDIAGNOSIS BE SURE TO "ZERO" METER BEFORE TAKING MEASUREMENTS. DOES THE MEASURED RESISTANCE APPROXIMATELY EQUAL THE VALUE GIVEN IN THE FOLLOWING TABLE?

COAX TYPE	RESISTANCE MEASURE IN OHMS
RG-58 RG-59	LESS THAN 0.2
RG-62 RG-62M	LESS THAN 3.5

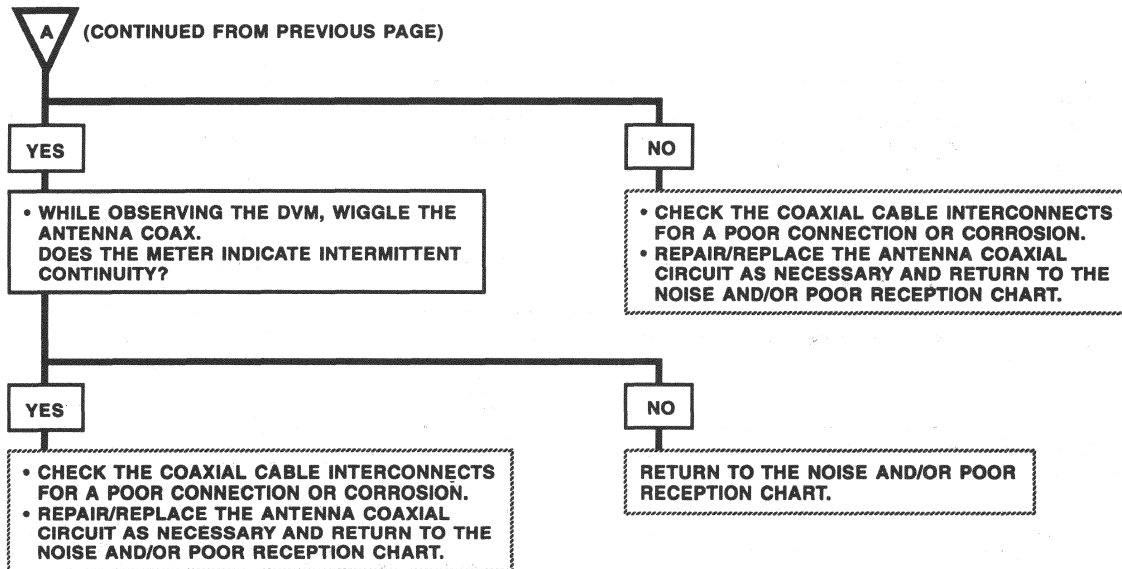
- CHECK THE BASE OF THE ANTENNA FOR A GOOD CONNECTION TO BODY GROUND.
- CHECK THE COAXIAL CABLE INTERCONNECTS FOR A POOR CONNECTION OR CORROSION.
- CHECK THE GROUND CONNECTION FROM THE BATTERY NEGATIVE CABLE TO THE BODY. REPAIR THE ANTENNA GROUND CIRCUIT AS NECESSARY.



(CONTINUED ON NEXT PAGE)

RADIO/AUDIO SYSTEMS

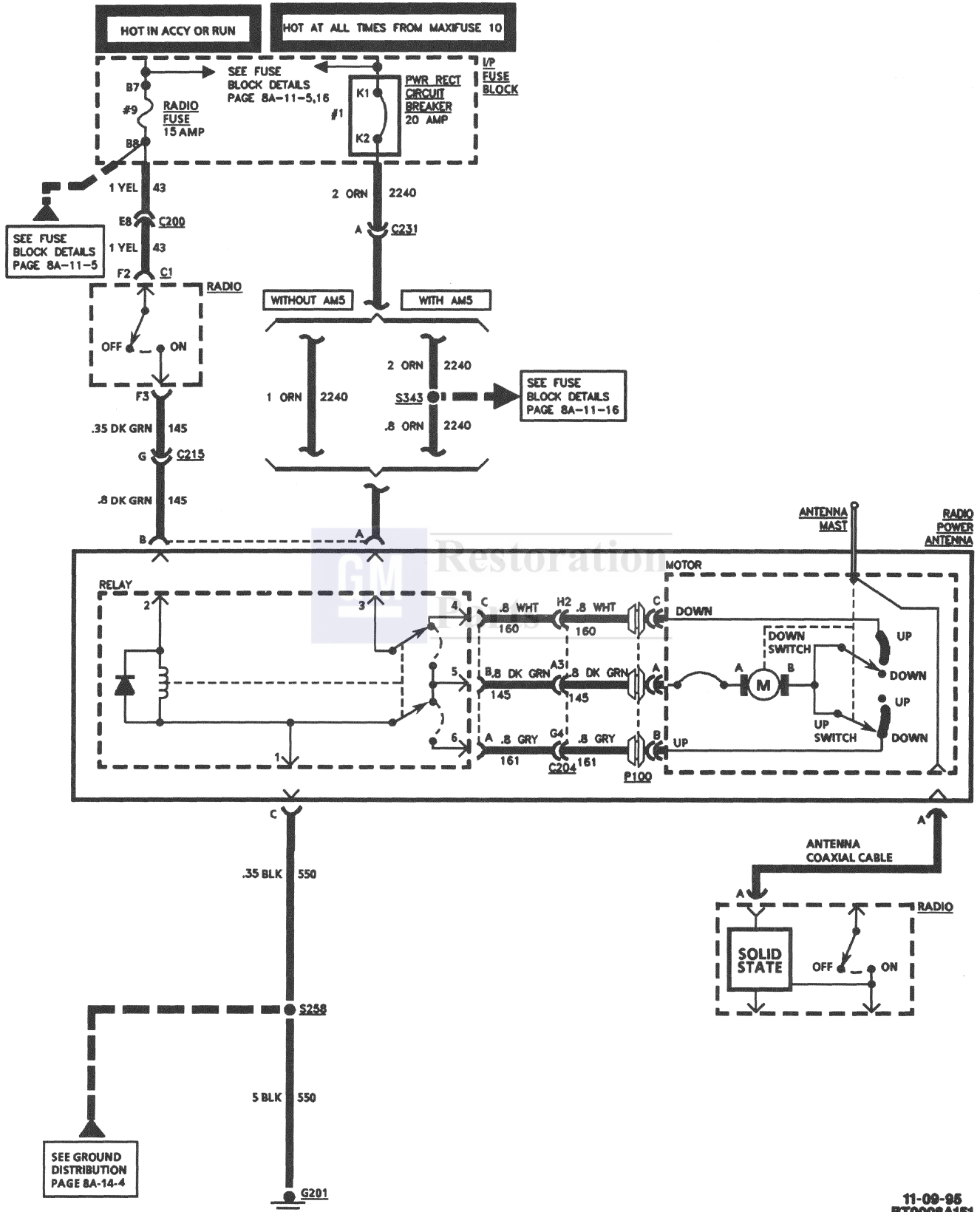
ANTENNA SYSTEM TEST



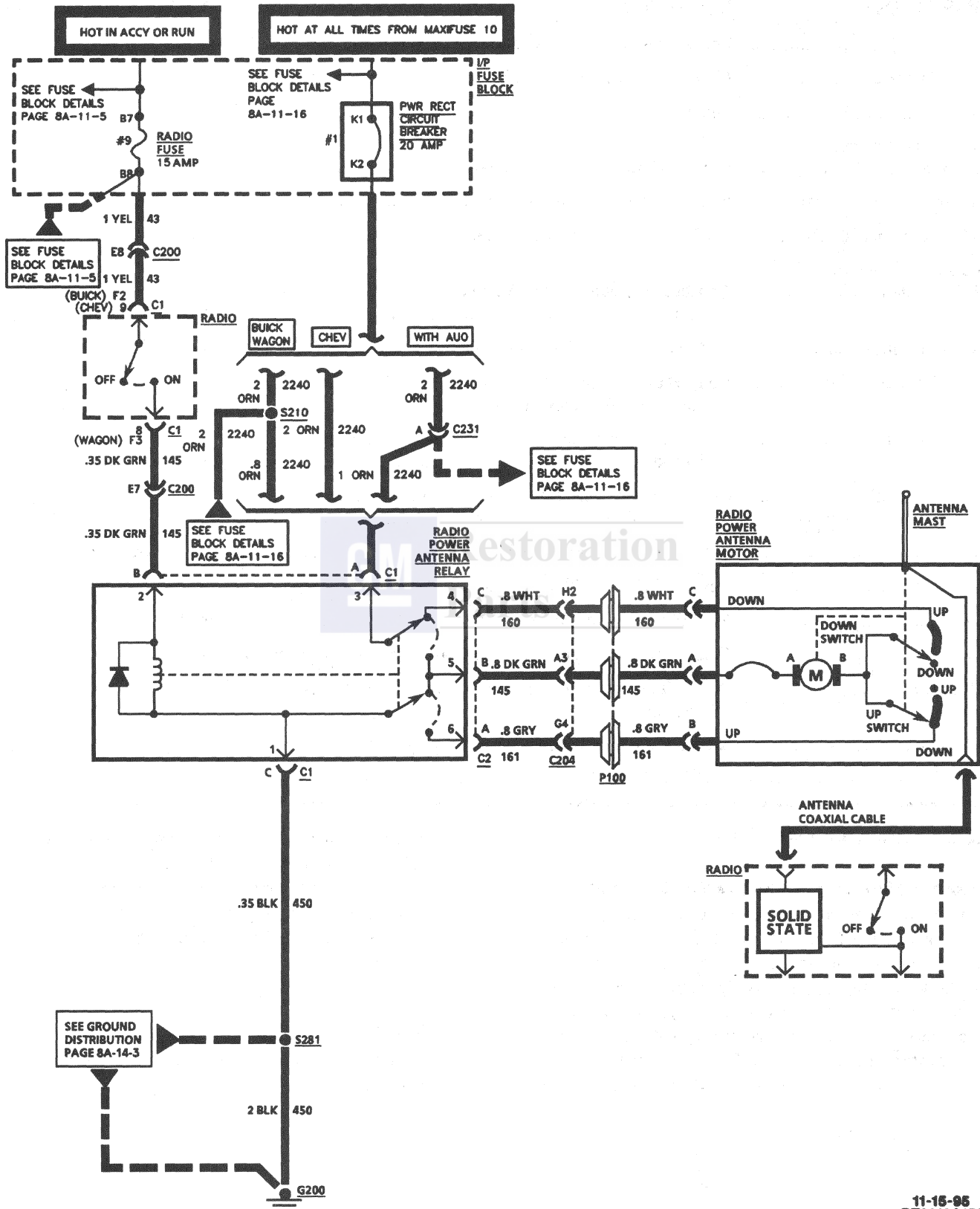
C6268



**POWER ANTENNA
(BUICK SEDAN)**



POWER ANTENNA (ALL WAGON AND CHEV SEDAN)



8A - 151 - 2 ELECTRICAL DIAGNOSIS

POWER ANTENNA

COMPONENT	LOCATION	201-PG	FIG.	CONN
Antenna Mast	Located on RH Front Fender, near Windshield.....	8	13	
I/P Fuse Block	Mounted to LH I/P, accessible with LH Front Door open.....	11	19	
Radio	Center of I/P	17	28	
Radio Power Antenna (Buick Sedan)	In Rear Compartment, RH Rear attached to Fender Support..	15	25	
Radio Power Antenna Motor	Behind RH Front Wheelhouse	8	14	
Radio Power Antenna Relay	LH I/P, left of Convenience Center.....	11	19	
Radio Power Antenna Relay (Buick Sedan)	Attached to Radio Power Antenna in Rear Compartment, RH Rear	15	25	
C200 (56 cavities).....	Body Harn to I/P Harn, bolted above Accelerator Pedal	14	22.....	202-1
C204 (37 cavities).....	Body Harn to Engine Harn, behind RH I/P between Blower Motor and I/P Compartment.....	16	26.....	202-3
C215 (10 cavities).....	I/P Harn to Cross Car Harn, at RH "A" Pillar, behind kickpad	18	29.....	202-4
C231 (6 cavities).....	Crossbody and Side Door Harn to Body Harn, at base of LH "A" Pillar, behind kickpad	19	30.....	202-6
G200.....	Base of LH "A" Pillar, behind kickpad	19	30	
G201.....	Base of LH "A" Pillar, behind kickpad	19	30	
P100	RH I/P forward of Blower Motor.....	18	29	
S258	Crossbody Harn, approx 12 cm from C231 branch breakout			
S281	Body Harn, approx 24 cm from Convenience Center branch breakout			
S343 (Buick Sedan).....	Crossbody Harn, 28 cm forward of Power Seat crossover branch breakout			

TROUBLESHOOTING HINTS

(Perform before beginning System Diagnosis)

If Power Antenna goes up or down only part way, check Antenna Mast for bent or dirty condition. Refer to SECTION 9A for cleaning and lubricating procedures.

- Check for a broken (or partially broken) wire inside of the insulation which could cause system malfunction but prove "GOOD" in a continuity/voltage check with a system disconnected. These circuits may be intermittent or resistive when loaded, and if possible,

should be checked by monitoring for a voltage drop with the system operational (under load).

- Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems (see "Troubleshooting Procedures," page 8A-4-0).
- Refer to System Diagnosis.

SYSTEM DIAGNOSIS

- Refer to the Symptom Table for the proper diagnostic procedure(s).

SYMPTOM TABLE

SYMPTOM	PROCEDURE	PAGE NUMBER
Radio Power Antenna will not extend.	Chart #1	8A-151-4
Radio Power Antenna will not retract.	Chart #2	8A-151-5
Radio Power Antenna goes up and down properly, but the Radio will not receive signals.	Refer to "Radio/Audio Systems."	8A-150-0
Radio Power Antenna Motor operates normally, but Antenna Mast will not extend or retract.	Replace Power Antenna Mast; refer to SECTION 9A.	



POWER ANTENNA

CHART #1
RADIO POWER ANTENNA WILL NOT EXTEND

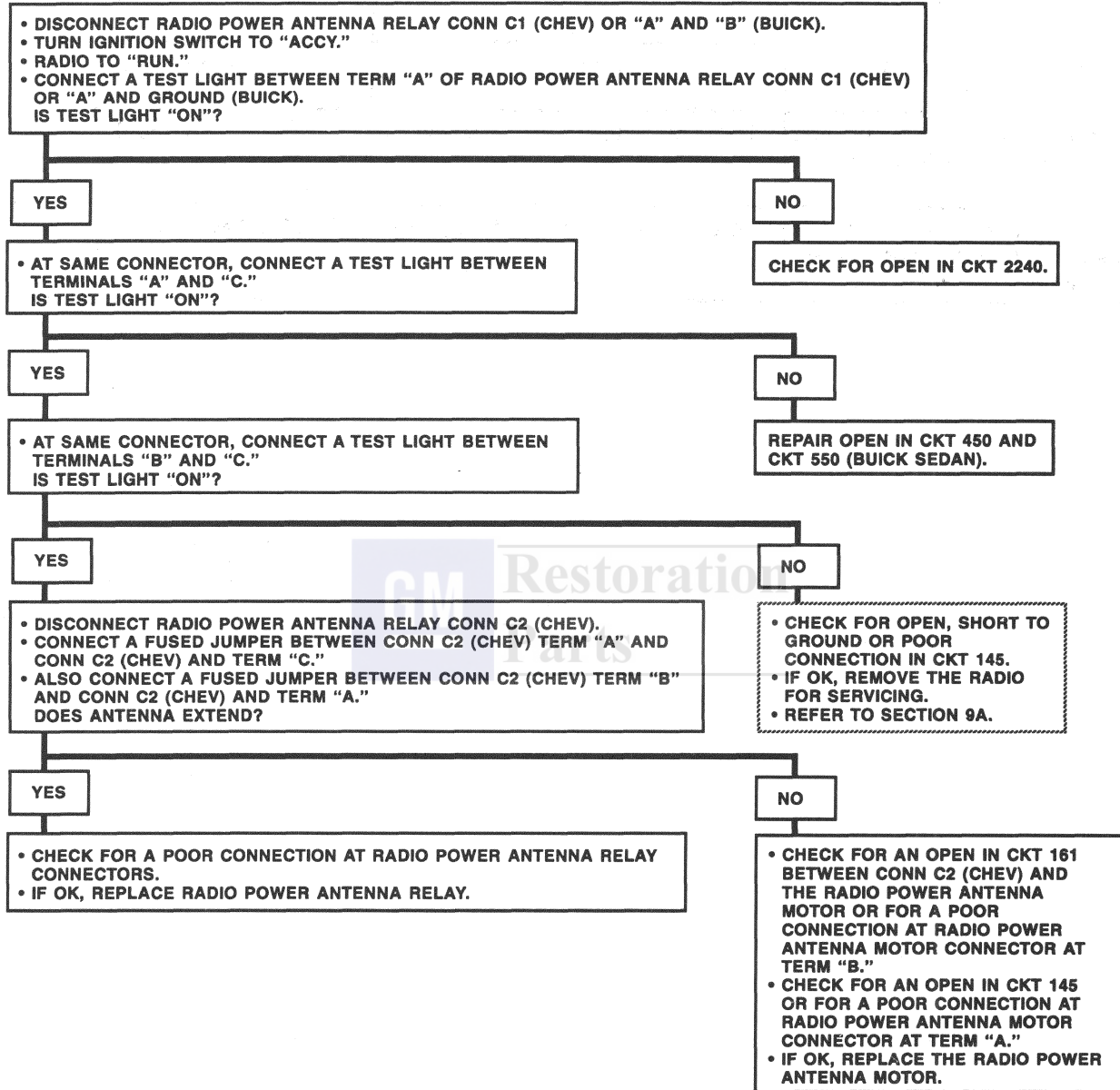
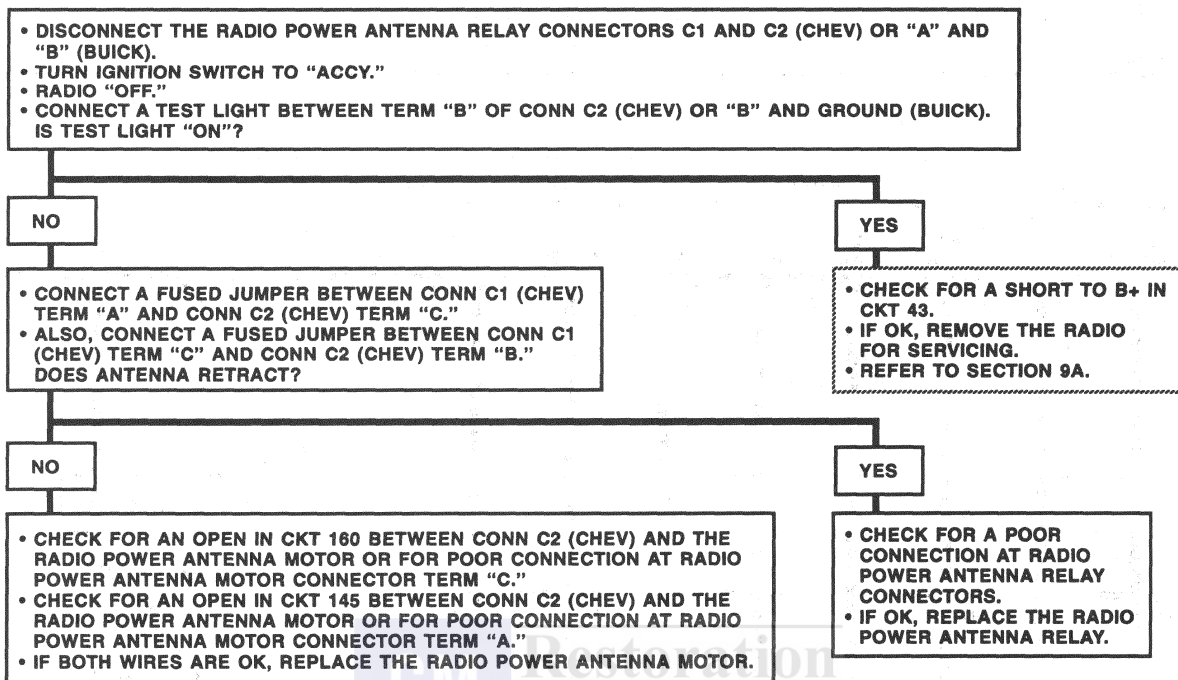


CHART #2

RADIO POWER ANTENNA WILL NOT RETRACT



C10121

CIRCUIT OPERATION

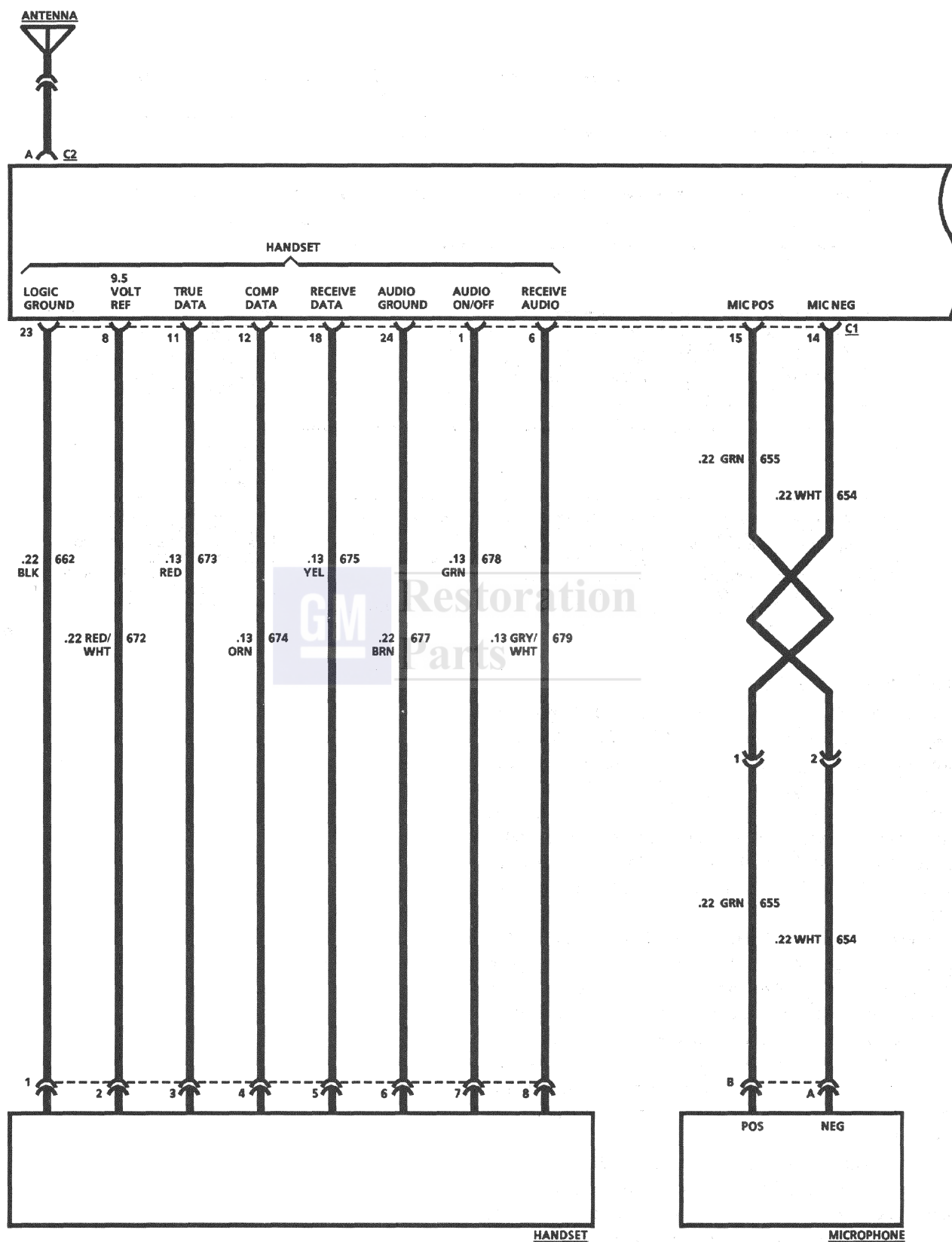
When the Radio Control is in the "ON" position, voltage is applied from the radio (CKT 145) to the Radio Power Antenna Relay Coil. The relay contacts close, and battery voltage is applied through CKT 145 to the Radio Power Antenna Motor. The "B" motor terminal is grounded through the "UP" switch, CKT 161 and the relay contacts. The motor drives the Antenna Mast up. When the antenna is at its full height, the "UP" switch opens and the motor stops.

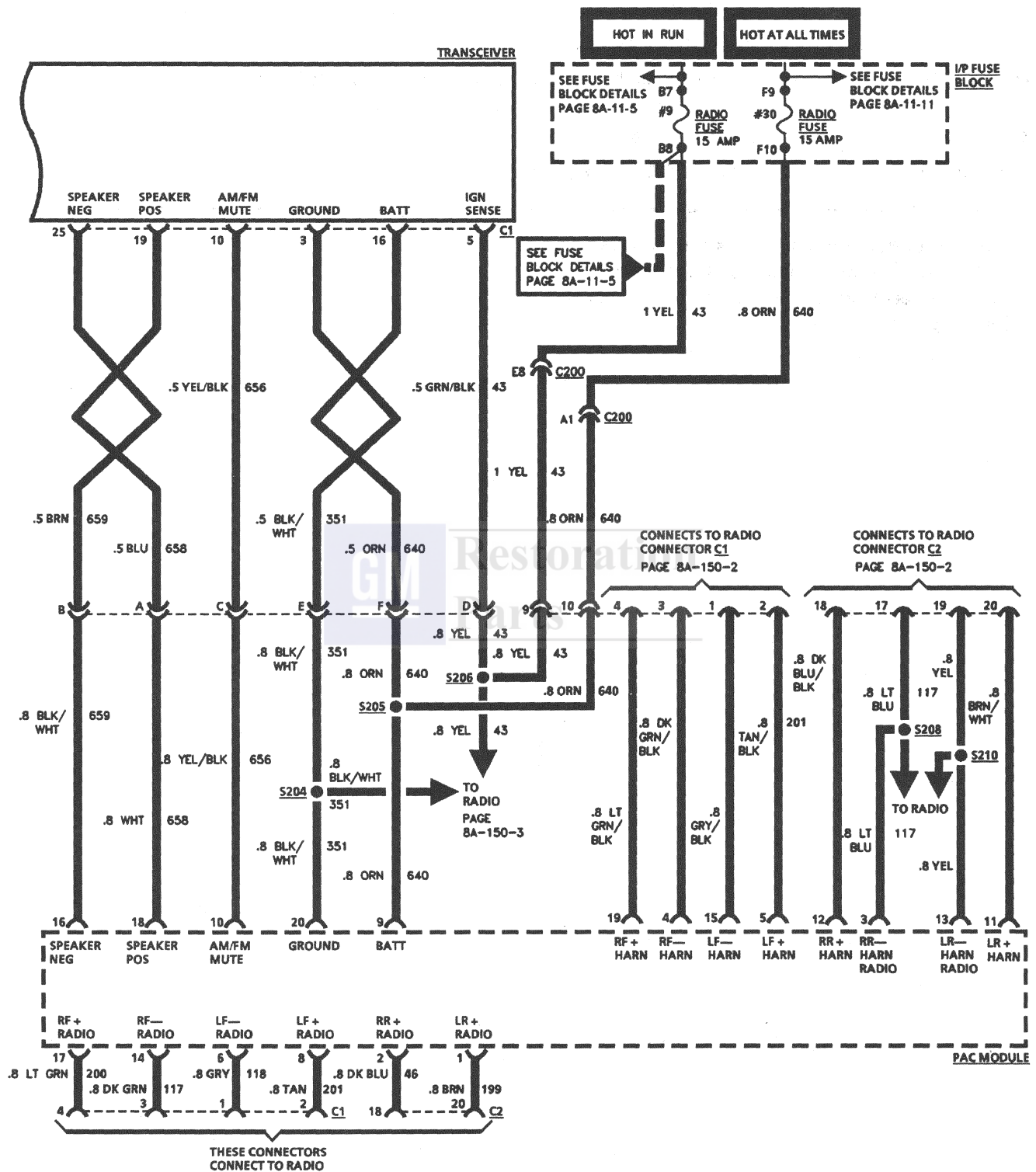
When the radio or Ignition Switch is in the "OFF" position, voltage is removed from the Radio Power Antenna Relay Coil. The Radio Power Antenna Relay contacts open, applying battery voltage to the motor through CKT 160. The motor ground is now CKT 145. Since the "DOWN" switch at the antenna is now making contact to CKT 160, the voltage to the motor has reversed polarity. It runs in the opposite direction, retracting the Antenna Mast.

At the end of the antenna's travel, the "DOWN" switch opens and breaks the current flow. Both sets of switches are now in the places shown in the schematic, the radio is "OFF," and the Antenna Mast is down.

The antenna is connected to the radio by coaxial cable.

CELLULAR MOBILE TELEPHONE





CELLULAR MOBILE TELEPHONE

COMPONENT	LOCATION	201-PG	FIG.	CONN
Antenna Conn.....	Center of Rear Windshield, cable routed down RH Rear "C" Pillar	8	13	
Handset Conn.....	Center of Tunnel, below I/P			
Microphone Conn.....	Center of Windshield Header, cable routed down RH Front "A" Pillar.....	26	37	
PAC Module Conn.....	Center of I/P, below Radio			
Transceiver Conn	In Front of Rear Compartment			

For Cellular Mobile Telephone diagnosis, refer to the Motorola Cellular Telephone Diagnostic Manual provided with the dealer installed Cellular Mobile Telephone.





COMPONENT LOCATION VIEWS

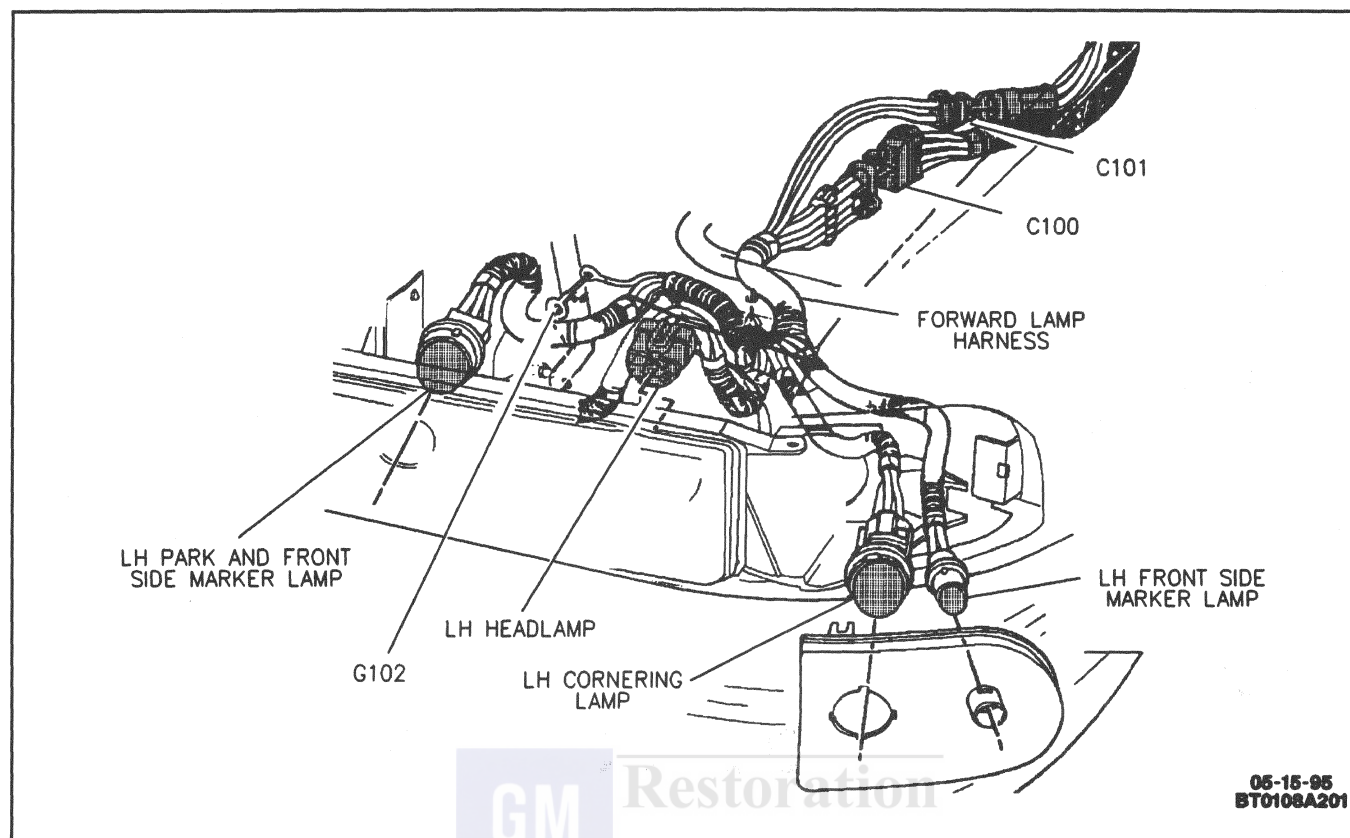


Fig 1 - Left Front of Vehicle

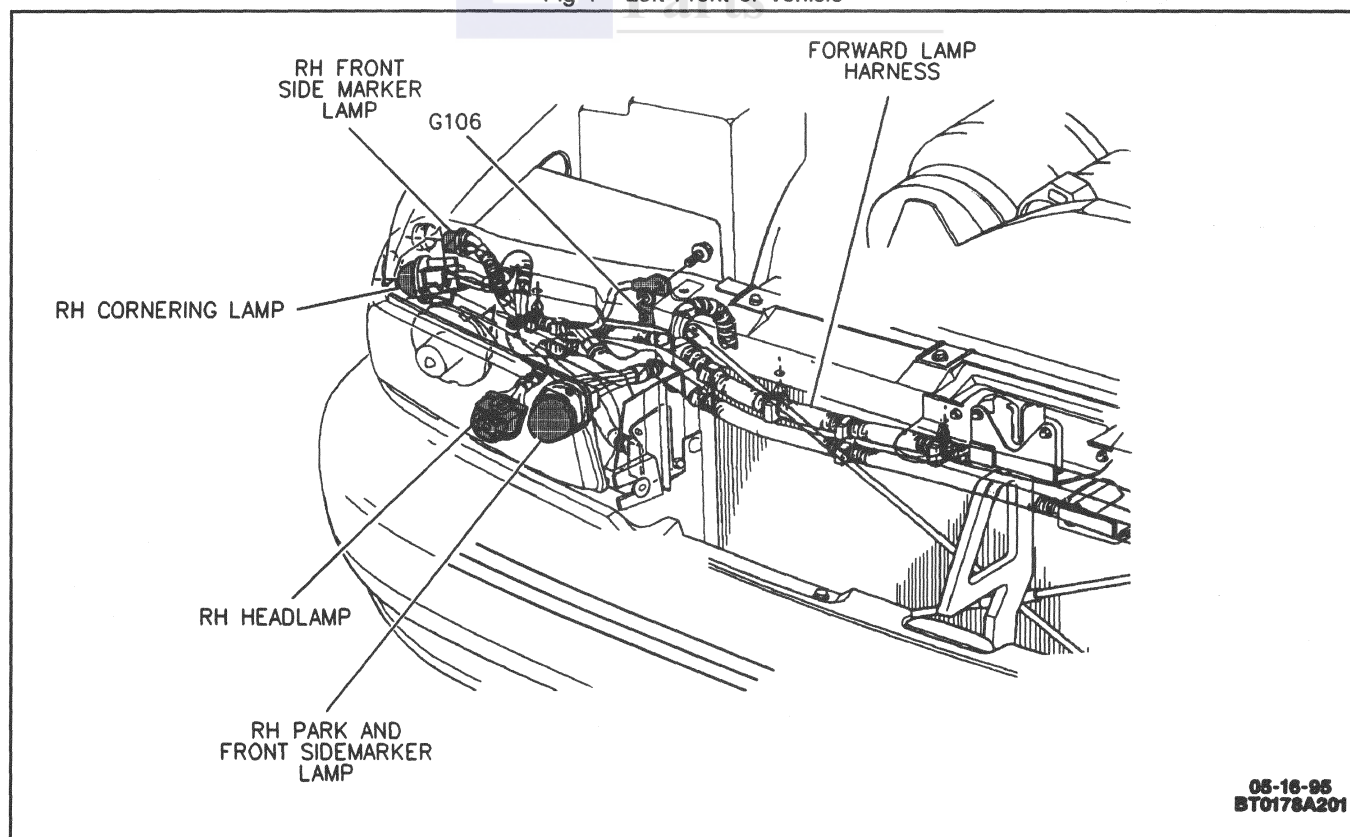


Fig 2 - Right Front of Vehicle

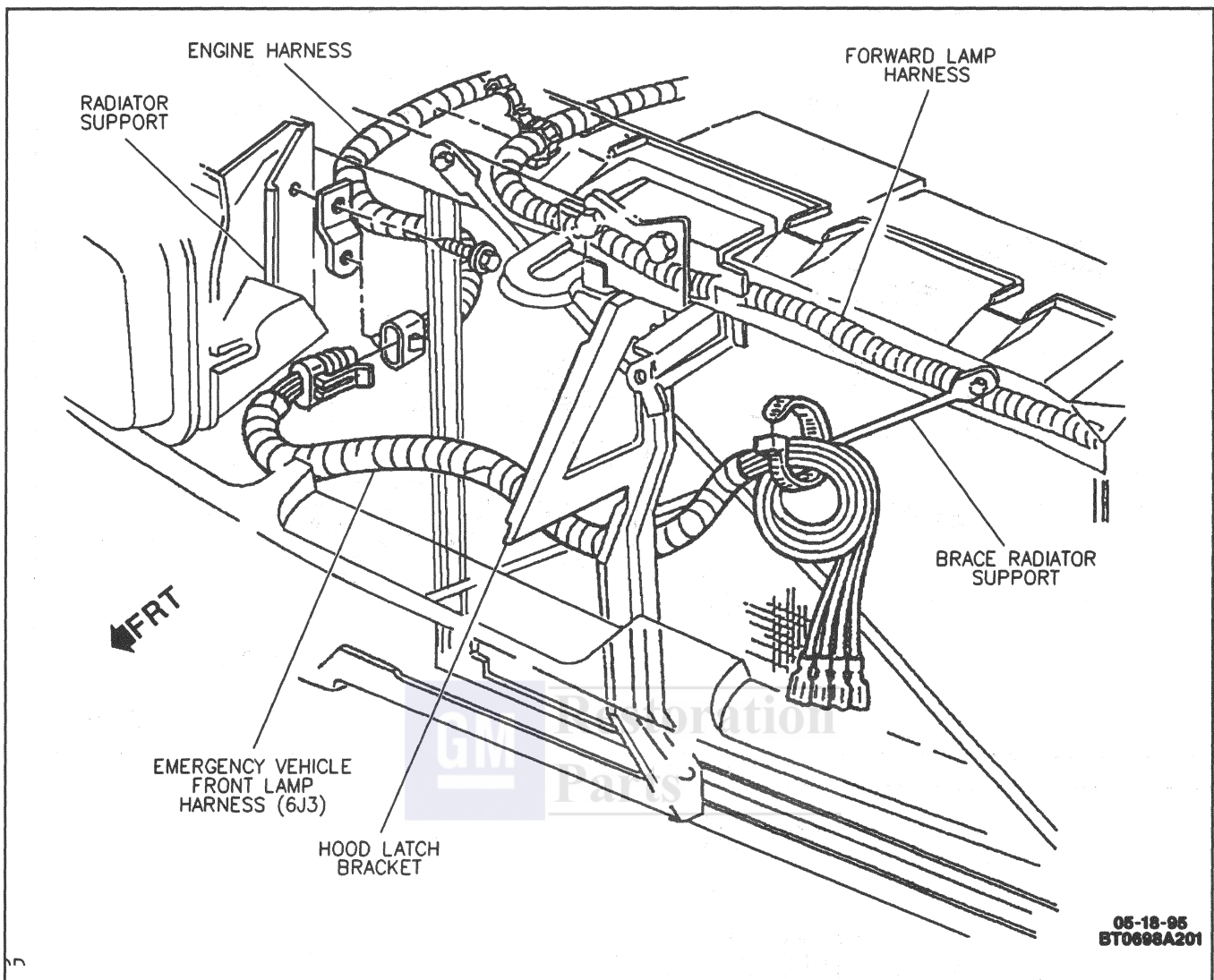


Fig 3 - Front of Radiator

COMPONENT LOCATION VIEWS

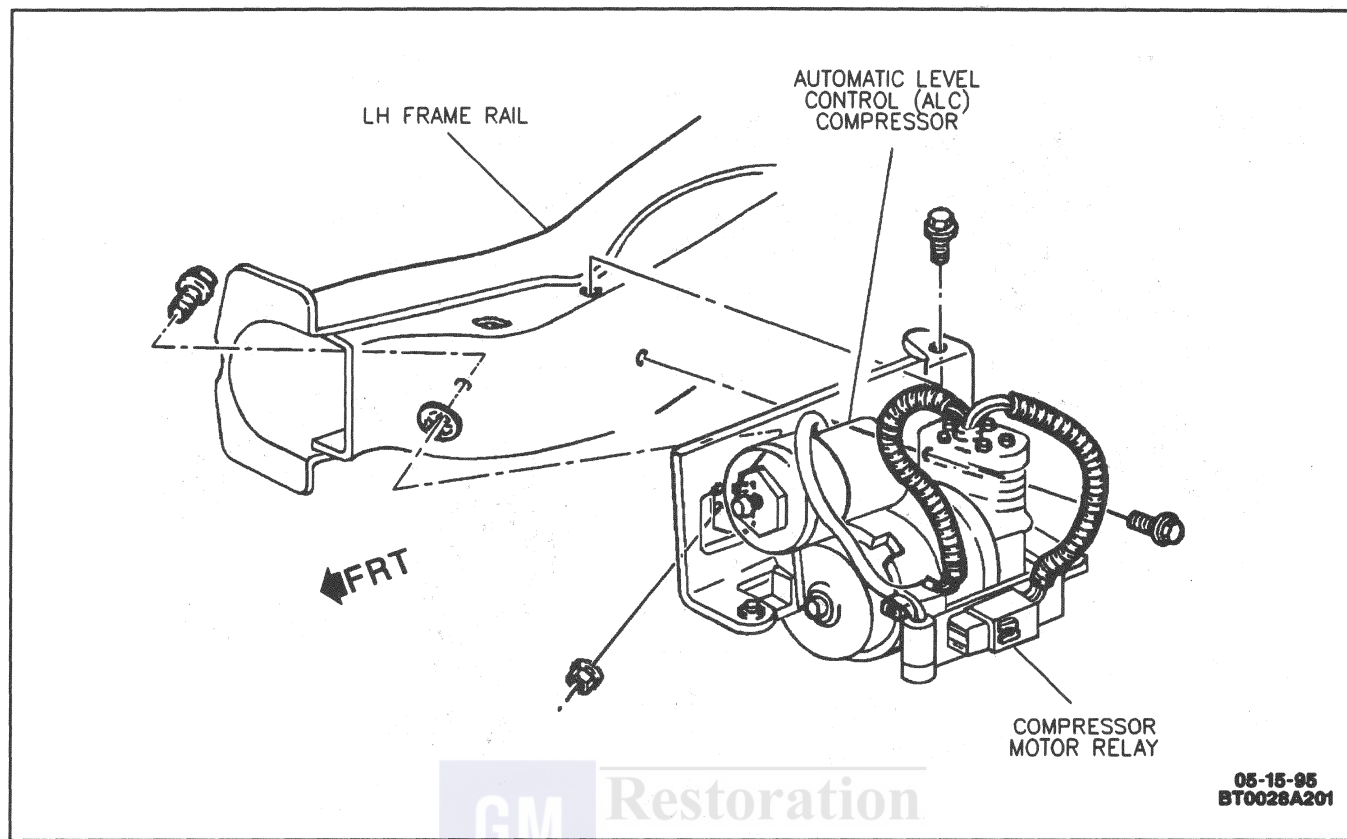


Fig 4 - Left Front Frame Rail

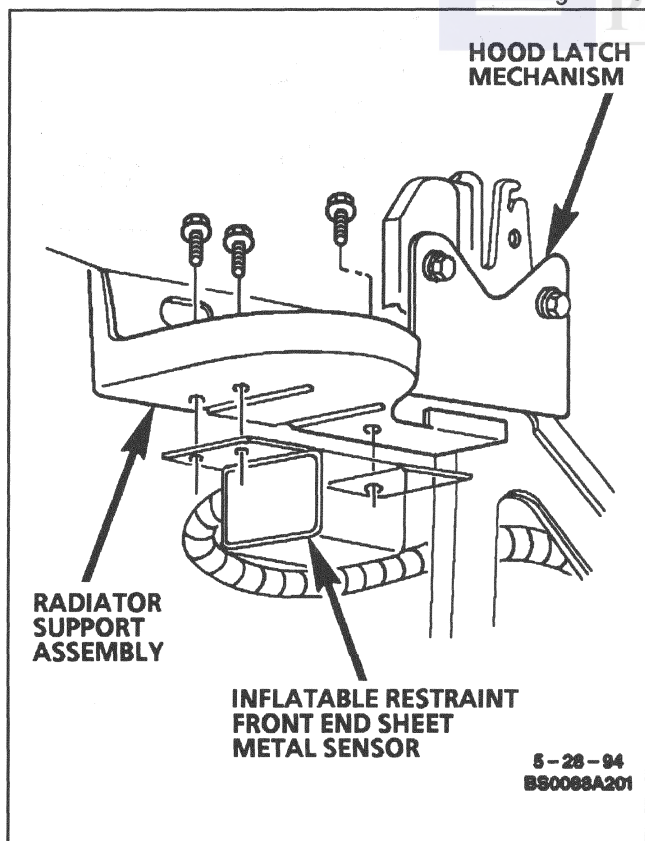


Fig 5 - Center of Radiator Support

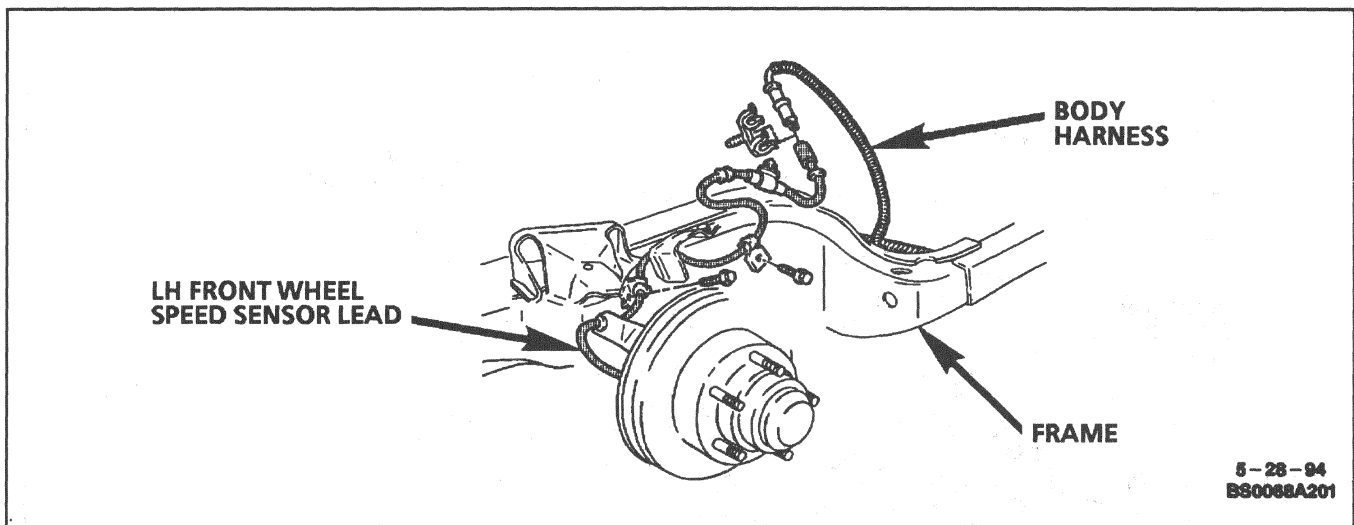


Fig 6 - Left Front Frame Rail

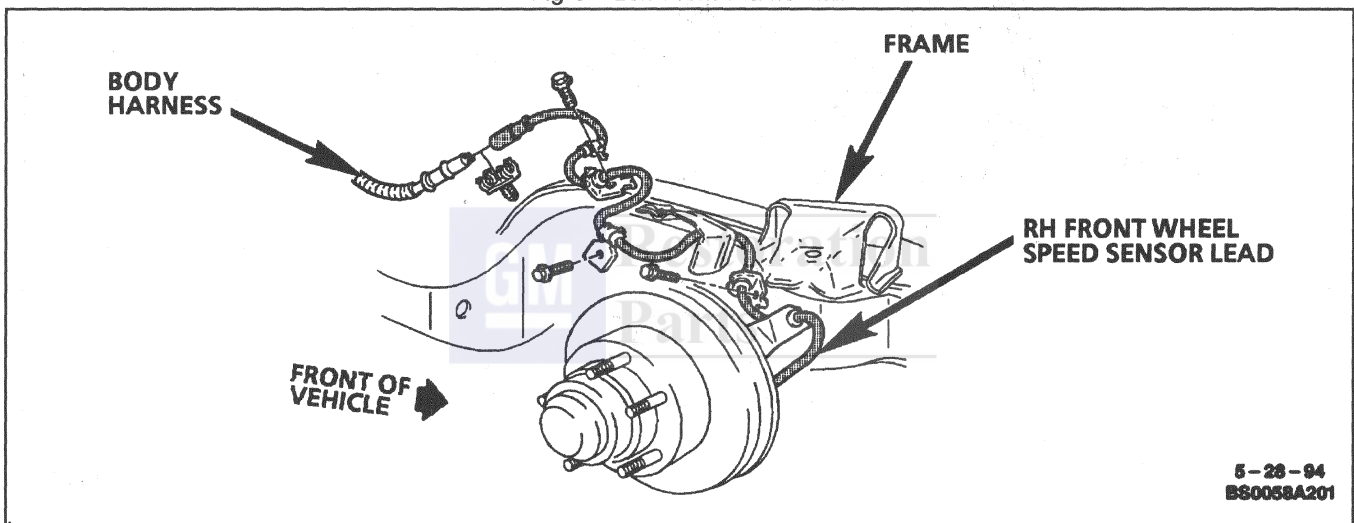


Fig 7 - Right Front Frame Rail

8A - 201 - 4 ELECTRICAL DIAGNOSIS

COMPONENT LOCATION VIEWS

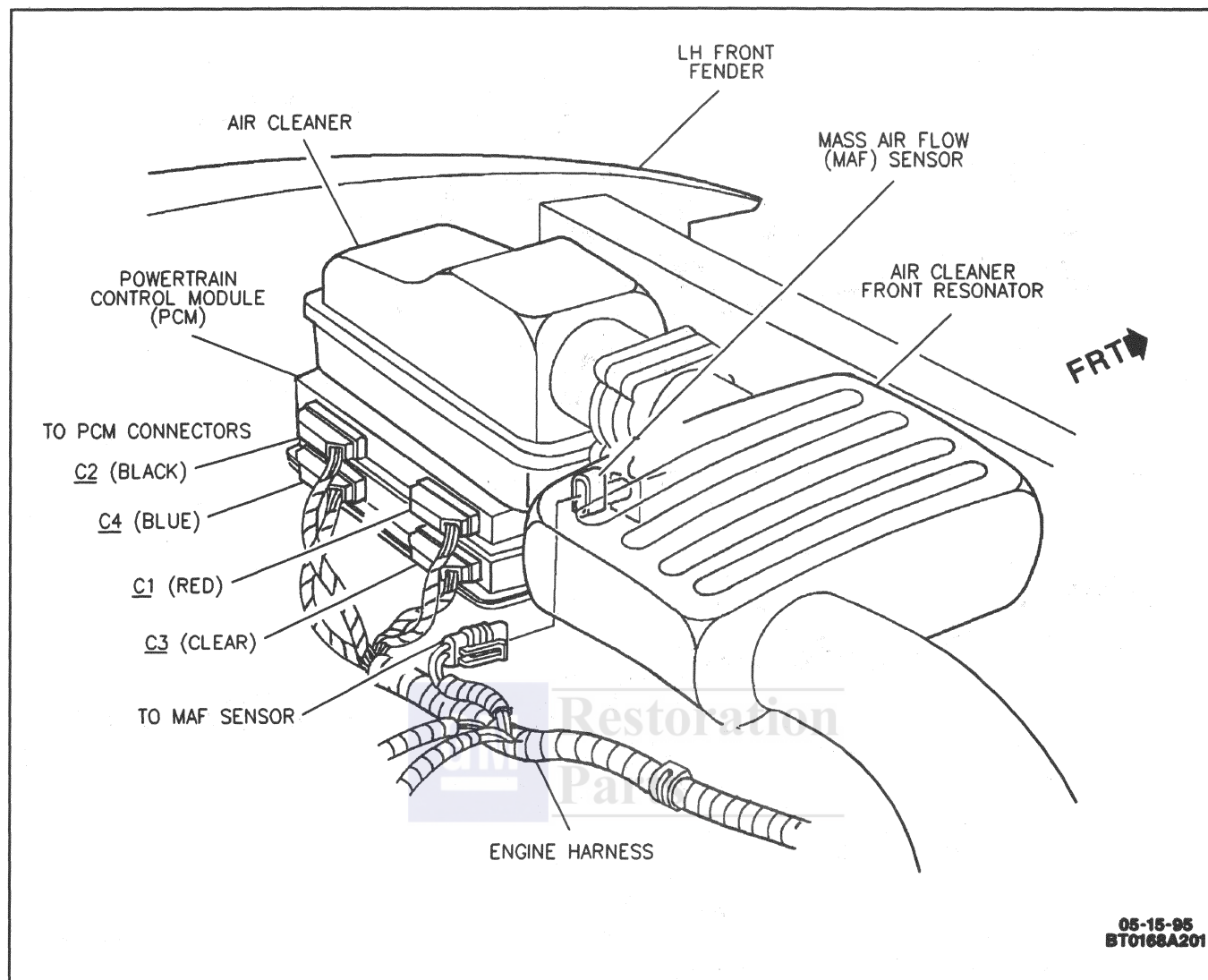


Fig 8 - Left Front of Engine Compartment

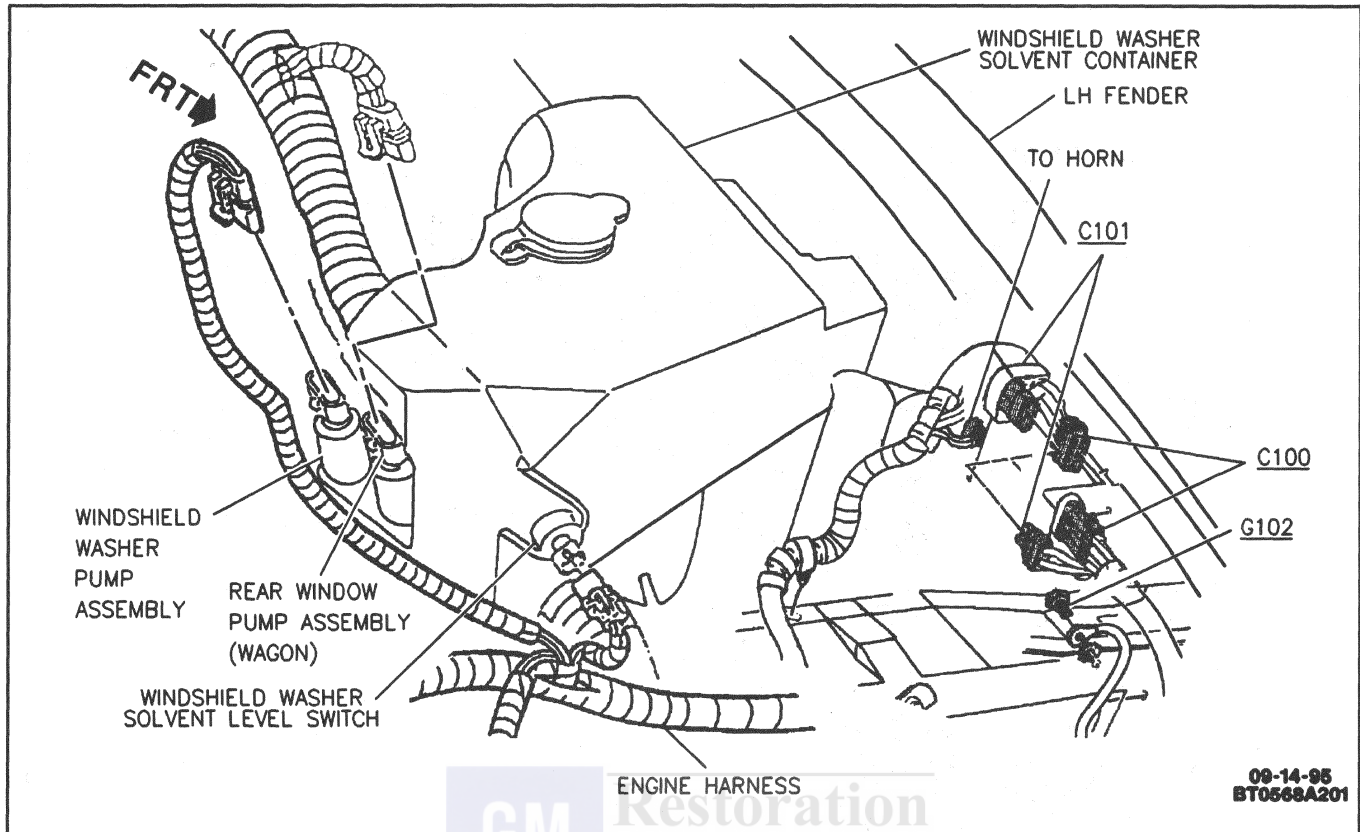


Fig 9 - Left Front of Engine Compartment

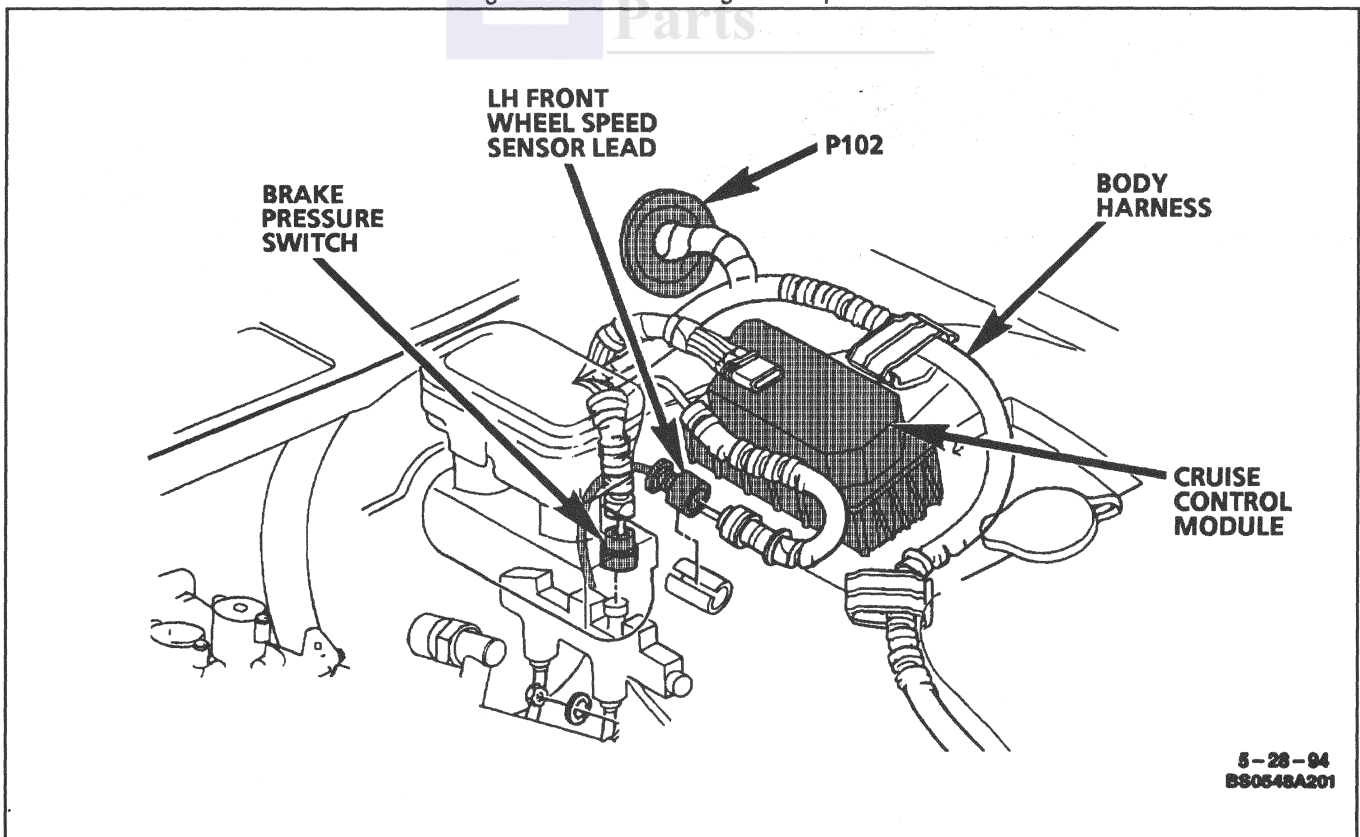


Fig 10 - Left Rear of Engine Compartment

COMPONENT LOCATION VIEWS

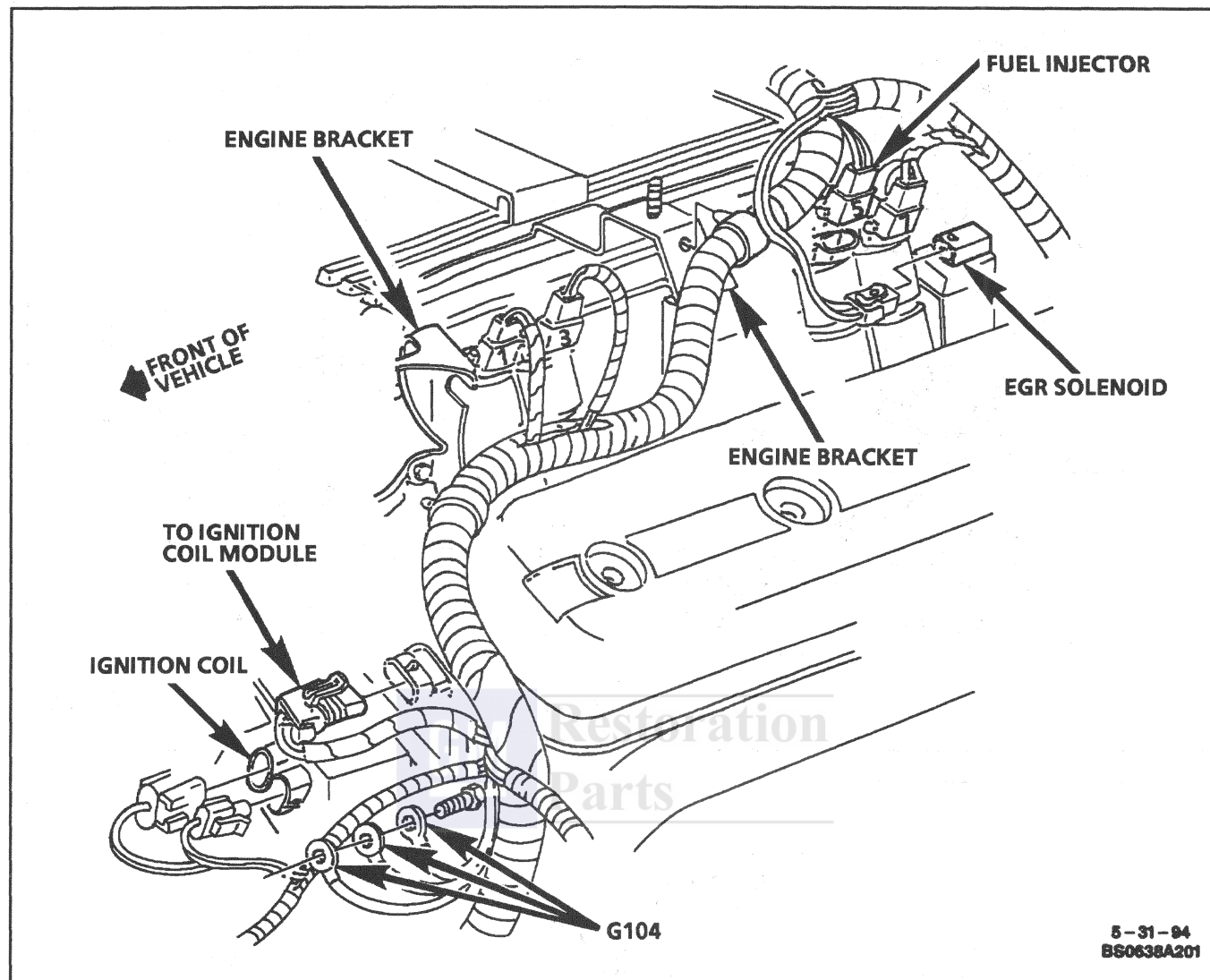


Fig 11 - Upper Left Side of Engine

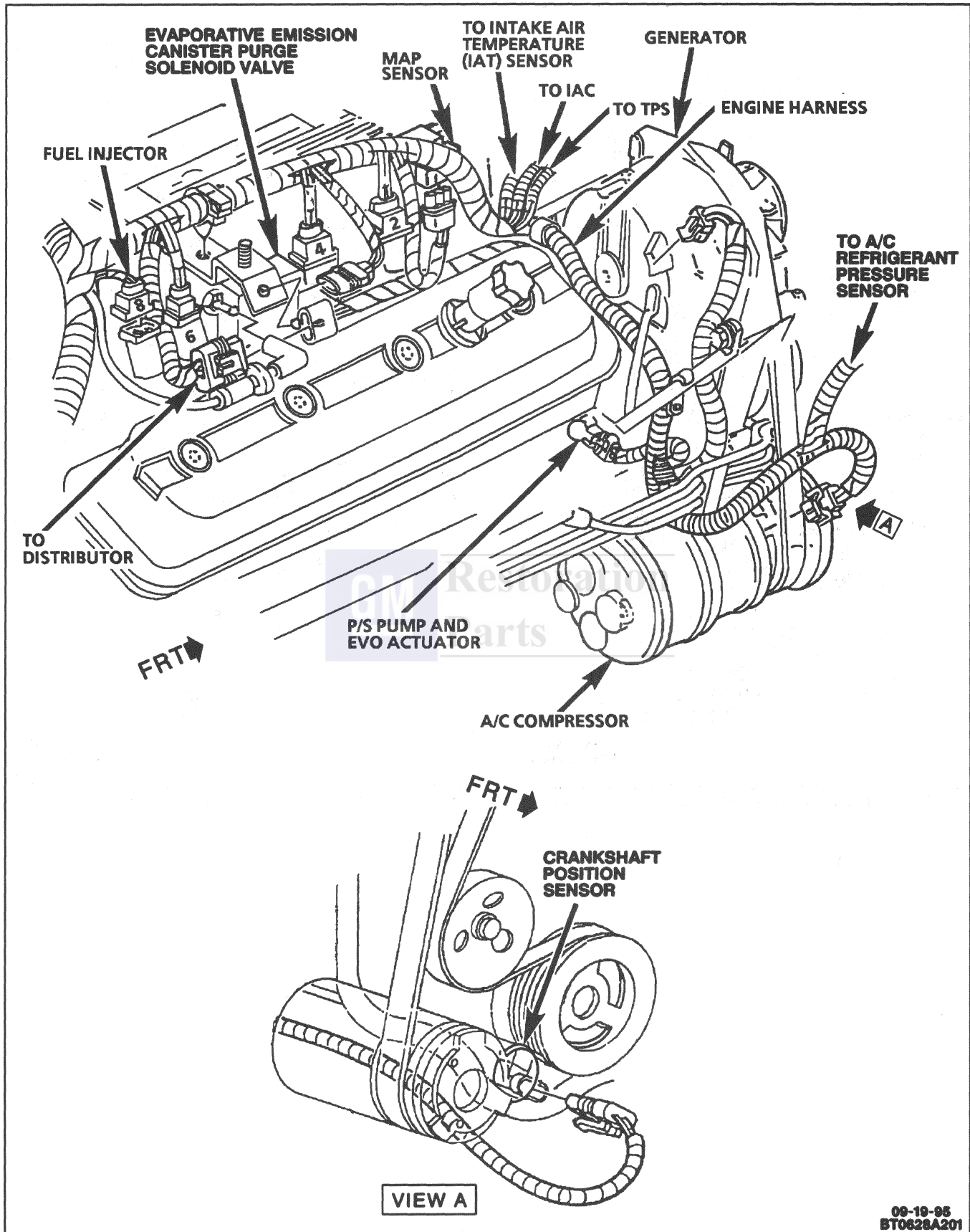


Fig 12 - Upper Right Side of Engine

COMPONENT LOCATION VIEWS

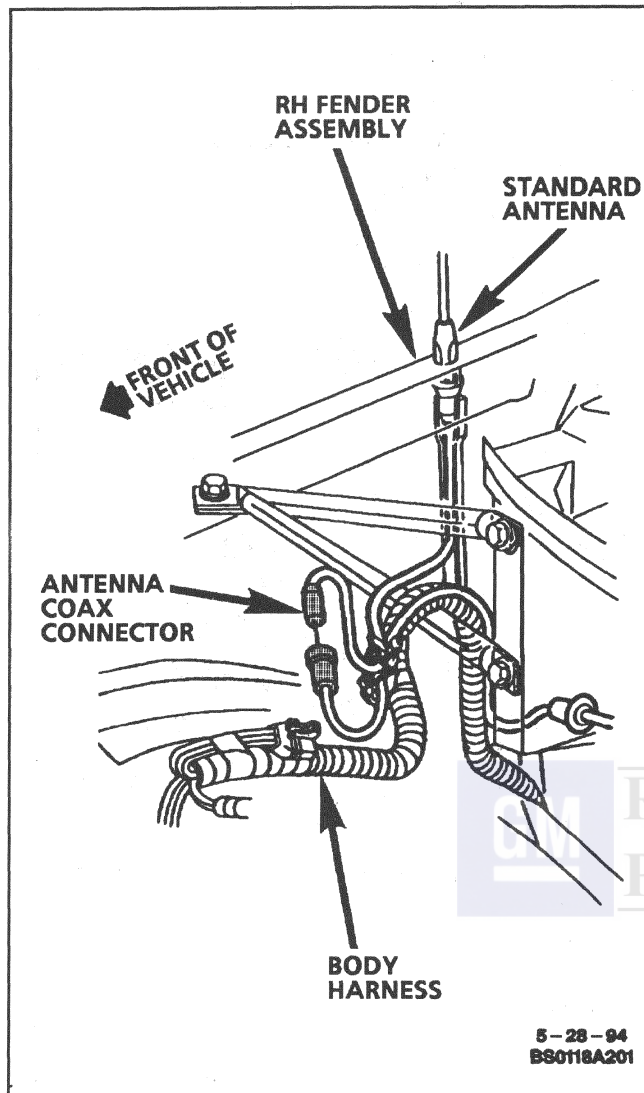


Fig 13 - Right Rear of Engine Compartment (with U73)

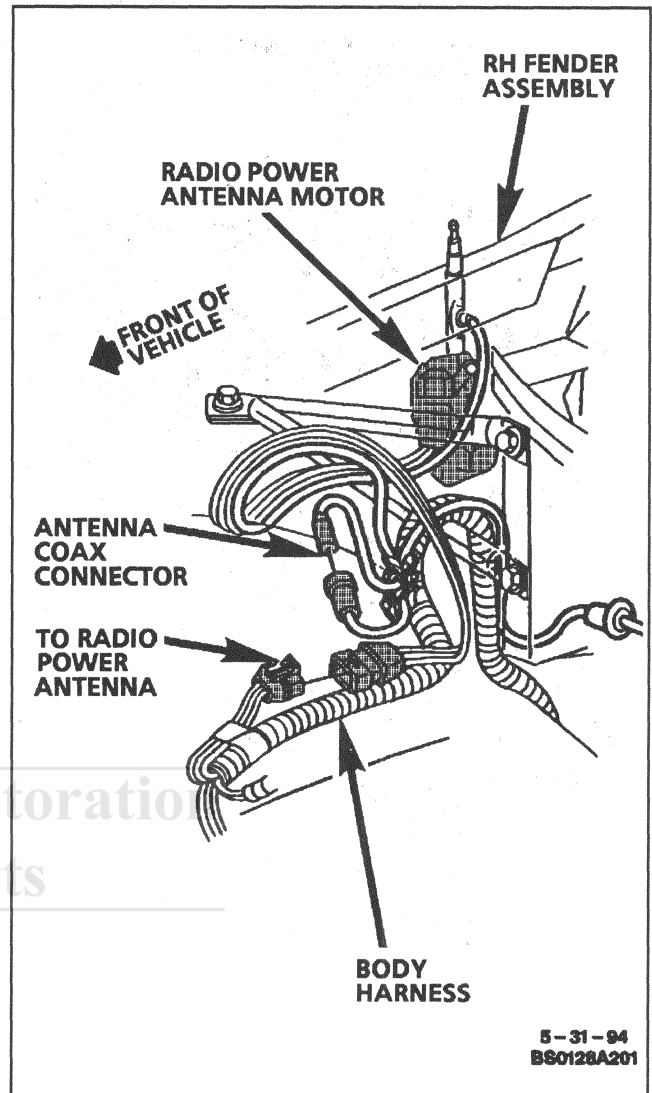


Fig 14 - Right Rear of Engine Compartment (with U75)

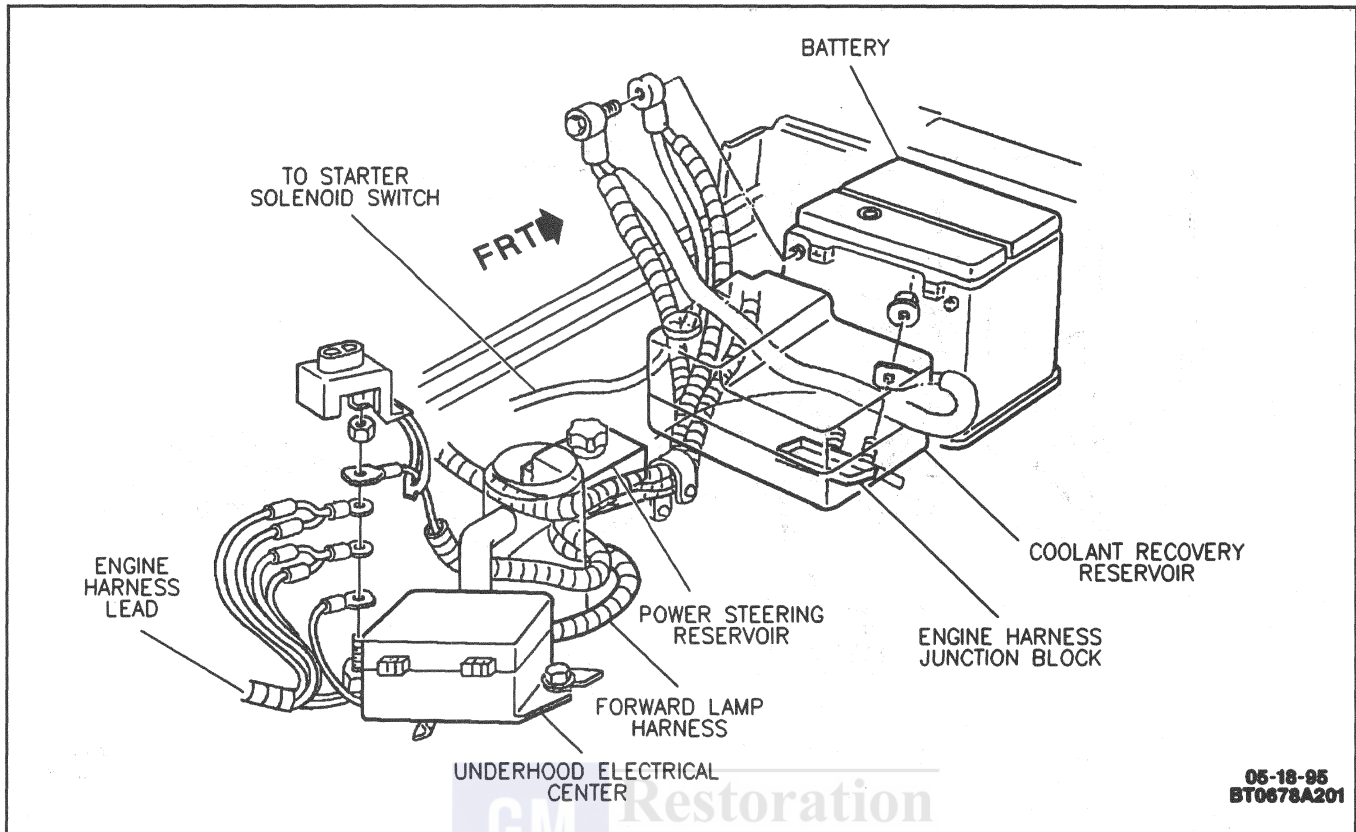


Fig 15 - Right Front of Engine Compartment

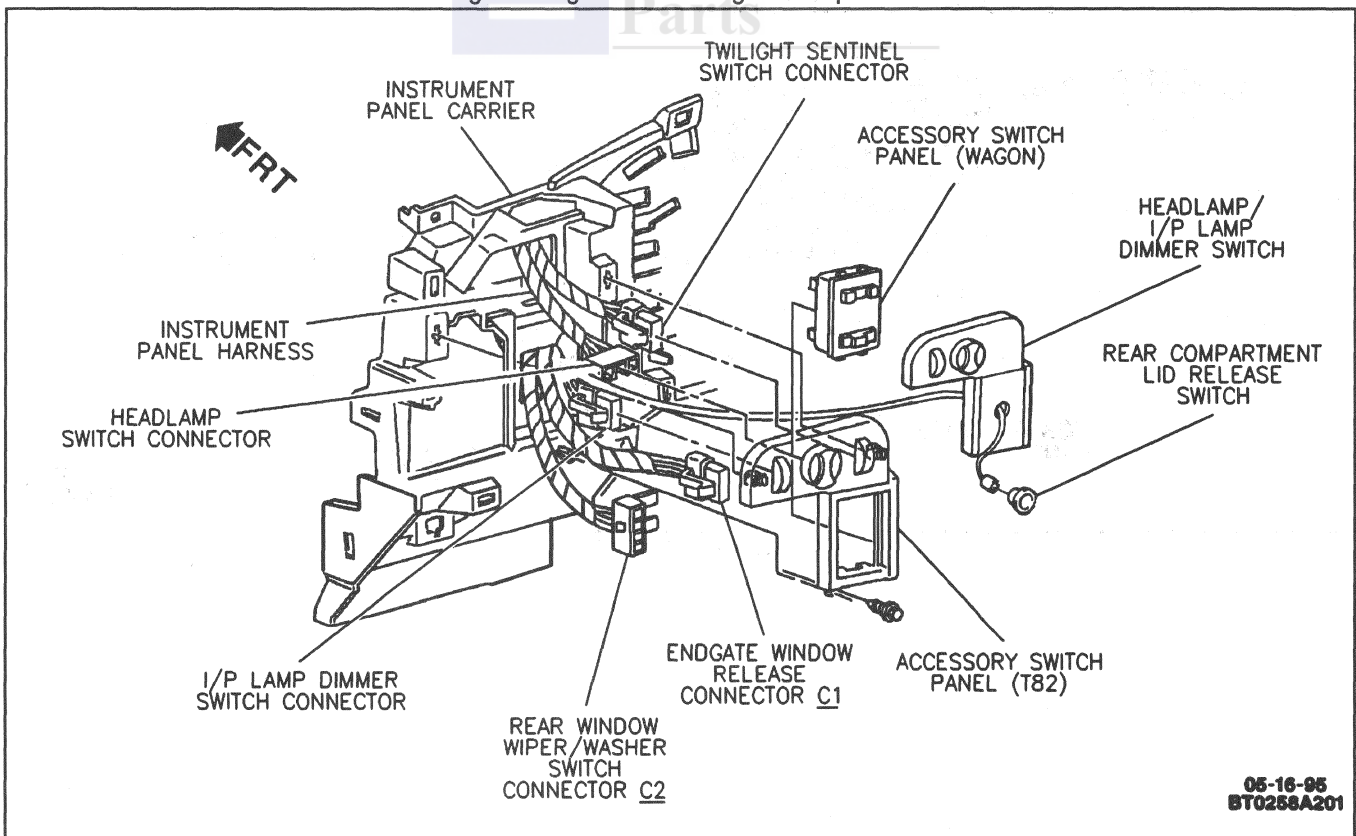


Fig 16 - Left Side of Instrument Panel (Chevrolet)

COMPONENT LOCATION VIEWS

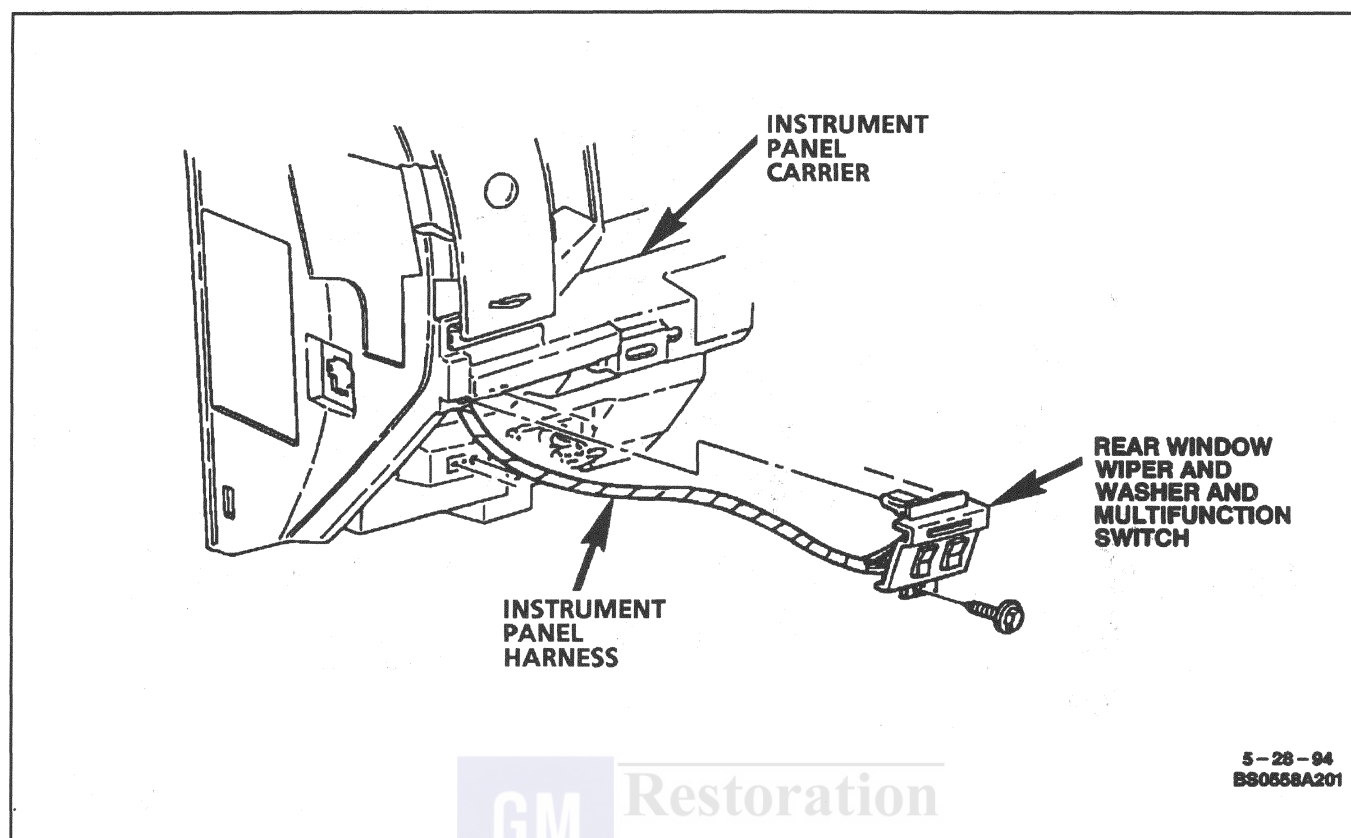


Fig 17 - Lower Left Side of Instrument Panel (Wagon)

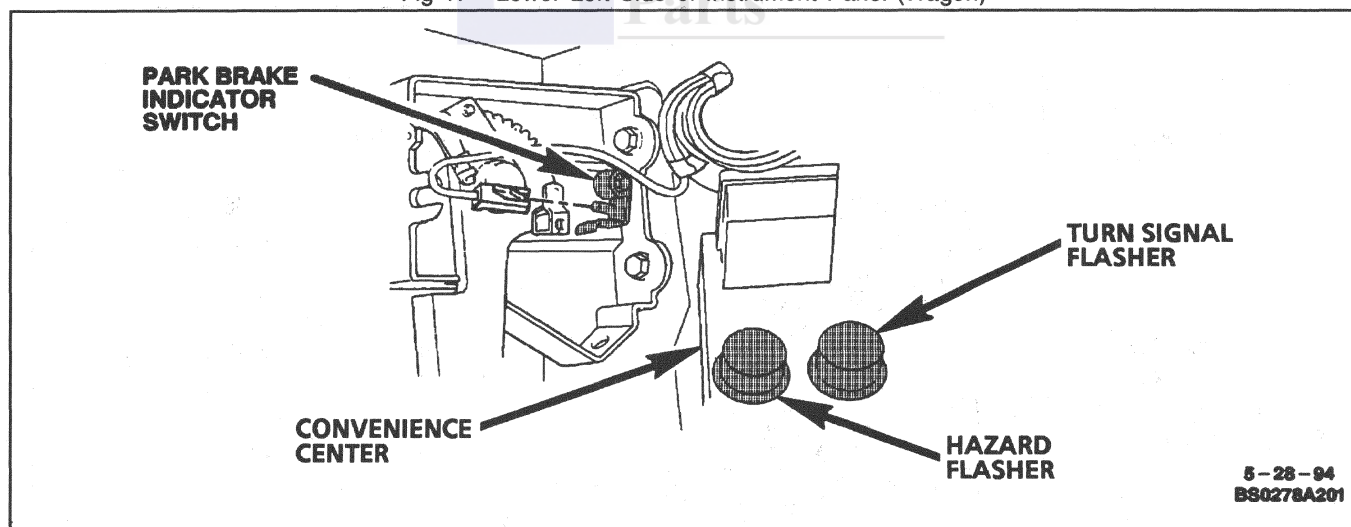


Fig 18 - Bottom of LH "A" Pillar

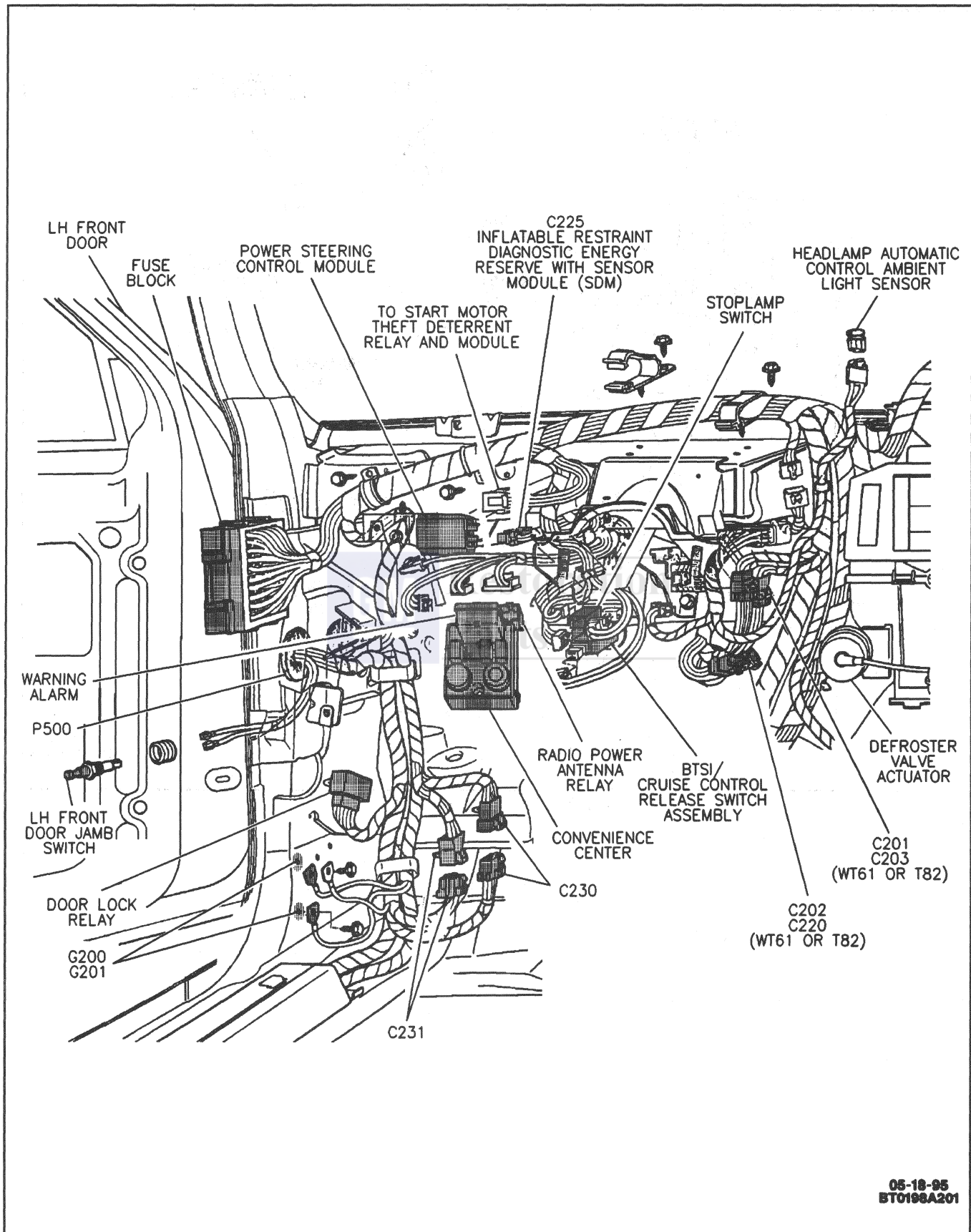


Fig 19 - Behind Left Side of Instrument Panel



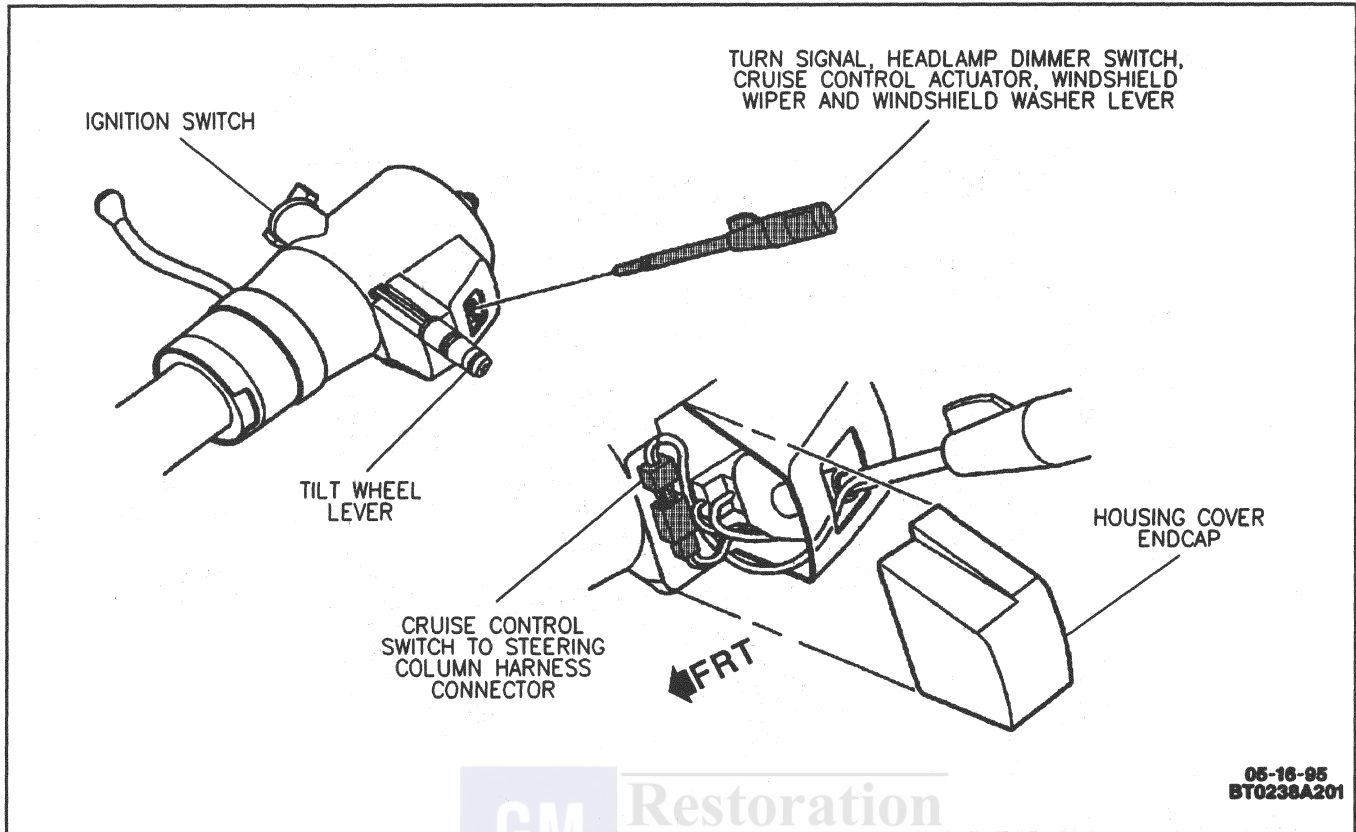


Fig 21 - Upper Left Side of Steering Column

COMPONENT LOCATION VIEWS

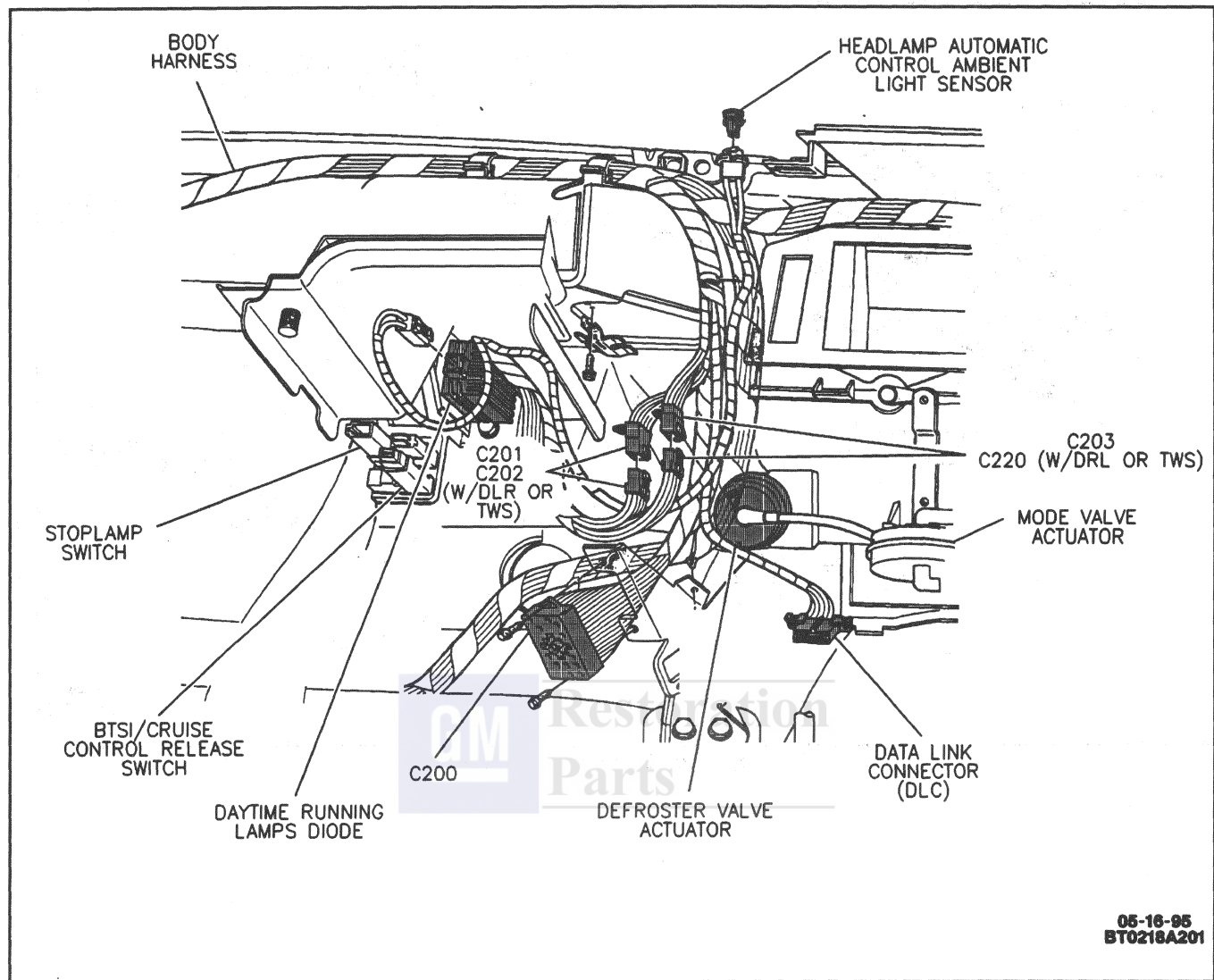


Fig 22 - Near Steering Column Bracket

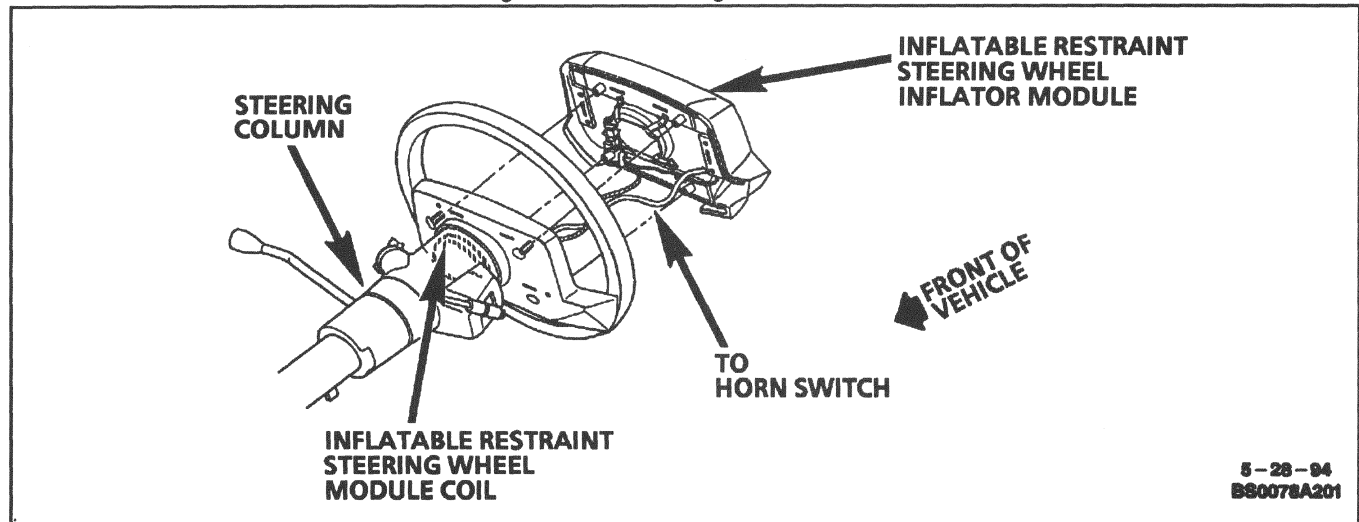


Fig 23 - Steering Wheel

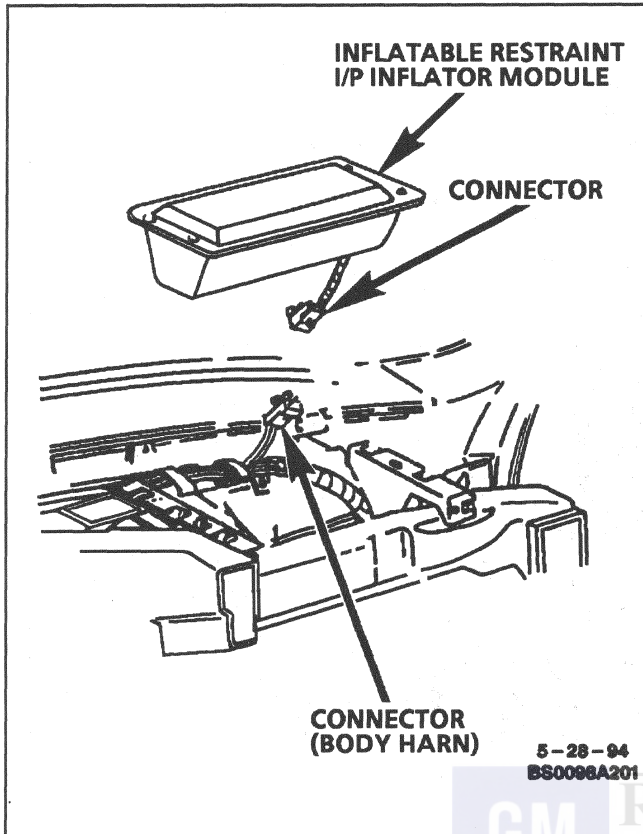


Fig 24 - Passenger Inflatable Restraint

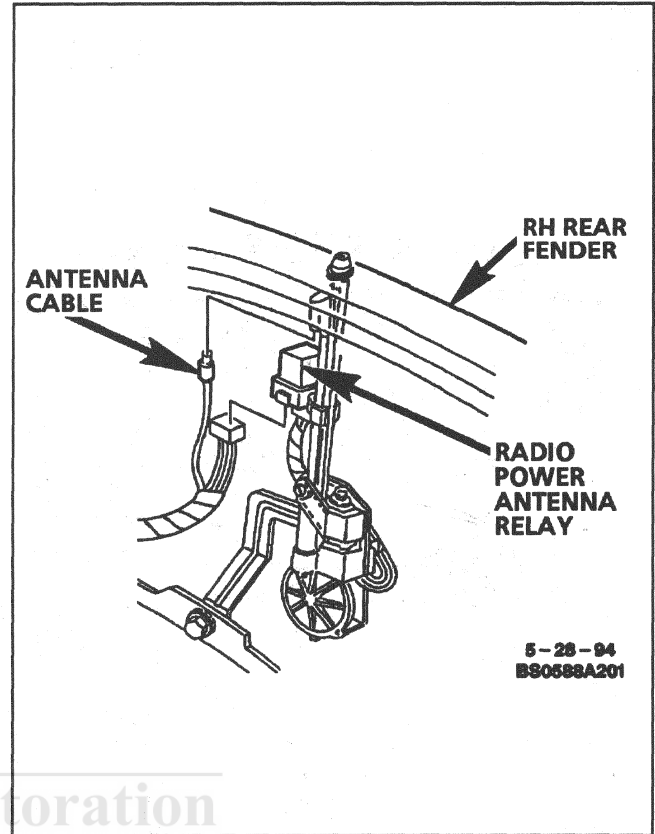


Fig 25 - Right Rear Compartment (Buick Sedan)

COMPONENT LOCATION VIEWS

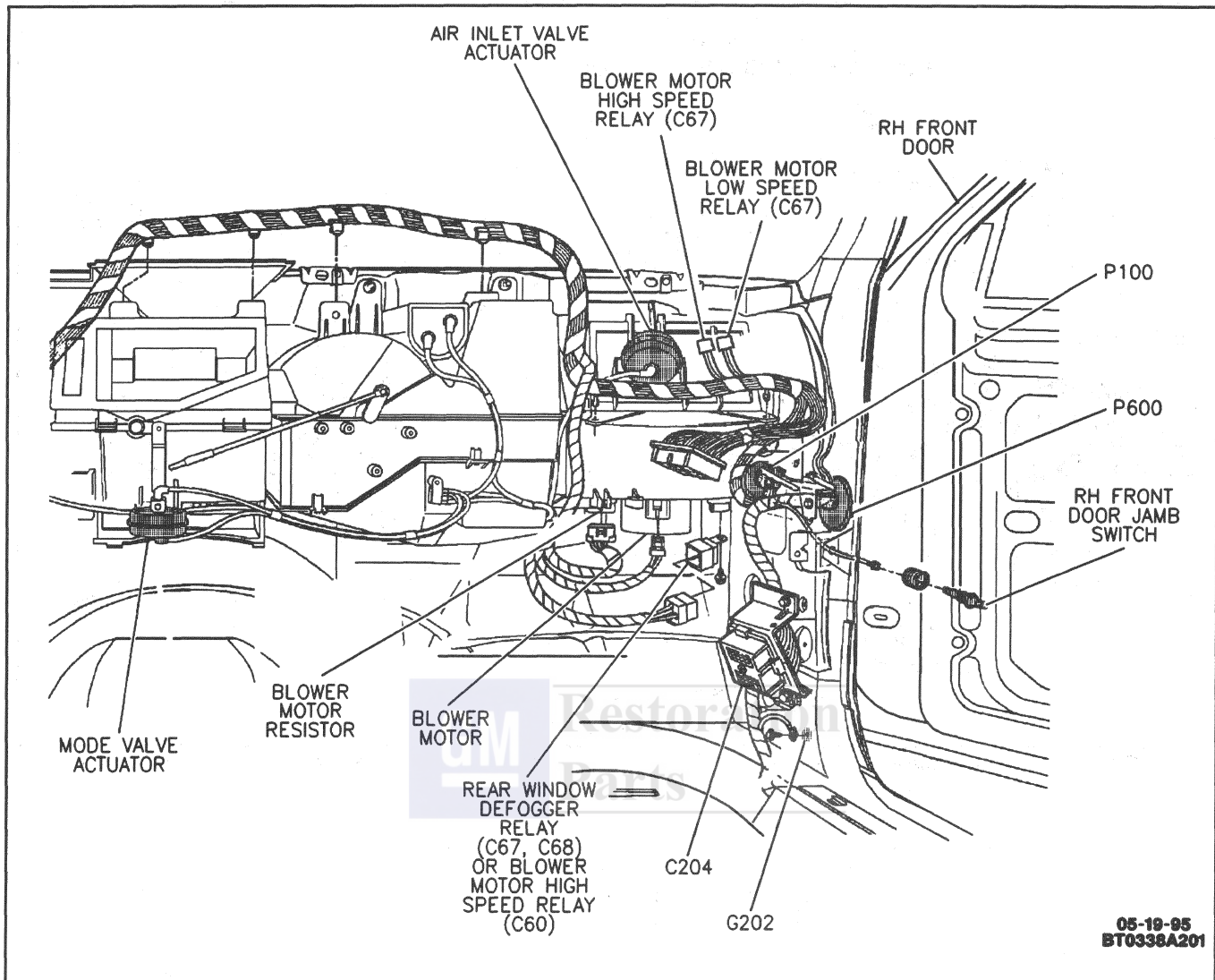


Fig 26 - Behind Right Side of Instrument Panel

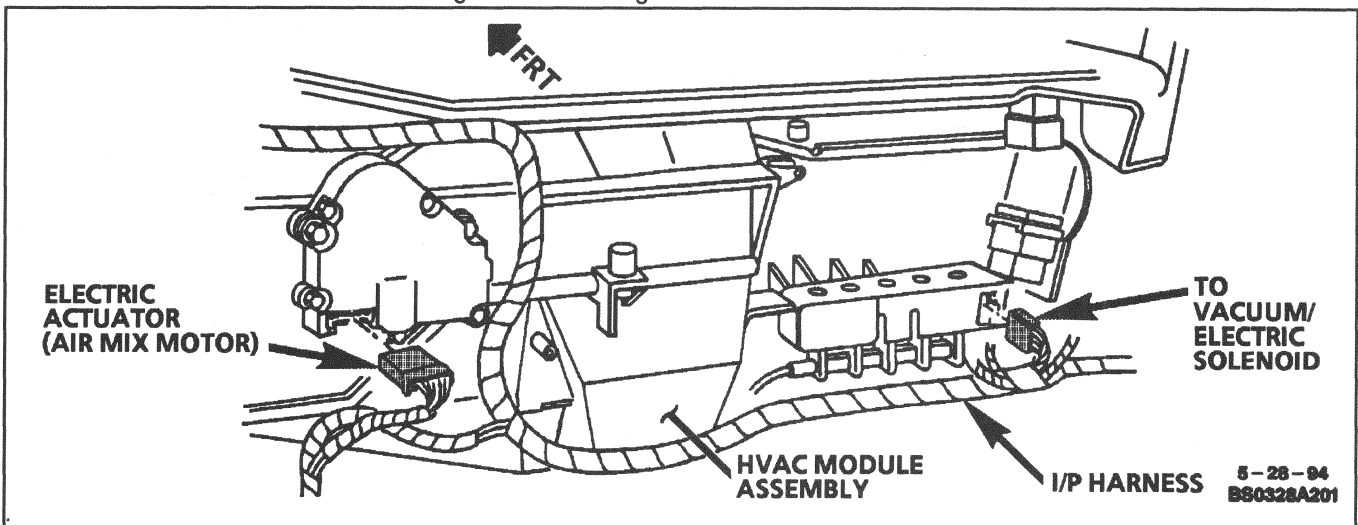
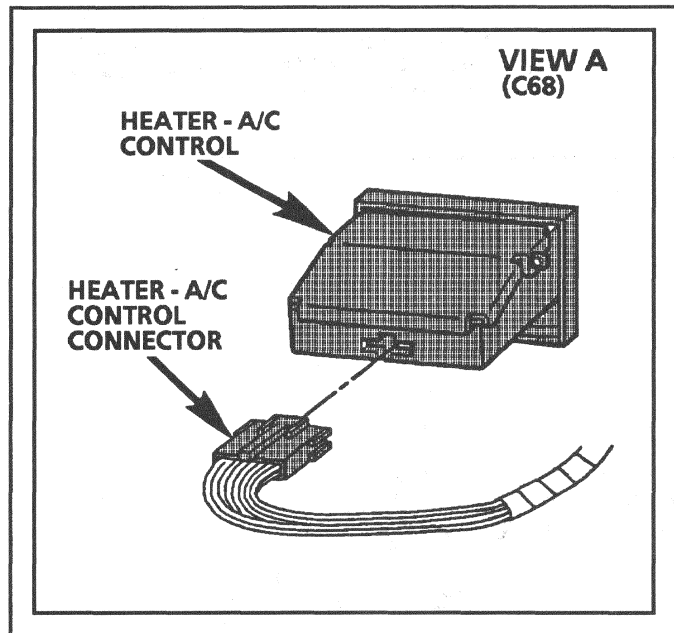
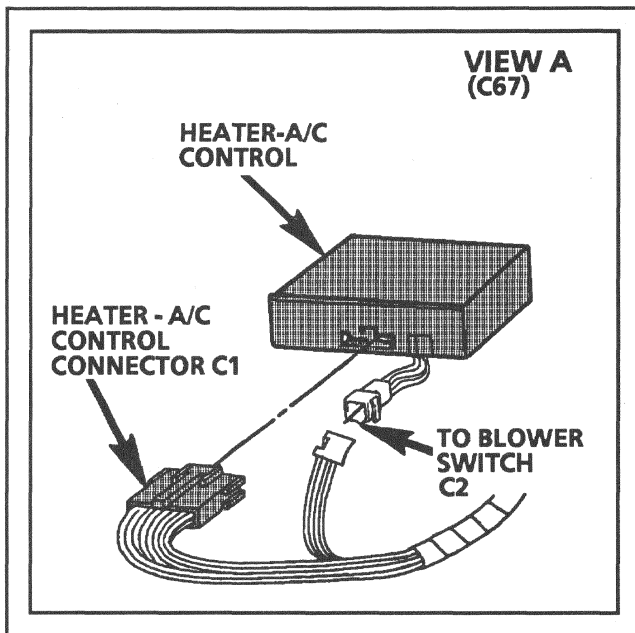
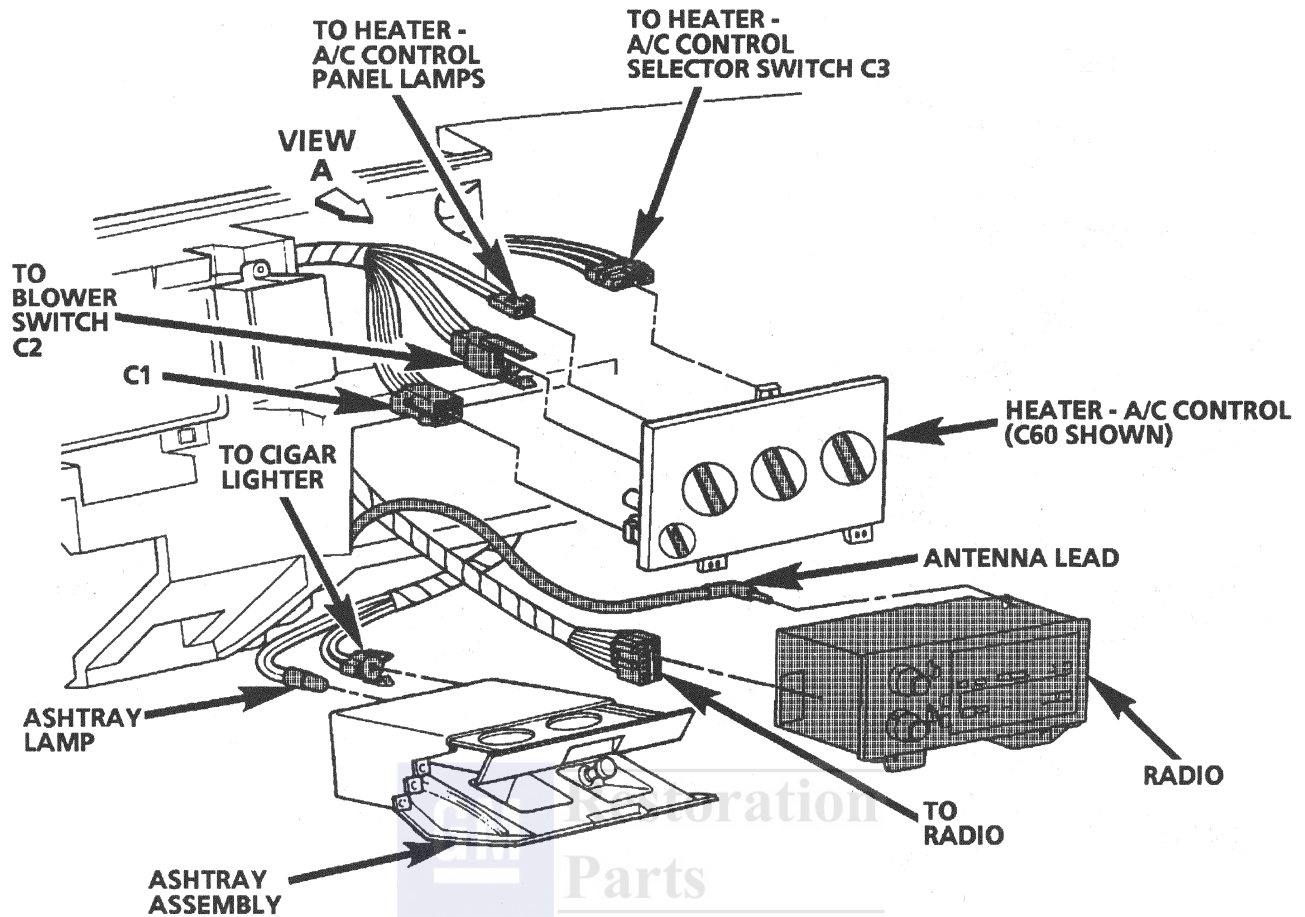


Fig 27 - Behind Center of Instrument Panel (with C67 or C68)



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Fig 28 - Front Center of Instrument Panel

COMPONENT LOCATION VIEWS

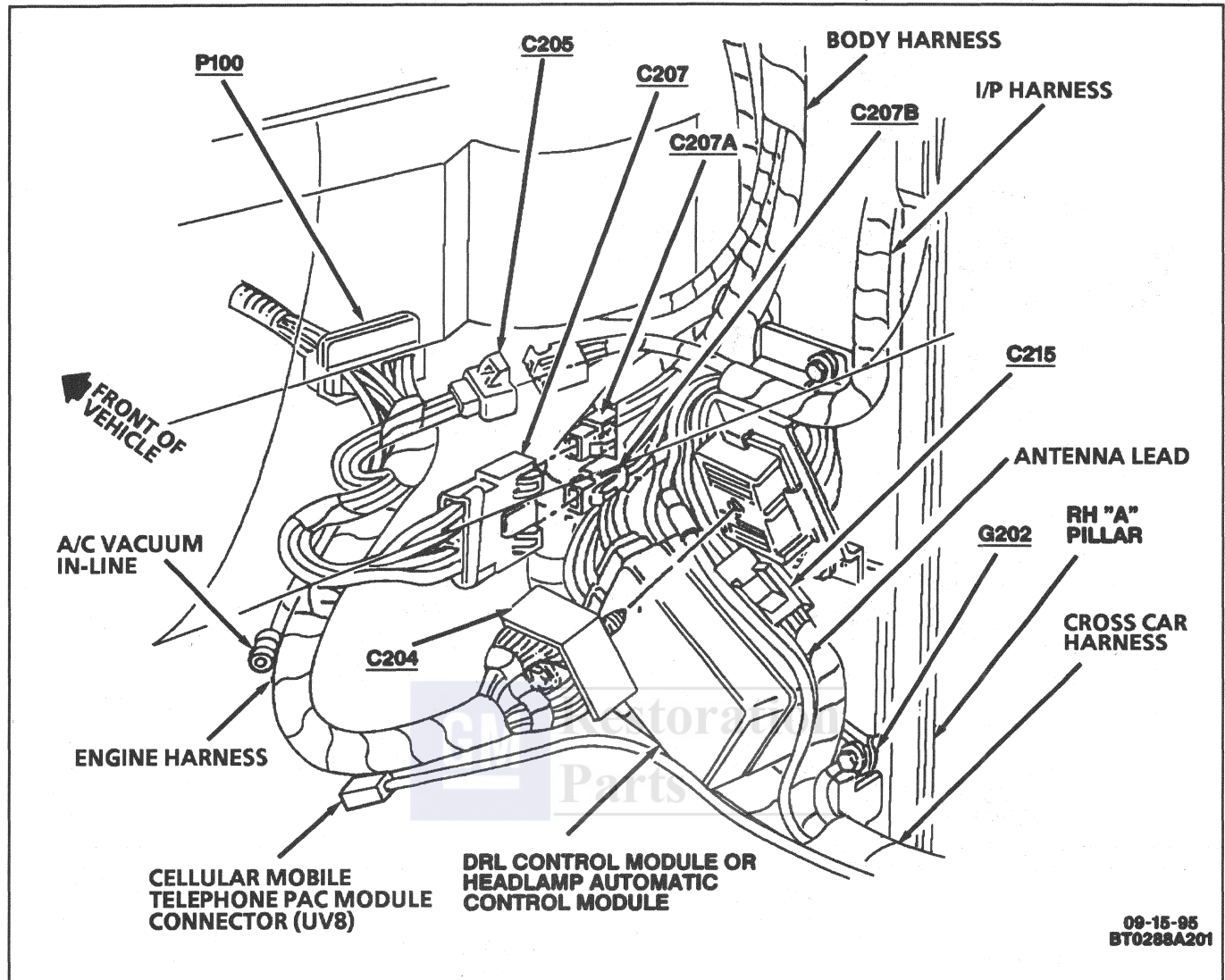


Fig 29 - Lower Right "A" Pillar

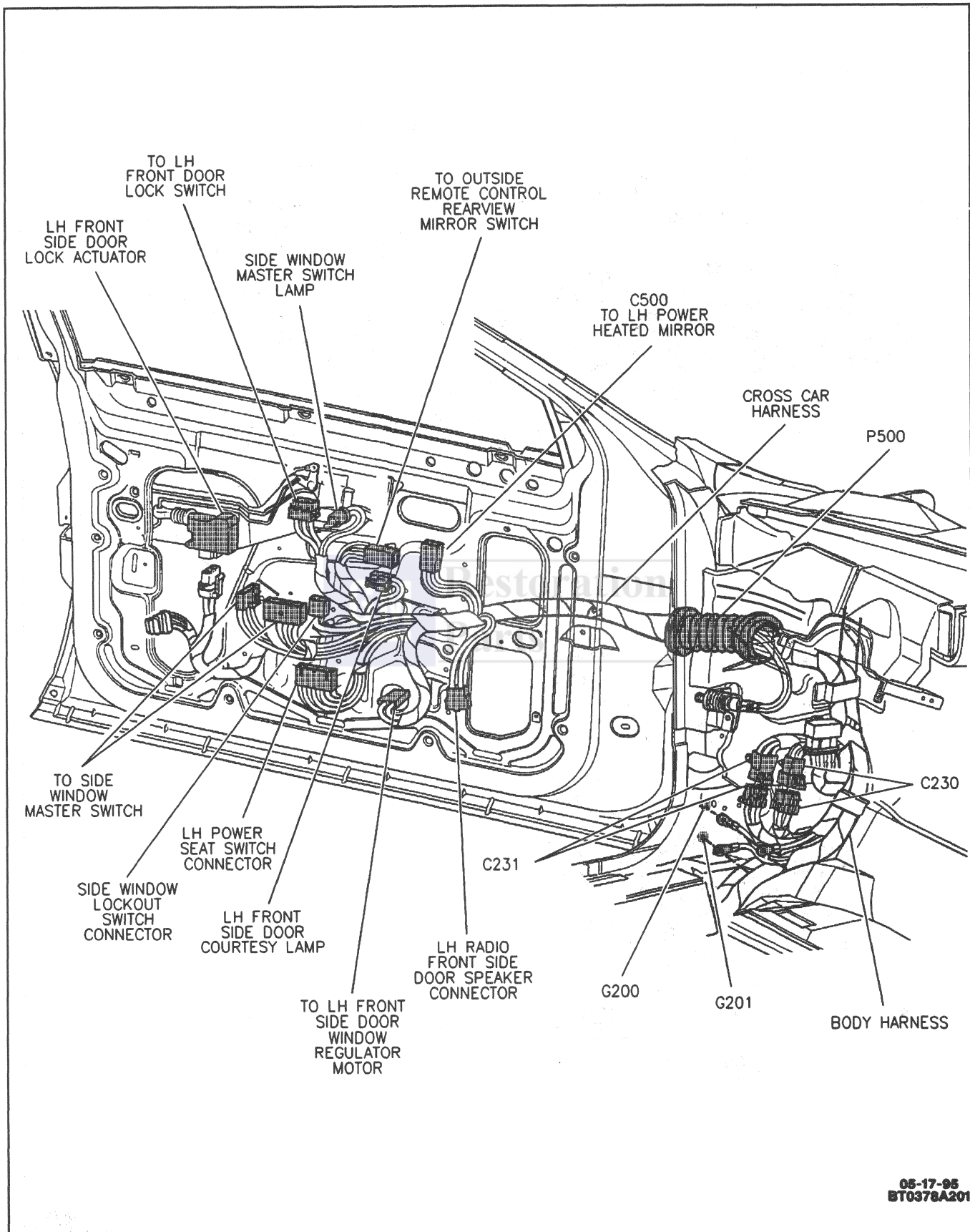
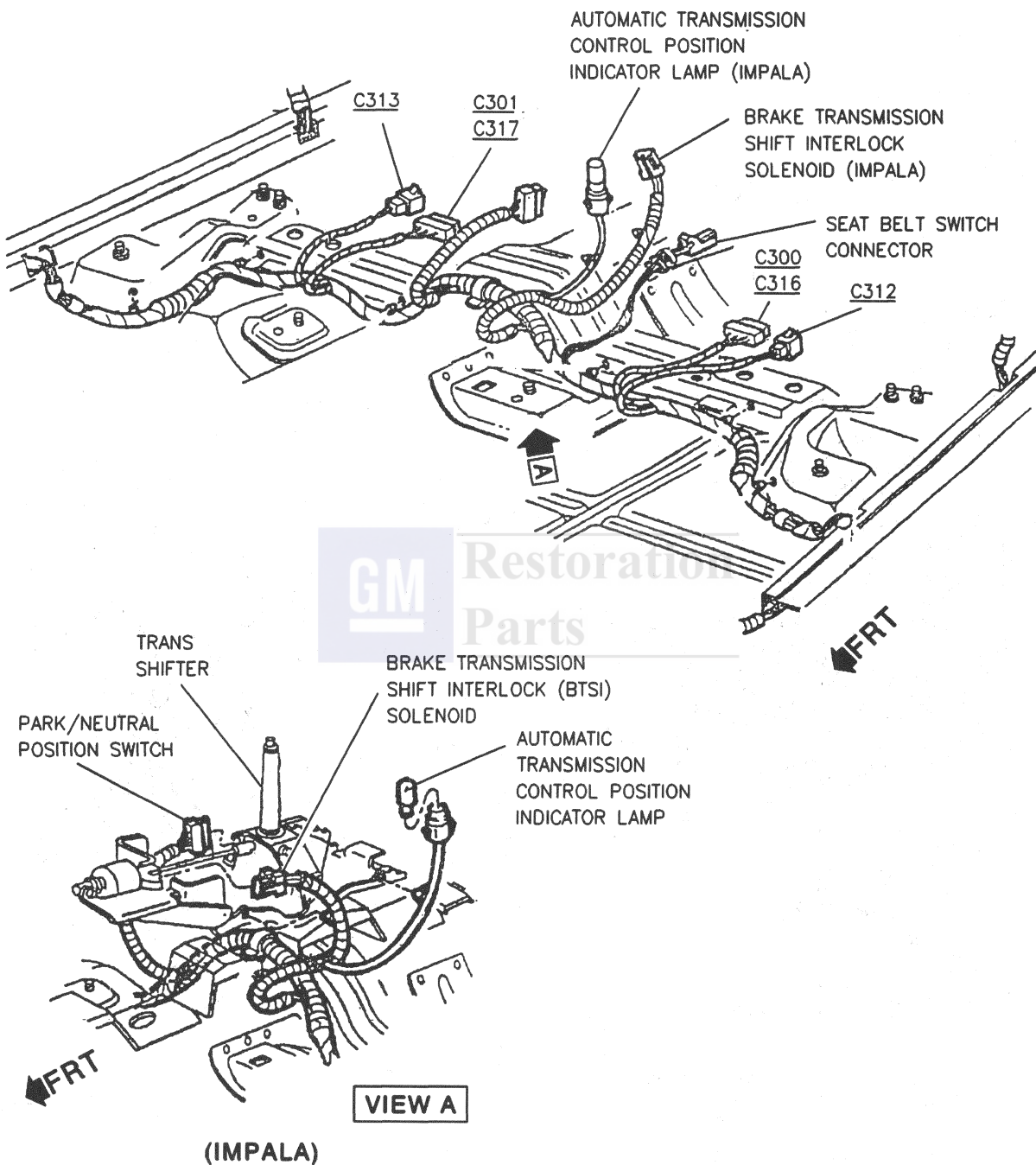


Fig 30 - Left Front Side Door and "A" Pillar

COMPONENT LOCATION VIEWS



09-15-85
BT0348A201

Fig 31 - Cross Car Harness

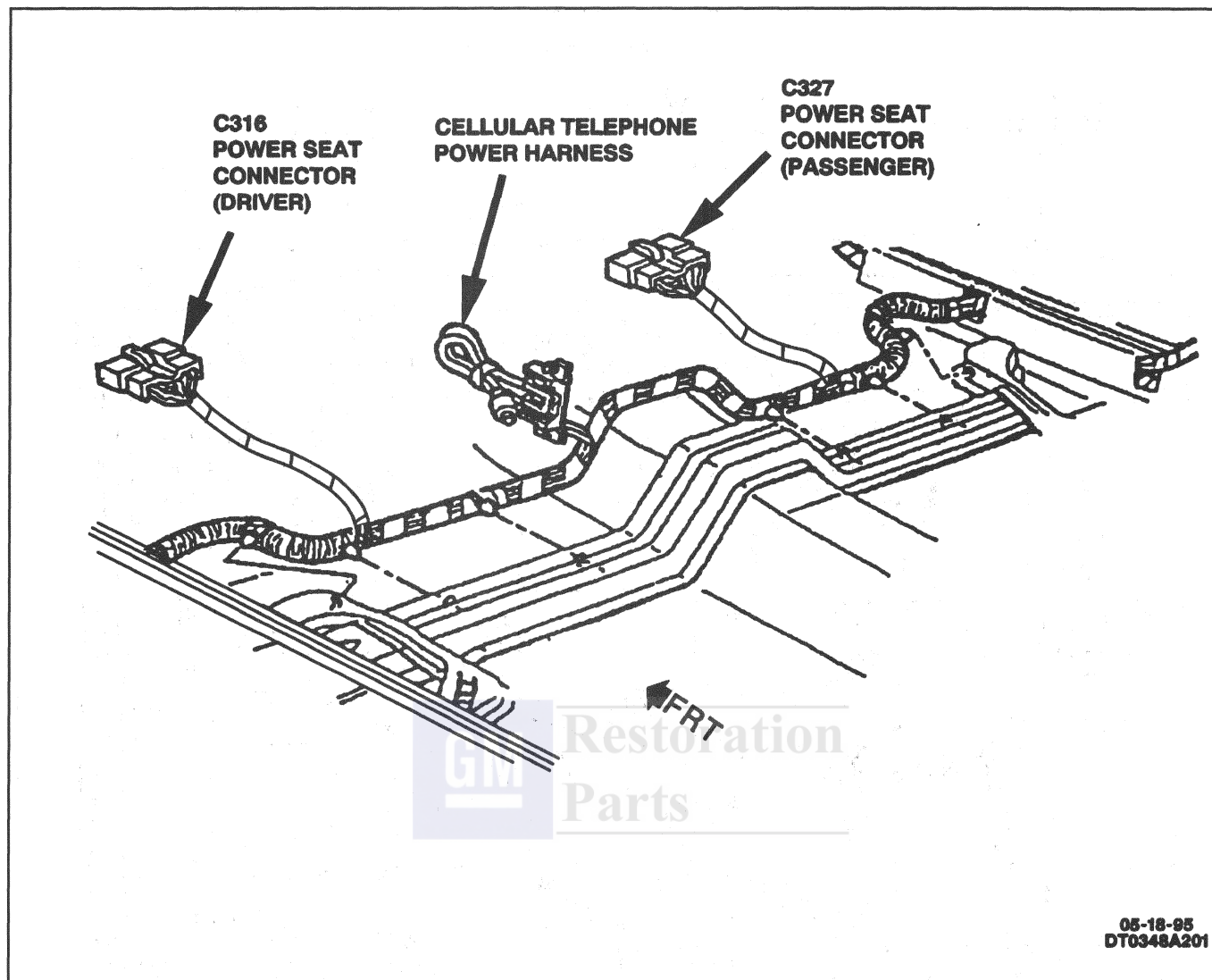


Fig 32 - Cross Car Harness (Buick with AM5)

COMPONENT LOCATION VIEWS

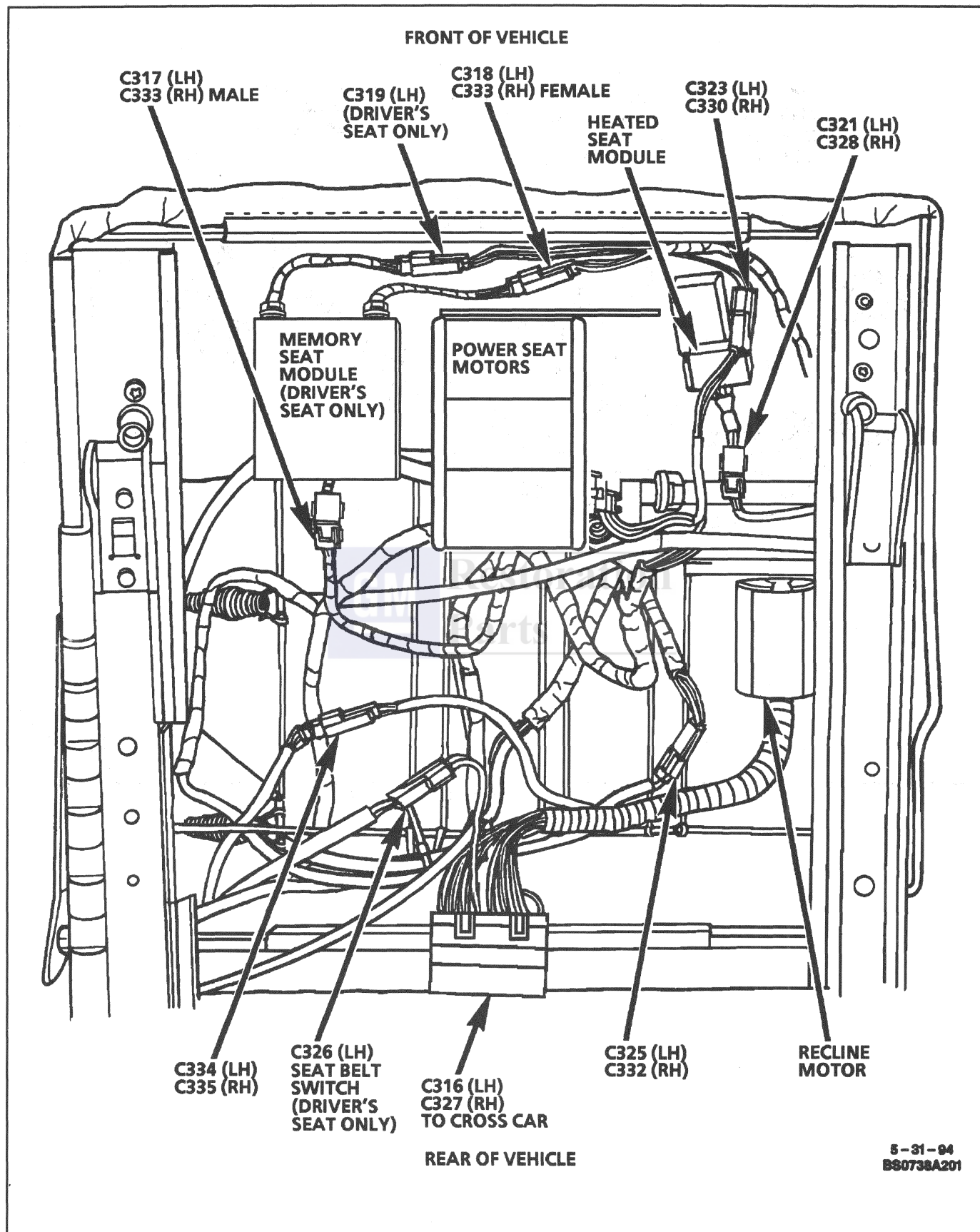


Fig 33 - Underside of Driver Seat, Passenger Seat Similar

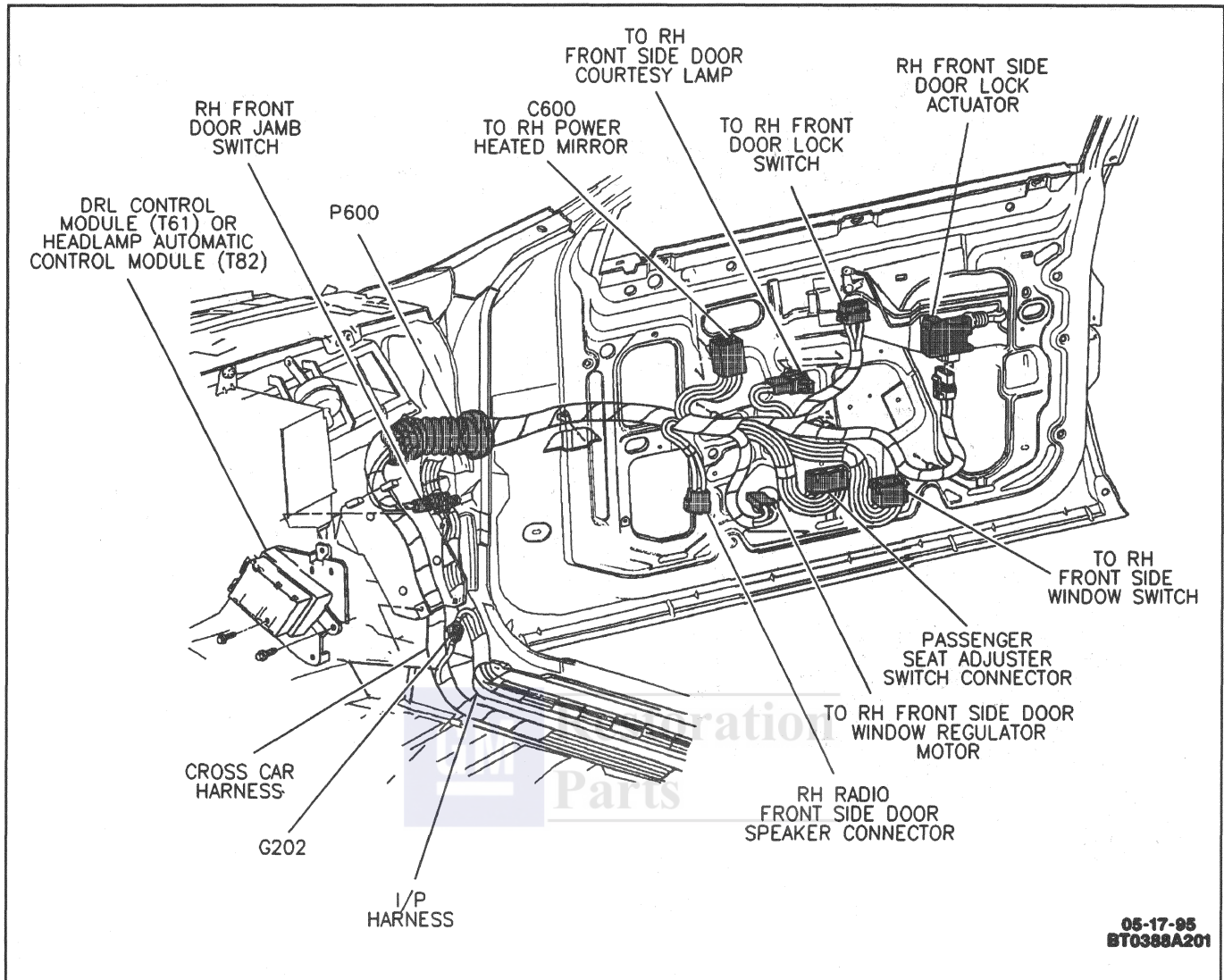


Fig 34 - Right Front Side Door and "A" Pillar

COMPONENT LOCATION VIEWS

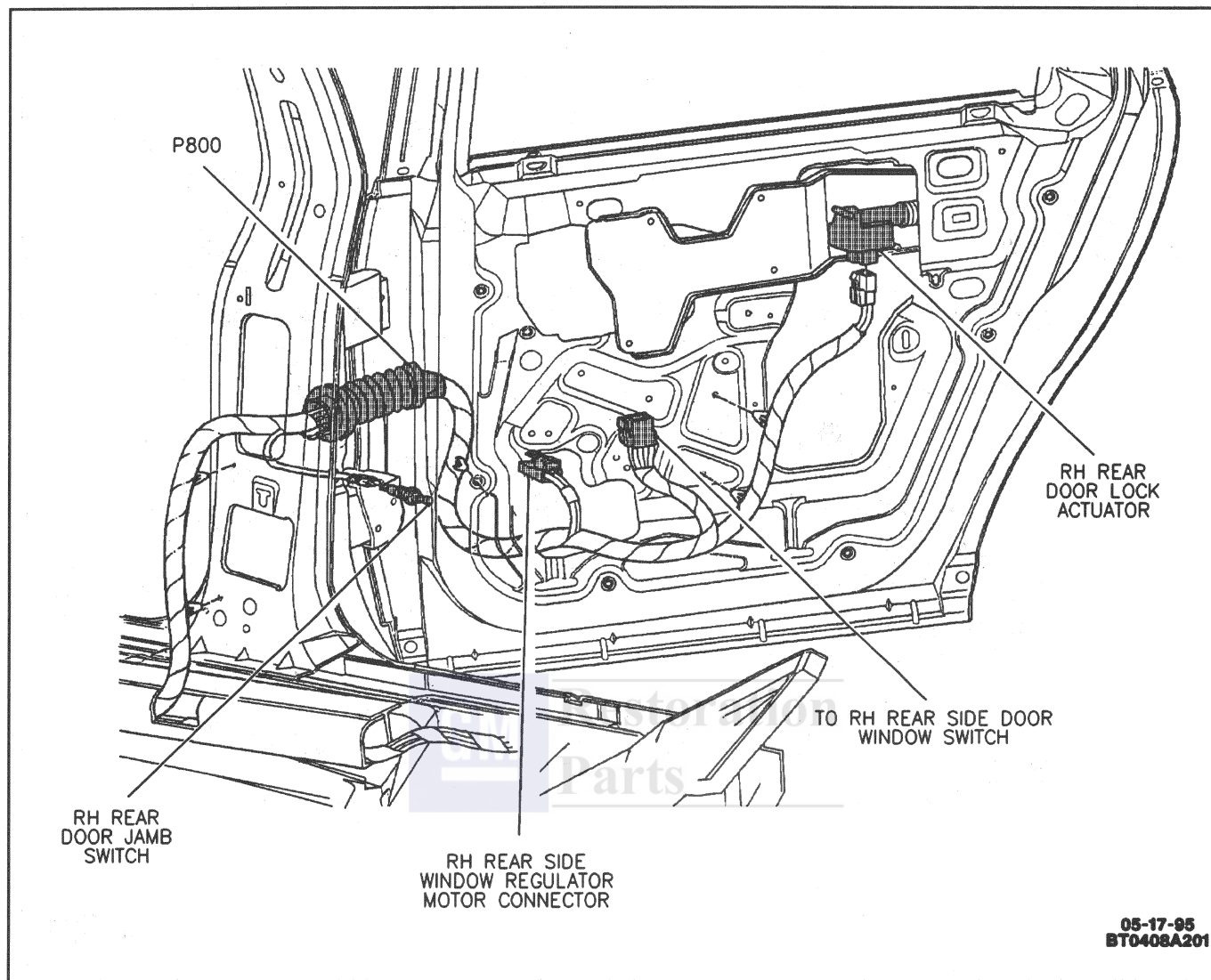


Fig 35 - Right Rear Side Door and "B" Pillar

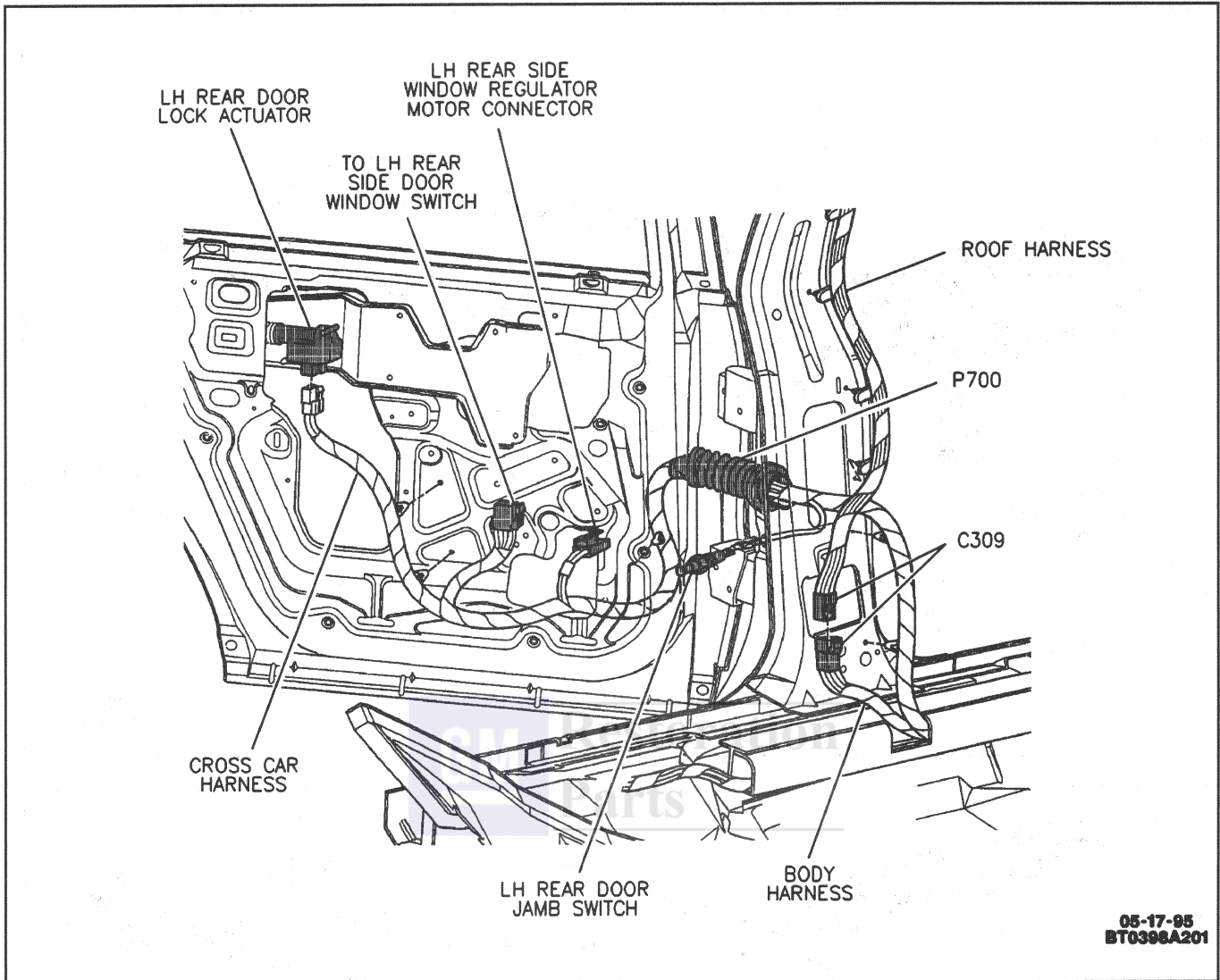


Fig 36 - Left Rear Side Door and "B" Pillar

COMPONENT LOCATION VIEWS

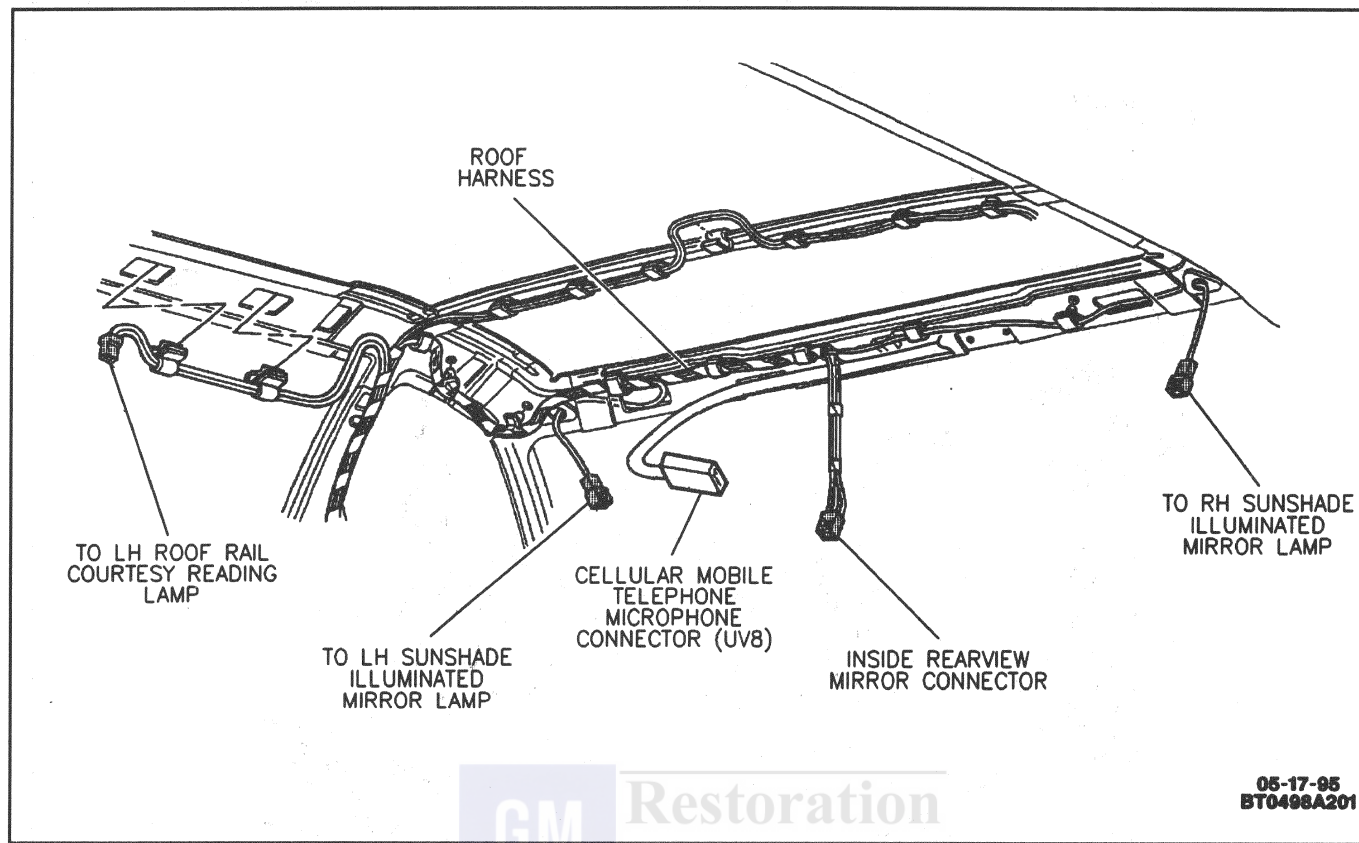


Fig 37 - Front Headliner

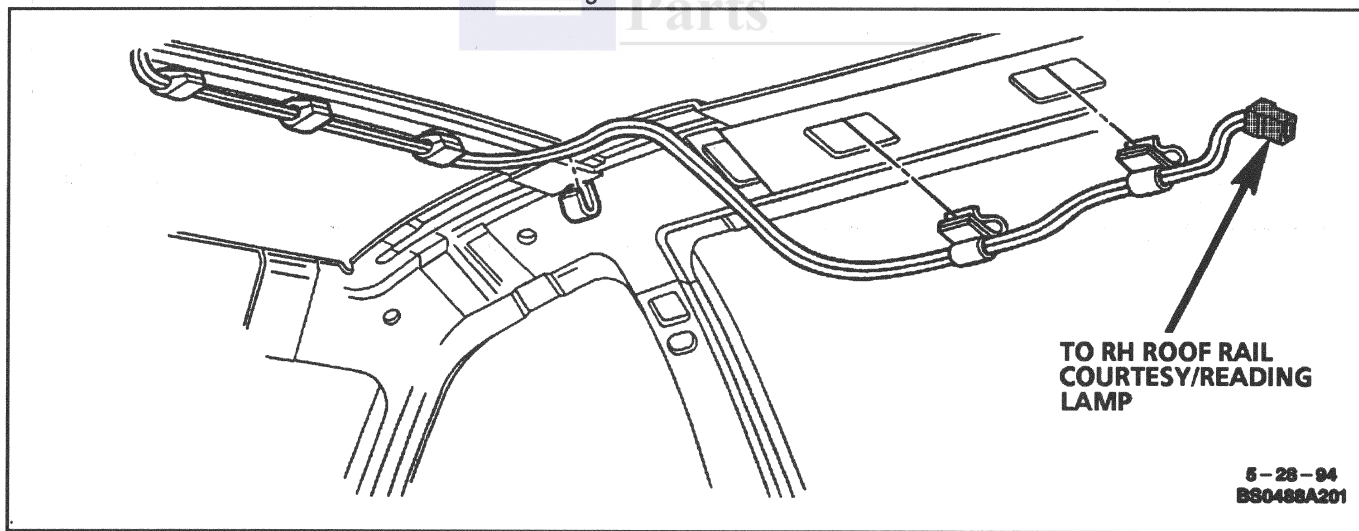


Fig 38 - Right Side Roof Rail

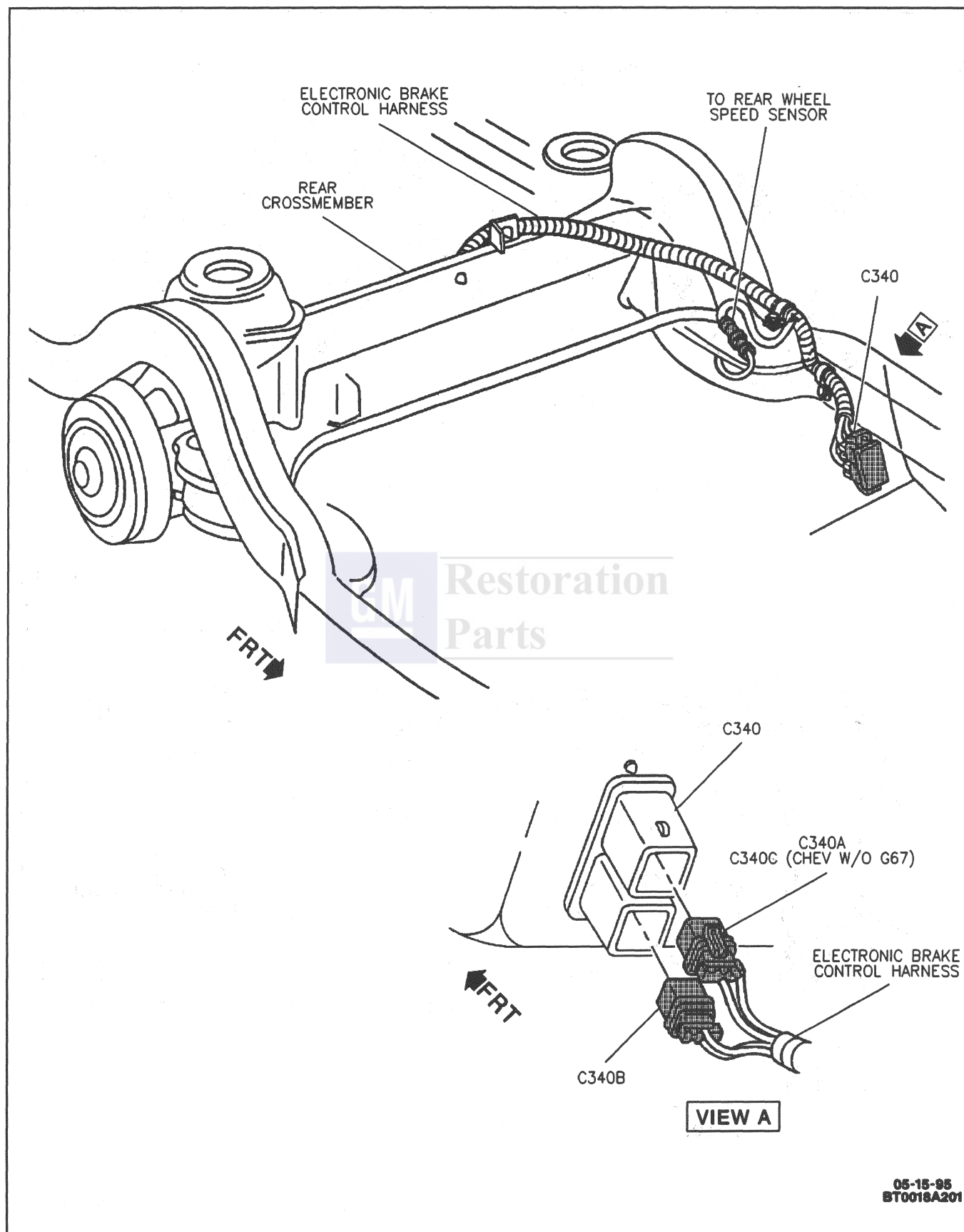


Fig 39 - Antilock Brake System Harness

COMPONENT LOCATION VIEWS

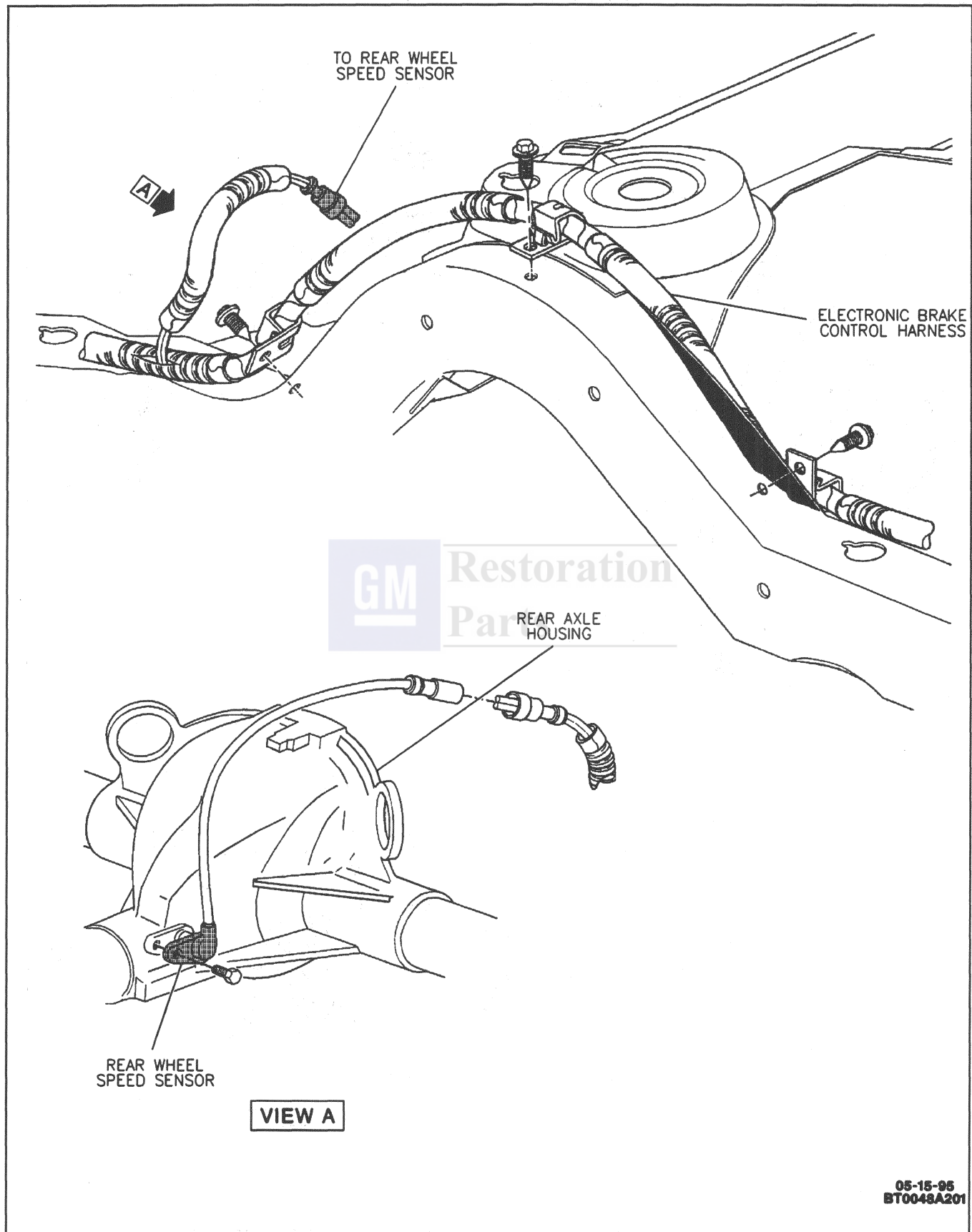


Fig 40 - Left Rear Frame Rail (without Automatic Level Control)

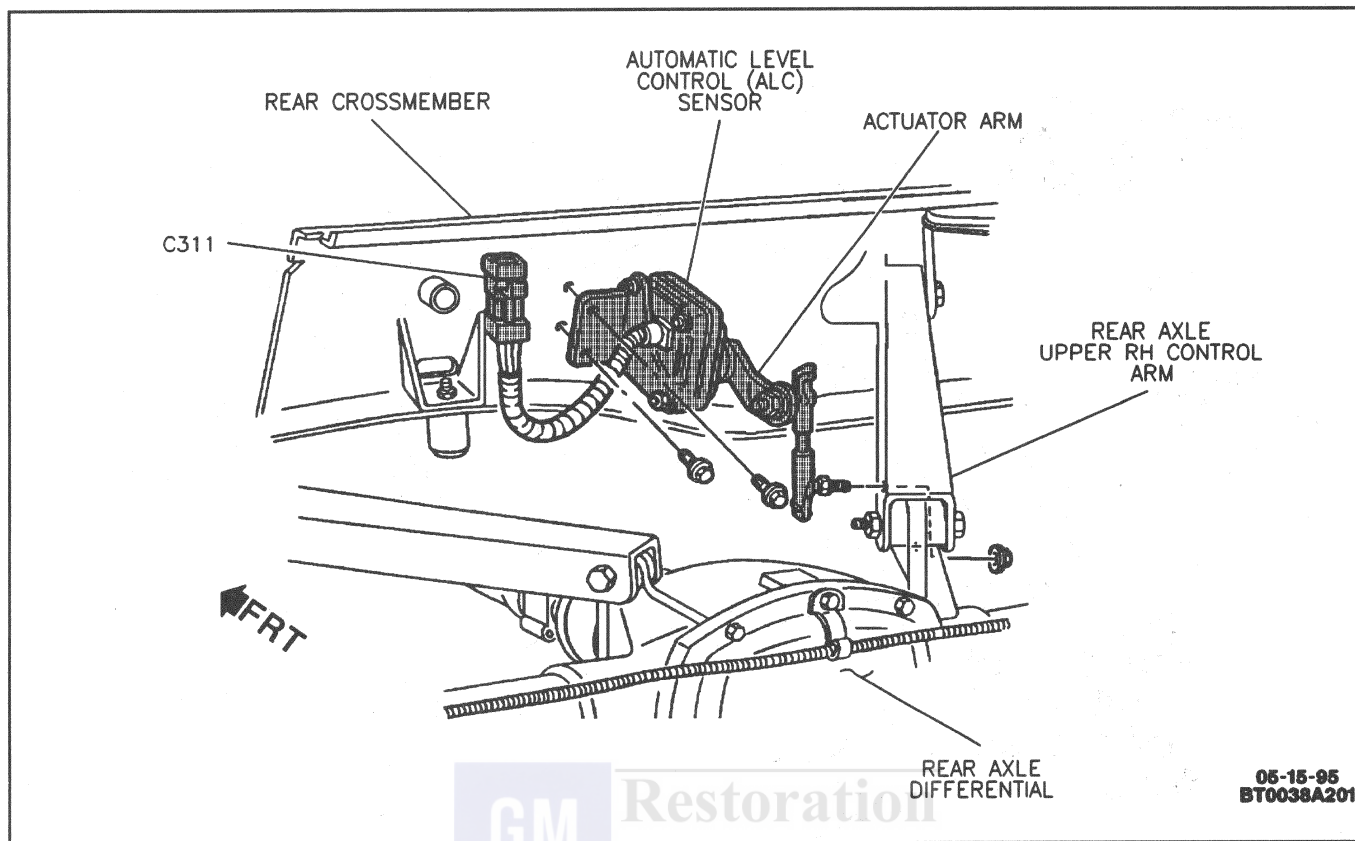


Fig 41 - Center of Rear Crossmember (with Automatic Level Control)

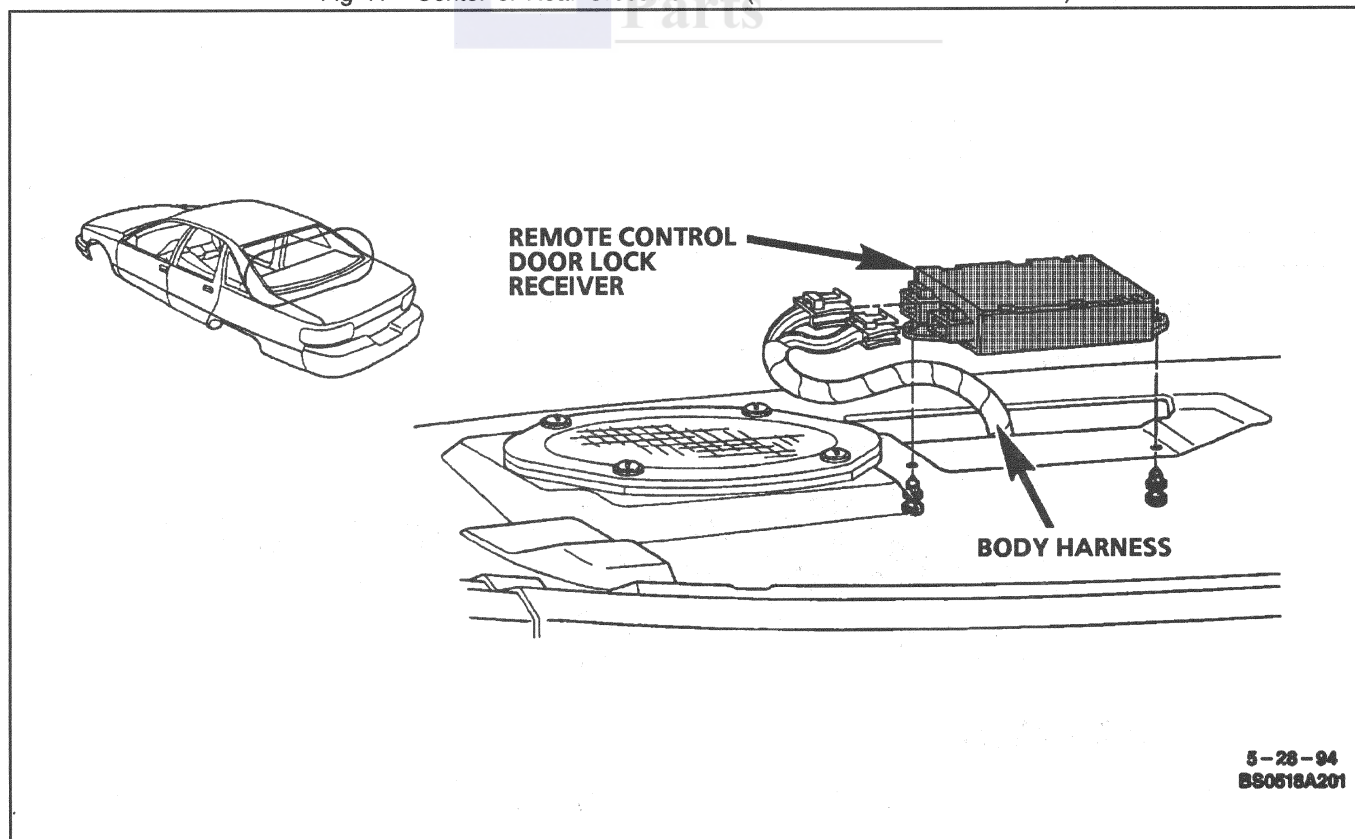


Fig 42 - Rear Shelf, Top View (Sedan)

COMPONENT LOCATION VIEWS

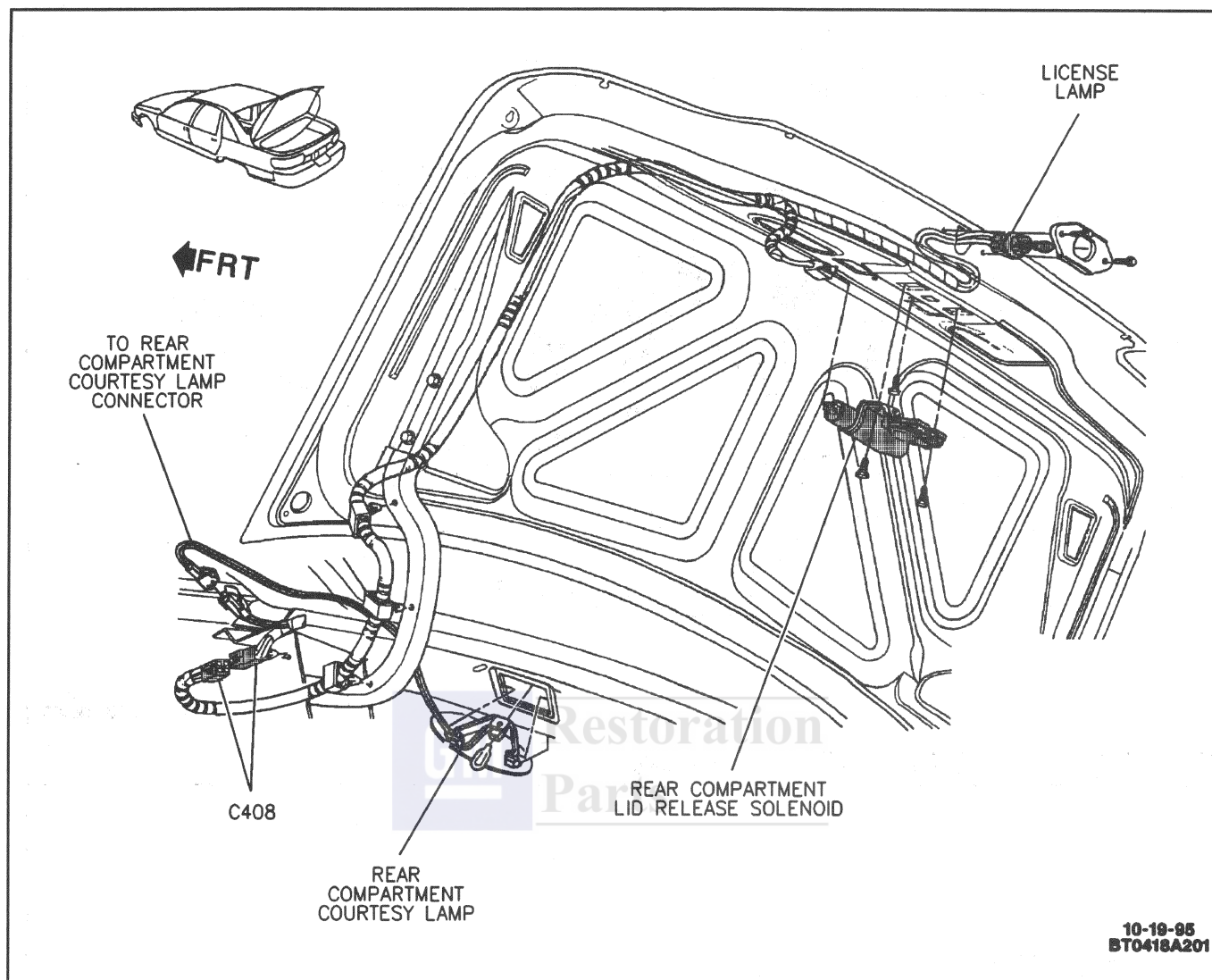


Fig 43 - Rear Compartment Lid

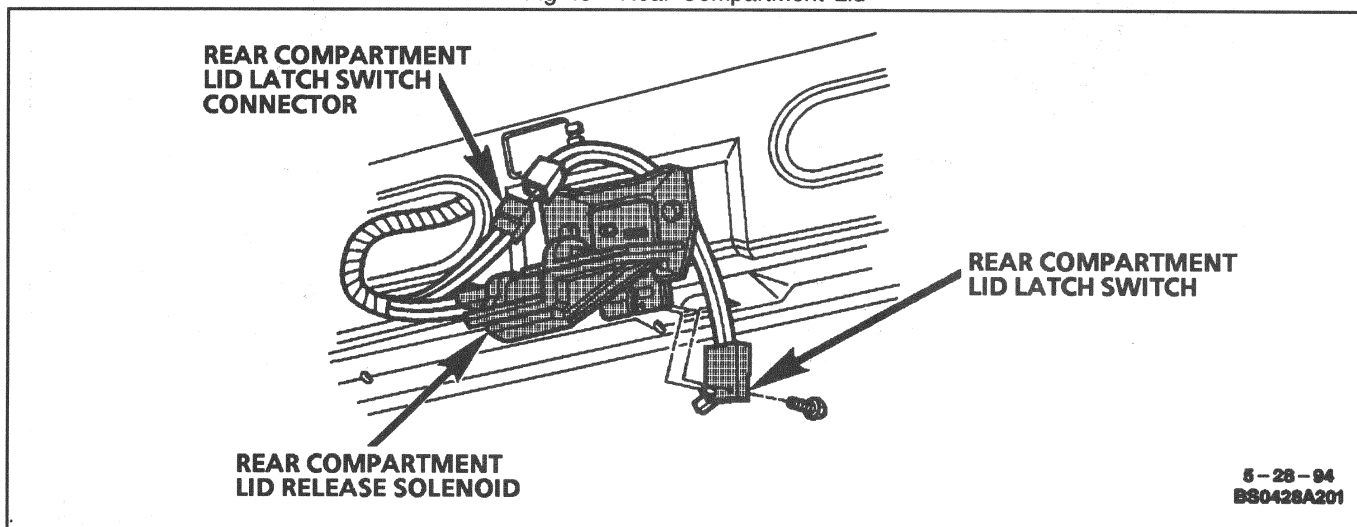


Fig 44 - Rear Compartment Lid (with A91)

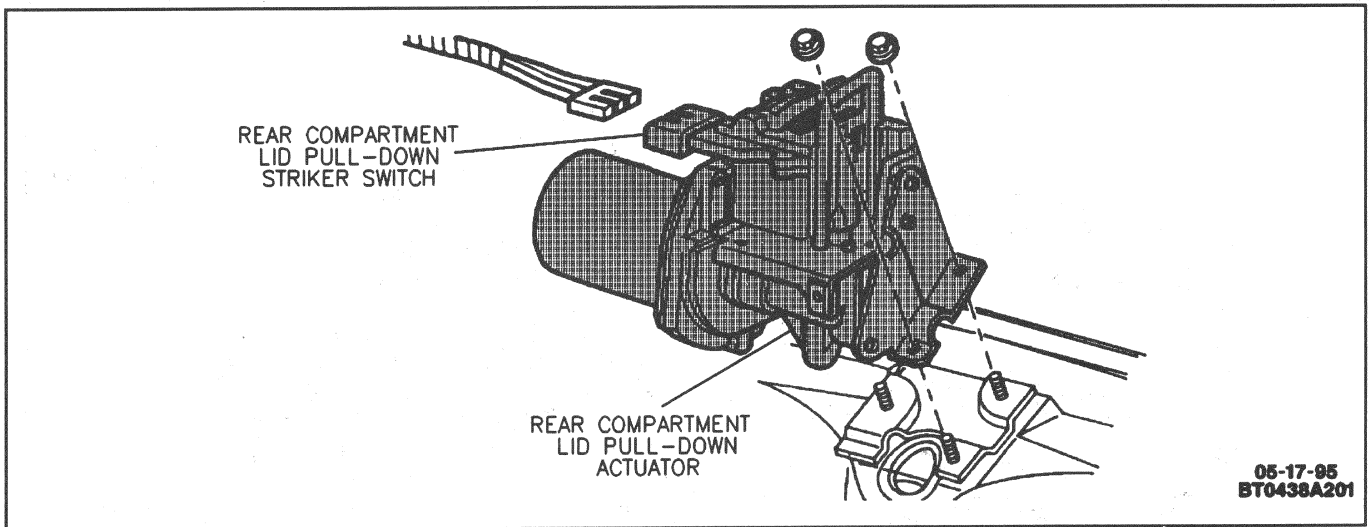


Fig 45 - Rear Compartment Lid (with A91)

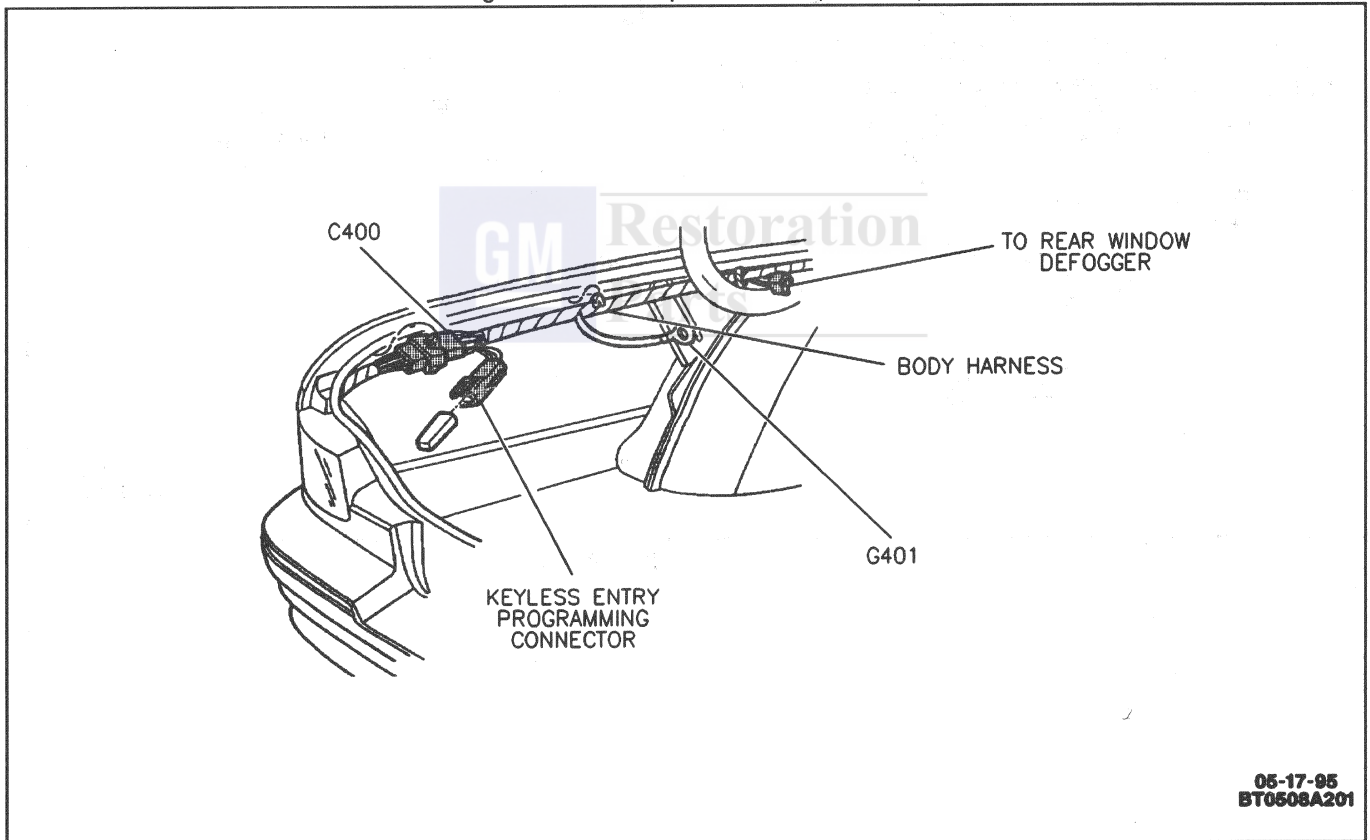


Fig 46 - Left Rear Compartment

COMPONENT LOCATION VIEWS

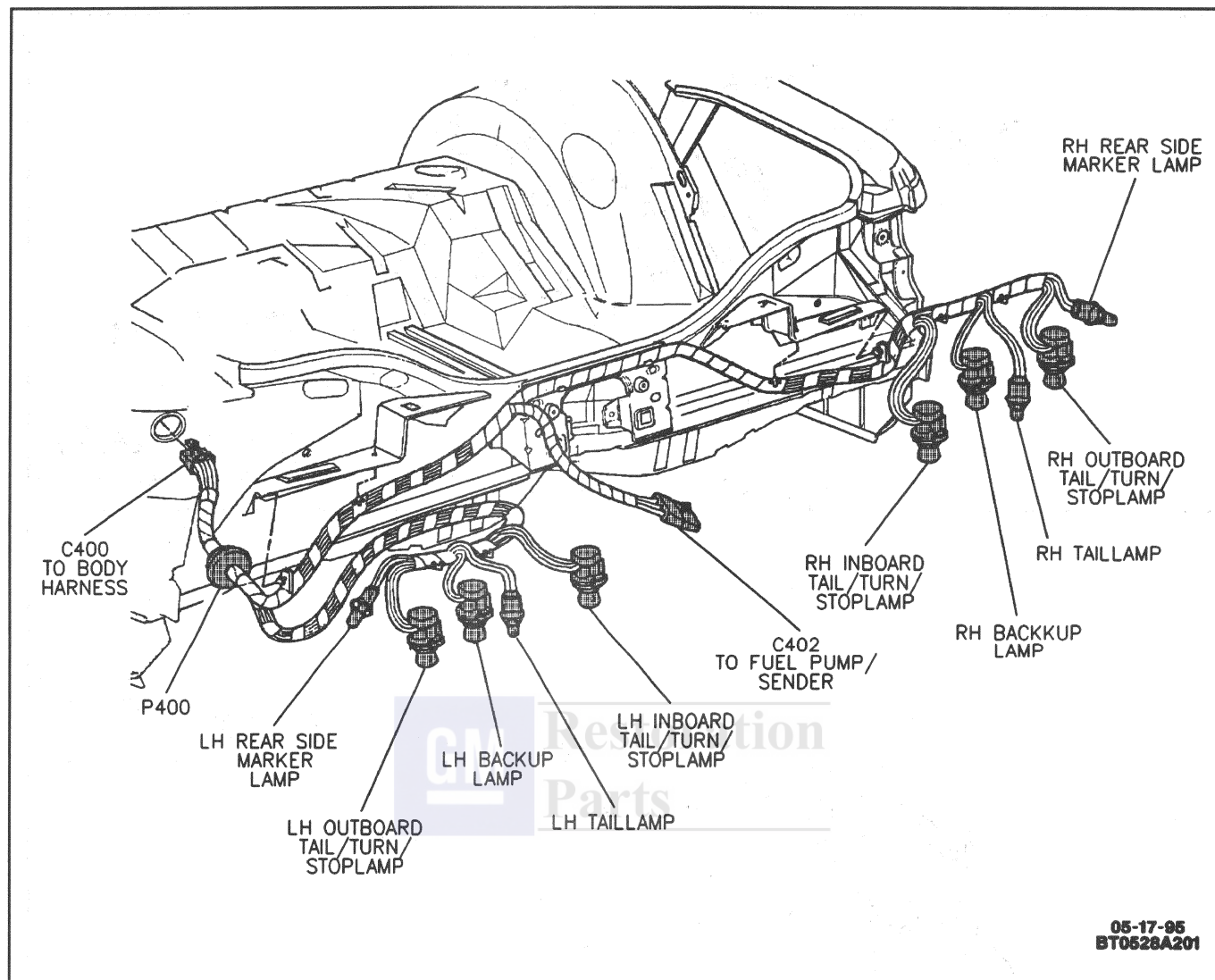


Fig 47 - Rear Lamps (Sedan)

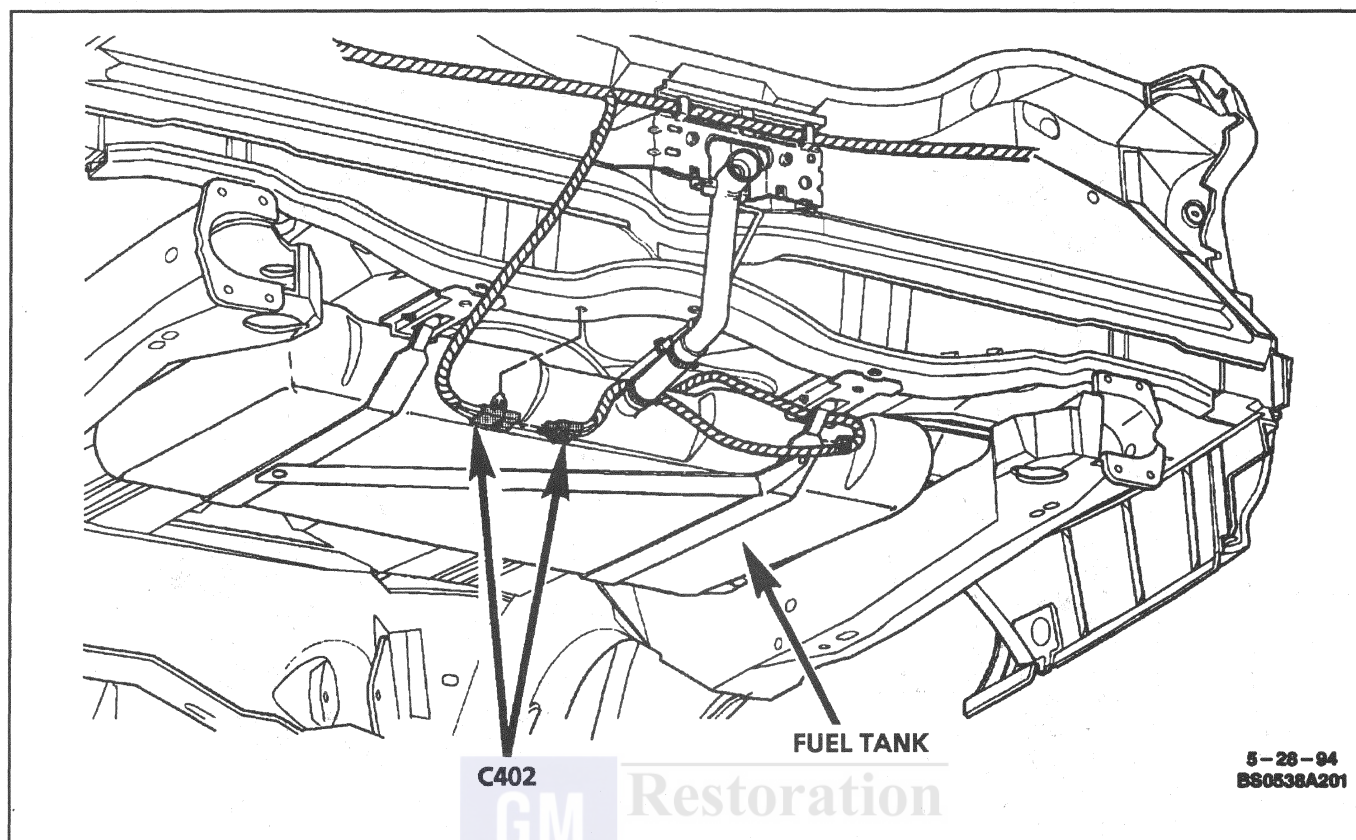


Fig 48 - Rear Underbody (Wagon Similar)

COMPONENT LOCATION VIEWS

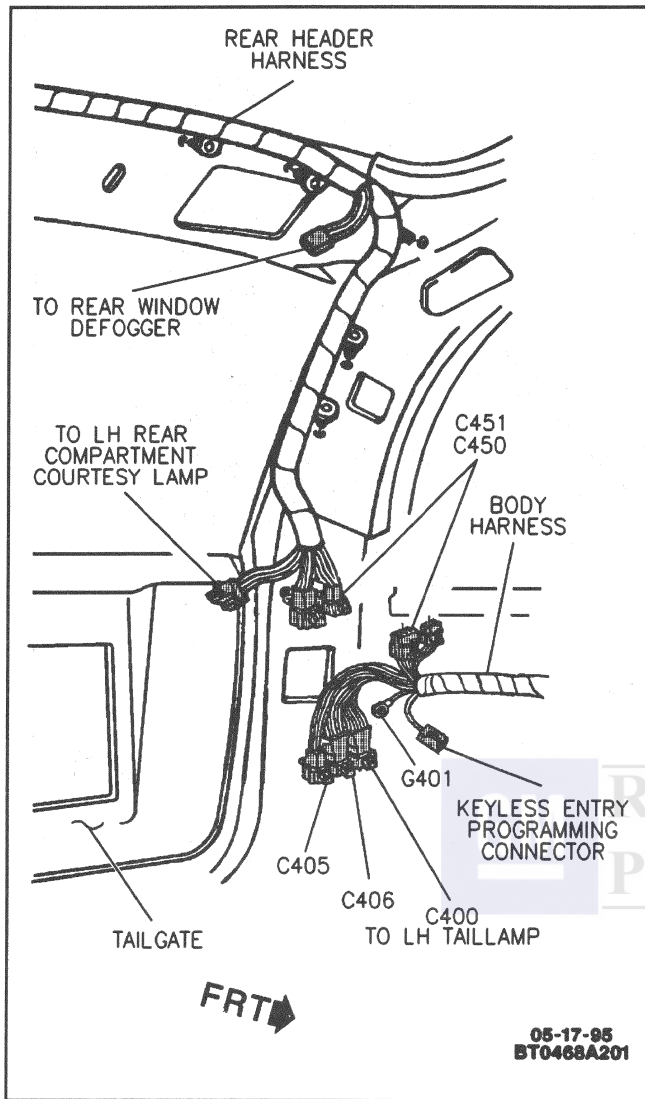


Fig 49 - Left "D" Pillar (Wagon)

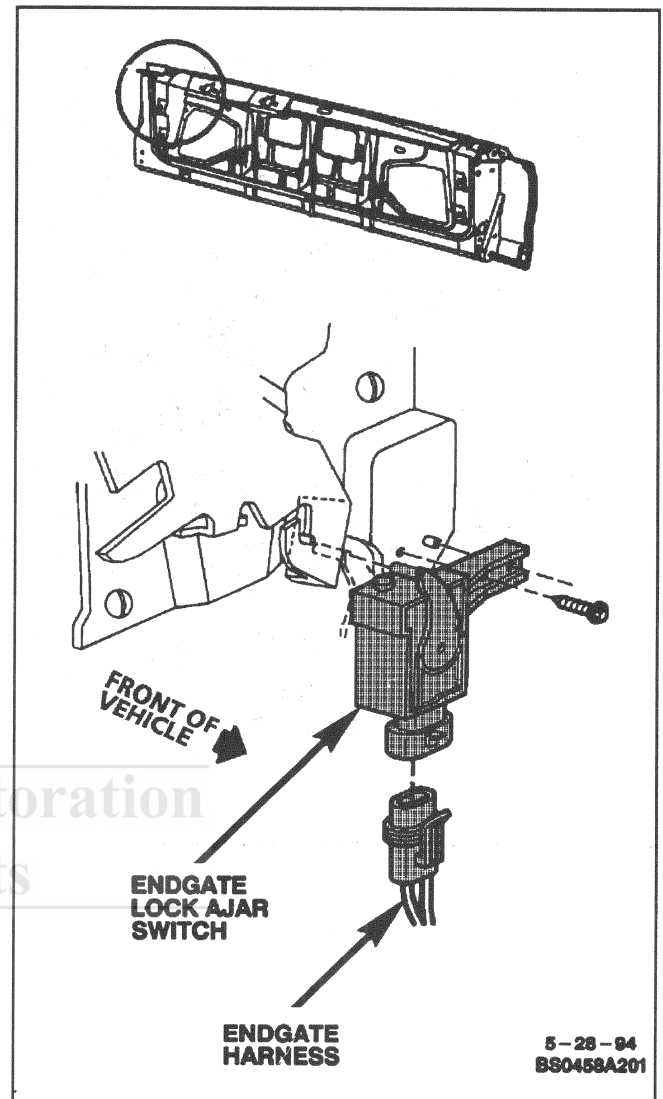


Fig 50 - Endgate Lock Ajar Switch (Wagon)

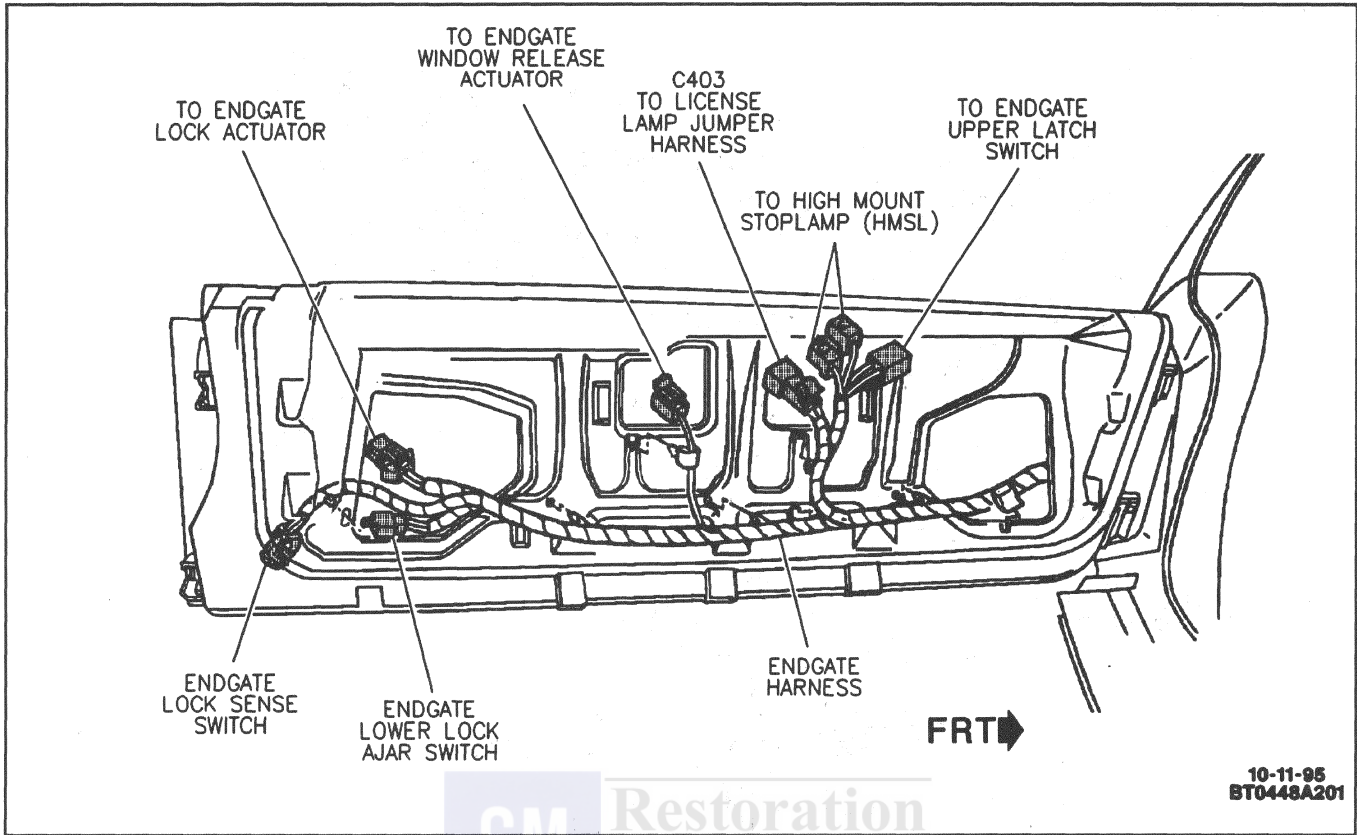


Fig 51 - Endgate (Wagon)

COMPONENT LOCATION VIEWS

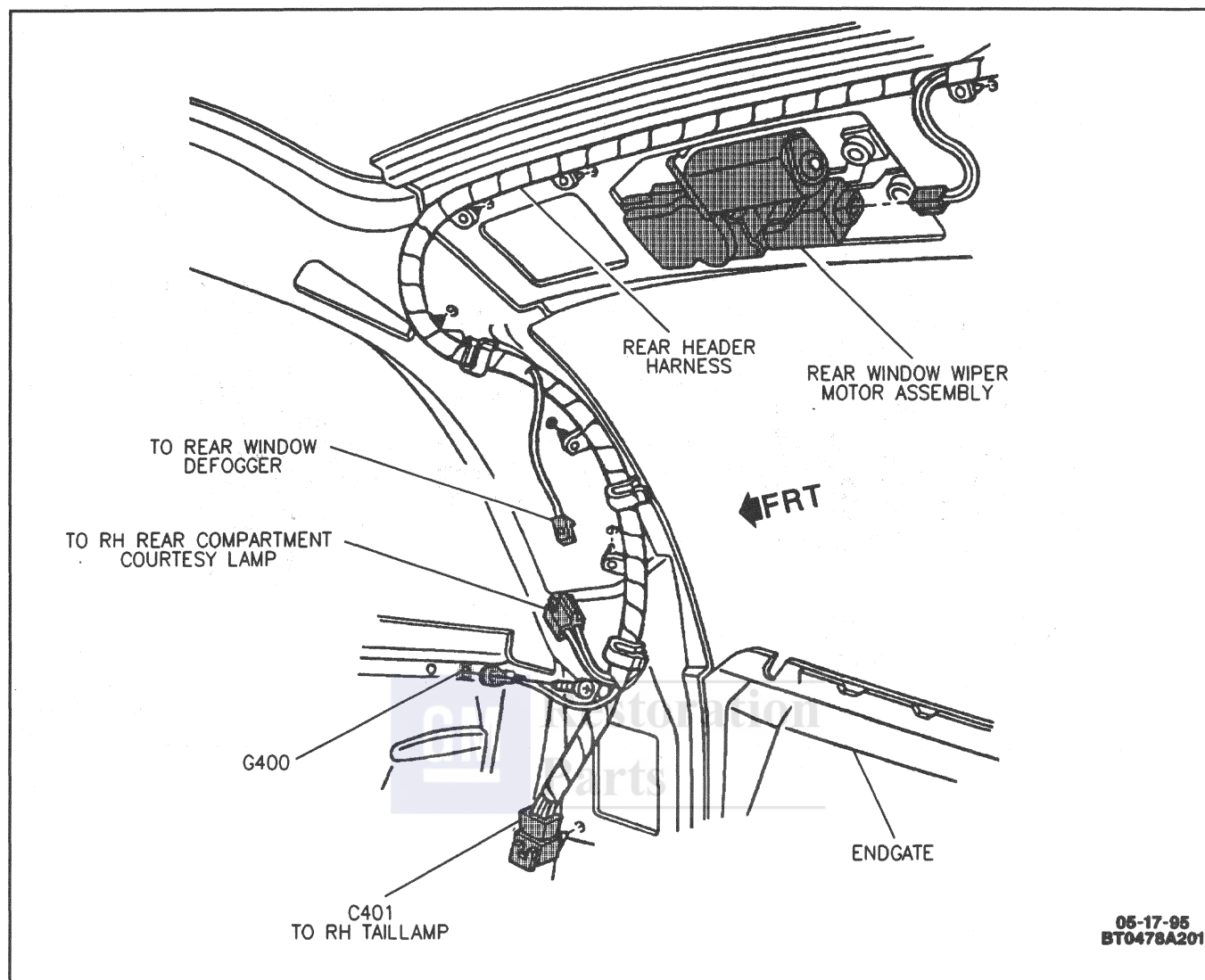
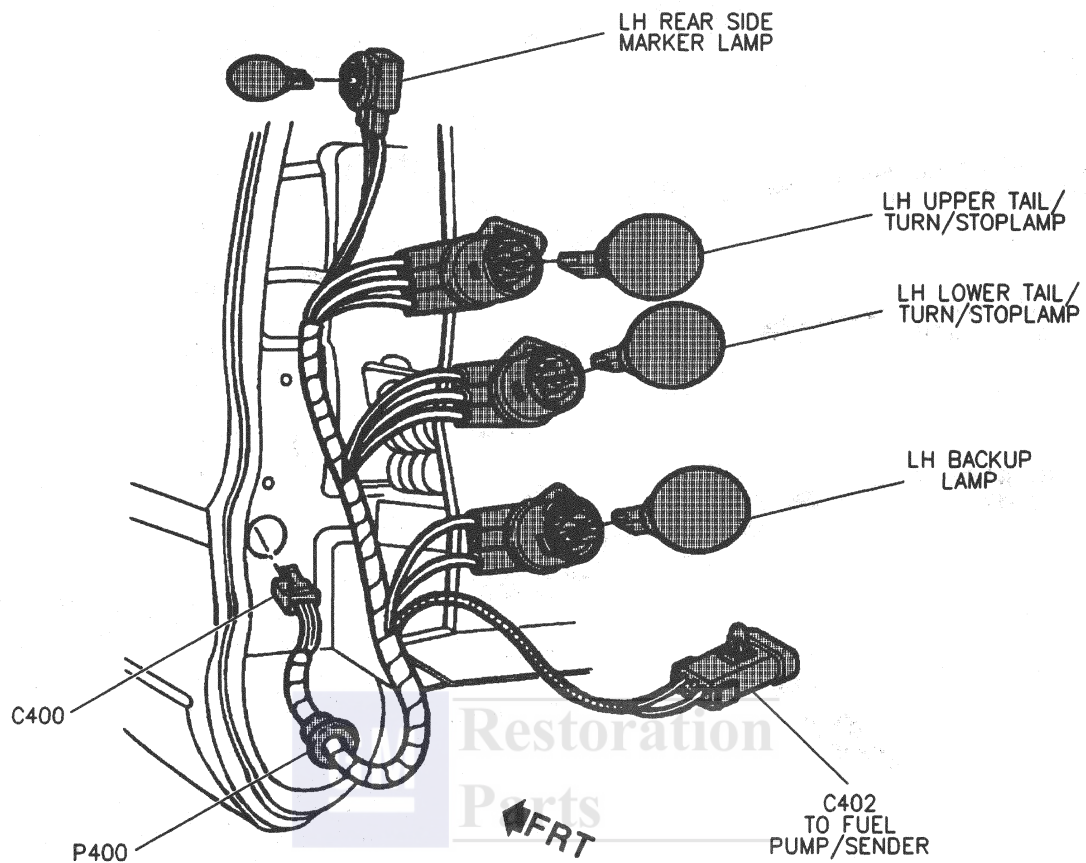


Fig 52 - Right "D" Pillar (Wagon)



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Fig 53 - Left Rear of Vehicle (Wagon)

COMPONENT LOCATION VIEWS

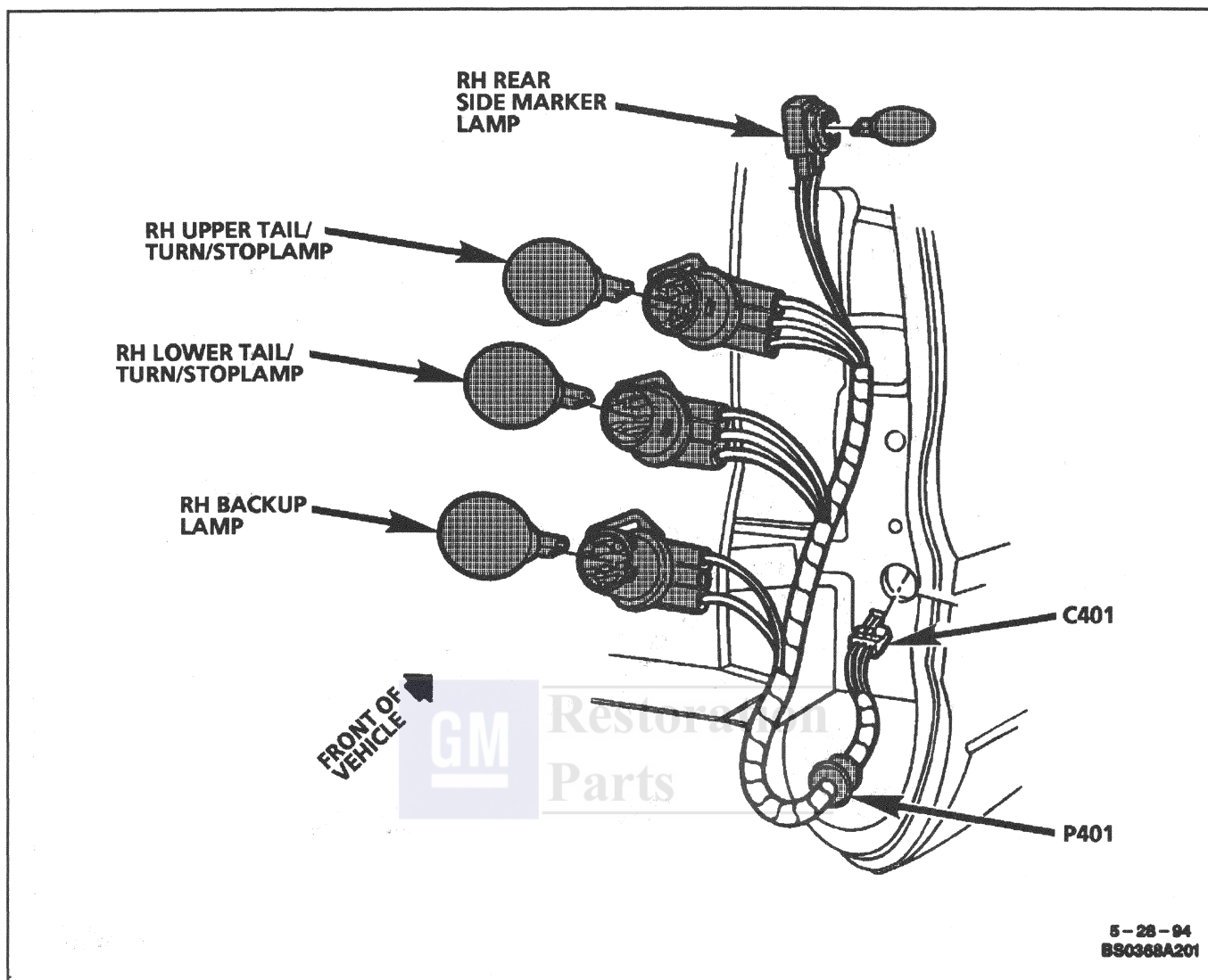


Fig 54 - Right Rear of Vehicle (Wagon)

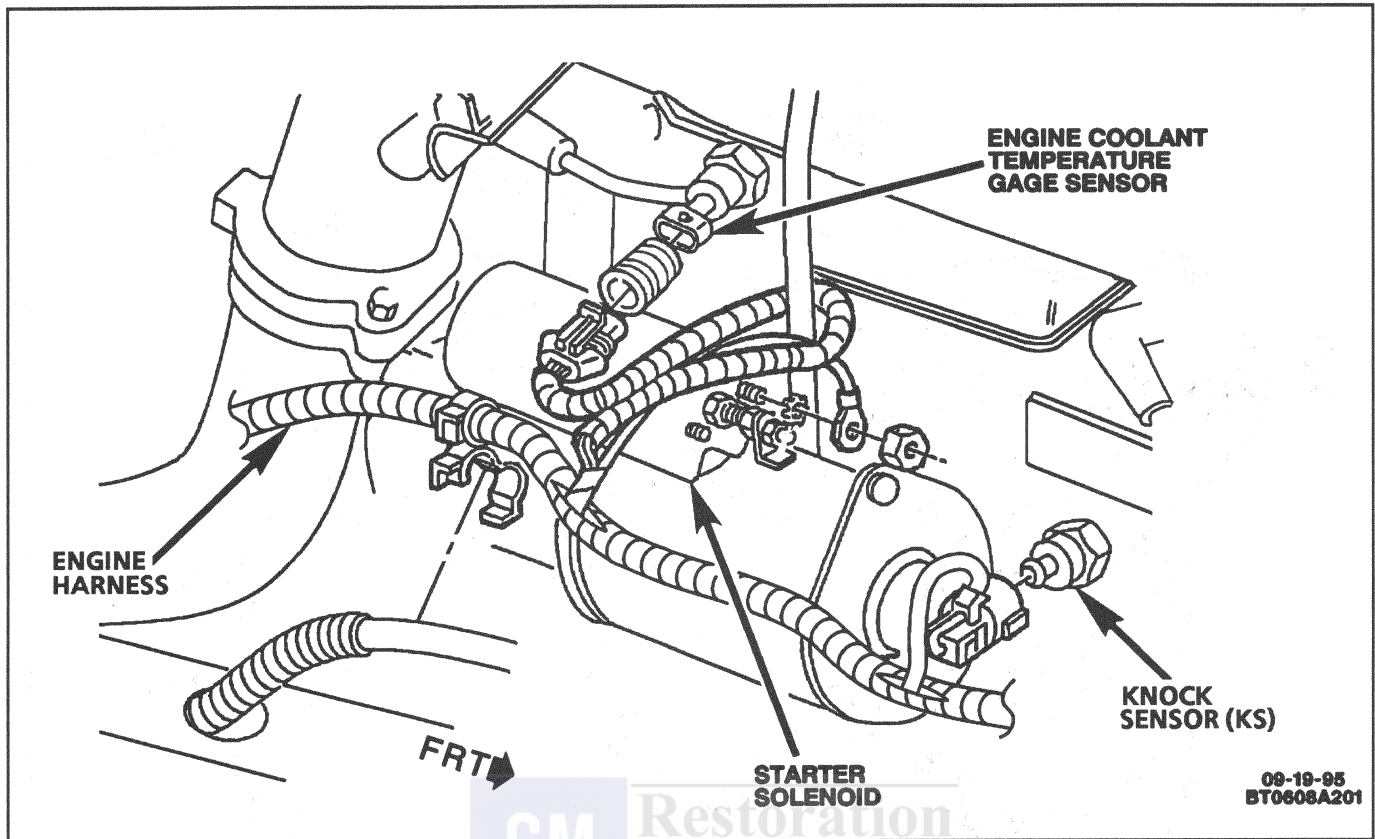


Fig 55 - Lower Right Side of Engine

COMPONENT LOCATION VIEWS

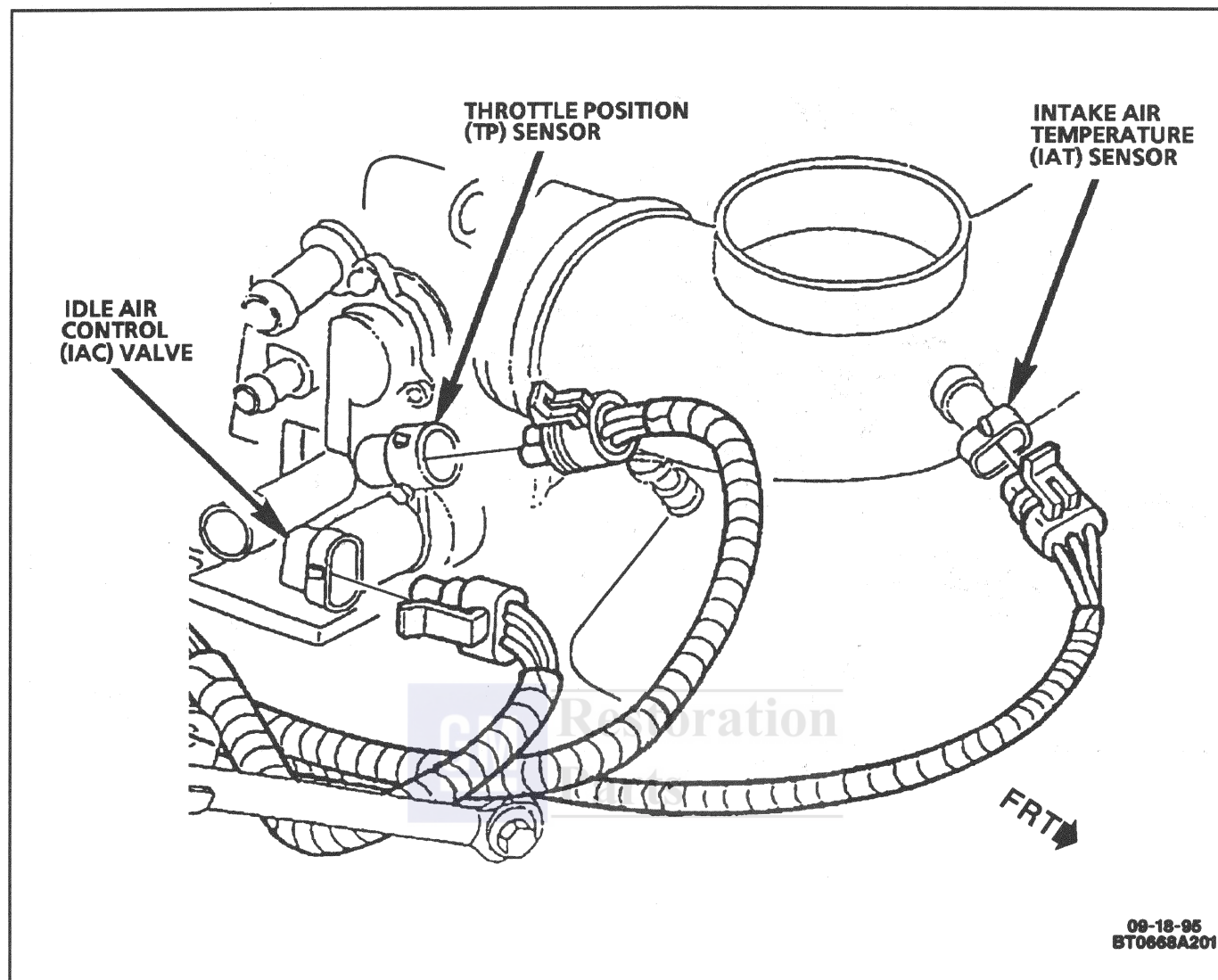


Fig 56 - Engine, Front Upper

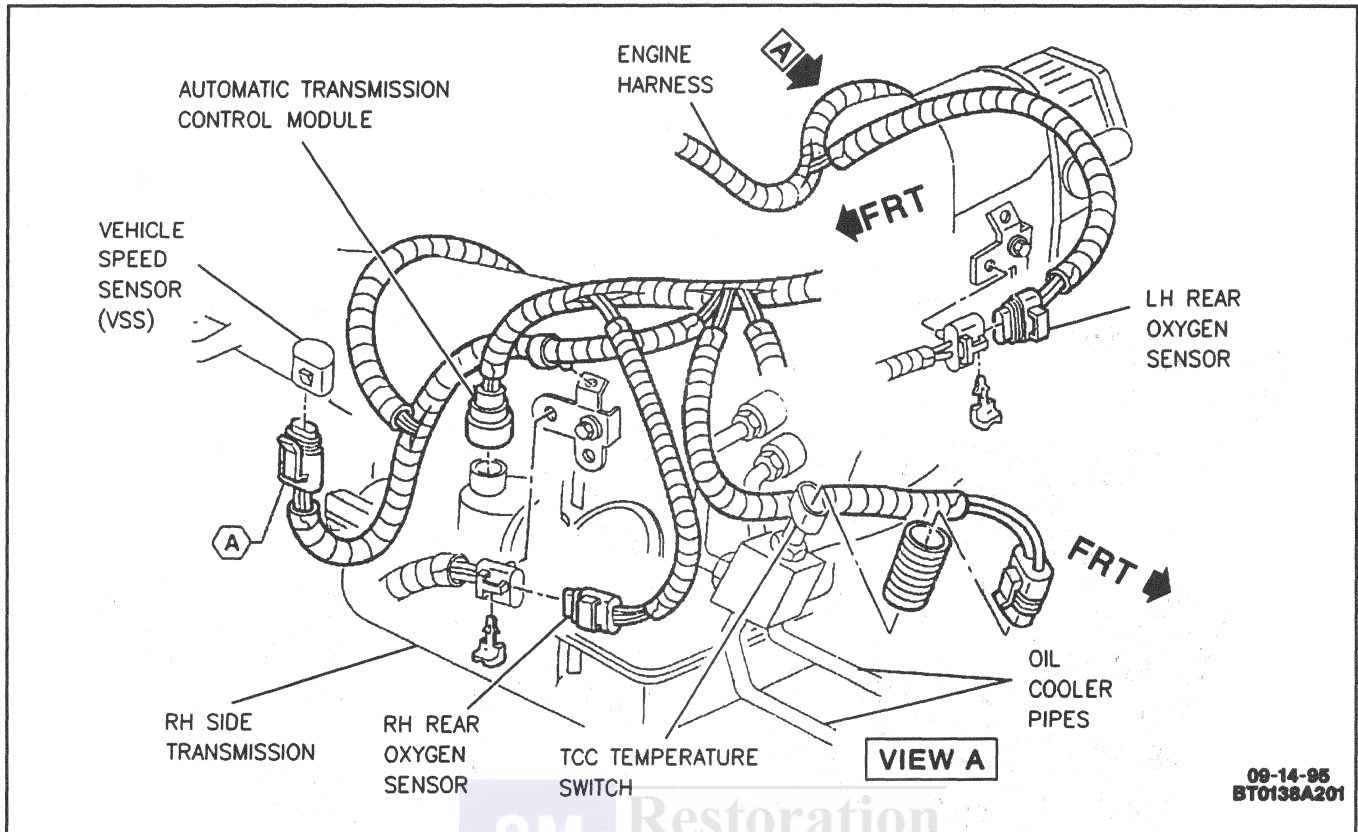


Fig 57 - Right Side of Transmission

COMPONENT LOCATION VIEWS

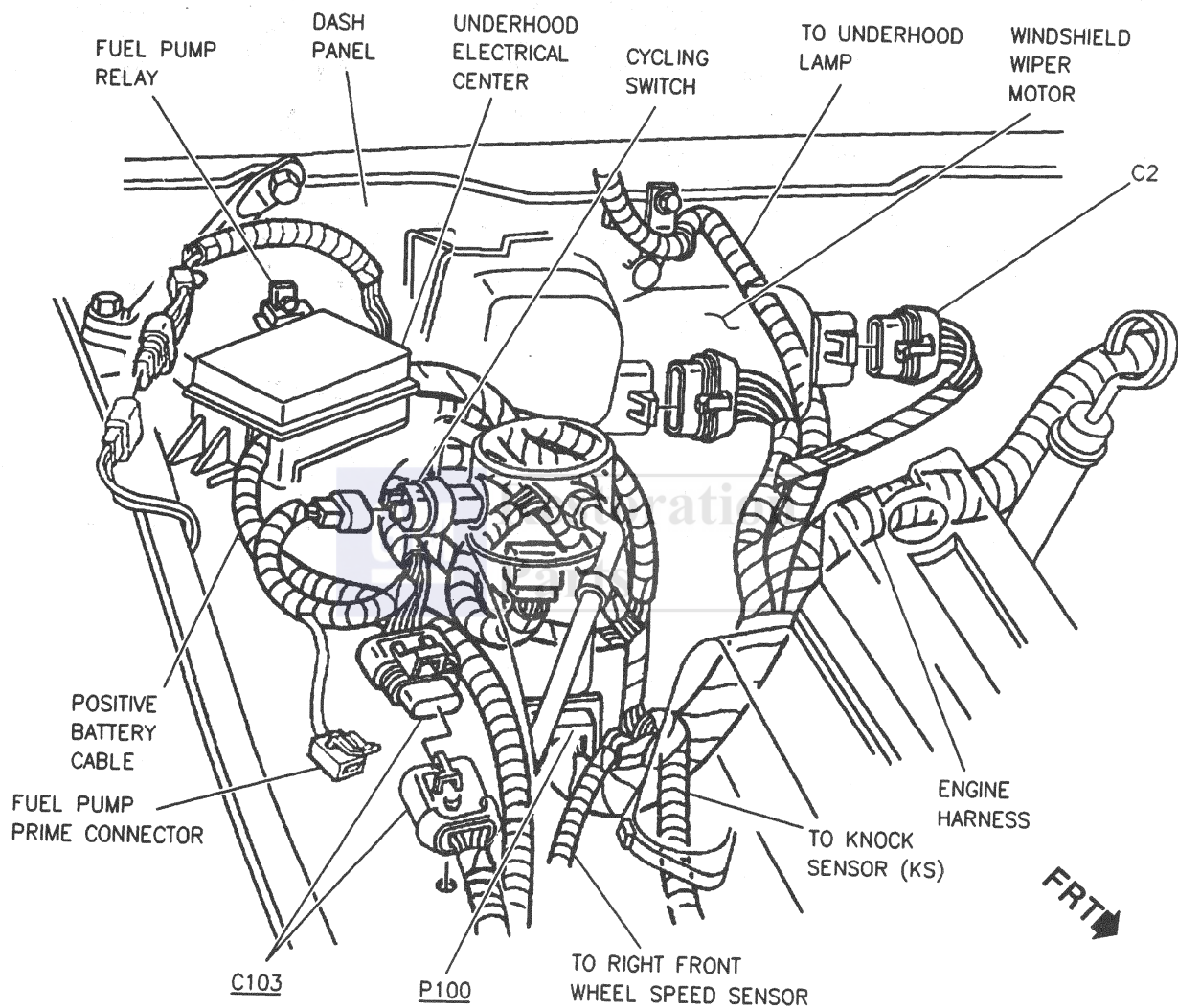


Fig 58 - Right Side of Engine Compartment

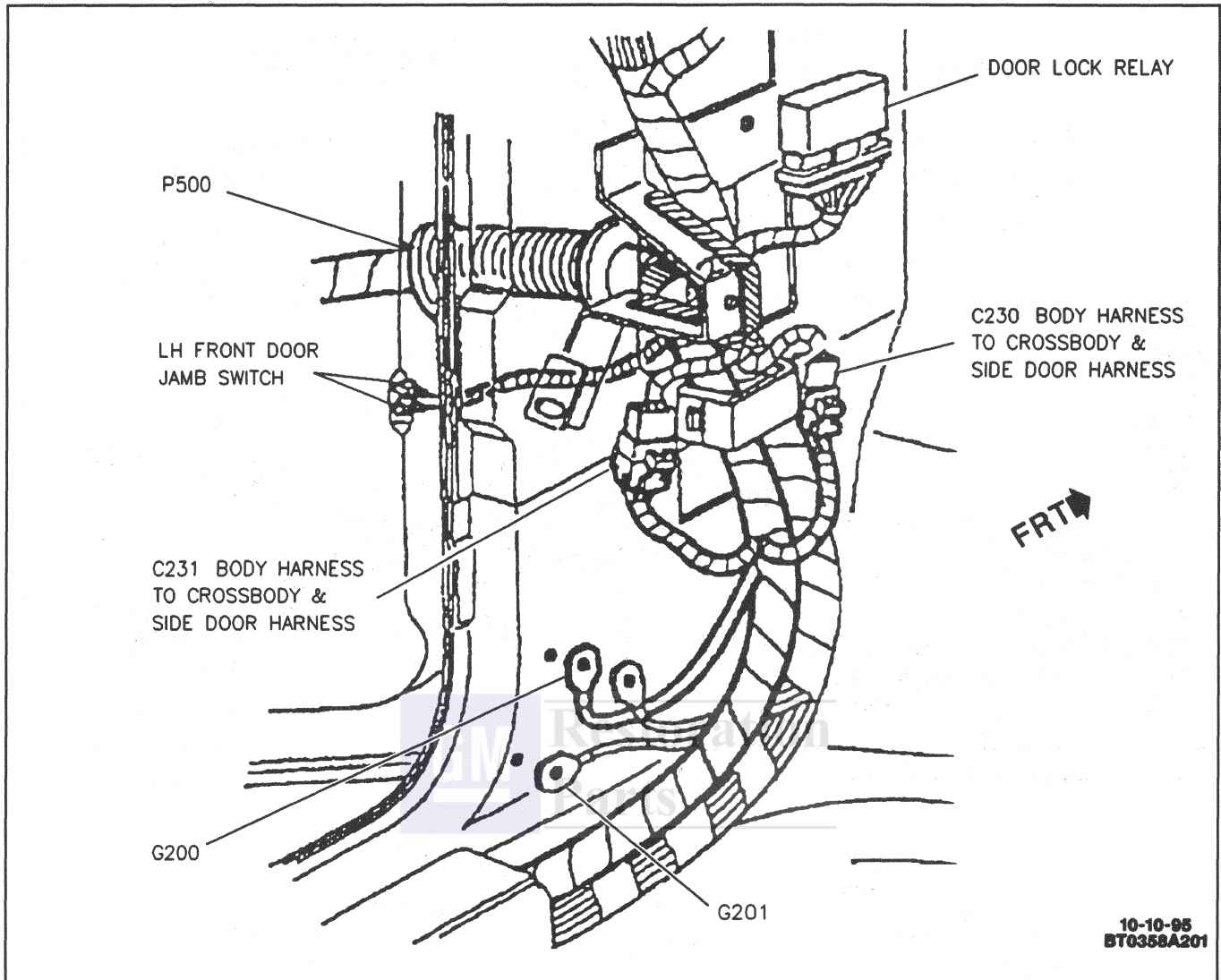


Fig 59 - Lower Left "A" Pillar

COMPONENT LOCATION VIEWS

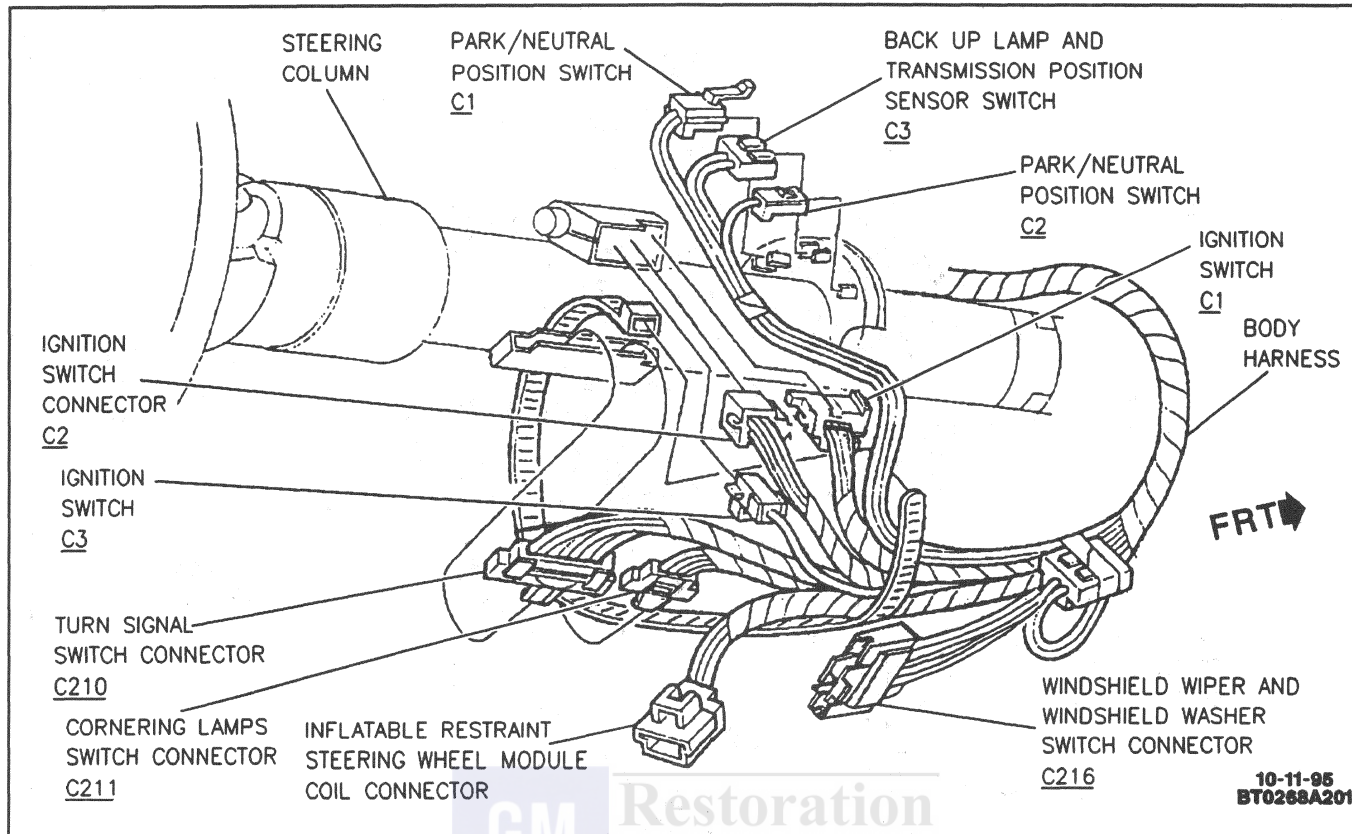


Fig 60 - Base of Steering Column

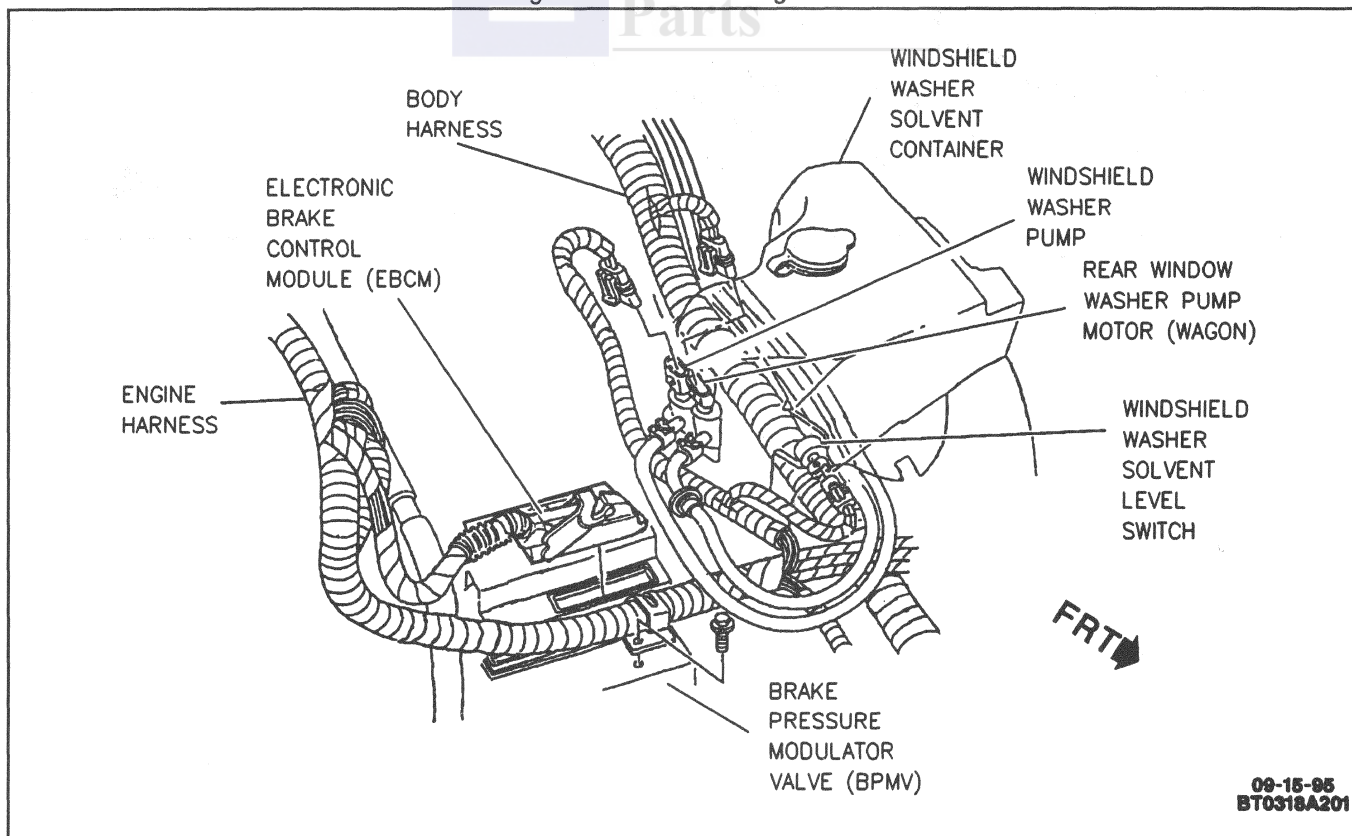


Fig 61 - Left Side of Engine Compartment

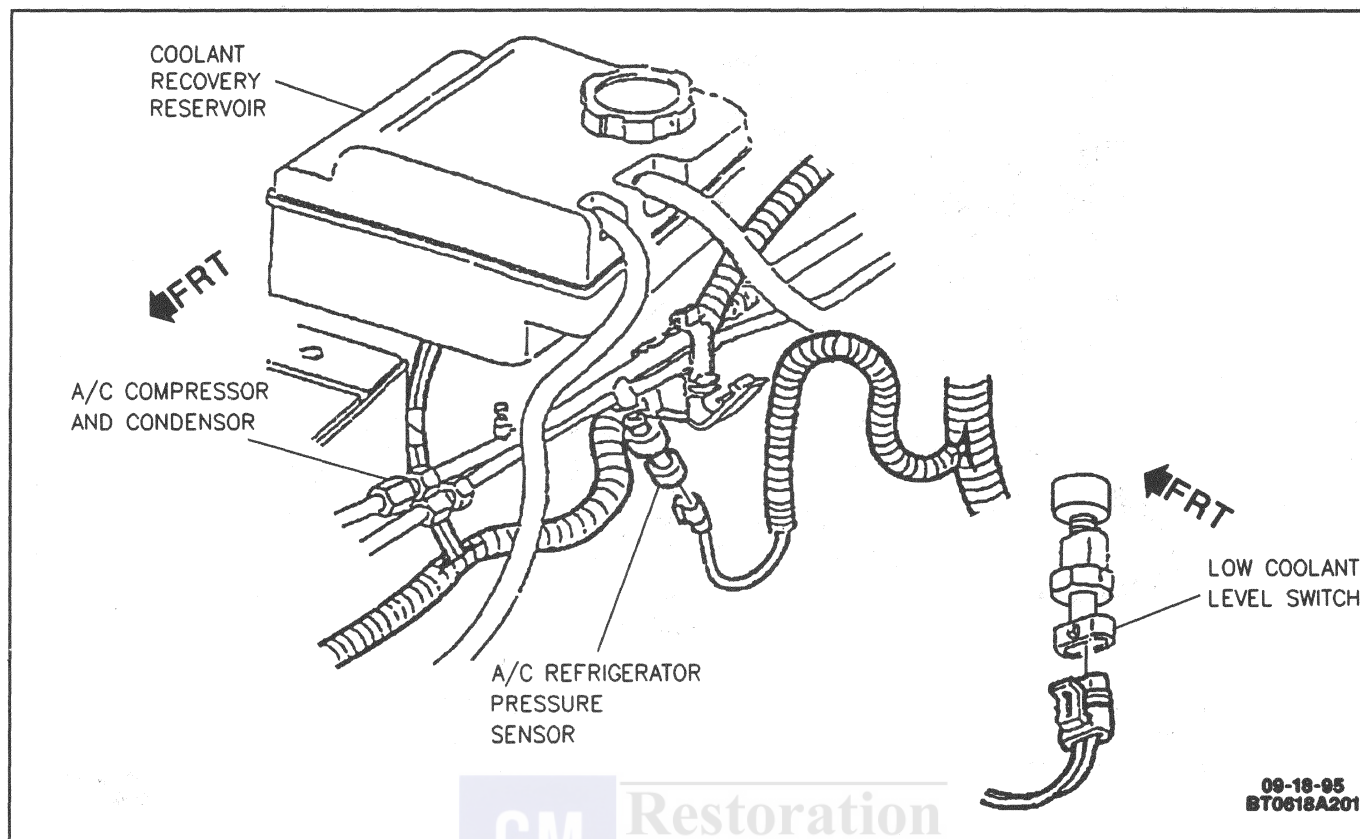


Fig 62 - Air Conditioning Pressure Sensor

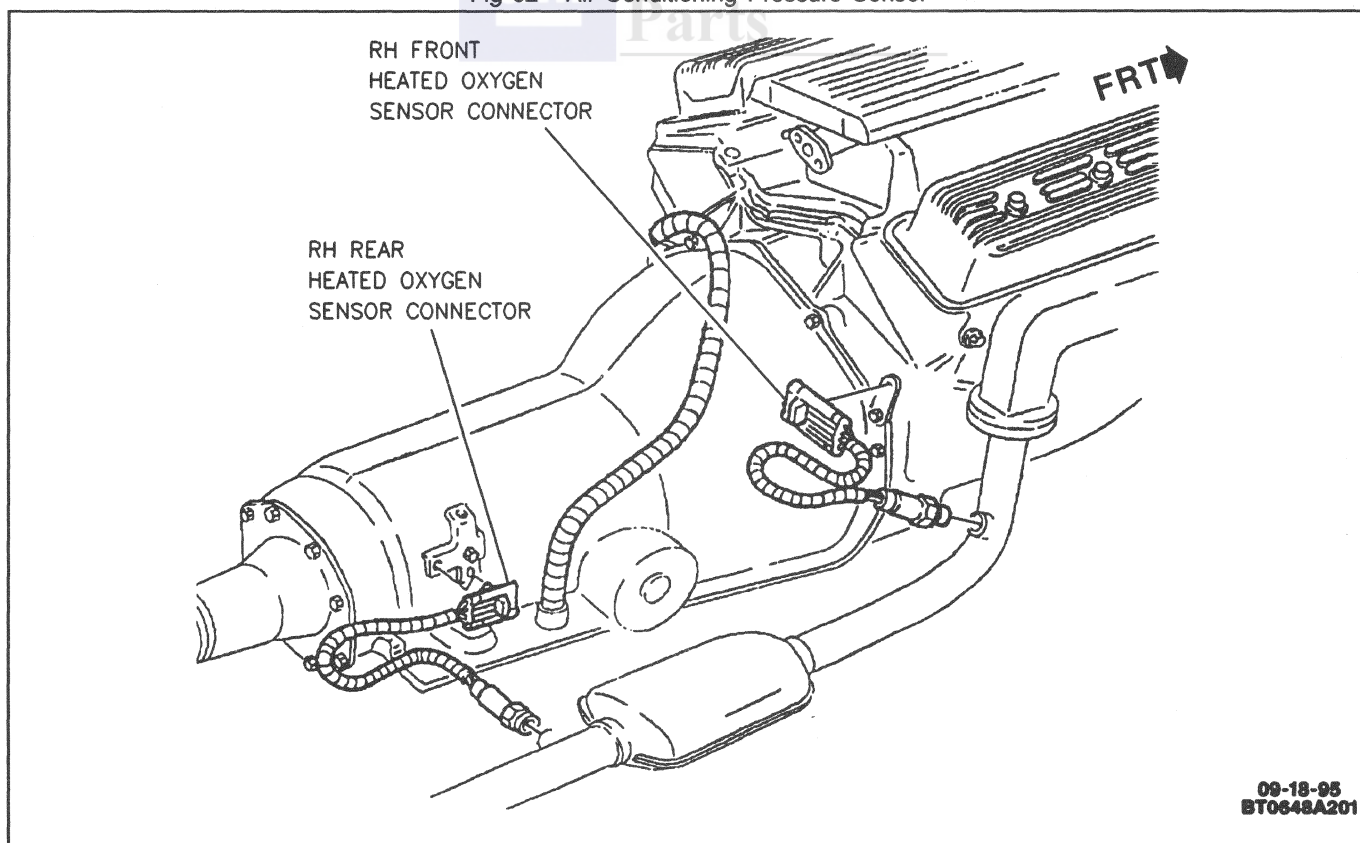


Fig 63 - RH Front and Rear Heated Oxygen Sensors

COMPONENT LOCATION VIEWS

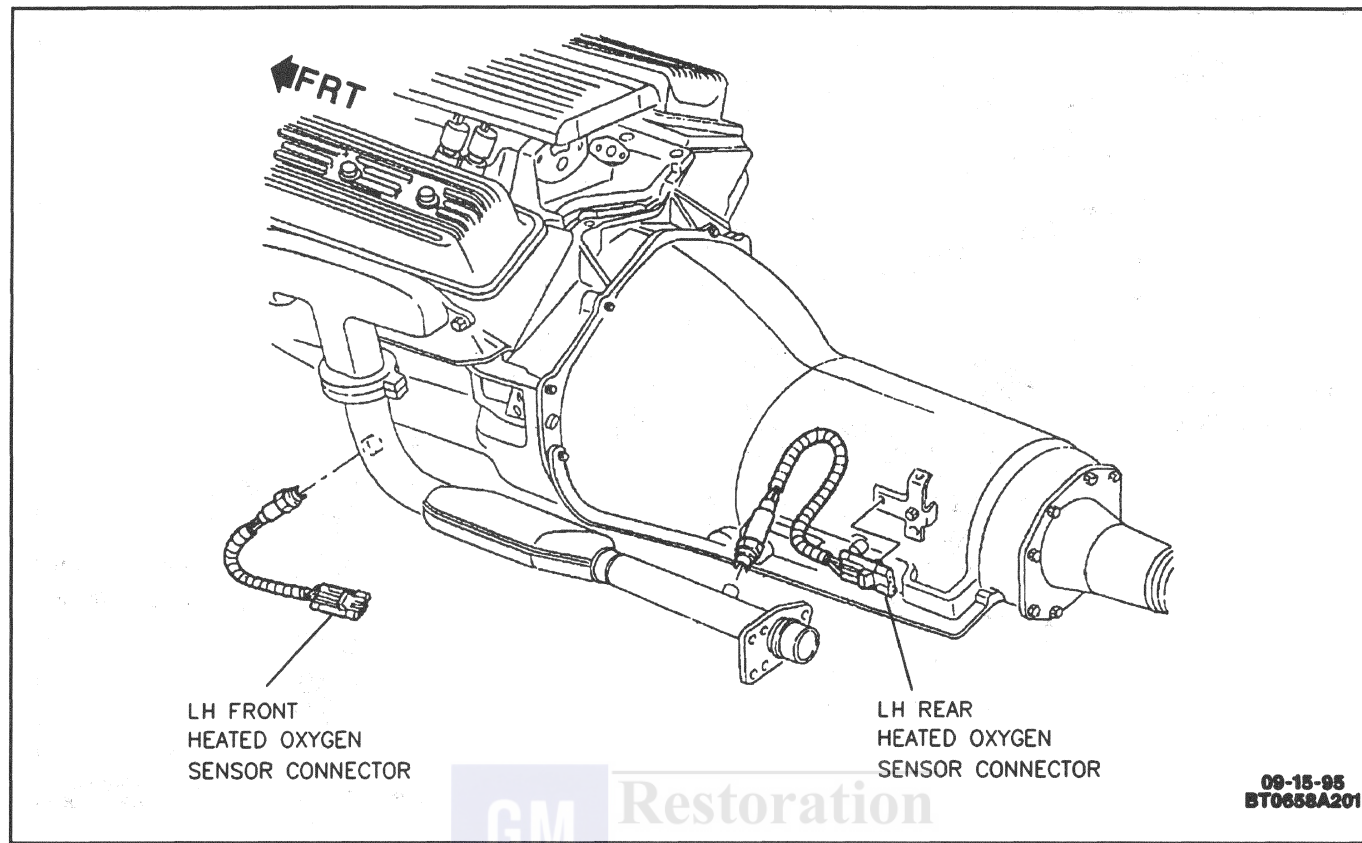


Fig 64 - LH Front and Rear Heated Oxygen Sensors

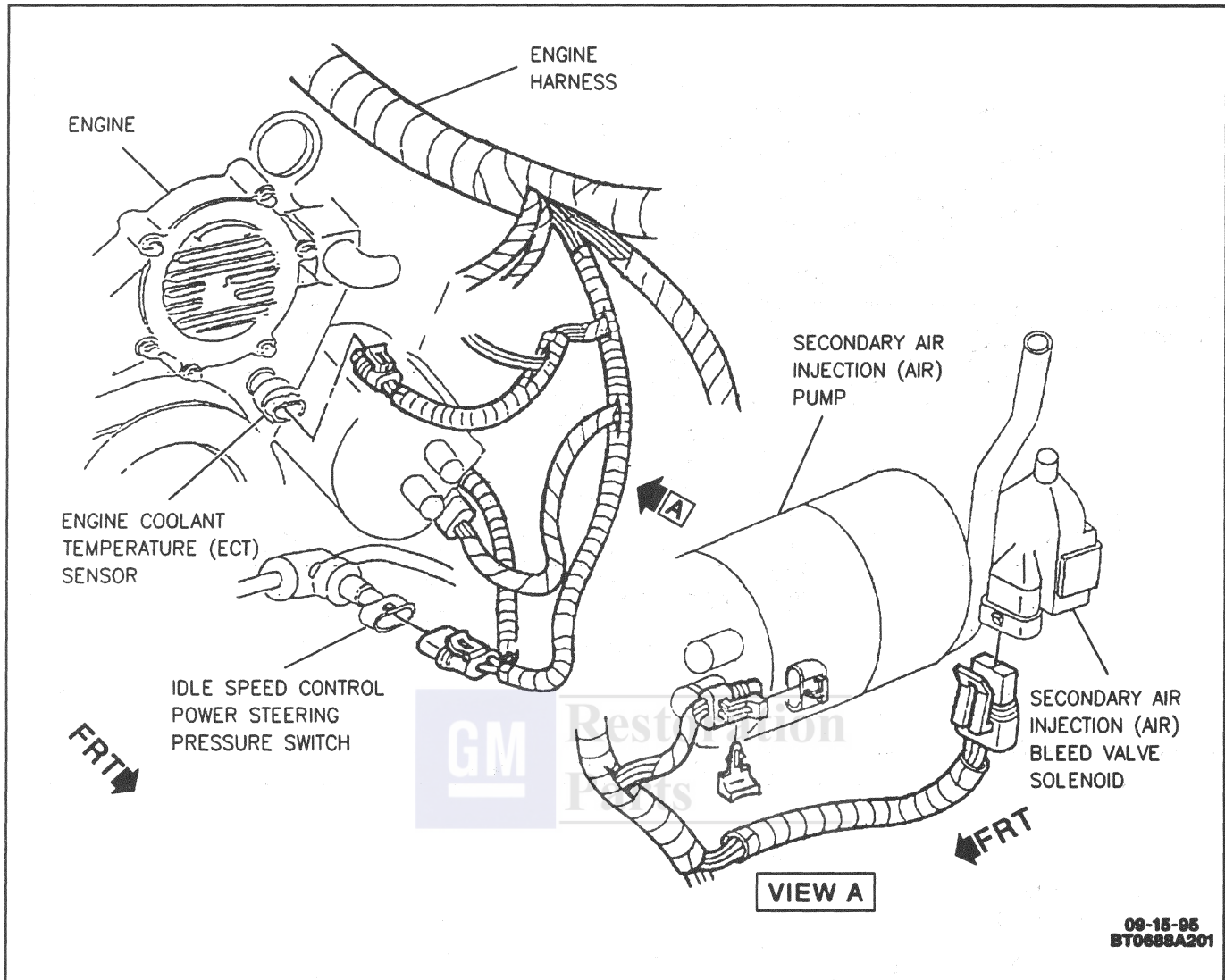


Fig 65 - Lower Left Side of Engine

COMPONENT LOCATION VIEWS

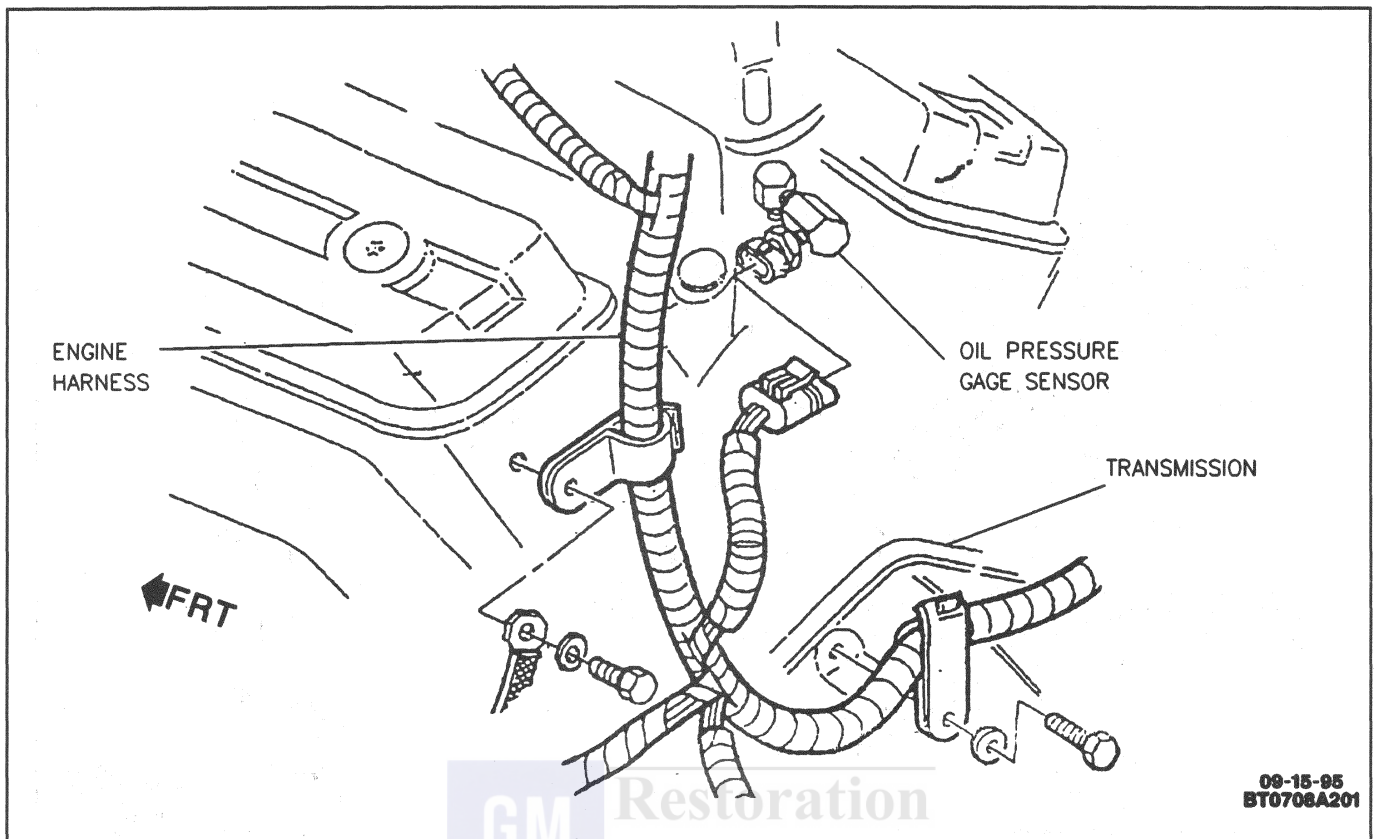


Fig 66 - Left Rear Side of Engine

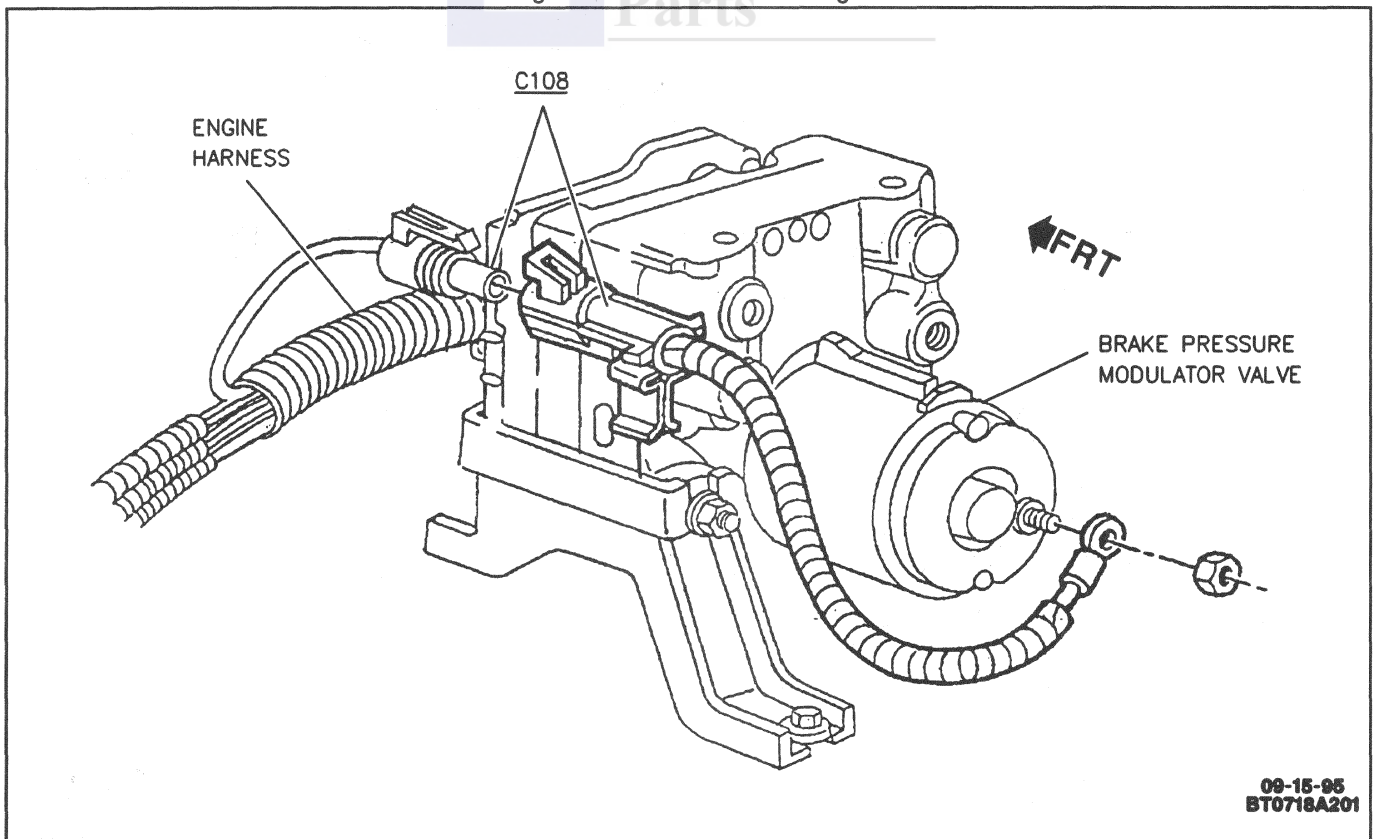


Fig 67 - ABS Ground

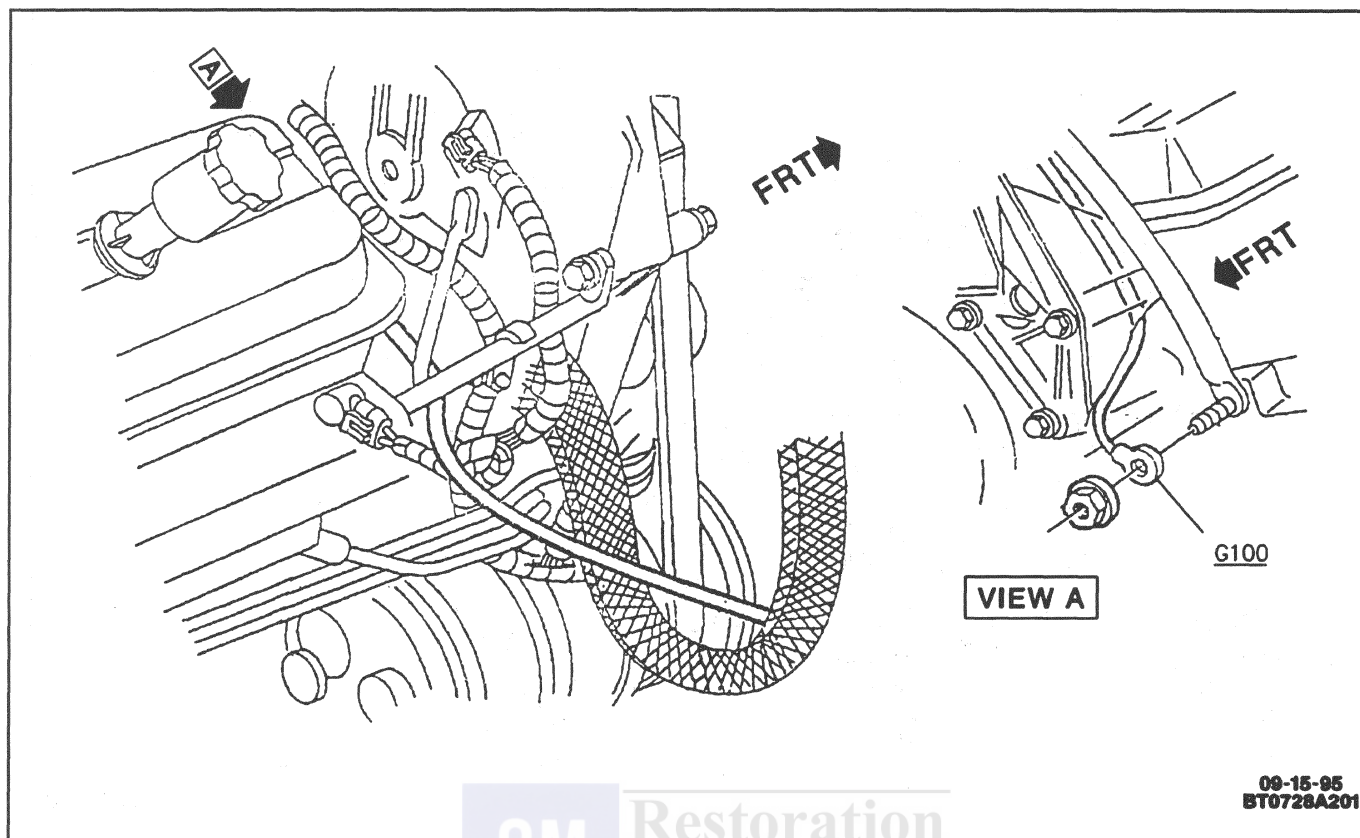


Fig 68 - Engine, Upper Left Hand Side

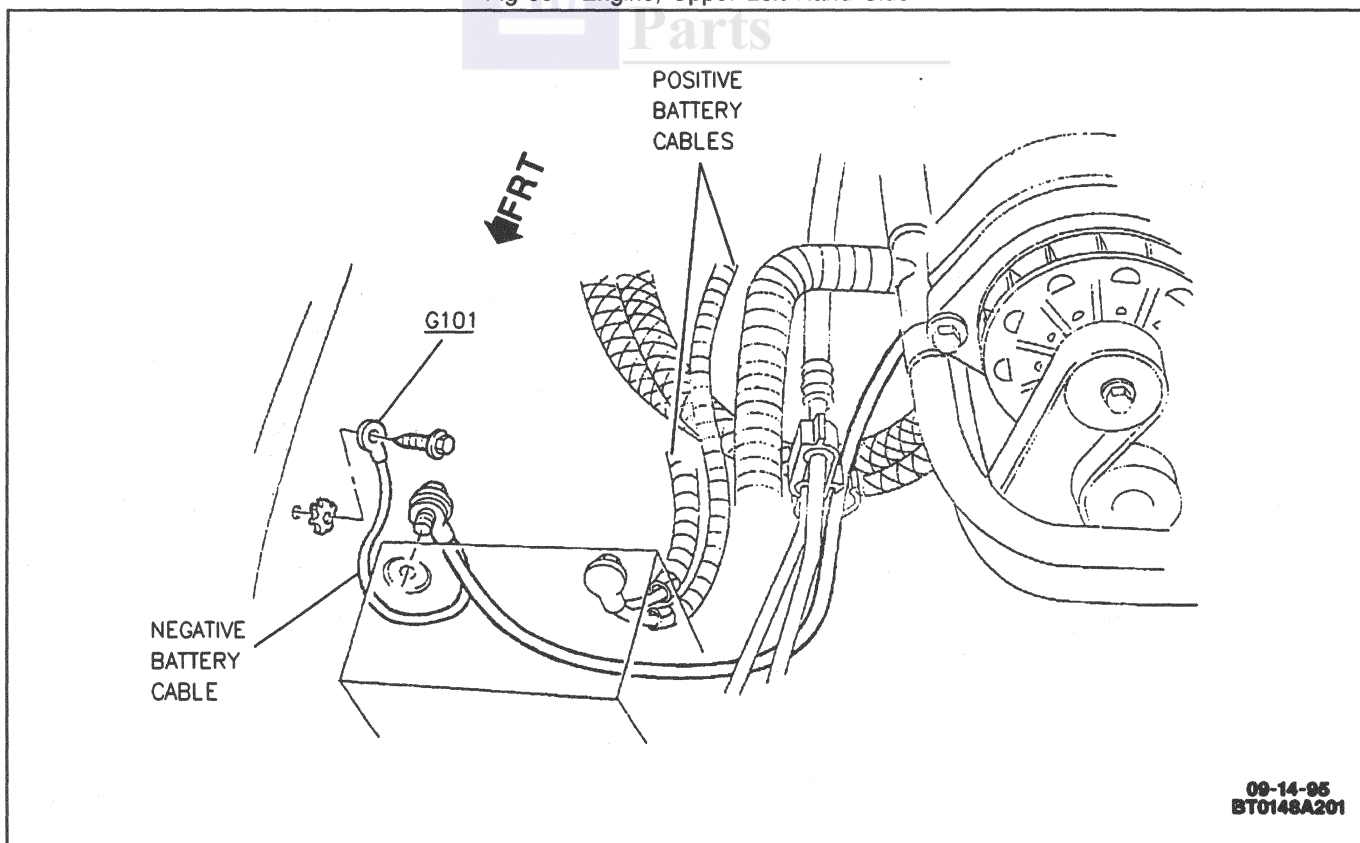


Fig 69 - Forward Lamp Harness, Right Side

COMPONENT LOCATION VIEWS

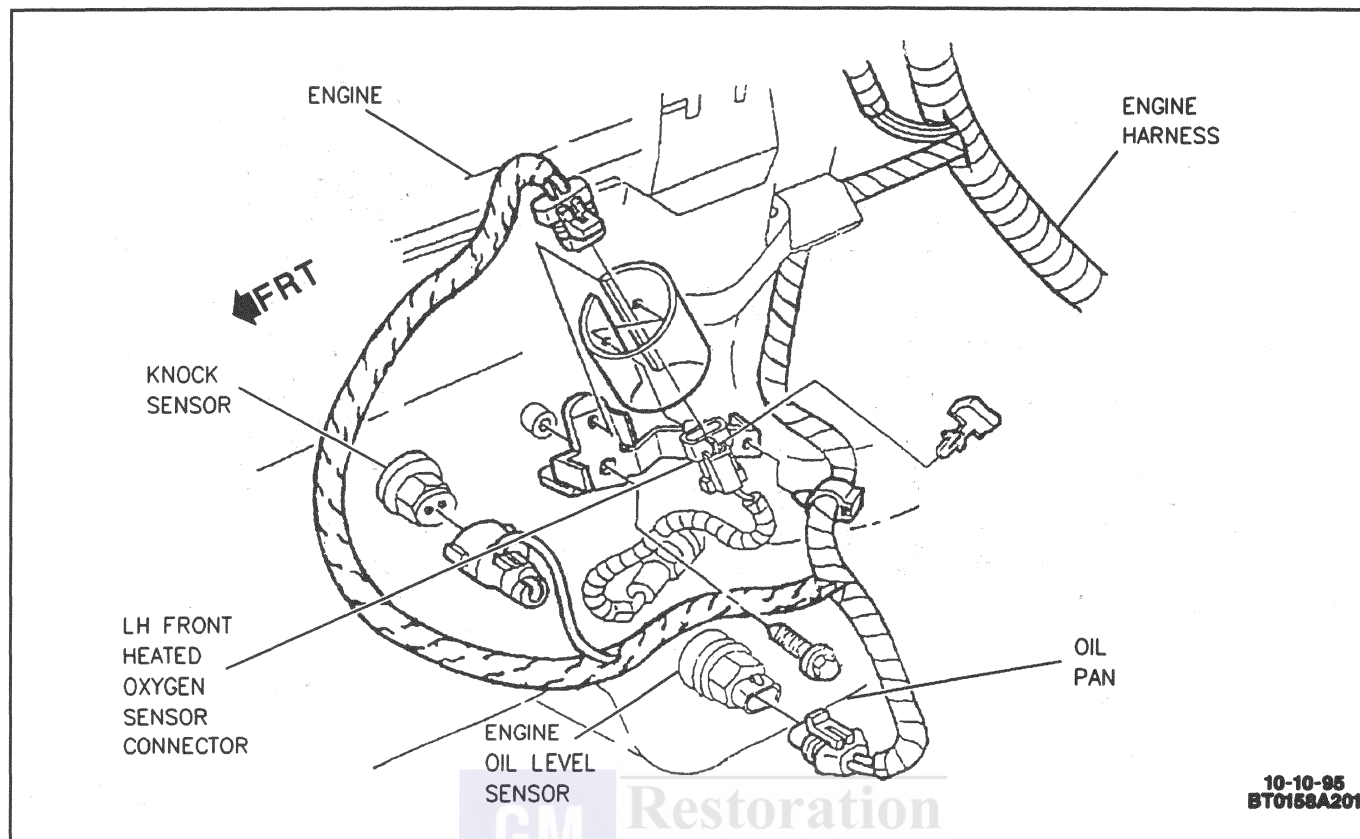


Fig 70 - Left Side of Engine

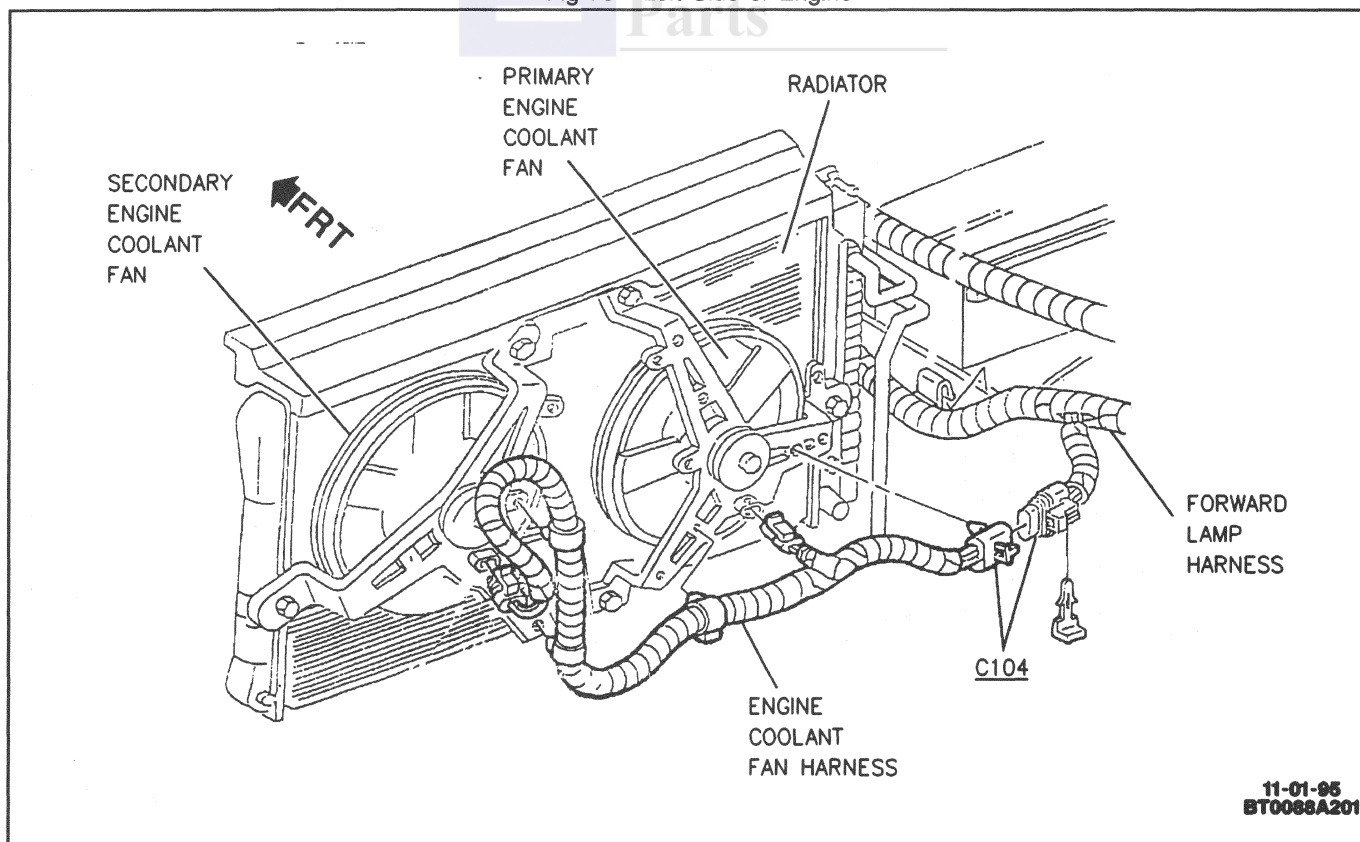


Fig 71 - Primary and Secondary Coolant Fans (Extra Capacity)

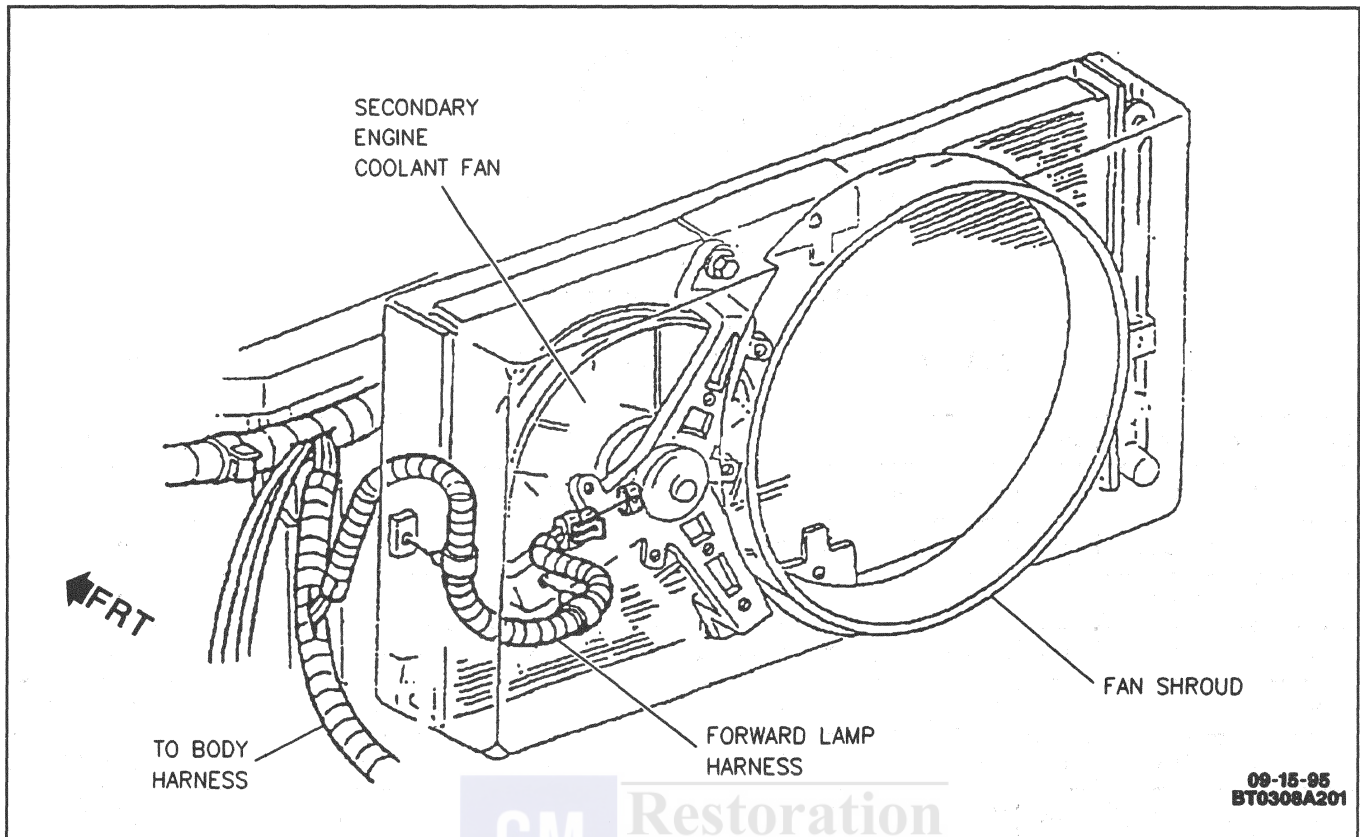
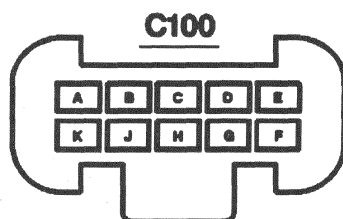


Fig 72 - Secondary Fans (Heavy Duty)

HARNESS CONNECTOR FACES



12065425

10 - WAY F METRI - PACK 150 SERIES

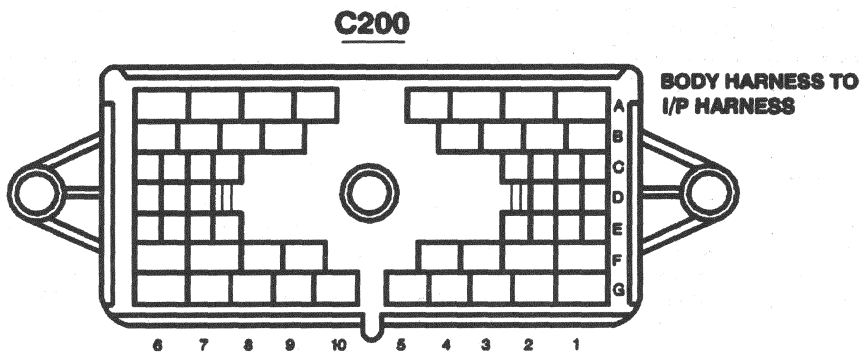
BLK

FORWARD LAMP HARNESS TO BODY HARNESS

5-27-84
BS0006A202

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A	LT BLU	14	LEFT FRONT TURN SIGNAL AND SIDE MARKER	8A-110-2
B	DK BLU	15	RIGHT FRONT TURN SIGNAL AND SIDE MARKER	8A-110-2
C	WHT	320	AUTOMATIC LEVEL CONTROL EXHAUST SOLENOID OUTPUT	8A-42-0
D	YEL	321	AUTOMATIC LEVEL CONTROL COMPRESSOR RELAY COIL OUTPUT	8A-42-0
E	ORN	57	LEFT FRONT SIDE, MARKER AND CORNERING LAMP POWER FEED	8A-113-0
F	BLK	58	RIGHT HAND FRONT SIDE, MARKER AND CORNERING LAMP POWER FEED	8A-113-0
J	LT GRN/BLK	735	AMBIENT AIR OUTSIDE TEMP SENSE SIGNAL	8A-68-0
K	YEL	1791	AIR TEMP VALVE MOTOR RETURN	8A-68-0

* WIRE COLORS AND CIRCUIT NUMBERS ARE THE SAME ON BOTH SIDES OF CONNECTOR UNLESS OTHERWISE INDICATED



56 - WAY F METRI - PACK MIXED SERIES
BLK

5-28-94
BS0018A202

*CAVITIES NOT LISTED ARE NOT USED

APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
S, W	A1	ORN	640	B+ TO RADIO FROM I/P FUSE BLOCK FUSE #30	8A-150-0
S, W	A2	PPL	209	BRAKE FLUID LEVEL INDICATOR LAMP OUTPUT	8A-81-2 (BUICK) 8A-82-1 (CHEVY)
S,W (C60) (C67)	A3	LT BLU	72	HEATER AND A/C CONTROL BLOWER SWITCH OUTPUT M2 TO BLOWER MOTOR RESISTOR	8A-63-0
S, W	A4	DK BLU/WHT	149	ROOF RAIL COURTESY AND READING LAMPS FEED	8A-114-0
S, W (CHEVROLET)	A6	PPL	293	SWITCHED B+ TO REAR WINDOW DEFOGGER GRID AND OUTSIDE MIRROR DEFOGGER	8A-61-0
S, W	A7	YEL	237	IGN POWER FEED TO FASTEN SEAT BELT INDICATOR	8A-76-0
W	A8	DK GRN	392	REAR WINDOW WASHER PUMP MOTOR FEED	8A-92-0
S	A9	WHT	121	TACHOMETER SIGNAL	8A-20-3
S, W	B4	PNK	39	IGN POWER FEED FROM I/P FUSE BLOCK FUSE #11	8A-11-6
S, W (CHEVY)	B6	ORN	1640	B+ TO REAR DEFOG SWITCH (CHEVROLET) OR REAR DEFOG RELAY (BUICK)	8A-61-0
S,W	B8	YEL	32	SWITCHED B+ FROM PARK LAMP SWITCH	8A-11-15
S,W	B9	RED	2	B+ TO HEADLAMP SWITCH	8A-10-0
W	C1	YEL	243	IGN POWER FEED TO REAR WINDOW RELEASE SWITCH	8A-92-0
S,W	C2	PPL	1807	SERIAL DATA SIGNAL	8A-20-1
S,W	C3	LT BLU	14	LEFT TURN INDICATOR IGNITION POWER FEED	8A-110-2
S,W	C8	ORN	2540	B+ POWER FEED FROM I/P FUSE #28	8A-11-10
W	D2	DK BLU	1544	ENDGATE WINDOW RELEASE SWITCH OUTPUT	8A-134-2
S, W (C67)	F1	BRN	64	LOW SPEED BLOWER MOTOR RELAY FEED COIL	8A-63-1
S, W	D7	PPL	30	FUEL LEVEL SIGNAL FROM FUEL TANK UNIT	8A-81-0 (BUICK) 8A-82-5 (CHEVY)

8A - 202 - 2 ELECTRICAL DIAGNOSIS

HARNESS CONNECTOR FACES

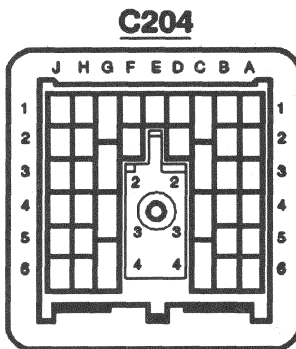
APPLICATION	CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
S, W	D8	DK GRN/WHT	817	VEHICLE SPEED SENSOR SIGNAL TO INSTRUMENT CLUSTER	8A-81-0 (BUICK) 8A-82-0 (CHEVY)
S, W (BUICK)	G7	GRY	728	PASS-Key® II FAULT INDICATOR	8A-133-0
S, W	E4	DK BLU	15	RIGHT TURN INDICATOR IGN POWER FEED	8A-110-2
S, W	E6	ORN	40	B+ POWER FEED FROM I/P FUSE BLOCK FUSE #33	8A-11-12
S, W	E7	DK GRN	145	POWER ANTENNA RELAY FEED COIL	8A-151-1
S, W	E8	YEL	43	IGNITION POWER FEED TO RADIO	8A-150-1
W	E9	YEL	1543	ENDGATE WINDOW SWITCH	8A-92-0
S, W (C68) (BUICK)	F2	GRY/BLK	754	BLOWER MOTOR SPEED SIGNAL FROM HEATER AND A/C CONTROL TO BLOWER MOTOR CONTROL MODULE	8A-66-0
S, W (C68)(BUICK)	F1	PPL	65	BLOWER MOTOR FEED	8A-66-0
S, W (C60) (C67)	F2	YEL	60	BLOWER MOTOR LO SPEED POWER FEED	8A-63-0
S, W (C60) (C67)	F3	TAN	63	BLOWER SWITCH OUTPUT M1	8A-63-0
S, W (C68) (BUICK)	F3	LT BLU/BLK	590	SUN LOAD TEMPERATURE SENSOR SIGNAL TO ELECTRONIC A/C CONTROL	8A-68-0
S, W (BUICK) (C68)	F4	LT GRN/BLK	735	OUTSIDE AMBIENT TEMPERATURE SENSOR	8A-68-0
S, W (C60)(CHEVY)	F4	BRN	641	B+ FEED FROM I/P FUSE BLOCK FUSE #17 TO HEATER AND A/C CONTROL	8A-63-0
S, W (BUICK) (C68)	F6	YEL	1791	TEMPERATURE INPUT	8A-68-0
S, W	F8	ORN	2040	B+ POWER FEED TO I/P DOOR LAMPS FROM I/P FUSE #35	8A-11-13
S, W (C60) (C67)	F9	ORN	52	SWITCHED IGNITION FEED TO HIGH BLOWER RELAY	8A-63-0
S, W	G1	DK GRN	135	ENGINE COOLANT TEMPERATURE GAGE SIGNAL	8A-81-0 (BUICK) 8A-82-1 (CHEVY)
S, W	G2	BRN	358	"AIR BAG" INDICATOR CONTROL, SWITCHED GROUND	8A-47-0
S, W	G3	ORN	1940	B+ POWER FEED FROM I/P FUSE BLOCK FUSE #29	8A-11-11
S, W (BUICK)	G5	WHT	85	"CRUISE" INDICATOR LAMP OUTPUT	8A-34-0
S, W	G6	TAN	800	SERIAL DATA LINE SIGNAL	8A-50-0
S, W (BUICK)	G8	LT BLU/BLK	71	HEATER-A/C CONTROL	8A-61-1
(BUICK)	G9	WHT	1294	ELECTRONIC VARIABLE ORIFICE SOLENOID FEED	8A-45-0
(BUICK)	G10	BLK	1576	REAR COMPARTMENT LID RELEASE SWITCH OUTPUT	8A-134-3
S	G10	BLK/WHT	56	REAR COMPARTMENT LID RELEASE SOLENOID FEED	8A-134-0

S=SEDAN

W=WAGON

* WIRE COLORS AND CIRCUIT NUMBERS ARE THE SAME ON BOTH SIDES OF CONNECTOR UNLESS OTHERWISE INDICATED

12020916

37 - WAY F METRI - PACK MIXED SERIES
BLKBODY HARNESS TO
ENGINE HARNESS5-28-94
BS0028A202

*CAVITIES NOT LISTED ARE NOT USED

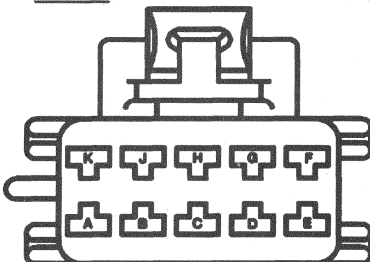
CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
A1	WHT	17	EBCM BRAKE APPLIED SIGNAL	8A-44-1
A3	DK GRN	145	POWER FEED POWER ANTENNA RELAY	8A-151-1
A4	BARE	514	REAR WHEEL SPEED SENSOR DRAIN	8A-44-2
A5	WHT	882	EBCM REAR WHEEL SPEED SENSOR INPUT	8A-44-2
B1	DK BLU	229	FUEL ENABLE SIGNAL THEFT DETERRENT MODULE TO PCM	8A-20-5
B2	PPL	420	SWITCHED IGNITION FEED TO TORQUE CONVERTER CLUTCH SOLENOID	8A-20-10
B4	DK GRN/WHT	817	VEHICLE SPEED SIGNAL FROM PCM	8A-81-0
B5	WHT	883	REAR WHEEL SPEED SENSOR INPUT GROUND	8A-44-2
B6	TAN	800	SERIAL DATA FROM PCM TO DLC CONNECTOR	8A-50-0
C1	PNK	3	B+ FEED TO IGNITION COIL THRU IGNITION SWITCH	8A-10-3
C2	GRY	120	SWITCHED B+ TO FUEL PUMP/SENDER	8A-20-7
C3	PPL	92	HIGH SPEED REQUEST SIGNAL FROM WINDSHIELD WIPER/WASHER SWITCH	8A-91-0
C4	GRY	91	WASH/HIGH/MIST/DELAY SIGNAL FROM WINDSHIELD WIPER/WASHER SWITCH	8A-91-0
D1	WHT	1294	ELECTRONIC VARIABLE ORIFICE ACTUATOR SIGNAL	8A-45-0
D2	BRN	1295	ELECTRONIC VARIABLE ORIFICE SIGNAL RETURN	8A-45-0
E1	YEL	873	LEFT FRONT WHEEL SPEED SENSOR RETURN	8A-44-2
F1	BARE	813	DRAIN WIRE RETURN FROM LH FRONT WHEEL SPEED SENSOR	8A-44-2
F2	LT BLU	830	LEFT FRONT WHEEL SPEED SENSOR SIGNAL HI	8A-44-2
G1	ORN	300	IGNITION SWITCH OUTPUT	8A-10-3
G2	PNK	94	OFF/MIST/WASH/LOW SIGNAL FROM WINDSHIELD WIPER/WASHER SWITCH TO WINDSHIELD WIPER/WASHER MODULE	8A-91-0
G3	DK GRN	95	OFF/MIST/LOW/HIGH SIGNAL FROM WINDSHIELD WIPER/WASHER SWITCH	8A-91-0
G4	GRY	161	POWER ANTENNA FEED, UP	8A-151-1
H1	WHT	121	TACHOMETER SIGNAL	8A-20-3
H2	WHT	160	POWER ANTENNA FEED, DOWN	8A-151-1
H5	ORN/BLK	434	PARK/NEUTRAL SIGNAL, SWITCHED GROUND	8A-20-1
H6	WHT/BLK	451	PARK/NEUTRAL POSITION SWITCH AND CRUISE CONTROL GROUND	8A-14-1

8A - 202 - 4 ELECTRICAL DIAGNOSIS

HARNESS CONNECTOR FACES

CAVITY	WIRE COLOR	CKT	DESCRIPTION	PAGE
B3	YEL	974	HAZARD LAMP FLASHER	8A-110-7
H3	LT BLU	975	HAZARD LAMP FLASHER	8A-110-7
H4	DK GRN	976	HAZARD LAMP FLASHER	8A-110-7
J6	PPL	1807	SERIAL DATA SIGNAL	8A-50-0

C205



12064769

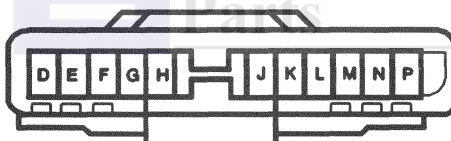
10 - WAY F METRI - PACK 150 SERIES

NAT

ENGINE HARNESS TO I/P HARNESS

05-01-95
BT0038A202

C210



12004147

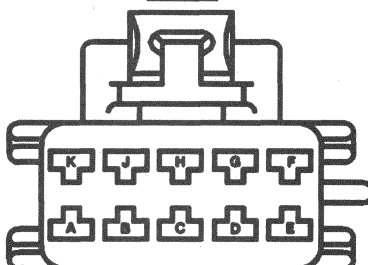
11 - WAY F PACK - CON I

BLK

TURN SIGNAL SWITCH

05-01-95
BT0048A202

C215



12064871

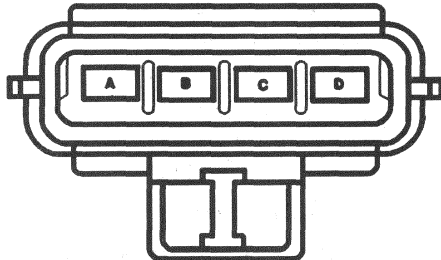
10 - WAY F METRI - PACK 150 SERIES

BLU

CROSSBODY & FRONT SIDE DOOR HARNESS TO I/P HARNESS

05-01-95
BT0068A202

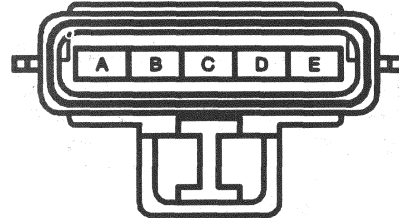
C101
C104
C121



12129565

**4 - WAY F METRI - PACK 280 SERIES
GRY**

C103

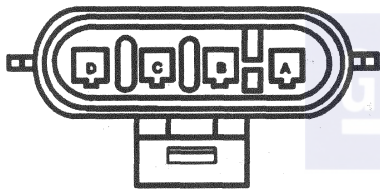


12084891

**5 - WAY F METRI - PACK 280 SERIES
MD GRY**

ENGINE WIRING HARNESS TO FORWARD LAMP WIRING

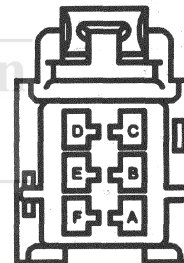
C120



12047950

**4 - WAY F METRI - PACK 150 SERIES
BLK
ENDGATE WINDOW RELEASE SWITCH**

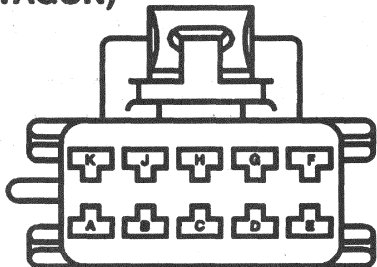
C201
C202
C400 (WAGON)
C401
C450



12064752

**6 - WAY F METRI - PACK 280 SERIES
BLK
HEATER AND A/C CONTROL (C67) (C2)**

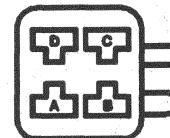
C203
C220
C230 (SEDAN)
C302 (WAGON)



12064769

**10 - WAY F METRI - PACK 150 SERIES
NAT**

C206A (SEO)
C206B (SEO)

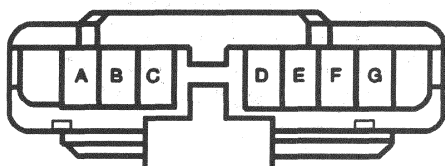


12047785

**4 - WAY F METRI - PACK 150 SERIES
BLK
INSIDE REAR VIEW MIRROR**

8A - 202 - 6 ELECTRICAL DIAGNOSIS
HARNESS CONNECTOR FACES

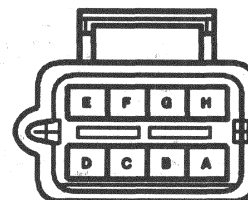
C216



12010430

7 - WAY F PACK - CON I
GRY
WINDSHIELD WIPER/WASHER SWITCH

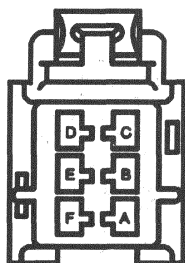
C231 (SEDAN)
C303 (WAGON)
C400 (SEDAN)



12066351

8 - WAY M METRI - PACK 280 SERIES
BLK

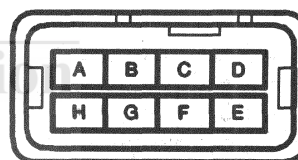
C300
C318
C319



12064752

6 - WAY F METRI - PACK 280 SERIES
BLK
CROSSBODY & FRONT SIDE DOOR
WIRING HARNESS TO SEAT HARNESS

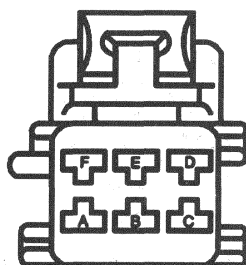
C306



12065396

8 - WAY M METRI - PACK 150 SERIES
NAT
BODY WIRING HARNESS TO CROSSBODY &
FRONT SIDE DOOR WIRING HARNESS

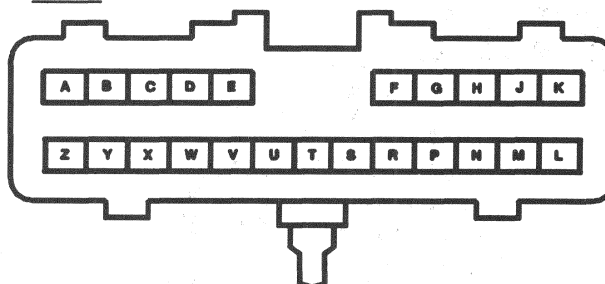
C309
C451



12064762

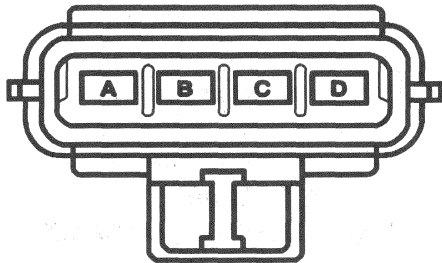
6 - WAY F METRI - PACK 150 SERIES
GRY

C316
C317

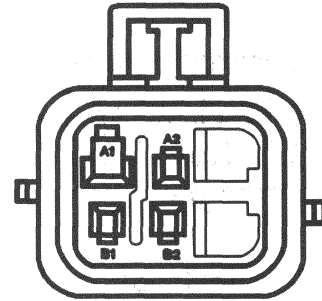


12092248

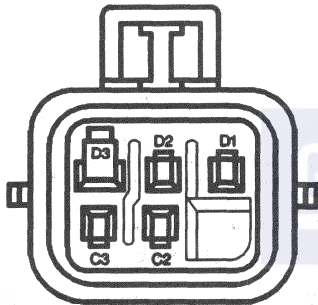
23 - WAY M METRI - PACK 280 SERIES
BLK
SEAT HARNESS TO BODY WIRING HARNESS

C340**12129565**

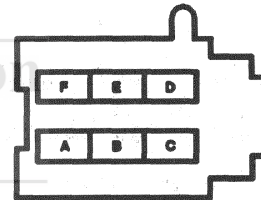
**4 - WAY F METRI - PACK 280 SERIES
MED GRY
BODY WIRING HARNESS TO
ANTILOCK BRAKE SYSTEM HARNESS**

C340A**12092793**

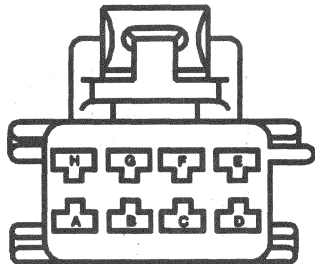
**4 - WAY F METRI - PACK 150, 280 SERIES
GRY
ANTILOCK BRAKE SYSTEM HARNESS TO
BODY WIRING HARNESS**

**C340B
C340C****12110481**

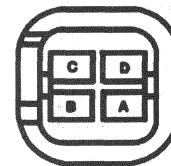
**5 - WAY F METRI - PACK 150, 280 SERIES
RED
ANTILOCK BRAKE SYSTEM HARNESS TO
BODY WIRING HARNESS**

C405**12089527**

**6 - WAY F METRI - PACK SERIES 280
GRN
REAR COMPARTMENT WIRING HARNESS TO
BODY WIRING HARNESS**

C406**12064766**

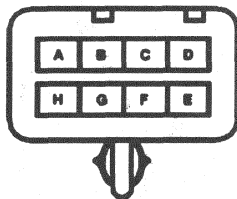
**8 - WAY F METRI - PACK SERIES 150
BLU
REAR COMPARTMENT WIRING HARNESS TO
BODY WIRING HARNESS
HEADLAMP AUTOMATIC CONTROL MODULE (C1)
REMOTE CONTROL DOOR LOCK RECEIVER**

C408**12066498**

**4 - WAY M METRI - PACK 150 SERIES
GRY
BODY WIRING HARNESS TO
REAR COMPARTMENT COURTESY LAMP**

8A - 202 - 8 ELECTRICAL DIAGNOSIS
HARNESS CONNECTOR FACES

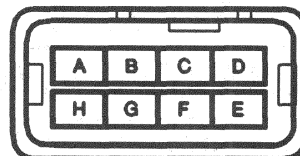
C500
C600



12084256

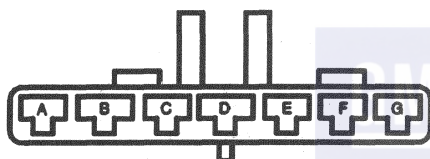
8 - WAY M METRI - PACK 150 SERIES
GRY
RH AND LH OUTSIDE REAR VIEW MIRRORS

C504 (IMPALA)



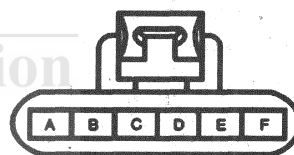
12065396

8 - WAY M METRI - PACK 150 SERIES
BLK
REMOTE CONTROL OUTSIDE REAR VIEW MIRROR (CHEV)



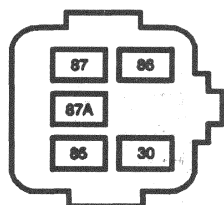
12065213

7 - WAY F METRI - PACK MIXED SERIES
BLK
ACCESSORY SWITCH PANEL (C1)



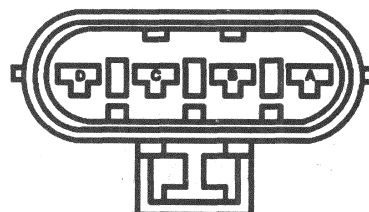
12064860

6 - WAY F METRI - PACK 150 SERIES
BLK
ACCESSORY SWITCH PANEL (C2)



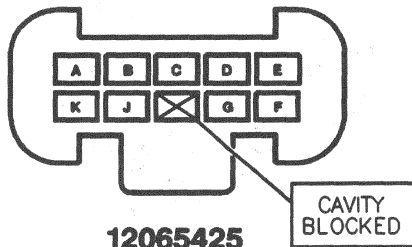
12110539

5 - WAY F METRI - PACK 280 SERIES
BLK
BLOWER MOTOR LOW SPEED RELAY
REAR WINDOW DEFOG RELAY
BLOW MOTOR HIGH SPEED RELAY



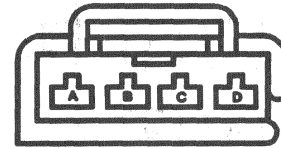
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4 - WAY F METRI - PACK 480 SERIES
BLK
BLOWER MOTOR RESISTOR
POWER WINDOW CONTROL MODULE (BUICK)



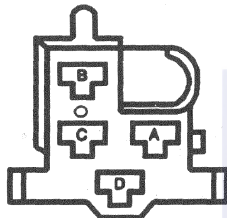
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10 - WAY F METRI - PACK 150 SERIES
BLK
CRUISE CONTROL MODULE



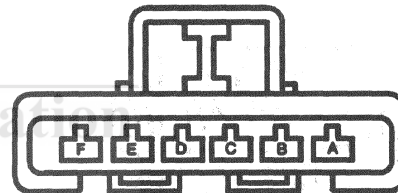
12092163

4 - WAY M METRI - PACK 150 SERIES
BLK
CRUISE CONTROL SWITCH



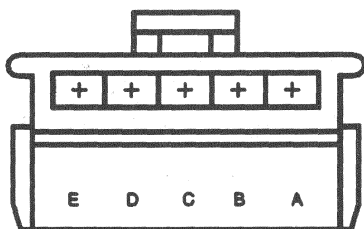
08917693

4 - WAY F 56 SERIES
BLK
DIMMER SWITCH



12059561

6 - WAY F METRI - PACK MIXED SERIES
BLK
DOOR LOCK RELAY
ENDGATE RELAY (SEO)



12124997

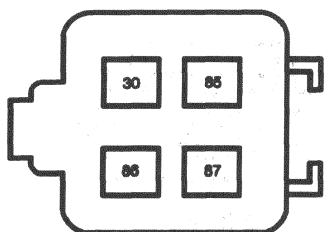
5 - WAY F METRI - PACK 150 SERIES
BLK
DOOR LOCK SWITCHES (BUICK)



12129135

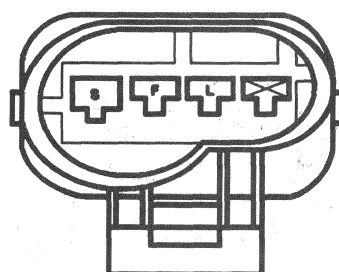
4 - WAY M METRI - PACK 280 SERIES
BLK
EMERGENCY VEHICLE REAR WINDOW PANEL LAMP

HARNESS CONNECTOR FACES



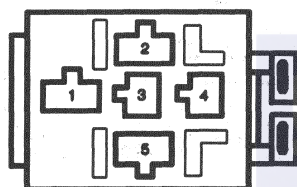
12129716

4 - WAY F METRI - PACK 280 FLX LK
GRY
ENGINE COOLANT FAN RELAY
PRIMARY, SECONDARY



12124898

4 - WAY F METRI - PACK MIXED SERIES
BLK
GENERATOR



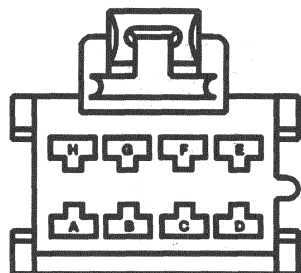
12034003

5 - WAY F METRI - PACK SERIES 630
BLK
HAZARD LAMP FLASHER (SEO)



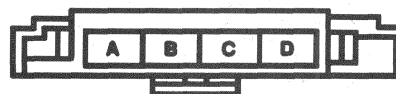
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4 - WAY F METRI - PACK 480 SERIES
BLU
HEADLAMP AND I/P LAMP DIMMER SWITCH (C2)
(CHEV)



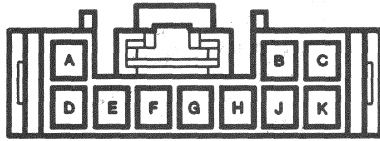
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8 - WAY F METRI - PACK SERIES 280
BLK
HEADLAMP AUTOMATIC CONTROL MODULE (C2)



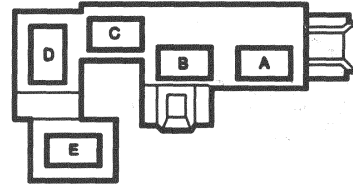
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4 - WAY F METRI - PACK 480 SERIES
MED GRY
TWILIGHT SENTINEL SWITCH
HEADLAMP AUTOMATIC CONTROL SWITCH (BUICK)
(C3) (CHEV)



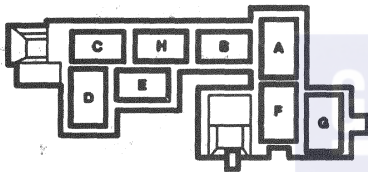
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10-WAY F METRI-PACK 280 SERIES
BLK
HEADLAMP SWITCH (CHEV)



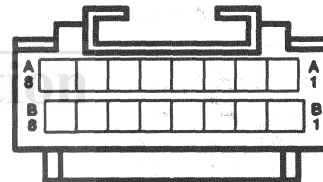
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5-WAY F 56/59 SERIES
LT GRY
HEADLAMP SWITCH (C1) (BUICK)



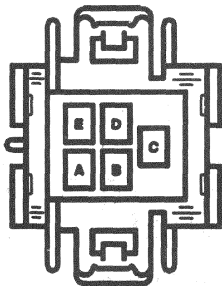
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8-WAY F 56 SERIES
NAT
HEADLAMP SWITCH (C2) (BUICK)



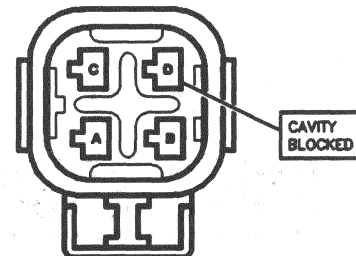
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16-WAY F MICRO-PACK
BLK
HEATER AND A/C CONTROL (C67) (C1)



12020813

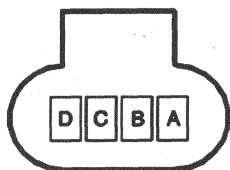
5-WAY F METRI-PACK 630 SERIES
BLK
HEATER AND A/C CONTROL BLOWER SWITCH
(C2) (CHEV)



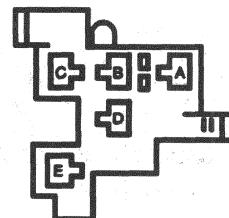
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4-WAY F METRI-PACK 480 SERIES
BLK
HEATER AND A/C PROGRAMMER

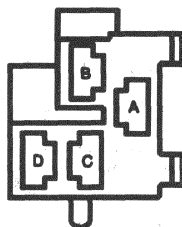
HARNESS CONNECTOR FACES



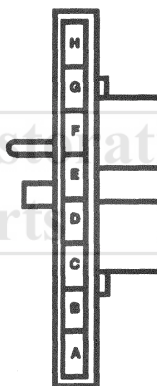
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4 - WAY F METRI - PACK SERIES 150
PULL - TO - SEAT
BLK
IDLE AIR CONTROL VALVE



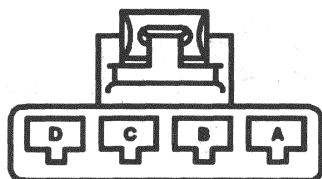
12010966
5 - WAY F 56 SERIES
BLU
IGNITION SWITCH (C1)



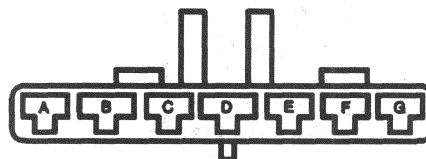
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4 - WAY F 56/59 SERIES
BLK
IGNITION SWITCH (C2)



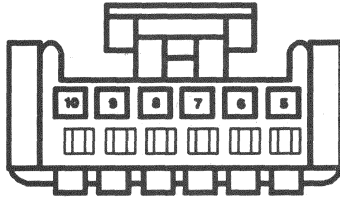
12064862
8 - WAY F METRI - PACK 150 SERIES
BLK
INSTRUMENT CLUSTER ENGLISH
METRIC SWITCH
REAR COMPARTMENT LID
RELEASE SWITCH (SEO)
REMOTE CONTROL
REAR VIEW MIRROR (BUICK)



12066571
4 - WAY F METRI - PACK 480 SERIES
BLK
SIDE WINDOW MASTER SWITCH (C1) (CHEV)



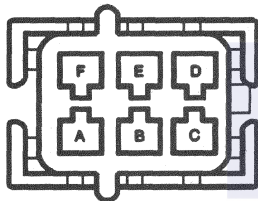
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7 - WAY F METRI - PACK MIXED SERIES
BLK
SIDE WINDOW MASTER SWITCH (C1) (CHEV)

**12040953**

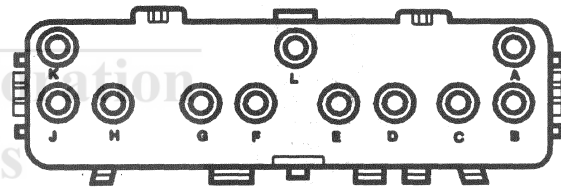
6-WAY F MICRO-PACK
BLK
MODE VALVE ACTUATOR

**12015307**

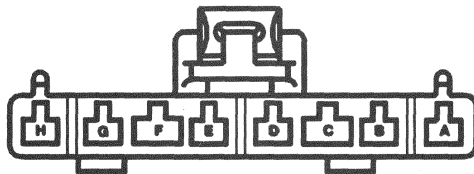
6-WAY F METRI-PACK MIXED SERIES
BLK
PARK/NEUTRAL POSITION SWITCH (IMPALA)

**12015344**

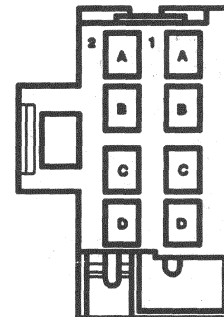
6-WAY F METRI-PACK 280 SERIES
BLK
DOOR LOCK SWITCH RH AND LH FRONT (CHEV)

**12034024**

11-WAY F PIN GRIP
BLK
POWER SEAT ADJUSTER SWITCH
(DRIVER OR PASSENGER SIDE)
BASE AND UP LEVEL (AM5) (BUICK)

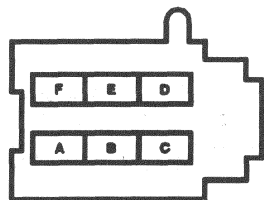
**12084603**

8-WAY F METRI-PACK MIXED SERIES
MED GRY
SEAT ADJUSTER SWITCH LH AND RH FRONT (CHEV)

**12047830**

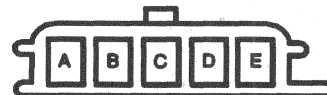
8-WAY F METRI-PACK 630 SERIES
BLK
POWER STEERING CONTROL MODULE

HARNESS CONNECTOR FACES



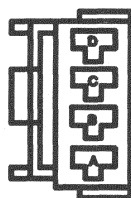
12089527

6 - WAY F METRI - PACK SERIES 280
GRN
WINDOW SWITCH LH AND RH REAR
RH FRONT (CHEV)



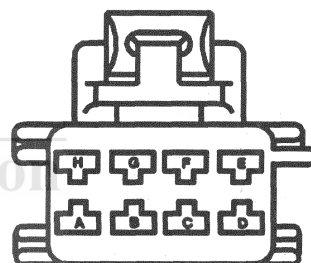
12059800

5 - WAY F METRI - PACK 150 SERIES
BLK
REAR COMPARTMENT LID PULL DOWN SWITCH



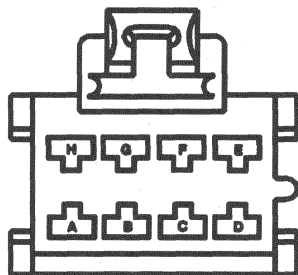
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4 - WAY F METRI - PACK 630 SERIES
BLK
REAR WINDOW DEFOGGER SWITCH (C1) (CHEV)



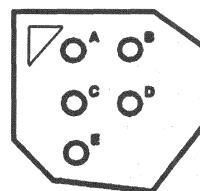
12064766

8 - WAY F METRI - PACK SERIES 150
BLU
DAYTIME RUNNING LAMP CONTROL MODULE (C1)
TWILIGHT SENTINEL MODULE (C1)
REMOTE CONTROL DOOR LOCK MODULE (C1)



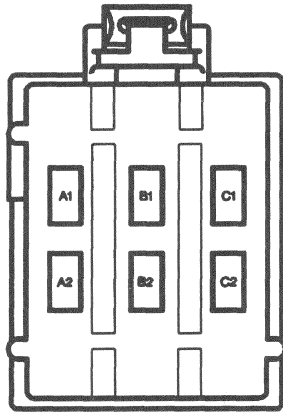
12064998

8 - WAY F METRI - PACK SERIES 280
BLK
DAYTIME RUNNING LAMP CONTROL MODULE (C2)
REMOTE CONTROL DOOR LOCK MODULE (C2)
TWILIGHT SENTINEL MODULE (C2)



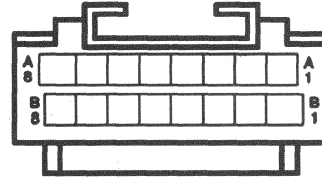
12004680

5 - WAY F PIN GRIP
NAT
SIDE DOOR WINDOW SWITCH LH AND RH REAR
RH FRONT (BUICK)



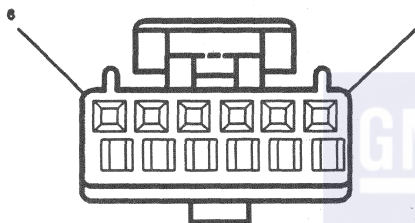
12110541

**6 - WAY F METRI - PACK 280 FLX LK
BLK
START MOTOR THEFT DETERRENT RELAY**



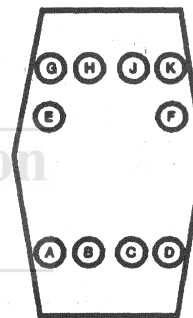
12110259

**16 - WAY F MICRO - PACK 100 SERIES
GRN
THEFT DETERRENT MODULE**



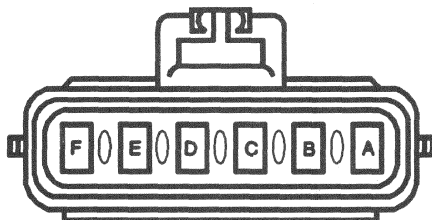
12064978

**6 - WAY F MICRO - PACK 100 SERIES
GRY
VACUUM AND ELECTRIC SOLENOID**



12010550

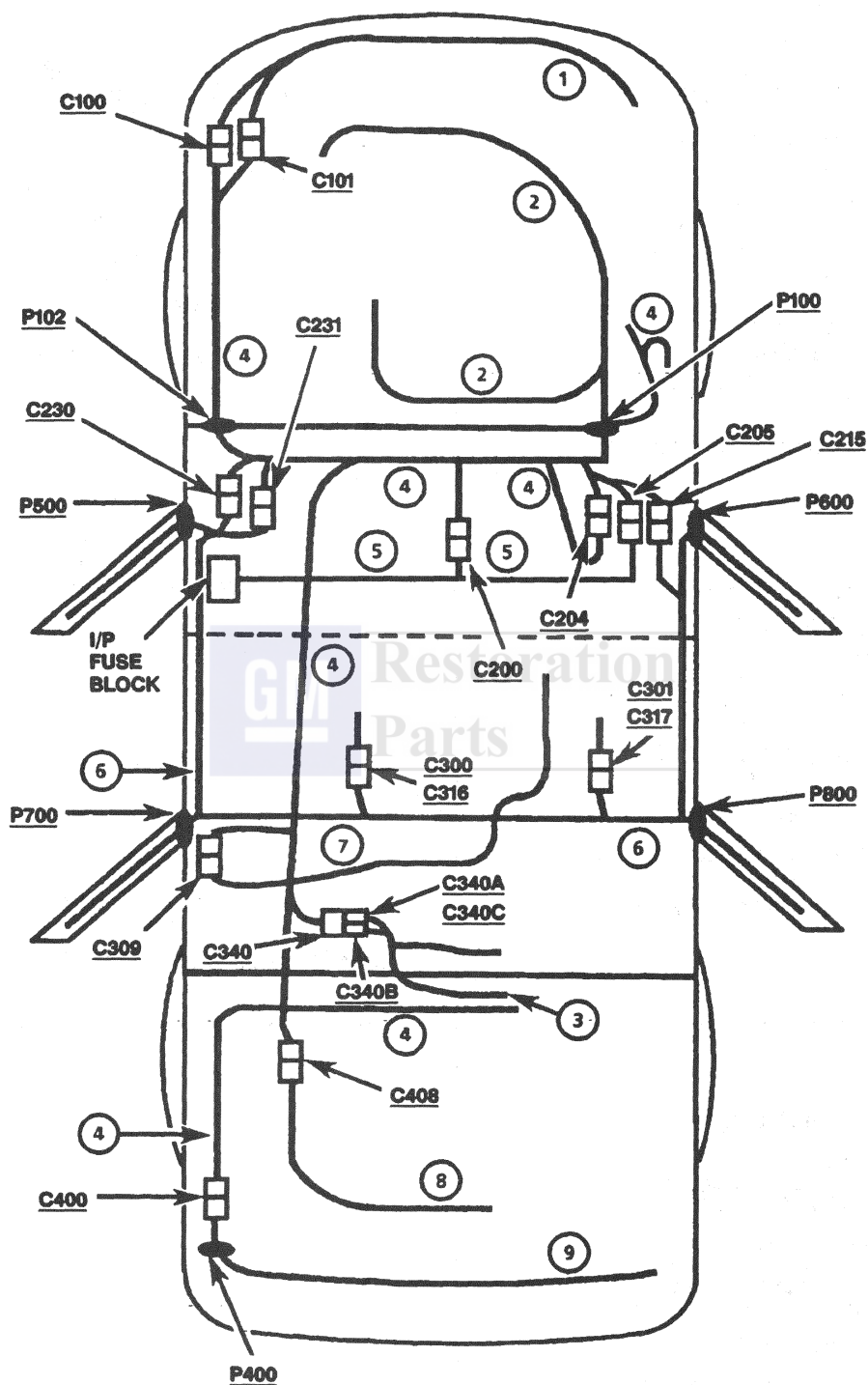
**10 - WAY F PIN GROUP
BLK
LH FRONT SIDE WINDOW SWITCH (BUICK)**



12059573

**6 - WAY F METRI - PACK 280 SERIES
BLK
WINDSHIELD WIPER MOTOR**

HARNESS ROUTING VIEWS
(SEDAN)



HARNESS LEGEND

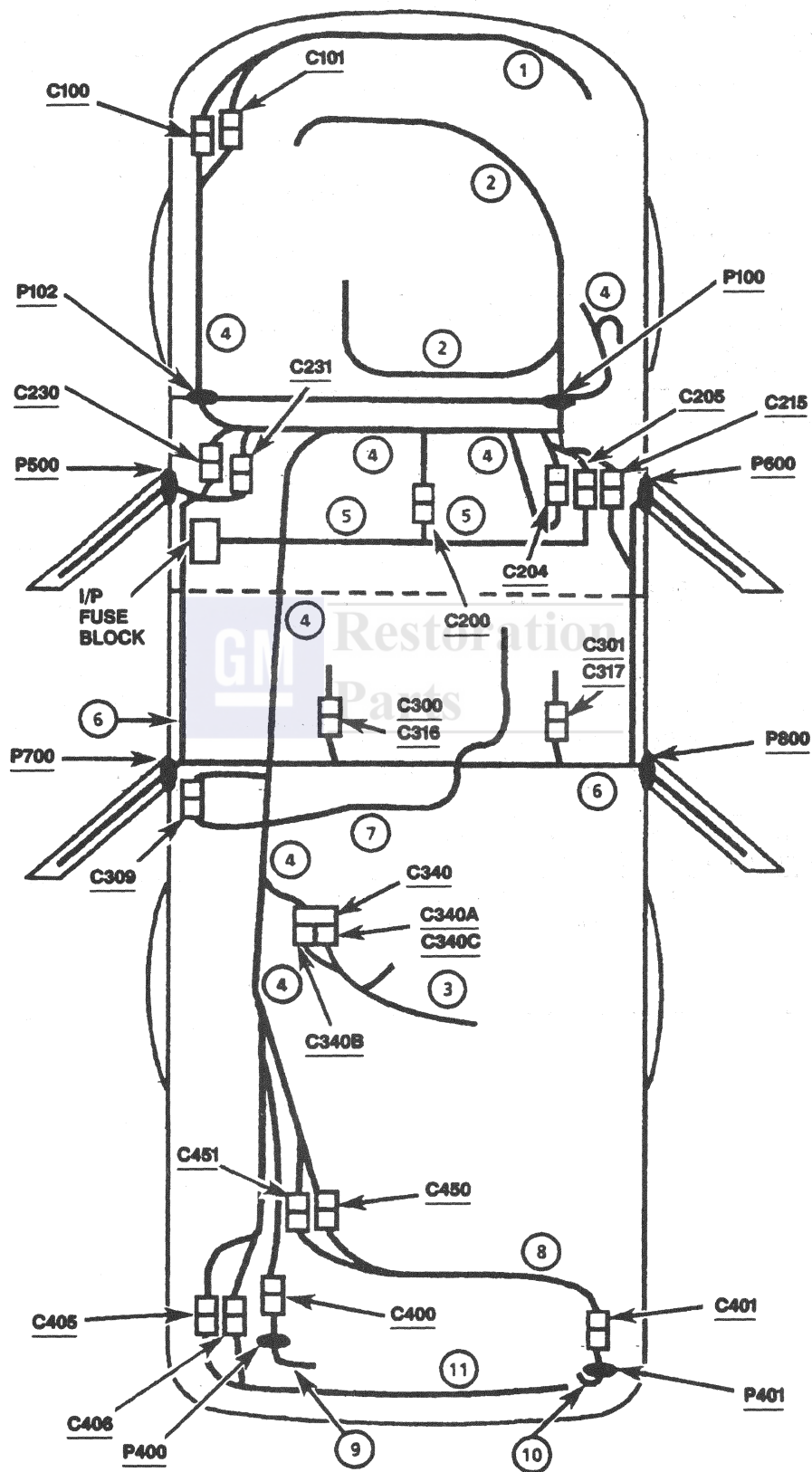
1	Forward Lamp Harness	4	Body Harness	7	Roof Harness
2	Engine Harness	5	I/P Harness	8	Trunk Lid Harness
3	ABS Harness	6	Cross Car Harness	9	Rear Lamp Harness

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CONNECTOR LEGEND**PAGE****FIGURE****CONNECTOR**

C100 (10 cavities)	Forward Lamp Harn to Body Harn, behind LH Front Park/Turn Lamp	201-5	9	202-0
C101 (4 cavities)	Forward Lamp Harn to Body Harn, forward of Washer Fluid Reservoir	201-5	9	202-5
C200 (56 cavities)	Body Harn to I/P Harn, bolted above accelerator pedal	201-14	22	202-1
C204 (37 cavities)	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment	201-16	26	202-3
C205 (10 cavities)	Engine Harn to I/P Harn, right of I/P Compartment	201-18	29	202-4
C300 (6 cavities) C316 (AM5)	Cross Car Harn to LH Power Seat Motor Harn, under LH Front seat	201-20	31	202-6
C301 (6 cavities) C317 (AM5)	Cross Car Harn to RH Power Seat Motor Harn, under RH front seat	201-20	31	202-6
C230 (10 cavities)	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" pillar	201-19	30	202-5
C231 (6 cavities)	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" pillar	201-19	30	202-6
C408 (4 cavities)	Body Harn to Trunk Lid Harn, upper LH side of Luggage Compartment	201-30	43	202-7
C309 (6 cavities)	Body Harn to Roof Harn, lower LH "B" pillar	201-25	36	202-6
C215 (10 cavities)	I/P Harn to Cross Car Harn, RH "A" pillar below C204	201-18	29	202-4
C400 (8 cavities)	Body Harn to Rear Lamp Harn, in Luggage Compartment on LH Rear Fender	201-32	47	202-6
C340 (10 cavities) C340A (5 cavities) C340C (5 cavities) C340B (5 cavities)	Body Harness to Antilock Brake System Harness, below LH Rear Floor Pan connected to Pass Thru	201-27	39	202-7

T5200



HARNESS ROUTING VIEWS (WAGON)

HARNESS LEGEND					
1	Forward Lamp Harness	5	I/P Harness	9	LH Rear Lamp Harness
2	Engine Harness	6	Cross Car Harness	10	RH Rear Lamp Harness
3	ABS Harness	7	Roof Harness	11	Tailgate Harness
4	Body Harness	8	Rear Header Harness		

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CONNECTOR LEGEND		PAGE	FIGURE	CONNECTOR
C100 (10 cavities)	Forward Lamp Harn to Body Harn, behind LH Front Park/Turn Lamp	201-5	9	202-0
C101 (4 cavities)	Forward Lamp Harn to Body Harn, forward of Washer Fluid Reservoir	201-5	9	202-5
C200 (56 cavities)	Body Harn to I/P Harn, bolted above accelerator pedal	201-14	22	202-1
C204 (37 cavities)	Body Harn to Engine Harn, behind RH I/P, between Blower Motor and I/P Compartment	201-16	26	202-3
C205 (10 cavities)	Engine Harn to I/P Harn, right of I/P Compartment	201-18	29	202-4
C300 (6 cavities) C316 (AM5)	Cross Car Harn to LH Power Seat Motor Harn, under LH Front seat	201-20	31	202-6
C301 (6 cavities) C317 (AM5)	Cross Car Harn to RH Power Seat Motor Harn, under RH front seat	201-20	31	202-6
C230 (10 cavities)	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" pillar	201-19	30	202-5
C231 (6 cavities)	Cross Car Harn to Body Harn, behind LH kickpad at base of "A" pillar	201-19	30	202-6
C309 (6 cavities)	Body Harn to Roof Harn, lower LH "B" pillar	201-25	36	202-6
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C451 (6 cavities)	Body Harn to Rear Header Harn, near center of LH "D" pillar	201-34	49	202-6
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C401 (6 cavities)	RH Taillamp Harn to Rear Header Harn, forward of Taillamps	201-36	52	202-5
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C340 (10 cavities) C340A (5 cavities) C340C C340B (5 cavities)	Body Harness to Antilock Brake System Harness, below LH Rear Floor Pan connected to Pass Thru	201-27	39	202-7

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